LIST OF ALL ABSTRACTS @ IS4SI 2017 Gothenburg

1 Bidirectional named sets as structural models of interpersonal communication

Published

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Treating communication as information exchange between systems, we employ the most fundamental structure in mathematics, nature and cognition, which is called a named set or a fundamental triad because it has been useful in a variety of areas such as networks and networking, physics, information theory, mathematics, logic, database theory and practice, artificial intelligence, mathematical linguistics, epistemology and methodology of science, to mention but a few. Here we use structural models based on the theory of named sets for description and analysis of interpersonal communication explicating its structural regularities.

2 Information as a Morpho-Ontological Process

Published

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The debate about information is clearly ontological: how do we know what is real? Which is the object of our knowledge? Only after having clarified this point we can start epistemological debates, which at their turn, are part of the ontological perspective (about nature, knowledge, and the world itself, here the vicious circle). Therefore: things do not happen in the world, but happen in our minds. For that reason, information cannot be considered something real that is just expecting to be captured by some information-gatherer entity like a human being. At that point the multidimensional aspects related to information integration produced by some special entities, which at their turn are constrained by specific morphological aspects, reveal the conflictive nature of reality as information. In fact, it is a process.

3 On the Informational Essence of Emergence and Evolution: An Analysis of the New Dualistic Approach

Published

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In his article “What is Information”, Robert Logan explores certain issues related to information on the basis of the connotation of information itself, and puts forward two important theories of "extended mind" and "symbolosphere". Based on the strong-emergence theory, Logan depicts the material emergence and non-material emergence, and proposes a new dualism view, a weak form of dualism. According to this, different from the biosphere, the evolution and reproduction mechanism in symbolosphere do not follow the rules of genetic inheritance, but the mechanisms of memes, belonging to the territory of information study. The new dualism faces the difficulty to correctly explain the ontological position of the symbolosphere, while the philosophy of information provides a standard solution in its theory of human evolution. The evolution of human beings not only contains a physiological inheritance pattern, that is, to follow the single evolution path with DNA genetic characteristics, but also includes psychological activity patterns and behavioral patterns in a three-dimensional way. For human race, the physiological and genetic characteristics will present themselves in the postnatal growth, at the same time, the characteristics of psychological and behavior patterns accumulated in years will also leave “traces” on the inherent genetic vector, which constitutes a new congenital genetic features. It is in this interaction and two-way activities of mutual development and realization between human and nature as well as culture factors that all the content of physiophere, biosphere and symbolosphere and their form achieve a completed, essential and unified integration.

4 An evolutionary view on function-based stability

Published

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How can things become stabile? This is a difficult question to answer, but we should nevertheless try, because of the answer´s importance for life, for us.
Admittedly the question sounds too broad to try to find an answer, but largely this is because we tried to find a universal answer, a universal answer instead of an evolutionary one. The large advantage of the evolutionary view is that reductionism is “only” needed to find the possible base for a phenomenon which is analyzed and which could as well be a relatively modern phenomenon and afterwards from this base ideas can be developed further; relatively modern refers to modern estimated from the duration the phenomenon influences developmental and evolutionary processes compared to the total duration of the evolutionary process on Earth.

5 Analysis of the internet development based on the complex model of the discursive space

Published

Rafal Maciag

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This paper aims to present a new way of understanding and elaborating the current state of the reality which remains in the substantial dependency on the technology. An example of such a relatively mature technology is the internet. This paper shows the coherent descriptive schema of it based on the idea of discursive space which has two essential ingredients: complexity as a generic model and discourse as its direct substance. Abstract discursive space is created according to the idea of the physical state (phase) space. Discursive space lets further to describe the knowledge phenomenon.

6 Augmented reality and perception of analogue and digital images and maps

Published

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The idea of combining information from a database with information derived directly through the senses is termed augmented reality. Augmented reality (AR) is that organically, in real-time and dynamically overlaying virtual images created by computers and other information on real environment which the observer sees. And when the observer moves in real environment, virtual information changes according to the movement, just like those virtual information truly exists in real world. AR is used with the mobile devices with GPS and WiFi connections. The user gives the system information to identify the desired destination, and the system then generates sufficient information. The disadvantages reveal themselves when there is no WiFi connection or there is no space in the storage of mobile device to maintain the image of the whole map. Then the traditional ways of recognition of localization must be used, most often with analogue (paper) map or image. The presentation of coding of some data and metadata on an image or a map (both in digital and analogue form) permits inter alia the inclusion of e.g. paper map or analogue image into the chain of digital devices use. Some solutions, remarks and comments concerning functioning of the digitally augmented (printed) map within the information society are presented.

7 Autonomy, Testimony and Informational Diversity

Published

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I'll follow a line of thought that suggests to intend "personal autonomy" in a social sense. The urgency to undertake this move arises because of the wide variety of informational sources we are exposed which influence our behavior. Social background represents the basis for autonomy; at the same time, interaction with others (real or virtual) enlarges the possibility for autonomous judgements. My attempt is to try to elucidate the connection between autonomy, knowledge by testimony and the exposition to informational diversity.

8 Characteristics of Information and Its Scientific Research

Published

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The purpose of this paper is to prove the basic law of information and its application in logic, mathematics and translation by expounding the ecological characteristics of information and its scientific research. The first is to explore the essence of information from the diversity, and then to explore the way of information science research from multiple perspectives. Finally, through the social-ecological characteristics of the phenomenon information, at the same time, through the logical-mathematical characteristics of essential information, Ultimately, reveal the basic law of information. The result is that the basic law of information and its application is proven in logic, mathematics and translation. The significance of the phenomenon is that the characteristics of the phenomenon information are highlighted in a variety of forms. The existence of the essential information is known in the order of its order and position in the generalized text gene and its combination form system. Since the machine translation is essentially the translation memory in the vocabulary , Phrases, sentences, paragraphs and chapters are more satisfied with the bilingual pair of levels, therefore, they are in logic, mathematics and language in three aspects to follow the basic principles, namely: this article reveals the three basic laws of information.

9 Fundamental Law of Information: Proved by Both Numbers and Characters in Conjugate Matrices [1]

Published

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Its purpose is to prove information law by logic, mathematics and translation. The method involves: the generalized bilingual logic established on both Aristotle 's formal logic and Frege' s mathematical logic, the linkage function established on both Turing's strong artificial intelligence using numbers and Searle's weak artificial intelligence using characters, the ontological knowledge established on both Saussure's general linguistics and Chomsky's formal linguistics. The result is that the basic law can be proved by digital and textual twin matrices. Its significance lies in that the global positioning system should be regarded as a special case of the generalized bilingual system.

10 Information and Intelligence in the Living Cell: A Fundamental Hiatus for Information Science?

Published

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The new panorama that computers and the new technologies have opened on the entire molecular processes of life, from bioinformatics to “omic” disciplines, and from systems biology to signaling science (to name but a few of the new bioinformational fields), have not cohered yet into a consistent informational scheme or new theory of the cell, so that further high-level characteristics such as meaning, fitness, complexity, and intelligence –closely related to the adaptive relationship with the environment– cannot be consistently approached. Rather, a spattering of dozens of specialized disciplines scarcely interconnected are dealing with multiple partial aspects. Subsequently, explaining the emergence of astonishing integrative inventions related to multicellularity, e.g., the origins of nervous systems and the further development of neuronal complexity, is left in the shadow.
An essential problem at the very root of today’s amazing accumulation of biomolecular data revolves around the absence of adequate conceptualizations on the LIFE CYCLE as the generalized source and sink of the information flows exchanged by the living system. Herein, leaving aside the specific matters related to the inner cellular informational dynamics, we will focus on the relationships between the advancing life cycle of the cell and the information flows of the environment.
What are the general conditions to advance a life cycle in the simplest cell? As an open self-producing system, a great variety of inputs and outputs are necessary (even for the simplest prokaryotes) not only consisting of matter and energy flows but also involving information flows. Our analysis herein will involve two basic aspects. On the one side, the structure of the prokaryotic signaling system itself, with all its variety of environmental signals and component pathways (what has

been called the 1-2-3 Component Systems), including the role of a few second messengers which have been pointed out in bacteria too. And in the other side, the gene transcription system as depending not only on signaling inputs but also on a diversity of inner factors: from metabolic products, to sigma factors, to house-keeping systems, to channels and transporters, etc. Actually, in spite of this remarkable degree of complexity, the gene expression system of bacteria is highly systematic in its hierarchic organization and has been compared to computer operating systems. So, there is room to explore the organized and systematic convergence of stimuli from different signaling paths "encoding" integrated aspects of the environmental information flows. The specific life cycle of the bacterium will be the essential factor motivating the classes of convergence to be found.
In particular, if we want to ascertain the effect that a given signal or specific information flow produces, we must count the new molecular presences and absences derived from the gene expression consequences of the signaling event. The meaning of a particular signal is thus established through "molecular mining". But there is no fixed reference there: the life cycle itself, in all its enormous multiplicity of possible 'moods' and trajectories, can only be established in retrospect, by 'freezing' it. At every instant we might look behind, we see that the reference that provides, generates, and fabricates the meaning has changed... The whole life cycle is but a temporal sequence of instantaneous meanings continuously churned out from the entire self-production processes and apparatuses of life. Looking from the angle of semiotic conventions, signals appear as compositional structures of the objects themselves, quite indistinguishable and inseparable from them and from the outer world as well; only with the advent of quorum signals and inter-species communication, we may partially distinguish between signals that denote the presence of a very important 'animate' object. As for the subjects, they appear themselves as life cycles in progress, and only that which pertains to the advancement of the life cycle has been evolutionarily incorporated as being part of the subjects' own communication and energy flows.
We have briefly examined the connection of the life cycle with meaning, and similarly we could advance the interconnection with intelligence, complexity, fitness... Some of this work has already been started by the present author (Marijuán et al., 2011, 2013, 2015); but there is a long way ahead. In the opinion of this author, the lack of adequate connection with the life cycle represents a fundamental hiatus in our conceptions around biological information and its correlate of biological or natural intelligence, and all the other associated concepts. Seemingly, without a meaningful interconnection with the life cycle, the further relationships with the information approaches of the physical and computational realms, as well as with the miscellany of humanities' fields, cannot be worked out properly.

11 Information: Subjective or Objective?

Published

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The target of this paper is to draw a comparison between information in living systems and information in inorganic contexts. The two representative contexts we will refer to are those of an organism and of solid state physics. We have published extensively elsewhere on the properties of a model hierarchy (e.g. Cottam et al, 2003; and most recently Cottam et al, 2016; Cottam et al, 2017), and to reproduce the entire derivation would be inappropriate for this extended abstract. Consequently, we will restrict ourselves to the brief sketch which follows, in the hope that this attenuated version is sufficiently comprehensible.

12 On the Emergence of Social Information Sciencein China and Our Research Outline

Published

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Social Information Science (or Social Informatics) is a new and inter-discipline branch subject in China and even in the world. This paper probe the emergence of social information science and the research outline of us.

1. The proposal of the social information science. We set up the research from an extension from the theoretical informatics to the concrete informatics; an internal bond of integrating various subjects in human and social sciences; an intersection and mutual permeation between the social science and the natural science; an intersection and interaction among human and social sciences, a modern information science and information technology; a strengthening to the research into the Social Epistemology.

Ⅱ. On the concept of social information. Social information directly is different with self-existent and natural information, and more related to human's autonomous creative activities, to society's culture inheritance, to social value, to human's spiritual interaction and to human's emotions.

Ⅲ. On the theoretical orientation of the social information science. Social Information Science is a concrete branch of informatics, a generation of sub-disciplines of social information, a kind of traversing and comprehensive research on individual social science from the angle of information, a kind of exchange and interaction between social theoretical research and the modern information technology.

Ⅳ. The research focus of the social information science. The paper lists 10 main focuses in the research of social information science. Such as the interweaving of the factual information and the valuable information, of the subjective information and the objective information, of the rational information and irrational information, of the general information and the idiosyncratic information; the difference between comprehensive information and restrictive information, the collision between purpose-oriented information and spontaneous information, the man-made increase and decrease and purposeful distortion of social information, the cognition, evaluation, interaction, intersection and even mutual restriction of information, the differences between the exposition and understanding of information, the different effects resulting from the passive reception of information and the active collection of information

Ⅴ.The system and frame of the social information science. In general, there should be four levels of researches if the social information science is to be viewed as a relatively independent subject: the philosophical level, the scientific theoretical level, concrete apply level, social information technology and methods.

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13 Structural Realism, Structural Information, and the General Concept of Structure

Published

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The main goal for this paper is to revisit and rehabilitate structuralist methodology based on the idea of invariance and symmetry for the purpose of the discussion of structural realism and its consequences for ontology of information. This paper continues the earlier work of the author carried out in this spirit. In the present paper the focus is on the general concept of a structure, not necessarily in terms of information, but with important consequences for the study of structural information. The conceptual study of the general concept of a structure is followed by an outline of the mathematical formalism suitable for the development of its theory.

14 The analysis of the internet development based on the complex model of the discursive space

Published

Rafal Maciag

[1] Jagiellonian University, Cracow, Poland

This paper aims to present a new way of understanding and elaborating the current state of the reality which remains in the substantial dependency on the technology. An example of such a relatively mature technology is the internet. This paper shows the coherent descriptive schema of it based on the idea of discursive space which has two essential ingredients: complexity as a generic model and discourse as its direct substance. Abstract discursive space is created according to the idea of the physical state (phase) space. Discursive space lets further to describe the knowledge phenomenon.

15 What we can discover from Dimensional Analysis of the information concept

Published

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Dimensional analysis is a technique used by scientists and engineers to check the rationality of their calculations, but it can also be used to determine the nature of the quantities used. Information is usually measured in bits, or binary digits, but it could be measured using any other base. I will be arguing that, given the possibility of an objective measure of information in terms of asymmetries,

and the relation of information to order, Schrödinger's suggestion that negentropy was an appropriate measure should be taken seriously. After clarifying this notion, I use dimensional analysis to show that negentropy has units of degrees of freedom, and that this is a sensible unit of information.

16 Information Philosophy Analysis of Traditional Culture Factors Affect Behavior

Published

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The existence of the cultural phenomenon indicates that social psychological patterns or behavior break through the scope of individual activities. Social group has its own "information", and the "information" dominates the psychology and action of individual.
Person is multidimensional existence—the existence of the society, and the condensation of social relations. People create the products of the world through their social practical activities, and it is also a way of information evolution...The evolution of the person's physical, psychological, behavior growing in evolution of command and control base on information.
Cultural elements, such as values, norms, customs, material culture, etc, have certain influence to the behavior all respectively. As a profound cultural background of the Chinese nation traditional culture, with a strong penetration and integration ability, cannot simply be critical or inheritance. East and west cultural exchange and collision increasingly commonplace today, the modern people, especially teenagers have changed a lot, so this is a new trend of our modern people's psychological and behavioral development. How to make full use of the centripetal force of traditional culture, and promote the health civilized practices of the social life is an important topic.

17 Discussion on the Necessity of Integrating Information Philosophy and Unified Information Science from the Perspective of Thomas Kuhn's Paradigm Theory

Published

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Thomas Kuhn's paradigm theory tells us that the science itself has a certain structure and the development of science has its own laws. His historicism research methodology in philosophy of science provides us a research approach having much referential values for investigating, predicting and programming the process and prospect of the development of Unified Information Science. And the paradigm shift of science firstly needs a breakthrough in its philosophical core-ontological presupposition. Therefore, this article will discuss how the development of Information Philosophy in China provides an opportunity for building the Unified Information Science from the perspective of

paradigm theory, analyzing what necessary theoretical foundations that paradigm theory provides for the integration of Information Philosophy and Unified Information Science.

18 Philosophy of Information: the urgent need to move away from entropy towards algorithmic information

Published

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Discussions about information centered, either in favor or against, the use of Shannon's information theory are not only ill-suited but cannot help the discussion unless it is left behind just as the theory of randomness did early in the 1960s with the theory of algorithmic information. While it is true that physics, and many other areas, have been painfully slow at moving away from Shannon entropy and still can find a wide range of applications for it, we will show how eventually more powerful generating and predictive data-driven models will—and should—replace it. I will argue that discussions in Philosophy of Information should be thus one step ahead instead of several behind, guiding not only the philosophical discussion but also leading and steering scientific attention. I will explain the relevance of algorithmic complexity as a salient property at the core of the scientific method, especially in the challenge of causality discovery, and how fears against moving away from Entropy based upon arguments of uncomputability are unfounded, as it precludes progress and embraces defeat.

19 The Case of Artificial vs. Natural Intelligence: Philosophy of Information as a Witness, Prosecutor, Attorney or Judge?

Published

Marcin Jan Schroeder

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The relationship between artificial and natural, human intelligence becomes currently an issue of the primary importance for the world. The threats of technological singularity in the form of ultraintelligent machines occupied many philosophers, but thus far nobody paid attention to the encroaching singularity of relatively low level automation which eliminates need for low skill labor force and threatens wide masses of human population. Economists predict that many occupations regarded as requiring high skills will become spurious too. The only solution for the optimal coexistence of the artificial and natural intelligence is in the reform of education. The solution does not require anything new as the liberal arts education promoted human intellectual development leading to the roles which machines least likely can assume.

Introduction

The relationship between artificial intelligence (AI) and natural intelligence of human being is not a new topic of philosophical inquiry. However, thus far it was not much more than a matter of speculative or futuristic reflection. After all, even now the introductory problem of defining

intelligence in its natural or artificial form has not received definitive, commonly accepted solution. The threats of "intelligence explosion" predicted by Irving John Good [1] or "technological singularity" anticipated by Vernor Vinge [2] and popularized by Ray Kurzweil [3] with the catastrophic visions of ultraintelligent machines escaping human control and comprehension do not belong to the primary concerns regarding the future of humanity. Global warming, degradation of environment, overpopulation, lack of sustainability in the use of fundamental resources, violent conflicts stimulated by religious and cultural intolerance seem much more dangerous and already fully manifested problems which require immediate intervention. Discussion of such a nebulous subject as artificial intelligence can be viewed as detraction from what actually is important and what should engage the limited available means for a collective action.

On the other hand most recent political developments of a global importance caught everyone by surprise, even those who strongly believe to become their beneficiaries. Their consequences are still unknown, but are of a grave concern for people all over the world, as they undermine political, economic and military stability everywhere. The conditions leading to Brexit or to the US presidency of Donald Trump, or in general to the wide spread of populism and to the rebellion against globalization, were diverse and complex, but there is no doubt that the main factor was the frustration and anxiety in developed countries generated by declining job market, specifically in the domains of economy engaging people with lower levels of education. The fact that at the surface it is a matter of rising popularity of populism and isolationism should not be misleading. Populism by the definition is addressing in its political actions large masses of less affluent parts of the society by utilizing resentment towards social elites as a way to gain political power. The problem is not in populistic or nationalistic ideologies, but in the conditions that make these ideologies attractive to masses. Of course, the acts of terrorism committed by a third party are very convenient tool for the propagation of populistic or nationalistic ideologies, so they cannot be completely dismissed, but the actual roots of the shift in this direction is always in the economic situation and its interpretation.

Thus, we have declining number of jobs for those with limited education which is interpreted as a result of globalization. In the US the tight job market in manufacturing is blamed on Chinese or Mexicans who in their countries do the same work for much lower wages and attract investment of American businesses. In the UK it is easy to convince people that their jobs are taken by Eastern Europeans or other EU citizens who can easily and legally immigrate to UK and who happens have frequently better education. The solution seems easy, close the borders, build the walls, withdraw from international political or economic unions, levy taxes on products from abroad and the life of all society will return to its old glory. For our purpose it is not important to assess truth or falsity of such bizarre economic recipes. More important is to investigate the actual source of the problem and since this source is closely related to the subject of the relationship between the artificial and natural intelligence, it is necessary to analyze the problem in the perspective of the philosophy of information.

This paper follows economic analyses which show that the main reason for declining job market for those with lower levels of education is not the abduction of jobs by labor force abroad or by migrants, but the technological progress in automation which eliminates need for less skilled work [4]. This progress is being associated with artificial intelligence and here we have our case of artificial vs. natural intelligence. It is the role of philosophy of information to reflect on the relationship between these two forms of intelligence, to assess severity of the problem of their coexistence and to seek solutions which will make this coexistence beneficial for humanity. The importance of such reflection is increased by the predictions in economic analyses that the fate of the low skill jobs in manufacturing will be soon shared by many or even majority of jobs defining the middle class.

The most important thesis of this paper is that we are already within the singularity anticipated by many authors, but this singularity is not caused by the arrival of ultraintelligent machines which are beyond our comprehension. The actual transformations which dramatically change human affairs are at the other end of intelligence spectrum and are related to jobs which require very limited capacities

that can be already implemented in robots. Thus the danger is not in artificial ultraintelligence, but in the army of artificial intelligent midgets capable of fast and accurate performance in only few highly specialized functions. If we want to defend ourselves against the danger of unpredictable consequences resulting from the further development of artificial intelligence (whatever is meant by it) and if we want to find the optimal mode for coexistence of artificial and natural intelligences, it is necessary to understand the problems involved in such coexistence.

Witness

The prediction of the problems arising with technological progress goes back at least to reflections of John von Neumann reported by Stanislaw Ulam in his friend's obituary: "One conversation centered on the ever accelerating progress of technology and changes in the mode of human life, which gives the appearance of approaching some essential singularity in the history of the race beyond which human affairs, as we know them, could not continue" [5]. Apparently this was the origin of the use of the word "singularity" by later authors who sometimes explicitly referred to this quotation. But von Neumann, whose work on self-reproducing automata stimulated visions of the machine domination in the works of more recent authors did not speculate on ultraintelligence. His concerns were more about the impact of technological progress on humanity and potential threats of dehumanization. These concerns were quite wide spread at those times very likely under the influence of the threat of the development of nuclear arms and the possibility of global catastrophe of their use. Martin Heidegger was one of the prominent philosophers addressing the issue of dehumanization caused by technological progress [7]. His message was weakened by the frequently voiced interpretations of his concerns as an attempt to avoid taking responsibility for his earlier support for fascism, but this does not diminish the role of the problems in the collective consciousness.

If the concerns about the detrimental impact of technology on humanity appeared so early, why are we so unprepared for changes today? The answer can be only speculative, but we can guess that the main reason was the recognition of the universal, ever present anxiety accompanying technological progress. Historical record from many centuries brings many examples of unjustified suspicions regarding technological news. We can consider just one randomly selected example from the remote past in order to illustrate how irrational were sometimes negative reactions to innovations. H. Spaichel of Nuremberg invented in 1561 a new type of lathe with a tool rest. Because of the opposition of other master metal turners and in order to prevent the invention to leak out from the local control the Municipal Council of Nuremberg decided in 1569 to destroy its model [8].

There is a legitimate question whether the current anxiety is just another example of hysteria brought by the fear of innovation. Economic analyses show that the phenomenon of disappearing need for low skill labor force is not just an expression of anxiety. Michael J. Hicks and Srikant Devaraj provides analysis that shows that 88% of lost jobs in American manufacturing is the result of the increased productivity brought bt technological innovation, mainly automation of the work requiring low skills [4]. Similar reasons for concerns can be found in the special report published by The Economist in June 2016, but in this case in a much wider range of occupations [9]. The report is quoting the results of research from 2013 on 702 occupations, putting in risk of elimination 47% jobs by automation in America, 35% in Britain and 49% in Japan.

The reports on the increasingly common "deaths of despair" among blue-collar whites in their fifties for whom the mortality rate is more than three times higher than for those who attained a bachelor degree in the US show the scale of social response to the situation [10].

Silicon Valley executives experiment in Kenya through an American NPO called GiveDirectly on the solution called "universal income" providing everyone (thus far in relatively small remote communities) some modest, but sufficient for relatively comfortable survival income without any work done [11]. The enthusiast of "universal income" claim positive results, but there are many fundamental methodological questions regarding any form of generalization to large scale societies.

Prosecutor and Attorney (These roles due to limited space are excluded from this extended abstract)

Judge

It is not a surprise that the role for philosophy of information is to become a judge. The judgment should be made based on factual analysis of economists and sociologists as witnesses, on the analyses of the respective roles and characteristics of artificial and natural forms of intelligence as voices of an attorney and prosecutor. The judgment unavoidably points at education as the only solution to the problems. There is no doubt that the problems are results of faulty educational systems, in particular educational systems of developed countries where education was allowed to stay way behind the technological progress.

This judgment requires an extensive explanation. It does not mean that we should introduce massive computer science or engineering components into entire process of education. We can predict that the process of computer programming will soon be automated. Appropriate human-machine interfaces will translate the objectives of human demands into tasks comprehensible for machines. The role of human intelligence which will be the last to be replaced by the artificial forms involves creativity, emotions, values, aesthetics, versatility. Thus, the most important missing element of education is on the side of the humanities, but we have to remember that mathematics and scientific exploration of the world are equally fundamental components of the human condition.

Is this prescription or court ruling new? Of course not. The liberal arts education has promoted this approach to education since Mediterranean Classical Antiquity. Similar goals can be found in Confucian philosophy. Therefore it is not a call for completely new forms of education, but for the implementation of the ideas of education which for centuries were prized, but never given sufficient support from those who are responsible for providing sufficient resources.

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20 The meaning of Information Civilization and Its Contemporary Value

Published

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The information civilization is neither a consequence of industrial civilization, nor an extension of industrial civilization. It is a new form of civilization. It challenges the ideas which were based on industrial civilization, and reshapes the way of how we observe the world, how we make decisions, how we think, play, educate and so on. It will break the structures which formed on the basis of industrial civilization. The root of industrial civilization lies on the separation between science and faith. Science is regarded as a tool to control the world where we are living. Therefore the industrial civilization is a civilization that aims to pursue the maximized personal material interests. The root of information civilization, by contrast, lies on the interconnection based on the information technology. This paper will discuss the meaning of information civilization by comparing the differences between information civilization and industrial civilization and then reveal the contemporary values.

21 Truth analysis of definition of information

Published

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Philosophy is a theoretical activity of constant re-conceptualization and a practical activity of constant externalization. Through the concept of information, Philosophy has been re-conceptualized in the Information Age. Concrete forms of human practical activities have also simultaneously changed tremendously. However, with regard to the nature of information, the debate between the scientific community and the philosophical community is still ongoing. Consistent with this, the definition of information is more divergent. The integration of science and philosophy requires the cooperation of scientists and philosophers : there is no doubt about that. More fundamental, however, is that when we propose a definition of information, we (whether scientists or philosophers) all expect and have identified that the definition of the information that we give is true. However, there are so many definitions of information: which one is true? Whose definition is true? What are the underlying reasons behind the multiple definitions of information? How should we give a definition of information? With this article I may also give no "real" answer, but I try to do a brief analysis.

22 " Cosmism of Water " and Existence , Non-existence

Published

Wu Tianqi

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" Cosmism of Water " is one of the earliest cosmism in the world. In many thoughts of the ancient civilizations, " water " is defined as a kind of original medium create and covers the world. So that, in those " Cosmism of Water " , " water " is a kind of exists that an all-embracing, the original, the only and no inner, outer and difference. But the properties of the water in these " Cosmism of Water " are very similar to the non-existence. So that " water " only is a kind of non-existence. And The " water " in these " Cosmism of Water " is become an abstract concept, then it will be the most primitive metaphysical concept in the human thought, a lot of concepts in the history of philosophy are similar with it . Thus we can find all the metaphysical concept in the history of philosophy is also points to the areas of non-existence .

23 A new round of science and technology revolution bring human society to Spiritual Civilization Stage -Spiritual Life Awakening

Published

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Description:
Human society is experiencing a new scientific and technological revolution,which impact all aspects of human society. Under this background,in this paper we discuss three new topics: the new division of human civilization stage, the philosophical paradigm of the new intelligent society and the guidance of individual spiritual life growth.

1.The new civilization stage - Spiritual Civilization Stage.

Life is the fundamental topic of human society, all the human civilization should ultimately be attributed to one topic:whether it contribute to the life improving or not. The new technological revolution, which is being carried out by information technology, will have a subversive effect on all aspects of human society. This paper, from the perspective of human individual spiritual life, re-divides several thousands years of human civilization.From personal spiritual life aspect,the civilization stages before this new technology revolution are all be classified as The Material Civilization Stage,including the industrial revolution stage, the stage of agricultural civilization and the earlier ancient civilization stage.The reason for this division is probably:

First, relative to the previous historical stage,for the most part the arrival of each new civilization stage has brought greater liberation and convenience to human production and daily life,and the last

industrial revolution brought great release of the productive forces, creating developed material civilization with abundant products, there is a very wide selection space for peoples' material life,such as eating,clouting,accommodation and transportation etc.The material world is colorful and gorgeous.However, from the perspective of nature life, no matter how rich achievements the industrial civilization creates,it only meet the various material needs,and provide material accessibility for all different product and living,so it could only still classified as material civilization stage.
On the other hand, the promotion and growth of individual spirit and spiritual life has not yet been truly opened up, but this should be the fundamental pursuit and end result of human survival in the world. This article points out that the new technological revolution will initiate the starting of human spiritual civilization evolution,human society develop to Spiritual Civilization stage. The individual life began to embark on the way of spiritual life promoting and detaching, so as to obtain higher and higher spiritual realm. Thus the growth of a wide range of spiritual life will lead to the rise of human civilization to a higher spiritual level, not just remain at the stage of material diversity accumulation . This will be revolutionary.

Second, currently people' activities are basically around the acquisition of various material needs , life itself is constituted by what it devote to,the most time of people is used to fulfill material and outer requirement,so every life now is essentially a material life,rarely related to spiritual and intelligent life level.This time science and technology revolution has brought intellectual revolution to human beings,people's these material life and activities could be replaced by intelligent,so human life will be liberated from material creating activities,human labor is becoming not an essential factor to large production,and furthermore rise to leader on the top.Then after life is liberated from materiality, where are the next entrances and exits of life orientation? That is developing from material life to spiritual life,get the exploring and sublimating of life essence start,namely the spiritual life.Make human life be fundamentally promoted at higher levels.Thereafter,human life will more and more turn to intelligence needs of spirituality.Human civilization then slowly and slowly transform from material stage to spiritual stage.

2.Second, the philosophical paradigm of the new era

Then the opening of the intelligent era, human society enters into the era of internet of all things ,everything is connected, a variety of traditional boundaries will gradually lose its binding force, such as the national division, culture distinction, region segmentation and so on.All human social mobility elements can be digitized into Data, which approach to an unified world, the future of human society will be towards a unified trend and direction,that is, China put forward the concept of "Community of Common Destiny".
Each social form has a philosophical paradigm as a guide, so what is the guide philosophy in this new era?Human society extends to much vaster space. Oriental civilization, especially Chinese culture and philosophy, emphasizing the cosmology of "The harmony between man and nature" and the principle of "the doctrine of the mean",yin-yang and five elements theory.The spirit of Confucianism, Buddhism and Taoism are all of holism world view,all pursue ultimate of life and guide man to improve life.
We propose that Chinese culture will take on the ideological guiding mission in this new human society form,which generated by this new scientific and technological revolution.And the the whole world will achieve unity in a broader sense.

3.Third, the growth theory of personal inner life

So what kind of spirit could be a inner growth guidance of the essence of life namely the spiritual life?In a universal sense,what kind of spiritual culture will become the leading culture of it ? This topic may include the dialogue between different civilizations of mankind, the integration of the subject, I boldly put forward, from the individual spiritual life growth point of view, different civilizations may be

at different levels of spiritual life. The spiritual growth of life follow a hierarchical order, such as the ultimate of Buddhism is Nirvana, but the middle process will experience a variety of sub-fruit. From the Christian culture, Jewish culture, Islamic culture, which are outside of China,to Chinese Confucianism, Taoism, Buddhism culture, these represent the highest attainments of human spiritual civilization,if we put them to one study platform of life and reconsider them all from the view of spiritual life growing,then we will find that,they are at the different positions, plays the different roles relative to spiritual life growing.And furthermore,there are hierarchy relationships between them,and they point to spiritual pursuit in a unified sense,ultimately serving the spiritual life growing subject. So based on this human fundamental topic of spiritual life growing,different civilizations come to stand on this point of culture convergence and force the generation of dialogue,coordination and fusion mechanism.Following the systematic construction of human spiritual life,these different cultures will be reconstructed and then produce a new form of innovative civilization achievement.This will be an exciting subject.

24 An Eco-Cognitive Perspective on the Philosophy of InformationKnowledge as a Duty

Published

Lorenzo Magnani

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The second half of the 20th century has seen the rapid growth of information science, technology, and engineering that amounts to a social and technological revolution. These new trends have generated huge changes in several areas of human life, not only in western societies. I think that in this new age of information civilization the problem of the relationships between information and knowledge has to be readdressed. In this perspective the new challenges related to the generation, distribution, exploitation of information and knowledge have to be seriously seen in the light of their political, economical, educational, cultural, and moral consequences. In my opinion, it is especially in the framework of a study taking advantage of an eco-cognitive perspective that we can reach interesting results, as I have tried to illustrate in my *Morality in a Technological World. Knowledge as Duty*: the technological advances generated by information science, technology, and engineering of contemporary society have outpaced our moral understanding of the problems that they create and have brought about consequences of such magnitude that old policies and ethics can no longer contain them. I believe that producing, distributing, and applying recalibrated information as appropriate knowledge endowed with optimal and prosperous outcomes has become a duty, one that is just as important as making scientific or medical advances. I contend that to manage these challenges and counter many of information technology's ill effects is essential to preserve ownership of our own destinies, encouraging responsibility, and enhancing freedom. I will also discuss how objects, structures, and technological artifacts which carry information and knowledge and at the same time also serve, often implicitly, as moral carriers and mediators.

25 Analysis of the Chinese Civic awareness development on the Internet

Published

Langlang Liu

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The citizen consciousness consists by four logical components: right consciousness, responsibility consciousness, the sense of participation and the awareness of the rules. with the help of the public sphere which opened by Internet, Chinese citizen consciousness is developing rapidly. But due to the Internet information spread is characteristics of openness, anonymity, virtual, showing too much emphasis on the rights of the individual, disparage the rights of others; a serious lack of sense of responsibility; sense of participation is strong but lack of rationality; rules lack of binding and recognition caused the rule consciousness weak.

26 Does Kun's Philosophy of Information define what is Information?

Published

Emanuel Diamant

[1] VIDIA-mant

The need for a generally accepted definition of "what is information" is self-evident and acute. However, Kun's definition of information as "a philosophical category indicating indirect being" is unable to satisfy this need, especially when it comes to an everyday usage of the term. That forced me to seek for a more suitable definition of information. Despite the differences, Kun and I agree that we witness today a paradigm shift from data-based computational way of thinking to information-based cognitive way of thinking (Kun calls that "informalization of science"). Below is provided a short comment on this issue.

27 Does Kun's Philosophy of Information define what is Information?

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28 Ecological Information: the Foundation of Ecological Democracy

Published

Youqiang Wang

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Different from traditional democracy, ecological democracy not only concerns the interests of people, but also pays attention to the benefits of nature. Its goal is the harmony, freedom, equality and sustainable development between humans, nature and society as a whole. Ecological democracy based on ecological information is necessary with dialogue, communication, exchange and consultation in order to jointly govern and protect the environment because the administrative region has divided the integrity and coherence of the geographical conditions into fragements. The scientific ecological information system constructed in relation to each other can predict the overall ecological evolutional trend and formulate corresponding counter measures. Ecological information plays an important and basic role to achieve the reconciliation between people and nature, and people to people.

29 From Systematic Way to Informational Way—The New Tendency of Contemporary Scientific Thinking

Published

Jian Wang

[1] Xi'an Jiaotong University

As a kind of thinking mechanism that grasps motion, change and development of objects on the whole, systematic thinking contains a whole set of thinking principles, methods and operation procedures. With the uprising popularity of studies on informational system science and complexity theory, information reveals a new field that the philosophy of the past has not discovered. Wu's works are putting forward a wholly new scientific thinking way: the Informational Thinking. We can conclude rationally from Wu's explanations of information that the character of informational thinking way can include and surpass the basic idea of systematic thinking way. So far as the whole process of scientific cognition is concerned, functions of informational thinking are expanded in several aspects.

30 Meaning generation for animals, humans and artificial agents. An evolutionary perspective on the philosophy of information

Published

Christophe Menant

[1] Independant scholar

Meanings are present everywhere in our environment and within ourselves. But these meanings do not exist by themselves. They are associated to information and have to be created, to be generated by agents. The Meaning Generator System (MGS) has been developed to model meaning generation in agents following a system approach in an evolutionary perspective. The agents can be natural or artificial. The MGS generates meaningful information (a meaning) when it receives information that has a connection with an internal constraint to which the agent is submitted. The generated meaning is to be used by the agent to implement actions aimed at satisfying the constraint. We propose here to highlight some characteristics of the MGS that could be related to items of philosophy of information.

31 On the Simplification and Complication of Cultural Symbols

Published

Guai-ning Li

[1] Xi'an Shiyou University

In the context of globalization, cultural exchanges have become an important way to promote the harmonious development of human society. In the process of cultural transmission or communication, each country or nation will first present its own image with some unique cultural symbols, so that these cultural symbols are an important part of world culture. The cultural heritage and continuous development is also an important content to achieve self-confidence of national culture. As a multi-ethnic country, China has a long history and splendid culture, its cultural symbols are more complex and diverse.China is a multi-ethnic country, in the long river of history, the common development of all ethnic group formatted the rich and varied, harmony in diversity cultural landscape ultimately. However, to make a country or nation culture widely and effectively spread, and truly promote human civilization and development, we must pay attention to the simplification and complication of cultural symbols are two-way parallel in the process of minority culture communication. For the transmitter, the simplification of cultural symbols is a double-edged sword, which is to promote and block the minority culture; For the receiver, the course of acceptance of cultural symbols, defamiliarization effect and reinterpretation will give new meaning to cultural symbols, which makes the meaning of cultural symbols tend to be complicated. The cultural symbols, whether simplified or complicated, should serve the needs of cultural heritage and development, and promote the progress of human society.

32 Philosophical Analysis on the Nature and Forms of Information - From the perspective of Marxist philosophy

Published

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[1] School of Economics & Law, Shaanxi University of Technology
[2] School of Marxism Studies,Xi'an Jiaotong University

The aim of this research essay attempt to reveal the nature of information form the perspective of Marxist Philosophy. The nature of Information is the first question that philosophy of information science and technology research must be answered, thus the problem is still debated. According to Marxist dialectical materialism method to the essence of information has made the analysis and argumentation, points out the essence of information between what is and its internal contact things, and this contact information is presented. Due to the connection between the protean and endless things, thus produce the endless, full of beautiful things in eyes, each are not identical information. To grasp the nature of information, must pay attention to and the specific form of information and information processing, the reorganization, transmission, storage, use and so on.

33 Philosophical Dimensionality of Information ecology

Published

Feng Xiao

[1] First and Corresponding author, presenter

The information ecology is not only a social problem（such as the political problem—information security, information policy, or economic problems and management issues）, but also a philosophical problem, thus forming a philosophical dimension of information ecology. This dimension focuses on the study of the information environment from the perspective of ecology and reveals some general attributes of the information ecology from the height of philosophy, as it is a spiritual phenomenon rather than a material phenomenon, it is a people-centered phenomenon, and also a value phenomenon, and so on.
Because of the value attribute of information ecology, People tend to pursue a good information ecology for their physical and mental health, which exists in our ongoing efforts to eliminate information pollution. The main source or the performance of information pollution in the Internet Age are displayed by the variety of anomie network behavior, such as the proliferation of spam, the prevalence of false information, permeating the toxic and harmful information, and implanting virus program to the network , and so on. We should take care of information ecology as same as protecting the natural ecology, and develop and manage it more reasonable.

34 Philosophy of Information Leading to the Fundamental Transformation of Philosophy

Published

Kun Wu[1], Ping Wang[2]

[1] International Center for Philosophy of Information, Xi'an Jiaotong University, China
[2] School of Humanities and Social Sciences, Xi'an Jiaotong University, China

Philosophy of information should not be taken as the study of philosophical problems in information science and information technology, nor it should be considered as a certain philosophy branch which is affiliated to or can be summed up into any existing traditional philosophy. "Partition of existential field" is the highest paradigm of philosophy; and only changes in the highest paradigm can constitute the revolution of philosophy. Philosophy of information has triggered radical changes in the highest paradigm of philosophy for the first time, so it will certainly bring about the revolution of philosophy.

35 Some Sociological Issues of Information and Internet Engineering

Published

Sanhu Li

[1] Magazine Agency, Guangzhou Academy of Governance, Guangzhou 510070, Guangdong Province, PR. China

In contemporary age, the information-internet engineering has been expanding to a global scale, and its deeply social embeddedness is characterized with the digital/material imbrications, cyberspace/user mediating practices, where a new network society emerges. In the network society, newly regional centers are made in the reconstruction of geographical space, personal growth becomes a cyber-action, and unadorned social structure now turns into the network structure. This new network society is a risk society, giving rise to both the disorganized actions (online mass incidents) and the deviant actions(telecommunication frauds). These actions violate the modest standards of public morality, influences on and even ruins the social life. In the face of so many social problems as well as challenges produced by the information-interwork engineering, it is emphasized that the engineering innovations(developing anti-hacker technologies) should play a panopticon-like role in the social governance of network, with its certain synopticon-like management as self-control(the supervision from the public via network) and legal management as external force.

36 The generation mechanism of Internet rumors——based on consideration of information philosophy

Published

Min Zhai

[1] Xi'an Jiaotong University; Shannxi Ligong University

Internet rumors with the help of micro-blog, WeChat and other emerging carriers showed great destructive power, can not only discredit belittle personal reputation, also to the social order, the stability of the country to form a strong impact and destruction. Therefore, it is of practical significance to explore the formation mechanism of the network rumors. From Schramm's model of mass communication, communication in the process of people playing as receivers and decoding communicators, encoding and code release role, while the philosophy of information theory, based on the understanding of people we know, as well as the information system in the theory of information creation is complex and random. Based on the above, this paper try to give a survey of Internet rumors generated the mechanism of ideas: the dissemination process plays an important role in the understanding of people is complex and random, and decoding is equivalent to the information creation, encoding and release code work is complex and random in this paper. This paper tries to construct the framework of the generation mechanism of Internet rumors from the above point of view, and investigates the formation process of the network rumors, in order to dig out the governance strategies of the network rumors in the deep level.

37 The Practice and Value Reconstruction of Modern Information Ecological Ethics: Beliefs, Argument and Strategy

Published

Zushe Yuan

[1] Shaanxi normal university

As a kind of thinking mechanism that grasps motion, change and development of objects on the whole, systematic thinking contains a whole set of thinking principles, methods and operation procedures. With the uprising popularity of studies on informational system science and complexity theory, information reveals a new field that the philosophy of the past has not discovered. Wu’s works are putting forward a wholly new scientific thinking way: the Informational Thinking. We can conclude rationally from Wu’s explanations of information that the character of informational thinking way can include and surpass the basic idea of systematic thinking way. So far as the whole process of scientific cognition is concerned, functions of informational thinking are expanded in several aspects.

38 The Scientization of Wukun's Information Philosophy

Published

Li Luo, Wujun Zhang

[1] Xi'an Jiaotong University; Xi'an University of Architecture and Technology

Wukun's information philosophyemerged in the 1980s,is the inevitable product of information age as well as philosophy development. Firstly,it adapts to the need of information globalization; at the same time,it summarized the science and philosophy development in modern day and beyond, and it is the theoretical quintessence of human beings in our long history cognizing and changing the nature. It based on the idea that information is the mediate existence, and revealed the world as a double existence of substanceand information. And also it disentangled the relationships between thinking and being (material and spirit), material and information,spirit and information scientifically.Accordingly,it achieved the unification of the materialistic information theory and information methodology,the relationship between information ontology, information epistemology and information axiology,as well as information evolutionism and information society theory.Thus,Wukun's information philosophy corresponds with the demands of information age, which represents the scientization of philosophy and the philosophization of science.

39 Phenomenological Reflection on Architectural VR Technology

Published

Li Luo[1], Wujun Zhang[2]

[1] Xi'an Jiaotong University; Xi'an University of Architecture and Technology
[2] Xi'an University of Architecture and Technology

Architecture is a three-dimensional space art. But for a long time, the architect's design is subject to two-dimensional drawing tools: drawing boards, compasses, triangular plates and tibs. Architects on the three-dimensional space, the form of imagination no matter how rich, must be its vision into two-dimensional graphics information——That is painted into architectural drawings, delivered to the building components manufacturing and construction side, the final building can be implemented in the three-dimensional world. The design is based on the visualization of sketches, drawings, samples (models), plans or ideas. Visualization and its handling, to achieve the premise of image creation, with the help of specific visual perception of thinking, the use of graphic language and painting media to see and think of the description.

Today, however, the advanced computer graphics analysis capabilities and data control manufacturing technologies that are catalyzed in the wave of information technology revolution provide an unprecedented and powerful means of designing and building dynamic and complex forms for architects. "Virtual reality" (VR) is a comprehensive computer graphics interactive technology, which uses a computer to generate a simulated physical and environment, through a variety of sensor devices to enable users to "put" to the environment, to achieve the user and the environment Of the direct interaction.

Virtual reality architectural design can also make people in the virtual building environment and even urban space, with different angles to peep or appreciate its external space and interior space dynamic image and layout features. It is produced by the integration, than the model or renderings more image, complete and vivid. It is worth noting that this is a new cognitive experience, the most important feature is the user's sense of the world feel and cognitive boundaries desalination. The main manifestations of this limit are two. One is the role of the body feeling becomes more important, the main content of the main body is no longer only the mind of the mind and mind based on cognitive practice, this change makes the body become an important part of the main content, which led to the " Body - subject "appears. Second, the body of their own direct perception of being shielded, people can only imagine the integration of visual, auditory and tactile feel, access to no real sense of protection, and even immersed in the virtual and realistic by the intelligent environment in.

Thus, VR technology to virtual reality and real boundaries have become "established facts", it seems to achieve a virtual and true seamless connection. From the cognitive point of view, this will make Cartesian "mind - the main" and Merleau - Ponty's "body - the main" trend of unity? Obviously, this problem must be from the human, technology and the relationship between the three aspects of the technical philosophy of phenomenological reflection.

40 A Dialogue about the Nature and Unification of Information Science and Information Philosophy

Published

Kun Wu[1], Pedro C. Marijuan[2], Zhensong Wang[1]

[1] School of Humanities and Social Sciences, Xi'an Jiaotong University, Xi'an City, Shaan'xi Province, China. 710049
[2] Zaragoza, Aragon Institute of Health Sciences (IACS), Spain

At the invitation of Prof. Kun Wu, Head of the International Center for the Philosophy of Information at the Xi'An Jiaotong University, Prof. Pedro C. Marijuan paid a ten-day academic visit to the University November 4 -14, 2016. During his visit, Prof. Marijuan presented three lectures to students and teachers and had two dialogues with Prof. Wu November 11th and 12th on the topic of "The Nature and Unification of Information Science and Information Philosophy". Under this main topic, several sub-topics were discussed, such as the origin and development of information science and technology, the concept of entity, the fundamental principles for building a unified information science, relevant bio-information studies, the epistemological media of information philosophy, the relationship between information flows and matter-energy flows, the statuses of computationalism and general information theory, the structure of unified information science and so on. This extended abstract succinctly displays some basic content of those dialogues.

41 A Preliminary Investigation to the Information Civilization

Published

Tianen Wang

[1] Division of Social Sciences, Shanghai University

Abstract: Information civilization is a human civilization relative to the civilization of matter and energy in the sense that information is neither matter nor energy, but it needs matter as its carrier and energy for its communication. Information civilization is a sharing civilization based on information nature. As the information layer of human civilization, it is the process of public information symmetrization with its humanity basis and philosophical foundation; Information civilization is an enslaving material civilization based on information mechanism. Human activity is increasingly becoming information activities that control material and energy; Information civilization is a human nature civilization based on information creative construction that conforms to the human nature most. Human history develops into the stage of the human nature civilization only in the information age.

42 A Reconstruction of Organization Management Model on the Basis of Complex Information System Theory and Technological Innovation

Published

Yan Yuan

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The series of concepts that are presented by complex information system theory, like the ontological information, information system and so on, not only can exploit new approach for the development of system thoughts, but also can provide the innovation of organization management theories a new horizon or route. As the core constituents of organizations, modern organization management models should be adjusted continuously according to the progress of our time, in order to conform to the development of organizations. And in a time dominated by information technology and information economy, the complex-information-relationships-based technological innovation will help to upgrade modern organization management models, which means that, based on such technological innovation, a brand-new organization management model conforming to characteristics of complex information system can be constructed. This article tries to reconstruct the organization management model by using the complex information system theory and by analyzing the relevant technological innovation. And this reconstructed organization management model, on one hand, can highlight the effectiveness of "information" in the organization management, to tally with the theme of our time; on the other hand, it gives the organization management model a holistic dynamic generation characteristic, to maintain the vitality of the model and to adapt the development nature of organizations.

43 A Study on Information Thoughts of Mohism in Pre-Qin Period

Published

Shuying Zhao

[1] Xi'an Jiaotong University

The information thoughts does not originate from modern science and technology. The simple information thoughts germinated in the splendid human ancient philosophies, including ancient Greek philosophies, ancient Indian philosophies and ancient Chinese philosophies. The pre-Qin thoughts and philosophies is the origin of Chinese culture and also is a very important part of ancient world culture. This article focuses on the pre-Qin Chinese philosophy school-Mohism, because, compared to other pre-Qin schools, the Mohism, inaugurated by Mo-tse, relatively paid more attention to the study of natural science. The theories and ideas about primitive elements of the universe, natural laws and correspondence between man and nature in Mohism embody abundant and profound information ideas and information thinking mode.

44 An Analysis of the Controversy between "Nominalism" and "Realism" in Middle Ages from the Perspective of Information Philosophy

Published

En Wang

[1] College of Humanities and Social Sciences , Xi`an Jiaotong University

From the origin of ancient Greek philosophy to the philosophy of medieval ages, although it appeared the discussion of "nominalism" and "realism" in medieval times, the exploration of the concept of "objective but non-real" did not get further developed. From the view of the inherent integration of the unity of general rationality on science and philosophy, professor Wu Kun revived the concept of "objective but non-reality" and creatively developed his "philosophy of information" system. Because the existence of "objective but non-reality" is inherently a kind of "crossover" field in the traditional philosophy, it certainty solve the problems of traditional philosophy from the ontology, which will lead to the breakthrough in the fundamental paradigm in philosophy, and the philosophy begin its fundamental turn.

45 An Eco-Cognitive Perspective on the Philosophy of Information Knowledge as a Duty

Published

Lorenzo Magnani

[1] Department of Humanities, Philosophy Section and Computational Philosophy Laboratory, University of Pavia, Pavia, Italy

The second half of the 20th century has seen the rapid growth of information science, technology, and engineering that amounts to a social and technological revolution. These new trends have generated huge changes in several areas of human life, not only in western societies. I think that in this new age of information civilization the problem of the relationships between information and knowledge has to be readdressed. In this perspective the new challenges related to the generation, distribution, exploitation of information and knowledge have to be seriously seen in the light of their political, economical, educational, cultural, and moral consequences. In my opinion, it is especially in the framework of a study taking advantage of an eco-cognitive perspective that we can reach interesting results, as I have tried to illustrate in my Morality in a Technological World. Knowledge as Duty: the technological advances generated by information science, technology, and engineering of contemporary society have outpaced our moral understanding of the problems that they create and have brought about consequences of such magnitude that old policies and ethics can no longer contain them. I believe that producing, distributing, and applying recalibrated information as appropriate knowledge endowed with optimal and prosperous outcomes has become a duty, one that is just as important as making scientific or medical advances. I contend that to manage these challenges and counter many of information technology's ill effects is essential to preserve ownership

of our own destinies, encouraging responsibility, and enhancing freedom. I will also discuss how objects, structures, and technological artifacts which carry information and knowledge and at the same time also serve, often implicitly, as moral carriers and mediators.

46 Analysis of Augmented Reality Technology from Philosophy of Information Perspectives

Published

Kunru Yan

[1] South China Unviersity of Technology

Virtual reality technology challenges the traditional epistemology, Augmented reality technology developed from virtual reality technology . Augmented technology adds a layer between human and the world, This medium is information. Augmented reality technology riches sense-data and augments human's experience from a Philosophy of Information perspective. Augmented reality technology to construct the display assumed object intermediary information, rather than to build the object itself, and that such construction from the intermediary role of information in our senses, it may bring us a real experience of the object. Subjective perception is the basis of intentionality and intentionality is going through the research of relationship of human, information and the world. We obtained through analysis of the intentionality of Husserl and Ihde's 'human- technology-world', Husserl's theory is lack of the analysis of physical world while Idle neglects the structure of the technical perception. Therefore, this paper will combine both Husserl's perception and Ihde's structure of "human- technology-world" to explore the changes augmented technology brings and the problem of technological intentionality.Augmented reality technology has enriched the sense of material and information, we can face the world itself, make the world 'demask'.

47 Cursive script space-time evolution in In the perspective of information philosophy from early cursive calligraphy which is formed by the history of traditional

Published

Erbin Yang

[1] 1
[2] Corresponding Author 2

In the perspective of information philosophy, This paper discusses Cursive script space-time evolution from a series of all-round information in calligraphy evolution about history tradition which based in *keep often and knew change.* In this paper, *Dudu* was thought to change brush method and standard cursive script. *Cuiyuan w*as thought to organization cursive stipple the position relations, Words handwriting coherent leaded to *A painting do not move. zhangzhi* was thought to take shape *yibishu* that before and after the continuous problem caused in the calligraphy stroke order successively time irreversibility, causing the cursive handwriting the determination of the overall coherence. Three people tradition of inheritance relationships formed the earliest cursive script. We

can see clearly in the space-time evolution of calligraphy aesthetic realization path, which follow cursive old-information and productive cursive new-information and a series of all-round information evolution, from "often" to "change" to form a new "often". The complexity of Cursive script had matured in informational-assimilation and dissimilation. Finally it is inspired to the succession and development of contemporary calligraphy for aesthetic path of cursive script.

48 Digital labor: hope of the liberation of human labor or a new form of alienated labor?

Published

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Digital labor already plays an important role in the development of modern society and it is related with the liberation of human being. There are two distinct arguments: one is that digital labor is the hope of liberation of human labor and bring another chance like a New Renaissance (Gordana Dodig-Crnkovic, 2003; Andy Feenberg 2014); another is that it is still a alienated form of labor(Christian Fuchs,2014).This article mainly focus on studying digital labor by dialectics through philosophy reflection.

49 Discussion on the Holographic Unification of Subject Information, Knowledge, Intelligence and Practice Activities

Published

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The information is an indirect existence world, which is different from the direct existence matter world. The knowledge is a systematized information assemblage formed by cognitive subject's perception and information process and creation of thought; the intelligence is active modes and methods that subjects with cognition and practice abilities grasp, manage, create, exploit, utilize and realize information (including knowledge); the practice is not an activity of pure materiality but a process of realizing subjects' intentionality information in the objects through implementing planning information.In the human activities, information, knowledge, intelligence and practice have a property of holographic unification.

50 Homo loquens meets homo informaticus: exploring the relationship between language and information

Published

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Homo Loquens meets *Homo Informaticus*: exploring the relationship between language and information

This paper explores the relationship between natural language and the phenomenon of information. It argues that the Philosophy of Information can provide a bridge between linguistics and information science by offering a deeper understanding of how these two spheres of experience are entangled. Proceeding from the author's 2002 Foundations of Information Science Online Conference paper 'The Phantom of Information' it first asks the question 'How can we best define information'? The author then offers a brief historical perspective on the Philosophy of Language (PL) and the Philosophy of Information (PI) and highlights where the two fields overlap and interact. He indicates how the 'information turn' of the 1990's grew organically out of the 'linguistic turn' in philosophy. The author treats the phenomenon of information as a new language with distinctive features akin to syntax, person, tense, aspect, voice and mood. Specifically he examines Chomsky's concept of recursion and redundancy, Wittgenstein's language as game, Saussure's *langue* and *parole*, Benveniste's *énonciation*, informative illocutionary acts (Austin, Searle), the semantic approaches of Dretske Floridi and Barwise, Grice's implicature and Carl Friedrich von Weizsacker's 'inevitable circle between language and information'. He briefly discusses Terrence Deacon's recent work in biological anthropology on language and information as it relates to his concepts of deixis, reciprocal reference and incompletion. Secondly, the paper indicates how the notion of 'information' is embedded in traditional grammar through adpositions which empower language as a faculty for thought and communication. The Subject/Object template of historical grammar imposed on all natural languages is reviewed
from the perspective of pragmatics. The notion of 'information' itself is traced back (by way of Capurro's *informatio*) to a configuration of ideas and concepts in classical Greek philosophy, specifically those of Epicurus and Chrysippus – the founder of formal grammar. Implications for the history and science of information are discussed. Finally, it proposes future directions for this area of study to explore how our total experience of the sphere of language and that of information are interconnected within a broader framework of mind. A distinction between cognition and *connaissance* is made. The faculty of human language, once the hallmark of humanism, is now under threat by the omnipresent Datocracy and its champion, *Homo Informaticus*. The informed and informing citizen, *Homo Informationis*, as defender of the information commons and infoversity, will need to ally with Herder's *Homo Loquens* if s/he is to survive. Information philosophers can provide a deeper understanding of these intriguing twin phenomena necessary for our civilisation.

51 Information in layers

Published

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This paper examines different uses of ideas of layers in philosophical and semiotic thinking and compares these ideas with the use of layers by engineers, especially for the design and analysis of communication systems. It looks at how some authors have drawn on layered thinking to discuss the information, and attempt to draw out some new insights into the nature of information.

52 Informational Productivity-the Productivity of Sustainable Development

Published

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The significant breakthrough and innovation obtained by modern information science and technology enable the "information" gradually become the internal driving force of economy development and social progress, causing a great advance of the productivity of modern society, and the information technology quickly transform into the actual productivity-informational productivity. From the perspective of dual-evolution of material world and informational world presented by information philosophy, and through using the information thinking mode and treating the "information" as a way of existence, this article will discuss the evolution of informational productivity and its role for sustainable development society.
First, this article will summarize the development process of productivity theories, and will analyze the formation conditions and the evolution process of informational productivity; second, it will expound that the informational productivity is a brand-new productivity form that is different from material productivity and spiritual productivity; third, it will make a dialectical analysis on the systematic, static and dynamic characters, properties and the inherent operation laws of the elements in the structure of informational productivity. At last, this paper will advocate that the realization of informational productivity will depends on the actual conditions, including economy, politics and cultural environments and so on, and will conclude that developing the information productivity is an inevitable road to realize the sustainable development society.

53 On the Information Selection of Scientificand Technical Communication

Published

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Abstract

This dissertation studies the problem of information selection of scientific and technical communication. In this thesis I analyze the characteristic, essence, element, structure, function, effect and obstruct in scientific and technical communication, discuss the process, mechanism, principle, method and the way of information selection. I also seek the value of achievements in scientific research and technological development, analyze its evaluation and transformation, explore the interaction between science-technology and society. I discuss the selective problem of scientific and technical education, scientific and technical popularization. In the process of globalization, there exists unbalanced information communication. At last, I discuss the relation between scientific-technical communication and international competition power. I put forward a proposal for building up an effective network of scientific and technical communication, which is very significant to the national innovation systems and social development. The main conclusions are: (1) scientific and technical communication is the bridge connecting science-technology and society. The communication process is a nonlinear dynamic system in which many elements interact. (2) In order for an effective application, it's necessary that the communication be all-round based on the need and appropriate selection, not only the information and knowledge of science & technology, but also the scientific method, spirit, civilization be communicated. In the meantime, the social problems need to be taken care of. (3) All individuals, communication media, education and research institutions, corporations, as well as the entire country need to take some proper steps according to the situation for effective selections. (4) During the process of establishing the national innovation systems, carrying out the strategy of sustained development and rejuvenating China through science and education, we must enhance scientific & technical communication and pay special attention to information selection. Part 1: Analysis for the system of scientific and technological communication Scientific and technical communication is one of communication behaviors of human, which was born when human civilization developed to certain extent. As a component of science and technology, it is called " blood circulation systems " of science-technology and society, which are the lifelines of economy and society. In the middle of the 20th century, the information and biology revolution marked the revolution of the modern science and technology. Meanwhile, there have emerged a lot of new features in the scientific and technological communication. Scientific and technological communication is one form of information communication, whose activities include scientific and technological writing, publishing, news, education, popularization, translation, information exchange, consultation, library, exhibition, museums, data base, etc. Knowledge and information of science and technology, through time and space crossover diffusion, realizes knowledge sharing among different individuals, transforms private knowledge into society-sharing knowledge. Instead of a combination of various methods and channels, system of scientific and technical communication is a unified organism, whose elements consist of communicator, content, media and receiver. They are interrelated and interacted, forming a structure of layered classes and gradations. . The functions of scientific and technical communication include: (1) to stimulate knowledge transformation and development of science and technology; (2) to train science and technology professionals , enhance

people's qualification of science and technology ; (3) to accelerate the transformation of scientific and technological achievements, benefit the development of economy and society; (4) to strengthen international communication and cooperation, carry forward human civilization . It is hoped to get long-term, expected, and positive effects. We must pay special attention to the behaviors of stealing the name of science but actually doing non-science and even against- science. Also, we must look at the system of scientific and technological communication as a subsystem of the grand social system. There are obstacles in the communication process, so it becomes necessary to remove them, to get ride of useless information and to select effective information. Part 2: The mechanism of information selection The information is extremely rich in modern society. It assumes the tendency of "knowledge explosion" and "information sea", which give rise to serious interference in the communication process, such as unnecessary, out-of-date, antiquated, false, rubbish and filthy information, virus information, etc. So we must select effective and beneficial information. The process of information selection includes information collecting, receiving, handling, treating, storing, retrieving, spreading, etc. It requires to differentiate, classify, analyze, compute, sort, code, label and organize the information to make them increment, so as to acquire maximum economic and social effect. People's cognition, emotion and will, which relate to background of knowledge, interest, favor, habit and economic situation, etc., play an important role in the selecting process. The communicator and receiver follow different principles. Of that the communicator complies with the rules of being efficient, objective, systematic, directed, matching, standardized, safe, etc. while the receiver obeys the law of selection, which includes selectively receiving, selectively understanding, selectively memorizing and selectively practicing, selects the needed information using the minimum effort principle to. Besides usefulness, efficiency and effect, convenience, safety, being economical should also be considered. There are couple of ways of information selection, namely, independent selection and passive selection. There are also a lot of tools for information selection, e.g. newspaper, magazine, book, broadcast, television, data base, network, etc. Some institutes of information services provide services on science and technology, which makes the information service professional and industrialized. Part 3: The valuation and selection of the achievements of science and technology One of the most important objectives of scientific and technical communication is to communicate and spread the achievements of science and technology. Science and technology have value and use value, or theoretical value and practical value, e.g. objective value and implement value, as well as truth value, education value, culture value, etc. There are two kinds of valuations to science and technology, namely, the valuation from the scientific and technical community, and the valuation from the society. More precisely, valuation is shown in the publishing, differentiating, identifying, quoting, rewarding and encouraging, etc. The achievements of science and technology are communicated and spread through valuation and selection. As property right of knowledge about the achievements of science and technology gets protected, technological monopoly should also be avoided. The information about science and technology, reversely, affects the development of science & technology. So it is necessary to select properly contents, not only the information and knowledge of science & technology, but also the problems related to science - technology and society, in the communication process, and to face up with the challenge raised by post-modern science. In modern society, science & technology and production form an entirety. Scientific research has benefited technological improvement, which drives economic development. The transformation of the achievements in science and technology involves in the process of commercialization and industrialization. So it is necessary to establish a channel between science - technology and society through scientific and technological communication. Part 4: The scientific and technical education, popularization and public selection The scientific and technical education is a necessary condition to put the system of science & technology into permanent operation. It plays an important role in communicating the knowledge, method and spirit of science & technology, and in training professionals. We must carry on the quality, intelligence, innovation and lifelong education. We need to combine the scientific and technological education with humanism education, recognize

the science & technology as a cultural process, pursue the unity of truthfulness, goodness and beauty. The scientific and technological popularization towards public, along with the mass media, is very important. It consists of news, publish, broadcast, television, data base, network, etc. The communication of science & technology to the public via the mass media requires a modified approach to the traditional presumptive models of communicative style. Conventional models of scientific and technical communication are based on implicit but unexamined assumptions that the most effective and important means of transmission of scientific and technical information are efforts aimed at the attentive segments of the population through specialized and detailed formats. Based on the theory of uses and gratification approach, we should select properly. People's qualification of science & technology in our country is poor, so we must take actions to promote. Attempts to reach inattentive audiences with scientific and technological information are customarily unsuccessful or have been deemed unnecessary altogether. The proposed model submits that not only are endeavors to communicate scientific ideas to the disinterested populace of overriding importance but can be quite successful if production styles are altered to reflect more "interest-motivating" designs. A new thrust toward capturing the attention of disinterested audiences before attempting to directly disseminate scientific ideas is proposed. Part 5: The globalization and selection of scientific and technological information The flow of information makes the world become an "earth village". The organic whole trend of the globe is clear. There exists serious unbalanced state on international information communication, so as to some "rich information countries" and some "poverty information countries" emerge. Scientific and technical information and knowledge occupy important places in the global communication, in which culture plays a role as "filter" and "catalyst". There is a need to introduce some foreign scientific and technological books to our country. Based on our conditions, we should translate and introduce the reams of information technology, biology technology, energy technology, material technology, and synthetic, cross subjects, etc. Modern culture relates closely with science & technology and education. There are many kinds of selections as tradition and background differ. We should maintain vigilance to the "culture imperialism " and avoid the "culture departmental selfishness". Scientific and technological communication relates closely with international competition power. On the times of knowledge-economy, national innovation systems are extremely important. The national innovation systems circle relations of production, consist of knowledge innovation, technological innovation, institutional innovation, managerial innovation, it is a kind of wholly synthesized innovation. The system of knowledge communication contains not only educational institution, but also the mass communication media. They are the same important on communication with production of knowledge. The system of knowledge communication acts as a bridge connecting knowledge innovation and knowledge application, also, it is the key factor of knowledge innovation and technological innovation. Establishing an effective network of scientific and technical communication is significant to the construction of national innovation systems, and to the realization of the strategy about rejuvenating China by science and education, and the strategy of sustained development, which is the sole correct selection.

Key Words: Scientific and Technical communication; System;Information;Selection

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54 Ontology or epistemology: a debate on the philosophical implication of information

Published

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Whether in the nearly 40 years' researches on Chinese Philosophy of Information (PI) ,or in the conversation between Chinese and Western PI, there has always been a fundamental topic ,which is the discussion or definition about the philosophic nature of information, focusing on whether philosophical meaning of information is a "ontological" concept or not, and how could it be possible to become into an issue of ontology. Is there "objective information" ("information-in-itself") and how to establish a world of "binary-unity of matter and information"? How could the information be possible to exist in the ontological sense, or how to establish the ontological status of information? Is "Ontological information" a kind of "ontological informationalism" or "Pan-informationalism"? etc. It is of great significance for the study on PI to sort out and reconsider these arguments.

55 PHILOSOPHY OF INFORMATION: REVOLUTION IN PHILOSOPHY

Published

Joseph E. Brenner

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This paper for presentation at the 4th International Conference on the Philosophy of Information is based on what Wu Kun has described as the convergence of science and philosophy taking place under the impact of information science and philosophy. I address the question of the extent to which this trend may be considered a revolution in philosophy and whether it is it important and useful to so designate it. This is a preview of a joint paper by Professor Wu and the writer which will go more extensively into the nature of revolution and the philosophy of science as such.

56 Philosophy of information and “new revolution of Philosophy”

Published

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Philosophy of information is the philosophy of the information era, is the essence of the spirit of the information age. It is also a new generalization of the development of contemporary science and philosophy, is the crystallization of integration of philosophy and Science. The quintessence of Philosophy of information is to introduce the concept of information as one of the most basic concepts of philosophy, and its demonstration of the "ontological" status and universal character of information, Furthermore, a complete set of philosophical theories to grasp the world and transform the world. Therefore, " outlook of Philosophy " has been reflected, The field of existence can be Redistricted, the basic problems of philosophy are completely expressed, and the ontology of philosophy can be reconstructed. Finally, the research methods of traditional philosophy will be transformed by information methods, it is trying to put the material (quality), energy and information in the theoretical framework of Philosophy of information, seeking the unified information theory.

57 Pushig Forward The Cooperation between Information Science and Information Philosophy

Published

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Information studies is still facing some fundamental isssues unsolved satisfactory. The variety of definitions for information is one of them. Some researchers think the universal definition of information, and therefore the unified theory of information, impossible.
This may be true if the efforts are made only by scientific researchers alone. However, the situation may change if the efforts will be made by the good collaboration between information scientists and information philosophers.

This article will show that, by employing the proper methodology, one kind of the principle of philosophy, the problem of variety in information definition may find better solution.

58 Reform and Innovation: The Social Science Research in the Era of Big Data

Published

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We are already living in the era of information Big Data. But many of us have not ready to correspond to the greatest change of our time. We should deeply understand the nature of big data and the opportunity and challenges it us, and consciously promote the reform and innovation of humanities and social science research.

1,Fully Understand the Big Data and Its Multi-dimensional Significances

What is big data? Some scholars define it as "large, high-speed, and/or changed information assets. To handle the new way to promote stronger decision-making ability, insight and optimization process is needed." Some scholars proposed big data with "4V" characteristics: Volume, Velocity, Variety, Value.

In my opinion, the emergence of big data is a positive product of human development to explore the world and human themselves

In a direct sense, compared with the "small data" or traditional data, big data refers to a huge database with the large number, various types, high-speed access and valuable data.

In a wider sense, big data means a system with data acquisition, storage, processing, transmission and application of the related information technology facilities, system and operation mode, a data oriented world.

In a broader sense, big data implies a new productive model with production, living, communication, thinking, practice and governance. Big data has not only changed people's life, but also serves as a comprehensive guide to a revolutionary change of the ways of human life.

In the broadest sense, big data means a kind of outlook and world viewpoint of relying on science and technology, new information and natural picture. Big Data has become a valuable system and methodology to prompt human being's self understanding and self promotion.

2,To Explore the Special Opportunities and Challenges of Big Data

The big data has given us a lot of challenges and opportunities in the humanities and social sciences research.

First of all, from the "assumption" or from the "data" begin our study? "bold hypothesis, careful Testing ", have always been the basic research mode in the past in the humanistic and social studies. In the era of big data, massive data and whole data offer us more focusing to do research based on the actual and multidisciplinary research fields.

Secondly, focusing our research on "individual sample" or "massive data"? Because of data collection difficulties, past researches in the humanities and social sciences have to depend on the sampling survey, all the conclusions with inference properties. In the era of big data, it is possible to design a collection of things through the whole sample, provide full data, facing a more solid and reliable object foundation and prerequisite for the humanities and social science research.

Third, "emotional contact" or "behavioral statistics" is more reliable to our research? In the past, to many researchers of humanities and social sciences, an objective and reliable research means to touch and to contact object directly, such as direct dialogue, face-to-face interviews, telephone interviews. But sometimes people may not say the truth! The research based on big data may know the behavior of large data statistics, data for fine-grained segmentation, the full range of long time

cumulative collection, and especially in a large number of people in the "mouse", "network voting" may provide the object more reliable and rational basis for the study of the humanities.
Finally, to probe the "Entity law" or "Statistics Law"? In the past, the humanities and social science researches are mainly based on local observations of the social phenomena, physical exploration. Big data will become social variables statistics, measure the calculated object, and track the society as the smallest unit "people" on the whole, take part in all data as the foundation.
3, Let Us Consciously Take Part in the Era of Big Data
First of all, conscious learning and effective use of complex thinking. The world of big data is an extremely complex world which requires complex thinking. The human world is a more complex emotional world and valuable world. Interactive and complex emotions are intertwined, full of uncertainty and risk, and there is the need to learn from the ideas and methods of complexity science.
Secondly, consciously to study and use big data technology. To use modern information technology and data processing equipment in the humanities and Social Sciences; to interpret the significance of the result of big data research; to lead humanities and social science research in the direction of digital social civilization.
Finally, to consciously update and develop ourselves as a success big data research subjects.

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59 Reinterpret Mencius' The Debate between Human and Animal"from the Two Dimensions Construction Theory of Information Philosophy

Published

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However, with the rapid development and inspiring enlightenment of biological sociology, it is found that the animal world is also quite complex, and the expression of their behavior and emotion also can be seen as good and evil, which is not unique to human beings. So Mencius' "four-mind of human nature" as the standard of distinguishing human and animal it could anew comprehend. this paper aims to deepen the cognition of Mencius' "four-mind of human nature" through the two-dimension construction theory of information philosophy.

60 Rigidity and Flexibility: A Comparative Study of Traditional Chinese and Western Music from the Perspective of Complex Information System Theory

Published

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In the history of science, we have experienced an era of natural science and an era of metaphysics. To date, these eras have been poorly linked. The universe in its entirety is comprised of a sensible natural world and a transcendental noumenal world. Experience is obtained from the sensible natural world, a rational summary is obtained from experience, and knowledge is obtained from the noumenal world. If noumenon of the universe, which is unknown, is excluded, our view of science will be incomplete. Moreover, as our minds are diverse, understanding noumenon is the cardinal task for science, despite its limited recognition. Knowing what noumenon is a prerequisite before making a decision.

61 Study on Li Erqu's 'Great Learning' epistemology——from the Perspective of Information Philosophy

Published

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Li Erqu is one of the three greatest Confucian at the beginning of the Qing Dynasty. His epistemology and cultivation theory inherit and develop Zhang Zai who put people's inside and outside together, and put forward one's heart makes appropriate and fast response to the changing environment outside. Therefore, he thinks the real Confucian has to build his spirit inside and struggle to become a ruler in the real life at the same time. Based on the old version of Great Learning, Li Erqu thinks the core of this book is "Mingtishiyong", the first step of learning is "Gewu", and the guiding principle is "Huiguozixin". Li Erqu's mode of interpretation reflects he combines Neo - Confucianism with the Lu - Wang Xin Xue. To an extent, Li Erqu's epistemology of the Great Learning tallies with some information construction theory in contemporary information philosophy.

62 The Case of Artificial vs. Natural Intelligence: Philosophy of Information as a Witness, Prosecutor, Attorney or Judge?

Published

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The relationship between artificial and natural, human intelligence becomes currently an issue of the primary importance for the world. The threats of technological singularity in the form of ultraintelligent machines occupied many philosophers, but thus far nobody paid attention to the encroaching singularity of relatively low level automation which eliminates need for low skill labor force and threatens wide masses of human population. Economists predict that many occupations regarded as requiring high skills will become spurious too. The only solution for the optimal coexistence of the artificial and natural intelligence is in the reform of education. The solution does not require anything new as the liberal arts education promoted human intellectual development leading to the roles which machines least likely can assume.

63 The expansion of the philosophy of information plays a key role in the sustainable development of human sciences and the society

Published

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: In the history of science, we have experienced an era of natural science and an era of metaphysics. To date, these eras have been poorly linked. The universe in its entirety is comprised of a sensible natural world and a transcendental noumenal world. Experience is obtained from the sensible natural world, a rational summary is obtained from experience, and knowledge is obtained from the noumenal world. If noumenon of the universe, which is unknown, is excluded, our view of science will be incomplete. Moreover, as our minds are diverse, understanding noumenon is the cardinal task for science, despite its limited recognition. Knowing what noumenon is a prerequisite before making a decision.

64 The Magic Power of Information: The Inner Drive of the Development of Information Society

Published

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The information society is a very popular topic and many researchers study on it from different perspectives. In this paper, the author will turn to information itself to discuss it. The concept and basic characteristics of information will be analyzed in this paper. The mechanism of information acting on human society will be discussed. Then, the challenge and solution method in the development of information society will be given in this paper. Lastly, the conclusion will be drawn.

65 The Ontology of Information

Published

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What is information? Does information have any causal power? Some scholars hold that information is a kind of substance, i.e., another kind of independent existence, and it has its own causal power. However, it is not conceivable in detail how the causal power happens. The current study in philosophy of mind on the ontological status of mental events and the psycho-physical causal interaction address the similar issues. We will argue that, information is not a kind of substance, the reality of information is dependent on physical systems, and its causal power happens only in signal systems (conscious or unconscious). The doctrine of supervenience on mereological relation between the system and its parts, and the non-reductive theory on the relation between two adjacent levels, and the parallel model of causation in the hierarchical structure of the world can shed light on the understanding of the ontological status and causal power of information.

66 The Philosophical Thinking Which is about the Information Pollution

Published

LI Guang-li LI Guang-li

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At present, information pollution is becoming more and more serious. Among them, the false information produced by the academic cheating is the worst. The philosophical roots of academic cheating has three: It is contrary to the principle of good faith; The pursuit of individual interests is

too much to deviate from the academic value; For being out of the basis which include the free information and self information, the new information of scientific innovation is pseudo regeneration information essentially.

67 The Study on the Essence of Chinese Calligraphy under the Horizon of Information Philosophy

Published

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What is the essence of Chinese Calligraphy? It is the most important and difficult question in the history of Chinese Calligraphy art. The explorations that ancient Chinese artists had made on this question can be classified into three main schools: the first school emphasizes the objective manifestation form, which is represented by Cai Yong's doctrine, "Calligraphy originates in the nature", and also is represented by Kang Youwei's "Calligraphy form theory"; the second school emphasizes the subjective information intention, which is represented by Yang Xiong's doctrine, "Calligraphy, the drawing of mind"; the third school emphasizes the combination of subjectivity and objectivity, which is represented by Liu Xizai's "theory of meaning and image." In my opinion, it is necessary to combine the subjectivity and objectivity when we want to understand the essence of Chinese calligraphy. To understand it, however, we cannot just depend on the ways, like savvy, metaphor and analogy, which are treated as Chinese philosophical methodology. We need to analyze the dialectical unification relationship in mind-form and meaning-image under the system of speculative philosophy, which means we have to use the logical thoughts in western philosophy. It is just that the traditional western philosophy cannot provide a reasonable explanation to the essence of Chinese Calligraphy, due to its dualism worldview of subject-object separation. But the information philosophy in contemporary China, which is built on the basis of criticizing such traditional dualism, can afford an explicit and systematic explanation to the essence of Chinese Calligraphy, and no matter the subjective mind and meaning or the objective form and image can be dialectically unified on the basis of information mediums.

68 Truth analysis of definition of information

Published

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Abstract: The definition follows the propositional logic, the definition of information is no exception. In recent years, the starting point of the research on the definition of information involves generally investigation of the history of the concept, interdisciplinary research and different aspects of cognition that includes ontology, epistemology, and linguistics and so on, the understanding about the definition of information is divergent. As long as it is about definition of information, regardless what kind of study, however, follows the propositional logic. So the true and false judgment about the definition of information is actually judgment on the proposition of the definition of information.

This paper classifies various kinds of intension and definition of the information in the propositional structure by analysing the propositional structure of definition of information and various kinds of defined method about definition of information.Keywords: Information; Definition; propositional logic1. Introduction1.1 Research Background and purpose of the workIn contemporary society, information research has formed a variety of paths and research paradigms. One of the most popular research paths at present in academia is the study of unified theory of information. Some scholars believe that it is necessary to form a unified theory of information and which is also feasible, although it can be obtained at different theoretical and practical levels.The investigation on the unified theory of information have the following aspects in summary: the unifying concept of information, the unifying definition of information, the unifying theory of information and the unifying research method of information.A variety of research institutions dedicated to the unity of information also emerge and rise: FIS (Foundations of Information Science), a workshop entitled Information Theory and Practice and the Unified Theory of Information (UTI) Research Group. [1]The research on the definition of information is one of the most important problems in the study of the UTI. Many supporters of the UTI provide the argument for the unified theory of information through the study of the unified information definition. Wolfgang Hofkirchner[2]and Søren Brier [3] are two of representative scholars.But there are scholars who believe that:"the lack of a commonly accepted definition of information is not as threatening as it may seem, as each study within the discipline may choose an own definition, as well as an own philosophical framework, when there are some alternatives to choose between. More important is the development of a common methodology of inquiry and some range of standard questions regarding the concept of information".[4] It can be seen that a unified definition of information is only a necessary condition of a unified theory of information rather than a sufficient condition. First, the study of UTI is not only the unifying definition of information, but also other aspects and levels. Second, it does not necessarily mean that we have a unified information theory even if we get a unified definition of information.

So this article is not to provide argument for a unified theory of information, but only to analyse the "definition of information itself "according to the propositional logic, to analyse when we put forward a definition of information, What we (both scientists and philosophers) presuppose? What we predicate? And fundamentally, as one of the most fundamental problems in information research, what the diversity of research methods and content the definition of information explains ？And then classifies various kinds of intension and definition of the information in the propositional structure by analysing the propositional structure of definition of information and various kinds of defined method about definition of information. 1.2 Research Method： When we (whether scientists or philosophers or interdisciplinary researchers) give the definition of information with propositional logic (In fact, we can only use the form of proposition or predication), we all expect and identify that the definition of the information that we give is true. In other words, for this definition we all have the truth appeal. However, by careful study we found that the truth value of this definition is actually not depend on our views. Namely, we have actually assumed the objectivity of the "intension and the extension "of the concept of "information", as well as the objectivity of our knowledge. The so-called objectivity refers to the independence of the fact to our judgment or opinion. Because if the definition of information is dependent on our views, then, we can give the truth value to our own predications or propositions. So, all the people who have defined information can be confident and take it for granted that the definition of information he was given is the most consistent with the meaning of the information, and his definition is really that one. But that is not the case.The reason why they think their definition is true is out of the consideration and attitude of pragmatism. In the sense of propositional logic, we find through the above analysis that a definition of information, in fact, already contains three different aspects of information simultaneously. The reason I have taken this analysis method is that ,On the one hand, follows the rules of the propositional logic itself, and on the other hand inspired by the analytical framework of Anton·Friedrich·Koch about the question of truth. [5]2. Truth analysis of definition of information In the first part I have briefly mentioned the

propositional logic analysis of information definitions , next I will analyse the different defined methods of information that have already exist. Of course it is impossible to list all ,here I can only give some representative point of view.In contemporary society, the study of information definition generally has the following categories : First, reveals the nature of information through investigation and analysis of the history of the concept of information.Second, interdisciplinary research is to examine the different definitions of information in different disciplines (philosophy, natural sciences, social sciences, computer fields), and to seek a unified definition on this basis.Finally, the different aspects and perspectives of information research: the ontological level of information inspection, epistemological level of information inspection, linguistic of information inspection, and phenomenological perspective of the study. Study on history of concepts reveals the development and change of the intension of the concept of information, which to some extent is beneficial to our understanding of the concept of information, the study of various interdisciplinary paths as well as research on distinct levels of cognition constantly expand and promote the referent range and content of information, which is also helpful to us to forming a unified definition of information, and then forms a unified theory of information. But what is more important is that we should make clear that to what extent the definition itself and the content which we want to describe are consistent, that is, to what extent the proposition of "information is ..." in line with the facts.And the more this kind of inner unity is stronger, the deeper the degree of conformity, perhaps our knowledge of the information is even more in-depth and profound. Otherwise, either there is a great difference between the content of this definition and the fact that we want to use it to descript ,or the fact that we predicate is not actually "information itself", but something else. This involves the legality and the validity of the use of information concepts. In the part of the introduction we already know that any definition about information contains actually three different levels of information. Now we can briefly state:

first, proposition itself on the definition of information , presupposes the objectivity of the information. Second, the true value of the definition predicates the objectivity of our knowledge about the information. Third, the diversity of information definitions indicates the pragmatic appeals for information definition.

3. Conclusion A variety of definition on information is actually different aspects of information.Through the propositional logic analysis of the information definition, in a large logic framework we can make these different aspects of information to be unified.References[1] Gordana Dodig Crnkovic, Wolfgang Hofkirchner. Floridi's "Open Problems in Philosophy of Information", Ten Years Later . Information 2011,2,331[2]Wolfgang Hlofkirchner.How to achieve a unified theory of information.Triple7(2):357-368,2009 [3] Søren Brier .Finding an information concept suited for a universal theory of information .Progress in Biophysics and Molecular Biology 119 (2015) 622-633[4] marcin j .schroeder .Foundations for Science of Information: Reflection on the Method of Inquiry .TripleC9(2):377-384,2011[5] Wahrheit, Zeit und Freiheit. Einführung in eine philosophische Theorie. Paderborn 2006 und Münster 22013[6]Adriaans, P. (2013). Information. Stanford Encyclopedia of Philosophy, 2013(Fall)[7]José María Díaz Nafría,Francisco Salto Alemany.Introduction to the special issue "What is really information? An interdisciplinary approach" tripleC 7(2): i-vi, 2009

69 Narrative realities and optimal entropy

Published

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'I suppose a quick anecdote is out of the question?' he croaked.
Conina sighed. 'There's more to life than narrative, you know.'
'Sorry. I lost control a little, there.' (Pratchett, 1989)
In his fantasy book series set in The Discworld, writer Terry Pratchett referred to the imperative of narrative as a force in nature. At its simplest, his characters respond to events in particular ways according to (stereo)type; at the meta-scale it is presented as an ontological structure that guides societies and larger historical events.
It sounds better when you tell the story of it: when a wagon or coach crashes, regardless of the context, there must come from it a burning, rolling wheel. And, of course, million in one chances happen all the time.
Treated superficially such narrative archetypes or rhetorical anecdotes are simply that: entities that have no more importance that their immediate effect. But I will argue that there is very little that is more important than narrative when we construct realities cognitively.
In fact, the claim is that the world of stories is more important than reality. There really is a narrative imperative as Pratchett suggested.
1 We do NOT live in a Cartesian universe
Firstly, we have to be wary of skepsicentrism, the supremacy of 'conscious' thought over any other form of human knowing. In particular other forms of coming to know and even knowledge exist. Descartes famously articulated the essentialist view in terms of becoming through thinking but it's simply not accurate when we consider recent findings in cognitive neuroscience (Damasio, 2006). We are only aware of about 10% of the cognitive activity in our brains (Norman, 2005; Lakoff and Johnson, 1980, 1999). We use confirmation bias , preferred selection (Immordino-Yang, 2015) and whole range of belief-based thinking (Shalvi et al., 2012) – most of which we are unaware of. When we become aware of it we use a further set of techniques to reconcile what we actually thought with what we think we thought (Ariely, 2012; Mlodinow, 2012).
To summarise: 'we' (what we think we are) are necessary but insufficient components in the construction of our own ideas and conceptions (Jones, 2017).
This talk will focus on these 'between' conscious mechanisms in order to present a slightly different definition of narrative. Rather than simply accepting that narrative is a conscious selection of stories subject to bias, I will argue that biases are the primary structure of narrative and that they are pseudo-fractal, acting at different scales in any narrative.
Motivated reasoning, for example, is one such mechanism and this has a very strong storytelling component to it. We can readily hold multiple truths (Hastorf and Cantril, 1954) and contradictions in our minds . We have to maintain our self-perceptions (Mazar et al., 2008; Kruger and Dunning, 1999) but we extend such 'storytelling' (or confabulation) to construct our realities too. This is not a superficial filter we apply to reality – it is our reality: red is not red (Lotto, 2004); . We really do not know ourselves (T. D. Wilson, 2002) and what we think of as our core personality traits change over time (Harris et al., 2016).
The trick to achieving all this 'mediation of truth' is to make sure that we can arrive at a reality we find acceptable:
"people are more likely to arrive at conclusions they want to arrive at, but their ability to do so is constrained by their ability to construct reasonable justifications for these conclusions" (Kunda, 1990).

In order to construct a 'reasonable justification' people use narrative structures and storytelling as forms of knowledge – story epistemes. Central to making this argument is the ways in which information is used.

2 Information is not enough / too much

The simply model of the transfer of information is not enough to explain the transfer of concepts. The model doesn't claim to either. As we discuss some complex concept or difficult ethical dilemma a huge range of 'meta-information' is required, whether this is existing knowledge; cultural situatedness; responsive adaption to the other person's reactions; projection of position; etc. etc.

The argument here does not propose that these metalinguistic events are epiphenomenal 'wonder tissue' (Dennett, 2013) – it is perfectly possible for them to be tangible and realisable entities at some pragmatic level in sense of James and Landauer (Landauer, 1996; James, 1904). The issue here is not their nature, but their number. At present, it is not possible to state whether the amount of information to be accounted for is computable or simulatable at any lower 'resolution' than the total system itself. It is a P versus NP problem (Cook, 1971).

And that leads to the next problem – humans simply do not have the 'bandwidth' to process a fraction of this information. This is considered, in evolutionary terms, to be one of the primary drivers for mechanisms such as cognitive bias, motivated reasoning, justified belief and others. To put it bluntly, our brains use about 20% of our body's energy at a resting state (40% when we are really thinking hard

So it is hardly surprising that we have developed strategies to optimise the use of this entropy-gulping grey matter. If you are making notes on this or even just scrolling up and down your interface in annoyance you are using your environment to offload some cognitive activity (M. Wilson, 2002; Kirsh and Maglio, 1994).

And interestingly, we are also more likely to 'lie' when we have lower cognitive resources available (Shalvi et al., 2012).

All of which suggests that there is some optimisation between information density and our efficient/effective use of it. That is, between too much or too little information 'processing' there exists a zone within which Homo Sapiens can operate (effectively) whilst still maintaining an acceptable energy usage (efficiently). Such optimal zones of operation can be seen throughout nature: Dawkins referred to this as the "survival of the stable" (Dawkins, 1976, chap. 2) and we see such optimisations occurring regularly in human interactions. In design the MAYA principle underlies successfully creative products in that they are optimised between being different enough but not so different they are difficult to 'process' (Hekkert et al., 2003; Tractinsky et al., 2000). It is argued that narrative operates, and indeed 'is', human concpetualisation in this zone of optimal effect and energy use.

Narrative, it could be said, is a naturally occurring means (mode?) by which entropy increases at an acceptable rate to human beings.

3 Characteristics arising from an optimised conceptual narrative

This zone of optimisation has to be understood, not as processing or computation of information, but as *human use* of information. As previously noted, our essentialist view of thinking fools us into believing in a linear or normative pattern to its structure – that we interact, then think, then at some point may recall this as an historical incident. But the actual process of cognition works in a very different way. Our memories are most definitely not essentialist and rely on re-cognition rather than linear recall (Mlodinow, 2012; Schacter, 1999). As a further example, we still view knowledge as acquiring, collecting and building, not reconstruction – this is known as the acquisition metaphor (Sfard, 1998). Each and every time we have a thought or memory we are *re*-creating it – not recalling it or even processing it.

This emergence of conception through cognition is not quite the same as processing or computing. Rather, if it is, it suffers precisely the same problem as the problem of concept transfer – it is (currently) a P vs nP problem. The utility of human use is entirely contingent on circumstance,

availability of energy and a whole range of other relative factors. It is a non-normative, situated for of use whose purpose and value is inter-dependent on its own situation. It is this very fuzziness of human use that allows us to retain 'superpositions' of information – to hold contradictions as valid truths.

The only way to deal with such a contingent complexity is through conceptualisation – an ill-defined cognitive, socio-psycho process. The emergence of such conceptions is dependent on their own efficiency and effectiveness, meaning they must be:

2.

This is necessary because of the need to optimise the complexity/energy gradients required to generate the concept. Doing this allows a lot more 'space' to do things with the narrative. For example, see Dawkins for (all internet) memes (Dawkins, 1976). Or consider basic, existing, embodied cognitive schema, such as 'light is good; dark is bad';

"In the middle of the journey of our life I found myself within a dark woods where the straight way was lost."

Such 'simple' concepts are exceptionally powerful because they take very little information to convey them and are easily conceptualised, not simply thought about. Once a conceptual metaphor is transferred (i.e. you 'get it') you cannot remove it. Sticky stories survive – others simply die.

3.

For example, metal and wood at the same temperature do not **feel** the same temperature (Veritasium, 2013). This type of experiential knowledge can conflict with other forms of knowledge and we can intellectualise and understand that what we feel is not necessarily the same as how we might describe it for the purposes of creating a scientific or engineering model. But what is more interesting is that even graduate physics students will make use of the experiential knowledge as a 'lie' to inform the intellectual knowledge. We only make use of knowledge that fits with our worldview. **Narrative emerges from, aligns with, and can only exist due to, emotional states and belief**. As Bohm suggested,

"Reality is what we take to be true. What we take to be true is what we believe… What we believe determines what we take to be true."

The extents to which we are prepared to act based on obvious falsehoods or where little evidences is available to support our beliefs are often incredible. And at no point do we even consider that we might be lying to ourselves – we don't need to because we are too good at pretending it's not a lie:

"…ethical evaluations are not a dichotomy between honest and dishonesty but rather a continuum stretching between the two ends." (Shalvi et al., 2012)

4 Summary

Much of this is already well established in a variety of disciplines and domains. Memes, sticky ideas, conceptual metaphors, rhetoric, etc., etc. have all been around for a very long time and research into how these are used in politics, business, design, and many other

And in many ways this sums up the 'multiple readings of reality' (Charmaz, 2000) we face, not as objects in the world, but as objects who create themselves continuously in their own realities. We are no more able to control our own constructions of reality than we are to control the bacterial populations in our gut. But we can elect to influence it – to be aware of it, reflect on it and, ultimately, to act on it.

"That is all as it should be, for in a question like this truth is only to be had by laying together many varieties of error." (Woolf, 1945)

Our human ability to 'lay together varieties of error' allows us to do incredible things – good and bad; stupid and wise. Truth or 'right' or good has no preferential transport route in any storytelling. As Mark Twain advised, "Never let the truth get in the way of a good story."

It's the story that matters. It's the optimal conceptual structure to help us navigate a perceptually rich environment; to retain a culturally rich social knowledge; and to continually reconstruct ideas of what the world might be.

The world of ideas and stories is the only world there is.
Let's leave the last word to Pratchett:
"The stories don't want you to think, they just wanted you to believe what you were told..." The Wee Free Men
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70 Decolonizing Information Narratives

Published

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1. Introduction

According to the *Oxford English Dictionary*, a narrative refers to "an account of a series of events, facts, etc., given in order and with the establishing of connections between them; a narration, a story, an account". Importantly, the entry goes on to state that in structuralist and post-structuralist theory, it refers to "a representation of a history, biography, process, etc., in which a *sequence of events* has been *constructed* into a story *in accordance with a particular ideology* [emphases added]." In what follows, I interrogate some contemporary narratives about 'the information society' from a critical race theoretical and decolonial[1] perspective with a view to constructing a 'counter-narrative' purporting to demonstrate the embeddedness of coloniality[2] in such discourses[3]. My approach is informed by a concern to draw attention to three issues: (1) the presence of various strands of apocalyptic[4], millenialist / millenarian[5] and utopian thinking – technological, economic, political, religious and racial – that contribute to shaping the generally tacit (and masked / obscured) background 'horizon' against which the (post-)modern information society is conceptualized; (2) the 'entanglement' of such strands in rather complex ways, thereby disrupting the possibility of straightforward linear / sequential accounting which is arguably basic to historical narrative[6]. In this connection, I am particularly interested in exploring the tacit operation of different 'root metaphors'[7] – specifically, those relating to time and process – within modern conceptions of history which remain hegemonic in information society discourses notwithstanding the impact of post-structuralist and anti-foundationalist critiques of modern approaches to history[8]; and (3) the need to consider the 'entanglement' of (1) and (2) in relation to the emergence of global, systemic and structural race / racism / racialization at the onset of colonial modernity during the long durée of the 16th century CE, and what I refer to elsewhere as the *algorithmic* 're-iteration' of this systemic phenomenon in various paradigmatic incarnations up to the contemporary era [9].
In addition to presenting concrete examples of information society discourse due to Floridi, Fuchs, Hofkirchner and others that might be subjected to critique with reference to the aforementioned

three issues, I am concerned to sketch the contours of a critical race theoretical and decolonial critique of how the idea of 'colonialism' has been mobilized in contemporary discourses about ubicomp, the IoT (Internet of Things) and Big Data / datafication. By way of a useful segue into such discussions, in what follows I engage with and offer some brief reflections upon an early critique of 'colonial' narratives embedded within 1990s 'cyber' discourse with a view to pointing out similarities and differences to contemporary discourses, and the persistence of coloniality in information narratives.

2. Decolonizing Cyberspace

Just over twenty years ago, in a somewhat polemical essay entitled 'alt.civilizations.faq: Cyberspace as the Darker Side of the West' [10], the cultural critic Ziauddin Sardar argued that "at the end of the second millennium ... the standard grand narrative appears to be going through a new and interesting twist: the darker side of the West is bouncing back on itself. The very materials with which the West painted all Other civilizations is now acquiring a life of its own and is threatening to recast the projected image as well as the self-perception of the West." (p.15) Against the backdrop of the long durée history of European colonialism commencing with the Columbian voyages of 1492CE, Sardar went on to state that "when the West ran out of *physical* landscapes to conquer, it moved into *mental* territories [and] when *mental* and *cultural* territories are exhausted, the West moves on to conquer the *reality* of Other people. The end of modernity ushers in the all-embracing totality of postmodernism. In Other peoples' reality, Other ways of knowing and being, Other identities, postmodernism has discovered new *spaces* to conquer and subdue ... For the conquest to continue unabated, new terrestrial territories have to be found; and where they don't actually exist, they must be created. Enter, cyberspace [emphases added]." (p.16) According to Sardar, the next phase of the colonial project was being enacted via the burgeoning 'frontier'[9] of a Western-constructed cyberspace with its attendant colonization of 'other' realities (ways of knowing and being) and their reduction to digital form as data and information (pp.19-20).

While Sardar is at least partially correct in his assessment of where Western colonial energies have been re-directed following the anti-colonial decolonization struggles of the 1960s which resulted in formal independence for various formerly colonized peoples, I would suggest that his focus on Western *re*-colonization of the 'other' (concomitant with colonization of the Western 'self') through a Western-constructed postmodern/postcolonial 'virgin terrain' of cyberspace *as* virtual reality (or VR)[10] fails to anticipate more recent developments that pointing to a re-colonization of the 'other' (and of the Western 'self') through technologies such as mobile and cloud computing, pervasive computing, ubicomp and the IoT, and the recent 'turn' to Big Data / datafication[11]. Put another way, contemporary expressions of 'digital expansionism' [14] gesture less towards the 'virtualization' of the real through its representation within simulations and VR, and more to the *augmentation* of reality through the embedding of RFID and related technologies, the aim being less one of replacing the territory (reality) with the map (simulation), and more of collapsing the distance between territory and map, to state things in terms of a Borgesian metaphor[12].

Yet I would suggest that Sardar's most penetrating insight in terms of what follows herein is his assertion that "the *mythic* notion of the frontier is *constructed* to bring the past into an organised, reinterpreted unity whose main function is to *give new interpretative emphasis* to desired aspects of how the dominated territory is to be controlled *in the future* and establish that 'progress' has been achieved [emphases added]." (p.39)[13]

3. Entangled Apocalyptics, Algorithmic Racism and the Myths of History

In this section, each of the above three issues is discussed further with a view to preparing the way for mounting a decolonial critique of some contemporary information society discourses.

3.1. Entangled Apocalyptics

My approach to thinking through the 'entangled' logics of race, religion, technology, power etc. in relation to the apocalyptic, millenialist and utopian thinking tacitly shaping dominant information society discourse is informed by a concern to identify what I consider to be transformative events of

an arguably decisive nature from a critical race theoretical and decolonial perspective[14]. In an earlier work [19], I described the 'Big Bang' of 'race' associated with the Columbian voyages of discovery in 1492 CE and the infamous Valladolid debates of 1550-1551 CE, and the need to interpret both these phenomena against the background of the fall of Constantinople to the Ottomans in 1453 CE and to the launch of the Crusades in 1095 CE; however, drawing on historical narratives presented by Noble [20], Davis [21] and others, there is a need to complicate the above picture by entangling these histories with 9th century technological developments within Europe and various post-Augustinian millenialist/millenarian 'turns' (or reversals) – including that of the Cistercian monk, Joachim of Fiore (c. 1135-1202) whose 'Theory of the Three Ages', allegedly based on vision while reading the Book of Revelation, led to an interpretation of the Christian Trinity *as* history[15]. I argue that these historical strands come together in ways that have abiding importance vis-à-vis the world system and the role of technology in furthering hegemonic projects: for example, Noble argues that since its rise in medieval monasteries, technology has been implicated in the Christian desire to restore humanity to the perfection of Adam prior to his fall – that is, the 'pre-lapserian' state of being (and knowing) – and from the 13th century onwards, technology has been presumed necessary in a millenarian struggle – rather, *war* – between Jesus and the forces of evil (or 'the Antichrist'), the outcome of which will inaugurate the eternal heavenly kingdom. Crucially, as Noble, Daniel [23] and Almond [24] show, the Antichrist has been identified in different periods within European history as the prophet Muhammad, Muslims or the Catholic papacy[16]. I want to suggest that this struggle remains significant in the context of the shift in the early 2000s from a neo-liberal to a neo-conservative politics, marked by an increasingly apocalyptic reading of world events by strategists within the globally-hegemonic US government concerned to wage a 'War on Terror' [22], and that this trajectory continues to be pursued by the present regime, albeit marked by a turn towards protectionism and a disturbing embrace of overt white supremacist 'Alt-Right' politics of an apocalyptic variety[17].

While conceding the obvious fact that there are various ways to engage with Biblical narratives, including those that support the reversal of the relationship between history and apocalypse previously described, I want to suggest that the historicizing of the Trinity effected by de Fiore contributed to setting in motion a train of apocalyptic developments aimed at what historian Eric Voegelin referred to as 'the immanentization of the eschaton'; furthermore, that such historicism, wedded to an increasingly positive view of the redemptive power of technology vis-a-vis recovery of the 'pre-lapserian' condition of Adamic perfection, ensured that such historically-immanentist and 'sedimented' utopian logics of 'three-ness' continued to be re-produced – or rather, *re-iterated* – in various conceptual frameworks including, crucially, contemporary information society schemes such as those presented by Floridi, Fuchs and Hofkirchner[18].

3.2. Algorithmic Racism

According to Coleman [28], "race as we know it is an 'algorithm' inherited from the age of Enlightenment." (p.184) I want to suggest that not only is race an algorithm, *metaphorically*-speaking, but that following the 'cybernetic turn' of the 1950s, the continued rise of informational, computational and algorithmic logics (technical, social, cultural, economic, political etc.) has resulted in a situation wherein the racial algorithm has engendered algorithmic formations of race[19]. Furthermore, at a time when sociology, anthropology and other related disciplines are being subjected to interrogation from postcolonial, decolonial and other 'critical' approaches, attempts are being made to recast these disciplines in algorithmic (computational, informational) terms – an algorithmically-*metonymic* 'turn'[20]. I am interested in considering such metonymic shifts in terms of the possibility of their constituting an 'iterative' transformation of the signified (meaning) attached to race, the 'floating signifier' [29], within what I would suggest is the 'algorithmic logic(s)' of race / racism within colonial modernity.

'Algorithmic Racism' (AR) [9] is a methodological framework, metaphorically-grounded in the figure of the algorithm, for conceptualizing the relationship between processes of racial formation (or racialization) within 'Western'[21] historical experience in relation to its (various) 'Other(s)'[22]. AR

postulates the existence of a historically-contingent, yet sedimented and 'dispositional', 'meta-process' linking racialization processes, and is motivated by a concern to assist with the disclosure of continuities masked (obscured, occluded) by transitions between different materializations – that is, 'iterations' – of race / racism in different historical epochs, and *a fortiori* in the transition from colonial modernity to the contemporary postmodern/postcolonial era. In this 'algorithmic' narrative, the history of 'Western' processes of racialization involving 'paradigmatic'[23] shifts from 'religious' to 'philosophical' to 'scientific' and latterly 'cultural' expressions of race / racism constitute re-articulations – or rather, 're-iterations'[24] – of the difference between the human (European) and the sub-human (non-European)[25].

In terms of the focus of this paper, I aver that AR has utility in exposing the "dark postcolonial underside" underpinning and tacitly informing developments associated with the rise of ubicomp, the IoT and Big Data / datafication, and facilitating parallel developments associated with Transhumanism and/or techno-scientific posthumanism, both rhetorical and 'material', in terms of disclosing the persistence of asymmetric race hierarchies and the 'algorithmic' (re)production of race / racism.

3.3. The Myths of History

Briefly, I want to suggest that decolonizing *information* narratives requires decolonizing *narrative* requires a critique of linear / sequential conceptions of history, and not merely in terms of the perspective from which historical accounts are produced – that is, in terms of embodiment and situatedness in relation to considerations of power – but also in terms of the paradigm / framework within which such accounts are articulated – that is, in terms of the body-politics (who) and geo-politics (where) of knowledge. My approach to critical engagement with the notion of history / 'the historical' is informed by the comparative and combinatorial approach to consideration of the different views of macro-historians from different periods and geographical locations presented in Galtung and Inayatullah [34]. While more recent approaches within the information society literature tend to frame macro-historical transformation with reference to the language of complex dynamical systems[26], and while world systems theorists such as Wallerstein [35] have endorsed such approaches as means by which to overcome a hegemonic Eurocentric universalism and progress (*sic*) towards a more 'genuine' universalism, it is arguably the case that the basic ideas on which such schemes tacitly draw are traceable, albeit in modified and/or eclectically-combined form, to those described in [34][27].

4. Decolonizing Information Narratives

Having elaborated each of the three issues informing the background to my critical race theoretical and decolonial engagement with contemporary information society discourses, I want to explore, albeit in brief, how the idea of 'colonialism' is being mobilized in discourse about ubicomp, the IoT (Internet of Things) and Big Data / datafication, and how such articulations are both tacitly informed by, and contribute to reproducing, coloniality – that is, the operation of colonial logics. My attention is directed, in particular, at the increasingly pervasive appeal to the figure of the algorithm in such discursive formations. While recognizing the important contributions made by disciplines such as critical code studies, critical software studies and, more recently, critical algorithm studies vis-à-vis exploring the masked operation of asymmetric power in relation to algorithmic (1) *mystification* (positing of algorithmic agency, fetishization), (2) *inscrutability* (problems of access to and control over algorithmic technologies), and (3) *normativity* (accountability given the outcomes of algorithmic deployment)[28], I argue that such studies tend to be framed against an assumed socio-material background of capitalism as world system that masks / occludes the constitutive colonial – and racialized – ontology of this system; further that such studies tend to focus on *methods*, while ignoring consideration of the body-politics and geo-politics of knowledge, thereby tacitly reproducing Eurocentric-universalism, and that there is a need to complement the critical discourse analysis of algorithms presented in such studies with a decolonial 'meta-critique' of such analyses (and their assumptions) so as to contest the universalizing tendency of such critical narratives.

Examples of the invocation of colonialism in information discourses include explicit recognition by Dourish and Mainwaring [14] of a 'colonial impulse' within ubiquitous computing and the IoT, analogically formulated with reference to 18-19th century British colonialism, yet thereby occluding earlier colonial projects, specifically those initiated by the Spanish and Portuguese during the 15th century which provided the historical setting for the emergence of the 'race' construct[29].

With regard to Big Data and decolonial interrogation of entangled apocalypticism and the myths of history, it is interesting to note that boyd and Crawford [47] describe datafication as "a cultural, technological, and scholarly phenomenon that rests on the *interplay* of technology, analysis, and *mythology* [that] triggers both *utopian and dystopian* rhetoric [emphases added]." (p.663)[30] Against such rhetoric they suggest that "as with all socio-technical phenomena, the currents of hope and fear often obscure the more nuanced and subtle shifts that are underway." (p.664)[31] While broadly concurring with this assessment, I want to suggest that if the methodological framework of algorithmic racism described earlier is sound, it is necessary to reconsider the rise of Big Data / datafication, with respect to both its rhetoric[32] (or mythology) and its reality (or 'material' power), in terms of how this "cultural, technological, and scholarly phenomenon" contributes to maintaining, expanding and refining (or adapting) the racial political economy of global white supremacy under what is purported to be an increasingly techno-scientific postmodern/postcolonial condition. In this connection, I would suggest there is a need to think about how datafication contributes to 'iteratively' re-inscribing the 'Digital Divide'[33].

In terms of reference to 'colonialism' within contemporary critical ('left') discourse about Big Data, Wyly [12] refers to "the increasingly aggressive colonization of the human attention span" (p.680) under the datafication paradigm, going on to assert that "this system is not yet totalized – there certainly are parts of social life that have not yet been colonized by automated epistemology, where individuals are more than digital individuals. But more and more urban life today is lived in the data ecosystem, where 'digital reduction becomes a causal element' … as people are subjected at every turn to data-driven systems of ranking, measurement, and classification to optimize 'choice' in an expanding panorama of ever more finely-tuned targeted advertising and behavioral modeling." (p.682) It is important to note that colonialism is here deployed without reference to its 'algorithmic' entanglement with racialization.

However, perhaps the most explicit mobilization of colonialism in contemporary Big Data discourse is that of Thatcher, O'Sullivan and Mahmoudi [40] who argue for thinking about the capitalist drivers underlying the phenomenon of datafication in terms of colonization – specifically, what they refer to as 'data colonialism'. While space precludes a comprehensive critique of their position, I would suggest that what is at work here is yet another race-less / de-raced – possibly even 'post-racial' – Eurocentric conception of colonialism that 'brackets' (marginalizes, erases) the 'material' links between colonialism and land, people and tangible resources, via recourse to an information-centric abstraction that allows 'colonialism' to be reductively, and economistically, framed in terms of labour. I further suggest that such a move both evinces and reproduces coloniality insofar as the discourse of 'data colonialism' co-opts the *signifier* 'colonialism' but disconnects it from its modern/colonial *signified* insofar as the experience of colonization *by the colonized* is ignored, thereby obscuring operation of the racialized logic of coloniality in this process[34].

Finally, with regard to history and decolonial attempts at resisting hegemonic discourses of linear progression vis-à-vis 'the future' that arguably constitute a form of the colonization of time[35], futurists Inayatullah and Milojević [49] argue that while advancing a critique of early 'cyber' discourses that were "overly utopian, seeing the emergent Internet as the solution to the world's problems of development and alienation" (p.60), they concede that they had not predicted "the dramatic uptake of mobile technologies throughout [the world's] poorer areas [and the] breath-taking development of applications – apps – that can assist the disabled and that can create seamless spaces for social and political protest movements to organize for social justice." (p.61) Despite such developments, they are at pains to point out that "issues of power, however, remain pertinent" (p.61), and that "as

network theory accurately predicts, node centers have dramatically increased their power", such centers being able "to influence others in disproportionate ways, often through the politics of fear and exclusion." (p.62) Crucially, their conclusion is that "by and large, centers of (former and current) power continue to receive much more attention than globally marginalized spaces." (p.63) While arguing that "the Internet has certainly participated in the 'decolonisation processes, giving power to communities and individuals' [and that] the world has certainly become flatter; at the same time, large corporations and *dominant worldviews* still define the real [emphasis added]" (p.65); again, while conceding that the "power to influence has been dramatically enhanced, provided an individual or a group has the means to do so", they draw attention to the fact that "the means are not only technological or in time and energy, *but also somehow linked to existing cultural templates*, thus deciding what gets to be heard and what is silenced [emphasis added]." (pp.65-66) I would suggest that in order to decolonize information narratives, thereby enabling us to understand *who* is speaking – and *allowed* to speak – and from *where*, it is necessary to consider the 'entangled' apocalyptic logics, algorithmic racism, and myths of history informing such discourses.

5. Conclusion

I should like to close with the following reflections of Inayatullah and Milojević [49]:

As we reflect on the future, what we certainly do not know is the nature of Web 4.0, if that occurs, i.e., will it be a merger of our minds with the Internet of things? … While it is certainly the disruption that the techno-utopians have imagined, the issue, for us, remains: how will power be circulated, and will the new Web be data/information-based or move toward communication/wisdom? Can power be dispersed, used more wisely, or will reality always be a realist zero-sum game? The futures of the Internet thus are multiple. What will emerge is far from clear.

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[1] By a 'decolonial' critique, I mean one that foregrounds considerations of the body-politics (who) and geo-politics (where) of knowing and being, and is preferentially disposed towards thinking through conceptual frameworks emerging from the margins / borders / periphery of the world system.

[2] Briefly, *coloniality* refers to the structuring logics (epistemological, social, cultural etc.) associated with European colonialism that emerged during colonization and which persist in the *post*-colonial era following the decolonization struggles that led to formal independence of previously colonized nations. For useful and detailed discussions of the concept of coloniality, the related idea of the 'colonial matrix of power', and why there is a need to replace the idea of 'the modern world' with that of 'the modern/colonial world', see [1].

[3] In constructing this decolonial 'counter-narrative', I recognize its 'subaltern' status within the terrain of information society discourses. As Inayatullah [2] perceptively remarks, "current global conversations are not communicative spaces of equal partners but conversations wherein one party has privileged epistemological, economic and military space ... Moreover, the language of such conversations uses the categories and assumptions of those that have designed the meta-conversation. We do not enter conversations unencumbered, as Foucault, Heidegger and many others have pointed out. Trails of discourses precede our words …Thus, before we enter global conversations we need to undo the basis of such conversations asking who gets to speak; what discourses are silenced; and, what institutional power points are privileged? ... Conversations come to us as neutral spaces for created shared agreement but they are Trojan horses carrying worldviews with them." (pp.239-240)

[4] Apocalypticism is the religious belief that there will be an apocalypse, a term which originally referred to a revelation of God's will, but now usually refers to the belief that the world will come to an end very soon, even within one's own lifetime. This belief is usually accompanied by the idea that civilization will soon come to a tumultuous end due to some sort of catastrophic global event.
[5] Millenarianism is the expectation that the end of the world is near and that a new earthly paradise is at hand.
[6] It is not merely that history is generated through the confluence of multiple causal chains – that is, that at least some, if not all, events are causally over-determined – but that the causal sequence, as hermeneutically (or interpretatively) framed contains 'feedback' or 'cyclicity, viz. how the past is understood contributes to the determination of the present, one effect of such determination being a 'backwards' transformation in how the past is understood.
[7] The notion of a 'root metaphor' was first introduced by Pepper [3], and an exploration of how metaphysical computationalism under an emergentist scheme might be understood in terms of two of the six root metaphors, viz. formism and mechanism, is presented in [4]. A more recent exploration of the 'major metaphors' informing European thinking appears in [5], while the relationship between metaphor, language and ideology in the creation of worldviews is explored in [6].
[8] For examples of such post-structuralist and anti-foundationalist approaches to history, see [7][8].
[9] Rather perceptively, Sardar states that "as an idea, the frontier is a tool of domination that arises from the certainty that one already has total control. As an instrument, the function of the frontier is to pass the routine practice of domination into the hands of the populace, to give them the illusion of freedom while they merely act out the actual effective control that is already predetermined, scrutinized and seen to be good by those with power. The frontier is the agency through which power elites get everyone to do their work while thinking they are acting on their own volition. Cyberspace frontier is no different. It has already been controlled; the populace are now being motivated to explore and settle in the new frontier. The ideologically constructed anarchy of cyberspace reflects the drive of the early settlers who colonised the territory like free agents, but only as the free agents of the evolving concept of a particular civilization." Crucially, he maintains that "what the cyberspace 'frontier' is doing as a first step is rewriting history: an exercise in catharsis to release the guilt of wiping out numerous indigenous cultures from the face of the earth, the colonisation of two-thirds of the world and the continuous degradation of life in the Third World that the West has engendered. Why else have these colonial metaphors of discovery been adopted by champions of cyberspace..." (p.18)
[10] Sardar maintains that "virtual colonisation is the new dimension of European colonialism." (p.33)
[11] Notwithstanding my critique of the shortcomings of Sardar's techno-futurist projections, it is important to note his somewhat prescient argument that "our concerns [have become] largely limited to discrete data or information at best. Knowledge in its true sense, let alone wisdom, never really enters the equation. We are constantly moving towards the left of the axis: discrete data – information – knowledge – wisdom." (p.28) In this connection, it should be noted that recent left-leaning disciplines such as critical code/software/algorithm studies target the ideological assumptions driving such 'leftward' shifts towards data-centrism which tend to be promoted by right-leaning corporations under late modern/colonial techno-capitalism. On this point, see [11][12][13] among other works.
[12] Here, I refer, of course, to Borges' single-paragraph short story from 1946 entitled "On Exactitude in Science" [15]. For an example of corporate think-tank mobilization of this Borgesian narrative in favour of datafication, see [16].
[13] In terms of the background 'horizon' informing the argument presented herein and other works exploring the reflexively-'entangled' relationship between race and information [17], and between and Orientalism and information [18], it should be noted that Sardar presciently maintains that "cyberspace is social engineering of the worst kind. Those who have made cyberspace inevitable have shaped its datascape with their subconscious perceptions and prejudices, conscious fantasies

and fears – all of them pulled out from the dark well of colonial projections ... The frontier was a merchant venture, just like the opening of the New World, and now cyberspace. But this venture cannot be envisioned without the context of an ideology and the mechanism of control. These, whether it be 'discovery' of the New World, the spice empires, settling the American West or cyberspace, are all the same: white supremacism, the West as the yardstick of civilization, the divine right stuff and military force ... Under colonialism [Eurocentric and Orientalist] fantasies framed and controlled non-Western cultures of the world. In the new colony of cyberspace, they bounce right back to surround Western man in the darkness of his own projections." (pp.38-39) For a discussion of the background 'horizon' informing the present argument, see [19].

[14] I refer to such events as 'Big Bangs' insofar as I consider them to be literally 'world-changing' in terms of their impact.

[15] According to Noble, Joachim of Fiore's theory was "the most influential prophetic system known to Europe until Marxism." (p.24) This position is supported by Gray [22] who maintains that "the division of human history into three ages had a profound impact on secular thought. Hegel's view of the evolution of human freedom in three dialectical stages, Marx's theory of the movement from primitive communism through class society to global communism, [and] Auguste Comte's Positivist vision of humankind's evolution from religious to metaphysical and scientific stages of development all reproduce the three-part scheme." (pp.12-13)

[16] It is important to appreciate that eschatological, if not apocalyptic, narratives involving a prophesied Messiah who will engage in battle against the forces of evil during the end times exist in all three of the so-called 'Abrahamic traditions' (Judaism, Christianity and Islam), whether this involves the coming of the Masiach ben Yossef who will destroy the Edomites and enemies of Israel, the return of Christ who will battle all the nations of the earth, or the advent of the Mahdi (that is, 'guided one') who will accompany the return of Jesus and fight to usher in an era of peace. Yet Christian apocalypticism appears to be somewhat unique in relation to its 'entanglement' with, and contribution towards, the construction of a linear / sequential understanding of the historical process as the unfolding of eschatological events of an apocalyptic nature – especially in the post-Augustinian form it adopted under the influence of thinkers such as Joachim of Fiore.

[17] It should be noted, however, that such crude / overt manifestations of white supremacism are not confined to the US context as events immediately following the outcome of the UK Brexit vote and the rise of 'far right' politics across Europe attest.

[18] Consider Floridi's [25] reference to the 'three stages of history' in the context of his argument for an ICT-based 'Fourth Revolution', Fuchs [26] deployment of Hegelian dialectics in formulating his critical theory of information, and Hofkirchner's appeal to Brockman's notion of 'Third Culture' – an updating of C.P. Snow's 'Two Cultures' – in the context of articulating a 'global sustainable information society'. In this connection, it is also worth pointing out in passing that futurist Alvin's Toffler's notion of the 'Third Wave' similarly realizes the Joachimite 'logic of three-ness' [21].

[19] For a brief discussion of some recent algorithmic / computational / informational forms of 'the racial', see [17].

[20] In this connection. Wyly [13] points to the 'return' of positivist ideas within the field of computational social science.

[21] On my reading, the signifier 'Western' must be understood in genealogical relation to historically-prior, related signifiers such as 'European', itself emerging from an earlier experience associated with the formation of Christendom. For a brief discussion of this genealogy, see [19].

[22] According to Gray [22], "the [Enlightenment] myth that humanity is moving towards adopting the same values and institutions remains embedded in Western consciousness" (p.104); crucially, on his view, this myth has an eschatological – more specifically, millenarian / millenialist utopian and apocalyptic – basis such that "history continues to be seen as a process with a built-in goal [emphasis added]" (p.105) Insofar as the ideas of process and goal (end-point, telos) are arguably essential to the definition of an algorithm, this means that history, seen in this way, might be construed as

algorithmic – that is, consisting of a sequence of iterations / cycles involving occasional 'branch' points at which decisions have to be made / taken. (It should be noted that such branch points are generative of information in the Batesonian sense insofar as they involve decision-making and selection among alternatives, viz. a 'difference that makes a difference'.) According to Gray, the goal of this eschatological (apocalyptic, utopian) historical algorithm relates to "the Enlightenment faith that humanity is moving towards a universal civilization" (p.104) – the universal here ironically being defined by a particular, viz. the Eurocentric, that masks / erases its particularity.

[23] The idea of a 'paradigm' is used here in relation to phenomena coming into the foreground relative to those that have (been) moved to the background. Crucially, such 'backgrounding' should not be understood as indicating the absence or erasure of a phenomenon, but rather its displacement as the dominant motif associated with a particular historical juncture and geographical site, such displacement necessitating a reconfiguration of what was previously paradigmatic.

[24] Importantly, Heng [30] maintains that "the Middle Ages were critically important and that medieval is not merely an arbitrary name devised to emplace a temporal interval in the West but more like the name of a repeating trans-historical pressure whose phenomenality renders later temporalities non-identical with themselves in ways that facilitate a multiplicity of (political and other) uses [emphasis added]." (p.424) Heng also refers to "postmedieval invocation of the Middle Ages in everything from popular culture to disciplinary history and formation to politics to built environments, inter alia." and that "euromedievalisms imported and transmogrified around the world, in postcolonies as well as in colonial and neocolonial spaces." (p.429) She also points to work by medievalists seeking to "erode a simple algorithm of temporal oppositionality by demonstrating the coevalness of present and past, in the sedimented pluralities of the present." (p.424) Yet I would suggest that it is not necessarily an algorithmics of historicity / temporality per se that is being contested by Heng, but rather a 'simple' algorithmics of temporal oppositionality wherein sedimentation does not feature. In my conception of algorithmic racism, different iterations of race / racism / racialization are marked by 'paradigmatic' shifts in formation – religious, philosophical, scientific, cultural, technological – which should be considered distinct, but not oppositional, and at least partly inclusive rather than wholly exclusive; in this sense, my conception of algorithmic racism might be seen to bear some similarity to Asad's [31] concept of 'tradition'.

[25] Following critical race theorist Charles W. Mills [32] and decolonial theorist Sylvia Wynter [33], I argue that the sub-human (which should not to be conflated with the broader category of the *non*-human) provides the 'ontological ground' against which the former is constituted through a process of hierarchical negative dialectical opposition, viz. the human (superior) as the negation of the sub-human (inferior).

[26] In this connection, consider the how the information society is framed in the discourse of Fuchs [26], Hofkirchner [27] and others.

[27] In an early critique of 'information era' discourse, Inayatullah [36] maintained that "its view of the future is overly linear, exponentially so" (p.235), further arguing that "slow time, lunar time, women's time, spiritual timeless time, cyclical rise and fall time and circular seasonal time are among the victims, leading to temporal impoverishment, a loss of temporal diversity where '21C' is for all instead of peculiar to Western civilisation." (p.236) In this connection, it is interesting to consider exponentiation in relation to Moore's Law which transhumanist Ray Kurzweil appeals to in connection with his 'Law of Accelerating Returns', as well as Floridi's appeal to the same phenomenon of exponentiation in the context of his argument for a 'Fourth Revolution' [25].

[28] Some important works in this regard include [12], [13], [14], [37], [38], [39], [40], [41], [42] and [43].

[29] In the context of outlining a proposal for a 'Decolonial Computing' [44], I have argued that "an appeal to 18-19th century British colonialism should foreground race matters *a fortiori*, yet Dourish and Mainwaring are completely silent about issues of 'race', as are other proponents of postcolonial computing who speak in terms of 'colonial', 'cultural' and 'power' formations. Is postcolonial theory here being used, perhaps unconsciously, to mask / obscure racial concerns? Is this a case of what

Mills [45] refers to as 'white ignorance', that is, an 'inverted epistemology, an epistemology of ignorance, a particular pattern of localized and global cognitive dysfunctions (which are psychologically and socially functional)' which involve 'white misunderstanding, misrepresentation, evasion, and self-deception on matters related to race' [46: 18-19]?"

[30] In terms of the utopian, boyd and Crawford argue that "Big Data is seen as a powerful tool to address various societal ills, offering the potential of new insights into areas as diverse as cancer research, terrorism, and climate change" (pp.663-664); and in terms of the dystopian, they maintain that "Big Data is seen as a troubling manifestation of Big Brother, enabling invasions of privacy, decreased civil freedoms, and increased state and corporate control." (p.664)

[31] boyd and Crawford maintain that "there are serious and wide-ranging implications for the operationalization of Big Data, and what it will mean for future research agendas ... We should consider how the tools [associated with Big Data] participate in shaping the world with us as we use them. The era of Big Data has only just begun, but it is already important that we start questioning the assumptions, values, and biases of this new wave of research." (p.675) While broadly concurring with this critical orientation, as stated previously, I suggest the need to complement the critical (discourse) analysis of algorithms presented in such studies with a decolonial 'meta-critique' that draws attention to the body-political and geo-political orientation of critical commentators in terms of how their analyses tend to reproduce a tacit Eurocentric-universalism vis-à-vis logic of argument and rhetoric of articulation.

[32] Contesting the claim by *Wired* magazine's founding editor Chris Anderson that "with enough data, the numbers speak for themselves", boyd and Crawford ask: "Do numbers speak for themselves? We believe the answer is 'no'. Significantly, Anderson's sweeping dismissal of all other theories and disciplines is telling: it reveals an *arrogant* undercurrent in many Big Data debates where other forms of analysis are too easily sidelined. Other methods for ascertaining why people do things, write things, or make things are lost in the sheer volume of numbers [emphasis added]." (p.666) From a decolonial perspective, I want to suggest that it is not mere hubris alone that is at work here, but also techno-scientific rhetoric that is being mobilized, albeit unconsciously – and here it is important to consider the operation of unconscious biases and dispositions in terms of 'epistemic ignorance' vis-à-vis social psychology as understood in relation to the historically sedimented racial contract underpinning colonial modernity [17] – in an attempt at blocking resistance to the hegemonic power of global white supremacy.

[33] boyd and Crawford rightly ask "who gets *access* [to Big data]? For what purposes? In what contexts? And with what constraints? [emphasis added]" (p.673), and go on to state that "in addition to questions of access, there are questions of *skills*. Wrangling APIs, scraping, and analyzing big swathes of data is a skill set generally restricted to those with a computational background. When computational skills are positioned as the most valuable, questions emerge over who is advantaged and who is disadvantaged in such a context [emphasis added]." (p.674) In this connection, it is important to consider how the development of such skills depends on access to and use of powerful computing platforms capable of mining the vast quantities of data generated by various means within the technological infrastructure of datafication. However, while making explicit reference to issues of gender (p.674), boyd and Crawford are silent on issues of race, deferring to what are arguably race-less / de-raced economistic readings of the Digital Divide and digital inequality, viz. "whenever inequalities are explicitly written into the system, they produce class-based structures." (p.675) Appeal to economism is also evident in recent work by Dourish who invokes historically-Eurocentric Marxist framings of feudalism in order to facilitate critical reflections on *the* Internet [39] and the 'other' of algorithms [42].

[34] I should like to suggest that another major difference between historical colonialism and the 'data colonialism' associated with datafication is that in the latter, resistance can be effected, at least partially, through non-violent non-compliance, whereas historical colonialism could, in general, only be resisted through direct counter-violence.

[35] In this connection, and in the context of a discussion of financial products, Venn [48] maintains that derivatives have "quickly become by far the most important element of finance capitalism [and] the biggest business in the world" that "the derivatives market concerns trading on the stock exchange centered on the predicted future values of assets; it is thus a trade in *virtual assets*, ultimately based on nothing but financial and *information technologies* that combine probabilistic knowledge and calculations with computer simulations *of the future*. The derivatives market *generates value out of the future as resource* [emphases added]. (p.483) Crucially, Venn goes on to state that his point is "not about this virtual world of finance that informational technology has produced. It is about the fact that *it is time itself which is being traded*, and the extent to which the drive to minimize the risks involved means *the abolition of the future as emergence and as indeterminate becoming* [that is, as something that is genuinely open to creative endeavor]. Basically, with the derivatives market, capital is obliged to *organize the present in such a way as to ensure the future conforms to what has already been predicted* by the probabilistic calculations. In order to ensure the future happens more or less as anticipated, capital must *abolish contingency* even as it plays with it, and it must bring everything within *the order of the orderable and the calculable* … The future thus becomes an extension of the present, and the present an intensification of the future. Capital controls the present by controlling the future. *[I]t is time itself which is being colonised* [emphases added]. (p.483)

71 Meaning, selection & narrative: the information we see and the information we don't

Published

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In a world that is highly saturated by data, sifting it and making sense of it has become increasingly important. A key mechanism for this process is narrative – the stories we tell about the world, whether in terms of politics or technology, which enable us to select information that we see as important. Yet narratives are highly contested and multiple. This article discusses the dynamics of narrative creation, via a process of selective information, arguing that this leads some people to see particular data as crucial information, while leading others to ignore it completely.

72 Predicative Competence in a Digitalised Society

Published

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In the current digitalised society, communication level requires high predicative competence and concept clarity to avoid predicative fallacies and to manage the contemporary information overload successfully. In this paper we review the fundamental conceptual and operative requirements to achieve this goal. This paper presents a relevant contribute to model and simulation, offering an example of new forms of evolutive inter- and trans-disciplinarity post-Bertalanffy modeling.

73 The Algorithmic Narrator

Published

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Facebook promises to make us readers and authors of our own stories, but in fact, Mark Zucerkberg's social network has created a production line of *narratable narration* that imprisons lives, biographies, and possible tales. Processing the metadata, behaviors and interactions of billions of users within the platform's walled garden, the algorithm imposes itself as an omniscient and totalitarian narrator, a predictive storytelling machine that benefits the only readers that truly count: advertisers.

74 What can we say about information? Agreeing a narrative.

Published

David Alan Chapman

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The nature of information remains contested. This paper proposes a set of principles for a narrative of information, and explores the consequences of taking these principles as normative in the present rhetoric of the information society.

A hypothesis of autism approached with the non-linear model

Published

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With autism (Autistic disorder), the patients will appear phenomenon like language disorder, communicating disorder and social disorder who are mostly two or three-year-old boy. Once the diagnosis confirmed, a lifelong bothering would be caused to the patients and their family. A novel hypothesis for the pathogenesis of autism which is called Double Mirror Reflection Model (DMRM) is put forward combined with the current brain science developments by this paper. The camera-monitor experiments explains the content of the hypothesis. With this paper, a new thinking is provided to the precaution and the diagnosis for autism.

75 Personal Data Protection Strategy Research Based on the Theory of Information Ecology

Published

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This paper introduces the core ideas of the information ecological theory, analyzes the report recently released by British House of Commons Culture, Media and Sport Committee named《Cyber Security: Protection of Personal Data Online》by information ecological theory framework including information man and information circumstance, elaborates the roles and ecological niches of the UK's Information Commissioner's Office, TalkTalk and its users, third-party partner agencies, and public safety agencies in the personal data protection ecosystem, summarizes it's experiences and practices in this theory frame ; On this basis, the article analyzes the existing problems of online personal data protection ecosystems, such as ecological chain fragmentation and ecosystem imbalance ; Then this work tries to find the possible cause of the problem, establishes personal data protection macro mechanism and proposes appropriate countermeasures.

76 On the Game Relations between Human and Big Data-based Machines in the Information Ecology

Published

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As a new type of machines, the big data-based machine, which may be called the ubiquitous machines, is qualitatively different from the traditional one. The purpose of this paper is to look beyond traditional understanding of human-machine relations and focus on the real challenge brought by the big data based machines in the context of information ecology.

77 Research on Mathematical Dialectical Logic for Intelligent Information Processing

Published

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Information ecology requires the support of intelligent information processing, while the latter requires the support of mathematical dialectical logic. This paper introduces the research status and prospect of mathematical dialectical logic for intelligent information processing, including: 1. several basic assumptions (axioms) about information and intelligence; 2. based on mathematical formal logic, gradually liberalizing the constraints to stablish the research compendium of mathematical dialectical logic theory system; 3. according to the forming mechanism of various uncertainties, the

principles and methods of defining and generating the complete operator cluster of mathematical dialectical logic on propositional level, establishing the complete operator library of intelligent information processing; 4. two application methods of the operator library in intelligent information processing; 5. prospects.

78 Error Resilient Video Coding for Wireless Visual Sensor Network

Published

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This work proposes an error-resilient video coding scheme for improving the ecosystem of Wireless Visual Sensor Networks (WVSNs). The reliable visual information communication is one of the most important factors in the ecological chain of WVSNs, i.e. "Visual Sensing-Compression-Transmission-Decompression-Monitoring/Decision". However, most of the existing works for WVSNs divide the information communication tasks into isolated episodes of "compression" and "error-protecting", without considering the interaction between them. In order to optimize the ecosystem of video information communication over WVSNs, this work first provides a discussion on ecology technology model of video transmission in the WVSNs. And then proposes a Distributed Video Parallel Coding scheme is proposed, which make use of the correlation of video information in the decoder side, to cope with the loss of video data over wireless error-prone channel. Specifically, this work proposes a Partition Irregular Repeat Accumulate codec, which exhibits better error resilience performance and obtain the same compression ratio with traditional video coding method. The experimental results indicate that the performance of the proposed Distributed Video Parallel Coding scheme is promising and can better optimize the ecosystem of video communication over WVSNs.

79 Factor neural network and information ecology

Published

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Factor space aims to describe the mathematical foundation of information science. Ecology is a new important branch of information science, factor neural network can be employed for information ecology.
Everything is the unity of the quality and quantity, quality refers the attributes of things. There are qualitative root, called factor. The first example of factor is the gene, called Mendel-factor in the beginning, Factor is the generalization of gene. Gene is the key that opens the door of biological information; factor is the key that opens the door of information and cognition science.
The human brain had the characteristic of factors, the sensory nerves of human brain is stratified according to characteristics; the phantom of knowledge in the brain is not empty, but was immobilized by synapses and synaptic tumor memory. Different people have different knowledge

structure, which left a different form of memory, we can call the activity or ecology of brain cells. It is the material background of information ecology.
Data is the carrier of information; once data put in a factor space, the data shows its semantic information automatically. Factor space is the living space of data and the plate of information ecology.
A factorial neural network is a neural network simulating human brain, which simulates the knowledge generation and memory organization of human being. It is more close to information ecology. We will introduce the basic principle of factorial neural network related ecology in the paper.

80 Good: Relaxation between Order and Disorder — A critique of an absurd ethics simply using the size of entropy as criterion

Published

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The moral principle that Mr. Floridi merely judges the Good and Evil with the amount of entropy is based on the simplicity and unipolar way of thinking. If practicing in accordance with his principle of Goodness that absolutely excluding entropy, then, in the field of nature and biology can only lead to the end of the dynamic changes, in the field of human mind and scientific development can only lead to rigid and stagnant, in the social field can only lead to fascist autocratic centralization system. The orderly and disorderly development of things have those limits, entropy and entropy increase is not absolute "Evil", information and entropy reduction is not absolutely "Good". In the evolution of universe and things embodied in it, there is no evil of eternal entropy increase, and no good of eternal entropy reduction. When the evolution of the whole entropy increases to a certain extent, it will naturally turn into the evolution of the whole entropy reduction; and vice versa, when the evolution of the whole entropy decreases to a certain limit, it will naturally turn into the whole Entropy increase in the evolution process. A reasonable ethical principle should reconcile opposing factors, such as information and entropy, orderly and disorder, integrity and reducibility, certainty and non-determinism, determinism and non-determinism, purpose and randomness, inevitability and contingency, and maintain a reasonable tension between these opposing factors. A reasonable conclusion can only be: Good - relaxation between order and disorder. In addition, the entropy theory (whether it is physical entropy or information entropy) that Floridi borrowed corresponding to order and disorder, and it only deals with grammatical information. The problem of information directly related to ethics and value is mainly in semantics and pragmatics, rather than simply in its grammar, and it is impossible to derive it simply and directly from the size of this formalized entropy. The lagging way of thinking, the deviation of the entropy and the understanding of information theory, led to Mr. Floridi's information ethical framework hardly to support his ambition to establish macro-ethics. In the same way, his information ethics is also very difficult to be the philosophical foundation of his commitment to the construction of human ecological civilization. In fact, as early as the 20th century, 90 years, Chinese scholars have put forward a general philosophy of value transcended the human-centered narrow position in the name of the natural ontology. This philosophy of value is not only compatible with natural values and human values, but also compatible with material values and information values. It is the value and ethical paradigm putted forward by such a philosophy of value laid the foundation for the construction of human information ecological civilization and the general philosophical basis of sustainable development theory and practice.

81 Mobile Video Communications based on Cloud Transcoding

Published

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This study present a mobile video communication ecosystem based on cloud transcoding, aiming at video communication anywhere, on any device at anytime. In the ecological chain of mobile video communication (i.e. "Capturing-Encoding-Transmission-Decoding-Display"), most of the efforts are focusing on "Encoding-Transmission-Decoding" to reduce the bandwidth requirement. In other word, most of the existing video coding schemes are focusing on the compression performance while sacrificing the computational complexity. For mobile-to-mobile video communication, both the transmitter and receiver devices may have limited computing resources. Consequently, the unbalance between the power consumption and compression efficiency is critical for the video communication ecosystem. Based on the advantage of the cloud computing, this study proposes a low complexity end-to-end video communication system based on cloud transcoding. A distributed video coding (DVC) to high efficiency video coding (HEVC) transcoder is proposed for implementation on cloud, while the user ends are computational light-weighted. Specifically, the motion vectors of DVC decoding are re-used to accelerate the partition process of each depth of CU in HEVC. As a results, the proposed ecosystem can shift most of the complexity to the cloud to ensure limited power requirement for end users.

82 Principles of General Ecology

Published

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The term *ecology* (*Ökologie* in German) was coined in 1866 by the German scientist Ernst Haeckel (1834–1919) from two Greek words *oikos*, which means *house*, or more generally, *habitat* or place of living and logos, which was used in ancient Greece denoting such concepts as *order*, *meaning*, *foundation* or *mind* (Odum, 2004). Haeckel's initiative instigated an approach, where European botanists investigated plant communities related to definite territories and their interdependencies, giving rise to the science of ecology, which was dealing not only with plants but also with other living beings.

In the contemporary science, ecology is a holistic study of living systems in relation to their environment by explicating patterns of, processes in and relationships between these systems.

At the same time, ecology as a whole contains such subdisciplines as plant ecology and animal ecology.

Plant ecology studies the distribution and abundance of plants, the effects of environmental factors upon the abundance of plants, and the interactions among and between plants and other organisms (Weaver and Clements, 1938).

Animal ecology is the scientific study of animals and how they related to and interact with each other, as well as with their environment, determining the distribution and abundance of organisms.
Together these two areas form *natural ecology*, whereas researchers also created other ecological fields. One of them is *human ecology*, which is an interdisciplinary and transdisciplinary study of the relationships between humans and their natural, social, and technological environments involving a variety of disciplines: geography, sociology, psychology, anthropology, zoology, epidemiology, public health, home economics, and natural ecology, among others (Young, 1974).
While ecology has traditionally dealt only with natural systems, the new field of *industrial ecology* studies industrial products as part of larger systems and processes including industrial behavior and biogeochemical cycles as a part of a system and aiming at reduction of the environmental impacts of production, consumption, and disposal.
Chinese scientist Yixin Zhong initiated *information ecology* (Zhong, 1988; 2017). This discipline is essentially important for information studies as a holistic approach to the existence and functioning of information processing systems, as well as for better understanding of information processes in all spheres of reality. If ecology of plants studies structures and processes in systems of plants, information ecology studies structures and processes in organizations of information processing systems and formations.
One more ecological area is *ecology of mind* suggested by Bateson (Bateson, 1973).
Researchers also study *knowledge ecology* (Bray, 2007; Shrivastava, 1998), which is an approach to knowledge management aimed at fostering the dynamic evolution of knowledge interactions between systems to advance decision-making and innovation by means of enhanced evolutionary networks of collaboration. In contrast to purely instructional management, which attempts either to manage or direct outcomes, knowledge ecosystems advocate that knowledge strategies should focus more on enabling flexible self-organization and self-improvement in response to changing environments.
In addition, American anarchist and libertarian socialist author Murray Bookchin introduced *social ecology* as a critical study of society (Bookchin, 2005).
Existence of different ecological disciplines needs a common foundation and presented in this work *general ecology* provides such a unifying foundation for all ecological studies.
The concept of *ecosystem* proposed by the English ecologist Arthur Tansley is central for different ecological disciplines. That is why we start our exposition with defining this concept in the most general context. To this, we describe how the global structure of the world affects the organization of ecosystems.
The large-scale structure of the world is represented by the *Existential Triad* (Burgin, 2012), which is given in Figure 2. Presenting the relationship between World of Structures, Physical World and Mental World (Figure 2. The Existential Triad of the World).

The three worlds from the Existential Triad are not separate realities: they interact and intersect. Individual mentality is based on the brain, which is a material thing, while in the opinion of many physicists mentality influences physical world (cf., for example, (Herbert, 1987)). At the same time, our knowledge of the physical world largely depends on interaction between mental and material worlds.
Note that not only people but also all information processing systems have their mentality. Let us look at a computer. The content of the computer's memory can be naturally treated as the mentality of this computer. For instance, the operating system is a part of the mentality of the computer.
The global structure of the world induces three types of ecosystems:

- includes physical systems and processes as its elements and components
- includes mental systems and processes as its elements and components
- includes physical systems and processes as its elements and components

When all three components of the world stratification are combined in one system, we have a *total ecosystem*.

An ecosystem is delineated by three parameters:

- , i.e., it is assumed that all elements and components of an ecological system belong to a definite region in the space
- , i.e., it is determined what elements and components of given ecological system are considered the most important from the point of view of ecological studies
- between its elements/components including processes as dynamic connections, i.e., it is determined what connections, ties and processes in given ecological system are considered the most important from the point of view of ecological studies

For instance, in a natural ecosystem, living organisms form the primary type of elements and a chosen area on the Earth shapes the region in the space. In this context, a natural ecosystem is composed of the dynamically interacting parts including all living organisms in a given area, which interact with each other and with their non-living environment.

In an information ecosystem, information processing systems form the primary type of elements and a chosen area on the Earth (may be the whole Earth) shapes the region in the space in which information processing systems are interacting with each other, and also with their environments. In addition, studies of information ecosystems concentrates on information processes going in the system.

Note that there are different kinds of information processing systems: technical information processing systems, living information processing systems, human information processing systems and so on.

Three grades of (types of) elements/components:

- elements/components
- elements/components
- elements/components

Ecological studies are aimed at understanding existence and functioning of the primary elements/components of ecosystems, as well as basic connections, ties and processes in these ecosystems.

A physical ecosystem contains parts, elements and components of three kinds:

- Natural parts, elements and components, which include physical systems and processes in nature
- Technological parts, elements and components, which include technological systems and processes
- Social parts, elements and components, which include social systems and processes

In a physical ecosystem, it is possible to consider only physical processes or also to take into account mental and information processes.

A mental ecosystem contains parts, elements and components of three kinds:

- Natural parts, elements and components, which include and comprise mentality and its components of living beings
- Technological parts, elements and components, which include and comprise mentality and its components of technical devices
- Social parts, elements and components, which include and comprise mentality and its components of groups, communities and societies of living beings and technical devices

In a mental ecosystem, it is possible to consider only mental processes or also to take into account information processes.

A structural ecosystem contains parts, elements and components of three kinds:

- Natural parts, elements and components, which include structures of physical systems and processes
- Technological parts, elements and components, which include structures of technological systems and processes

- Social parts, elements and components, which include structures of social systems and processes

The general ecology standpoint shows that it is possible to study information ecosystems either as physical ecosystems or as mental ecosystems or as structural ecosystems. It gives three perspectives at information ecosystems allowing researchers to obtain better knowledge and understanding of these systems. One more possibility is to study total information ecosystems combining all three perspectives in one model.

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83 The Communication of Health Knowledge in Social Media under the Special Chinese Culture Context: the Moderating Effect of Loss of Face

Published

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The communication of health knowledge in social media plays an important role in public health literacy and health behavior promotion. But with the accumulation of user-generated health knowledge in social media, more and more misleading health information, health gossip and health rumors are inhibiting the communication of health knowledge and the development of information ecology in social media. This study focuses on the information ecology in social media and contributes to the communication of health knowledge in social media ecology, highlighting the characteristics of health knowledge and the special Chinese culture. Based on the definition of three effective communication forms embedded in the communication of health knowledge—the fear communication, the trust communication and the face communication, an explanatory framework is constructed to examine their interactions and impacts on the communication of health knowledge in social media. Data collected from 329 respondents was tested using a partial-least-squares (PLS)

approach. The results indicate that fear communication and trust communication both act as effective communication forms contributing to the communication of health knowledge; face communication acts as a barrier constraining the trust communication while no effect on fear communication. Theoretical and practical contributions are discussed in this paper.

84 A Model of Deceitful Information Communication: Some Views on Theory and Practice of Semantic Information

Published

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In the field of information science and philosophy of information, semantic information[1] is a hard nut to crack. In spite of this situation, some scholars pay their attention to this topic.
Recently, with the development and popularization of modern information technology, network and telecommunication fraud is becoming more and more common and serious. Similar cases suggest that theorists must study a new type of semantic information: deceitful semantic information and deceitful information communication.
In ancient times, some scholars concerned about some issues of communication. In modern times, Claude Elwood Shannon established a modern theory of communication and proposed a model of communication in 1948. However, the model is widely called Shannon–Weaver model of communication and regarded as the "mother of all models." [2]
Shannon-Weaver model can be illustrated as follows.
Sender
Message
Encoding
Signal
Channel
Transmitting
Decoding
Message
Receiver
Interpreting
Noise
On one hand Shannon distinguished signal from message; on the other hand Shannon says, "The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently the messages have *meaning*; that is they refer to or are correlated according to some system with certain physical or conceptual entities. These semantic aspects of communication are irrelevant to the engineering problem."[3] It means that Shannon excluded the semantic dimension in the field of communication.
However, as far as social communication is concerned, the semantic dimension has to be included rather than excluded. Weaver points out that there are three levels of communication: level A as the technical level, level B as the semantic level, and level C as the effectiveness level.[4]
Because of the difficulty of semantic research, only a minority of scholars research the topic of semantic information and semantic information communication in the field of information science.

We have to admit that in the field of traditional information science, semantic information and semantic information communication is the most difficult topic.
As for semantic information communication, there are three kinds of communication: normal semantic information communication, secret semantic information communication and deceitful semantic information communication.
This article focuses on the last one.
As for deceitful communication, a new model should be proposed, because Shannon-Weaver model no longer fits for this situation.
A model of deceitful communication can be illustrated as follows.
㊀----------㊁----------㊂----------④----------
Cheater/sender

Original message
Feigning
Cheater/sender
————
Deceitful message

Encoding
Signal
----------⑤----------⑥---------- ⑦---------- ⑧
Channel
Transmitting
Noise
Decoding
Deceitful message
Distinguisher /receiver

Penetrating
Penetrator/original message
or
Cheatee/deceitful message
In comparison to Shannon-Weaver model, this model has four characteristics.
First, in the aspect of role structure, besides sender and receiver, four new roles enter into this model, which are cheater, distinguisher, penetrator and cheatee.
Second, in the aspect of operation, besides encoding and decoding, two new operations enter into this model, which are feigning and penetrating.
Third, while Shannon-Weaver model involves only level A that Weaver defines, the model of semantic information communication involves the semantic information. What's more, semantic information is divided into two kinds, normal semantic information and deceitful semantic information. The model focuses on the latter.
Last but not least, in the aspect of ethics and axiology, the most important thing is that the concept deceitful information can be interpreted as a neutral concept rather than a negative one. For examples, when one tells a white lie or a spy for the sake of justice sends deceitful information in order to mislead the enemy, the pieces of deceitful information have positive value. In a word, the impact of deceitful information can be negative or positive.
In order to interpret this model, we should emphasize four points.
First, in the field of traditional information science, semantic information seems to be a paradoxical topic. On one hand semantic information is regarded as an important topic in theory; on the other hand semantic information approach is regarded as useless in practice. For example, a telegram

cannot be charged by semantic information rather than by words. However, in the field of information ecology deceitful semantic information becomes an important issue which should be studied.
Second, although Weaver points out there levels of information, he does not explain how to change level A of information into level B. According to linguist Ferdinand de Saussure, sign is a unity of signifier and signified.[5] Going a step further, we can consider that when a person uses a symbol he gives it a semanteme. So the process of communication includes two main operation, giving meaning and interpreting meaning.[6] This is why and how semantic information is produced and can be changed.[7]
Third, semantic information is divided into two categories, normal semantic information and deceitful semantic information. As for semantic information communication, it is important to note that the model of deceitful semantic information is formed by adding cheater and feigning at beginning and distinguisher, penetrating and cheatee to Shannon-Weaver model.
Finally, at first appearance, deceitful semantic information which is false information is a particular topic rather than a general one in the field of semantic information study. However, from point of view of giving meaning and interpreting meaning, on one hand deceitful semantic information is not semantic-information-itself as symbol, but is a result of giving meaning by cheater; on the other hand deceitful semantic information can be believed information or exposed information both as a result of receiver-distinguisher's penetrating his received information. It means that besides ordinarily giving and interpreting normal meaning, people must attach importance to special giving and penetrating deceitful meaning, which is also a common social phenomenon.

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85 A non-linear analogy procedure for gene repair

Published

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Non-coding DNA region takes an important role in genetic variations that affect human disease. Owing to the ECODE project, it is convenient for bioinformatics researchers to find informational content in non-coding DNA sequences. In this paper, for analogy of non-coding DNA sequences, logistic map is applied, which felicitously stimulates the chaotic behavior of gene. By this way, two statuses were set, healthy status and ill status, generated by logistic map with two different system parameters. And two sequences were set, healthy sequence and ill sequence. These two sequence had same length and initial value. However, every single piece of healthy sequence was in healthy status, while four fifth of the ill sequence was in healthy status and the one fifth was in ill status. To repair the ill part of ill sequence by replacing it with adaptive sequence, ill sequence's healthy part nearby the ill part was compressed four times to generate a new sequence of same length of ill part. Displaying the ill part with the new sequence and conducting a similarity analysis between healthy sequence and repaired sequence, it is showed that the repaired sequence is highly similar to the health sequence. In fact, as to this gene repair, by using healthy neighbor to replace ill part is essentially repairing the system parameter. This indicates that changing the parameter of a body system will change the status inside body. This concept may provide a new direction to biomedical study.

86 A Theory of semantic Information

Published

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Shannon Theory of Information has dealt with the theory of statistically syntactic information. However, the semantic information is much more concerned in everyday life and academic studies. Therefore, a theory of semantic information with applications is presented in the paper.

87 AI and Data Science: The two driving for new technology innovation

Published

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In this paper, the author will present the new power of integration of Artificial Intelligence and Data Science to the new big data era and stimulate the technology innovation in the fourth industrial revolution. A new ecosystem will be presented for the integration of AI and data science. Case studies of precision medicine and personalised healthcare will be discussed to explore the power of the integration of AI and Data Science, as well as the opportunities and challenges.

88 An assessment on the hidden ecological factors of the incidence of malaria

Published

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Confounding effects of climatic factor have a greater influence in the incidence of malaria and its considerably changes in space and time. In this study we explored a new ecosystem for the assessment of hidden ecological factor to the incidence of malaria. Partial least squares structural equation model (PLS-SEM) technique is proposed for the identification of hidden ecological factors from a classified data for climate indicators and the confirmed reported cases of malaria in Ejisu-Juaben, Ghana. The results of exploratory factor analysis (EFA) identified three confounding factors that are significantly influenced the malaria incidence in the study area. Factor I is related to minimum temperature and relative humidity, Factor II is related to maximum temperature and solar radiation and Factor III is related to precipitation and wind speed respectively. Further, the hypothetical SEM was refined using the results of EFA and produced PLS-SEM structure to enable selection of hidden ecological factor. Among the three Factors showed, the Factor I was identified as the most influential hidden ecological factor of malaria incidence in the study area, as evaluated by communality and Dillon-Goldstein's indices. These results was also validated using lagged cross-correlation between Factor I indicators and malaria incidence, and found positive association at lag 1, and also the credible interval of the estimates was robust. This study findings highlighted an important issues related ecological approach to the prevention and control malaria. We conclude that minimum temperature and relative humidity were accountable for high malaria incidence and should be given greater weight of consideration in strategising policy for prevention and control of malaria transmission in the study area.

89 Big Data, the Jungle of Information Evolution

Published

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In the first part, the three basic mechanisms, similar to the biological world, of the evolution of information system are described as the duplication, variation and selection (or elimination). Semantic information is presented by the way that I = I（P @S）,connecting a bit string, in this paper. Based on this definition，it will be able to more clearly describe the duplication of information in its evolution. Variations of information come from human communication needs, and other numerous social causes, leading to the landscape of a wide variety of variations. On selection (or elimination), it's not only similar to the biological world, but also has its inherent characteristics, such as: "judging that the information is true or false", "verifying that information is validity or not ", this priority not only is very important, and getting more and more tough. However, the suitability and effectiveness of information play an extremely powerful role on selection (or eliminated). Based on WeChat, an huge APP platform, the article shows these characteristics.In the second part，the changes about the evolution of information are presented. The first: the correspondence of semantic information with bit string had made a giant step, by Shannon, in information evolution. The second: every human individual is associated with a large collection of bit string, which is rapid expansion through human activity based on the fast development of IT technology, and has become a brand new resource for human. The third: information evolution with "big data" as the main characteristic has changed the traditional definition and paradigm on knowledge. By applying data directly to the social activities, "flat" mode, much more efficiency, has appeared in the human society. The fourth: the information world is an open complex system, and human society has been its major external environment that supplies promotion and energy to the information world .The fifth: human must remain calm in facing the new state with intelligent machines, to be symbiosis, coexistence, and development together with them，and to dealing right with bad and kind information.

90 Error Resilient Video Coding for Wireless Visual Sensor Network

Published

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1. Introduction

Wireless Visual Sensor Network (WVSN) improve the quality of human daily life like ubiquitous city and healthcare services, which may be deployed in failure-prone environments, and video transmission code easily fail. The reliable visual information communication is one of the most important factors in the ecological chain of WVSN, i.e. "Visual Sensing- Compression- Transmission- Decompression- Monitoring/Decision". Information ecosystem has been widely used, and applied as a mature theory in the education construction or an improved understanding of modern health information. But few researcher have study the ecosystem of video transmission. Jannis Kallinikos took the video as digital object and studied the production and distribution of video content in the internet media ecosystem. Tiwari A proposed method and apparatus to provide an ecosystem for mobile video. However, most of the existing works for multimedia divide the information communication tasks into isolated episodes of "compression", "power consumption" and "error resilience", without considering the interaction between them. In order to optimize the ecosystem of video information communication over WVSN, this work first provides a discussion on ecology technology model of video transmission in the WVSNs. And then make use of an error-resilient video coding scheme, Distributed Video Coding (DVC), for improving the ecosystem of WVSN. In order to jointly consider the "compression", "power consumption" and "error resilience", this paper first proposes a Distributed Video Parallel Coding (DVPC), which make use of the correlation of video information in the decoder side, to cope with the loss of video data over wireless error-prone channel. Then a Partition Irregular Repeat Accumulate (PIRA) codec for distributed joint source-channel coding (DJSCC) scheme has been proposed for better error resilience performance, while remain the power consumption constrained.

This paper is organized as follows: Section 2 describes the proposed DVPC and the DJSCC based on the proposed PIRA. The experimental results and discussion are located in Section

2.The proposed error resilience video coding

This work provides an ecosystem model of video coding and transmission in the WVSNs. For the WVSN nodes, the video capture devices may not have enough computer power and resources, thus the encoder needs the lower complexity. Meanwhile, there is channel loss in the video transmission part, which affects the decoding quality. The error resilience of video coding scheme plays an important role in improving the decoded video quality. In summary, the traditional video coding schemes, such as HEVC, are based on high complexity and power consumption of encoders, which are not applicable in the WVSN. On the other hand, DVC is an innovative paradigm which shifts the processing complexity from encoder to decoder, and has better error resilience in the video transmission. According to the methodology of information ecology, this work proposes a balance video coding scheme between "complexity", "compression", "power consumption", "error resilience" and "decoding quality", which is named DVPC.

In the DVPC scheme, all of the frames are divided into Key Frames (KF) and Wyner-Ziv Frames (WZF) according to the GOP size and the WZF are encoded using WZ codec. The pixels are grouped into

blocks, and DCT is applied to each block in order to compute the coefficients. Each DCT coefficient is quantized according to a quantization parameter, which is decided by the chosen quantization matrix. Then, each coefficient was extracted into bit planes. Then, they were encoded using the proposed PIRA encoder. In the proposed PIRA, the side information, Channel error-prone condition, and the received parity bits are used to calculate the initial LLR of the iterative decoding.
The DJSCC encoder based on PIRA is comprised of three steps: (1)Source partition: Divide the information bits into k0 groups of n bits. (2)Encoding: The bits are encoded. (3)Rate Compatibility: Generate a random sequence to be the transmission mask, which is known by the encoder and decoder.

3. Results and Discussion

In order to validate the error resilience of the proposed DVPC, the Rate Distortion (RD) performance was tested over wireless channels. A PIRA code was designed in a rate of 1/2 and length of 1584, firstly. In all of the experiments, the luminance of the standard video tested sequence ('Foreman') was encoded at 15-fps. The transmission channel for different erasure ratioswas evaluated. The PSNR of the DVPC decreased less than that of the LDPC-based DVC by approximately 0.15 dB in the 'Foreman'.
In order to compare the time complexity based on different channel codes with no loss, we calculated the Average Time Save (ATS) ratios between the LDPC-based DVC and the DVPC scheme. Four QP matrix {1,2,3,4} for the tested sequences result in different bit rates. With the higher bit rates, the more time saved by the DVPC scheme. Some times saved about half of codec time. Thus the PIRA is a low delay channel codec and is suitable for practical DVPC.
As shown in these experimental results, the proposed DVPC scheme exhibits a better error resilience and lower time complexity than the LDPC-based DVC. In a word, the proposed DVPC scheme achieves an ecology balance between "complexity", "compression", "power consumption", "error resilience" and "decoding quality", and is very effective for video transmission over wireless channels.

91 Information Conversion and Intelligence Creation

Published

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The most typical, and also most significant, activities for humans is the interaction between human subject and object. Within this framework, what the subject received is the information presented by object (termed "object information") in outside world and then what the subject has to produce is the intelligent action reacting on the object. How can the intelligent action be produced based on the object information ? The paper will analyze the problem and give the answer.

92 Information Ecology and Cognitive Justice : Core Value and Methodological Principles of Information Ecology

Published

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1.The Information Ecology and Its Significance
From the perspective of science, the introduction of information ecology is the expansion and application of the principles and methods of ecology in the information science researches.
From the perspective of real practice, the real problems that the information ecology encounters is the irrationality and injustice in the information survival, information processing, information transit and information sharing, including the information overload, information pollution, information harassment and information crime. It calls for the fairness as well as justice in theinformation occupation which provides the necessary requisite for the cognitive justice.
If Chinese researches on the information science generally lag behind western developed countries, the emergence of the information ecology in modern China which has been attached great importance to represents an advanced self-awareness. Information enables Chinese information science to rise to the similar standard of international information circle and it can realize the advanced development via taking the advantage of the Chinese market—the world's largest information system and the fastest expanding information market, which would lead the world's information technology and the future of the culture in a step-by-step manner.
2.Core Values of the Information Ecology
Cognitive justice is the necessary basis and the cognitive prerequisite for social justice and fairness. However the information justice serves as the prerequisite for the cognitive justice. Information Ecology promotes the information justice and cognitive justice through the focus and researches on the information ecology and it is endowed with unique core values.
On Information and Information Researches, Pro.Zhong Yixin depicts the process of information ecology: ontological information→epistemological information→ knowledge→intelligent strategies→intelligent behavior, which enlightens us a lot.
(1)Whether the external social and political cultural environment is rational and orderly, whether it is harmonious, and whether there exist external constraints which hinder the natural existence and healthy evolution in the information ecology etc.
(2)Whether in the certain information system the plural subjects,complex objects and the intermediary elements are sound,the organization healthy, the structurereasonable and the function comprehensive, etc.
(3)Whether in there certain information system the operation approach is reasonable and orderly, the operation process steady and safe, the operation monitoring timely and reliable and the operation function effective, etc.
(4)Whether in the specific information system the trend and direction incertain information system is reasonable and healthy, the transition method suits the logic and the how to better the structure for the future form in a more reasonable manner, etc.
3.Methodological Principles in Information Ecology
Methodology in information ecology is of great importance to the research and application of information ecology which should be attached great importance to.

Professor Zhong Yixin offers the logic chain and advocates the integration research of information society→information education→information philosophy→information science→information project→information management →information economy→information society which is of great instructive significance.

We put forward several methodological principles of researches on information ecology from the perspective of cognitive justice in hope that we can direct the value orientation of the information ecology.

First, objectivity. The original properties, features and regularities are respected which correspond to principles and methods of the information ecology system to study problems of the research information ecology and enhance the publicity,scientificness and transparency of the information system.

Second, systematicity. Status of various kinds of information elements in the information ecological system should be respected and valued and meanwhile the systematic features and systematic functions of information ecology should be strengthened and therefore the integrity, coordination and organicity of the information ecological system can be enhanced.

Third, subjectivity. It is suggested that the dominant positions of different people in the ecological information system be respected and given the great attention, that people's responsibility for the information ecology be implemented and that the purposiveness,value and orientation of the information ecology be further enhanced.

Fourth, the justice. It is suggested that power of different sectors be respected, interests of various parties be secured and the legitimacy, readability and efficiency of the interpretations on the information form be strengthened.

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93 Information Ecology: Proper Methodology for Information Study

Published

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Due to the great difference between matter and information, the methodology of reductionism featured with "divide and conquer", which has been proved very successful, is no longer sufficient for information study. Instead, the new methodology named information ecology should be employed. The concepts related to information, information process, information system, and information ecology will be explained, the reason why information ecology can be regarded as the proper methodology for information study will be analyzed in the paper.

94 Inherent emotional feature extraction of neonatal cry

Published

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As machine learning for emotion recognition always needs a large number of samples, the method of mining the inherent emotional feature of life with a small number of samples is explored in this study. Neonatal demand for the outside world comes from the instinct without interferences such as intentions, and cry is the main medium of communication between neonates and the outside world. Thus, Neonatal cry is selected as the object of this study. The inherent emotional features of neonatal cry are excavated based on the nonlinear method. The minimum embedding dimension of neonatal cry is taken as the feature representing nervous system activity and emotion. It is found that the minimum embedding dimension of neonatal cry in the state of pain is higher and that in the state of sadness is lower. This result is consistent with related research of brain nerve activity under different emotions. The minimum embedding dimensions of neonatal cry at multiple scales are analyzed. It is also found that the minimum embedding dimension of neonatal cry in the state of pain has a certain change rule in different frequency bands. And this result is also consistent with crying characteristics in the state of pain. The extracted emotion-related parameters, which reflect the inherent physiological feature of the human body, can be used to identify and classify emotions by sounds.

95 Knowledge ecological trees in factor space†

Published

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The law of information transformation reveals the essential of cognition, to fasten the process of information transformation for cognition body, we present the knowledge ecological tree analysis and algorithm in the paper based on factor space theory, which provides a plate of mathematical description for information ecosystem.

96 Methodology Challenge to Human Body Medicine Study

Published

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There have many categories of human body medicine existed in the world. Two of them are in China, namely Traditional Chinese Medicine and Western Medicine. Both of them have achieved good results on one hand and been facing problems,owing to the different methodologies - reductionism

for Western Medicine and Ecology-ism for Traditional Chinese Medicine. It is explained in the paper that there is a need for integration of the two methodologies for the complex human body medicine study.This is really the challenge to human body medicine study.

97 Mobile video communications based on cloud transcoding

Published

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1. Introduction

The rapid development of mobile communication technology (e.g. 5G communication) has contributed a lot for video transmission. However, the energy consuming issue of traditional video coding standard is still challenging due to the complex encoding paradigm. In the existing mobile video communication, most of the efforts are focusing on "Encoding-Transmission-Decoding" to reduce the bandwidth requirement. In other word, most of the existing video coding schemes are focusing on the compression performance while sacrificing the computational complexity. Obviously, these methods often focus only on the compression part and ignoring the power consumption which is critical for practical scenarios, which would lead to the unbalance of the video communication ecosystem. Information ecosystem theory has been widely used in recent years, and applied as a mature theory in the healthy hospital information ecology systems and agriculture domain. All of these studies have employed the "Ecological Methodology" to understand the information process deeply, but few researchers have study the ecosystem of mobile video communication. So, this work presents a mobile video communication ecosystem based on cloud transcoding, aiming at solving the unbalanced relation between the power consumption and compression efficiency.

2. Problem analysis

For mobile-to-mobile video communication, both the transmitter and receiver devices may not have enough computer power and resources. Meanwhile most of the traditional video coding schemes for mobile devices divide the information communication tasks into isolated episodes of "compression performance" and "power consumption" etc., without considering the interaction between them. Therefore, how to find a more effective method to meet the requirement of the mobile communication devices is an urgent problem. On the one hand, traditional video codecs, such as HEVC are based on the frameworks which have encoders of higher complexity than decoders. On the other hand, DVC is an innovative paradigm which shifts the processing complexity from encoder to decoder. In order to provide a mobile video communication framework of low complexity at both end-user devices, combining with the characteristics of two video coding schemes, this paper proposes an improved DVC to HEVC video transcoder based on cloud computing. In the proposed ecosystem, the computational complexity can be taken over by the transcoder which has a powerful processing capacity, so that the unbalanced relation between the power consumption and compression efficiency in mobile video communication ecosystem could be effectively solved.

3. Proposed video transcoder

In the proposed video transcoder, the main idea is to exploit the valuable information of the DVC decoding which can be used for the HEVC encoding algorithm, so that the more power resource can be saved during the transcoding process. It is well-know that the HEVC encoder adopts a recursive quad-tree partition to split CTUs into CUs through a complicated Rate Distortion Optimization (RDO)

process, which brings the huge computational complexity. In this paper, the process of the partition of each depth of CU in HEVC could be accelerated by re-using the motion vectors (MVs) information of the DVC decoding stage.
In DVC, the key frames are encoded using HEVC Intra, so they can be directly transmitted to the receiver without any transcoding conversion as I frames in the transcoder device. For the same GOP (Group of Pictures), there would be some inter-frame correlation between the P frames and I frames. The partition modes of P frames could be based on the partition modes of I frames, but the proportion of I frames CUs depth are greater than P frames as high as 90%. To this phenomenon, a block merging method based on data statistic model is proposed to handle the problem to some degrees, e.g., every four '8×8' CUs and '16×16' CUs will be directly merged into one '16×16' CUs and '32×32' CUs respectively. After that, a rough CUs partition model of P frames may have a large difference with the original partition model of P frames in HEVC. Therefore, a block repartition algorithm for P frames is proposed based on the motion vectors (MVs) generated in DVC. For each CUs, we find five points which include four vertexes and one central point to calculate the mean and variance of the corresponding MVs to decide whether the CUs need to be divided. If the mean and the variance is both greater than a threshold, it indicates that the CUs exists some irregular movement area, the current CUs will be split into four sub-CUs, or the CUs stays constant.

4. Results and discussion

In order to validate the effectiveness of the proposed mobile communication ecosystem, which is based on fast transcoding algorithm from DVC to HEVC, several sequences are tested. The HEVC testing model HM16.1 are adopted for simulation bench. The reference transcoder consists of a full DVC decoder followed by a full HEVC encoder. Experimental results show that compared with the reference transcoder, the proposed transcoder can achieve of 60% to 50% total encoding time saving with negligible rate distortion drop.

98 On the information selection of scientific and technical communication

Published

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This dissertation studies the problem of information selection of scientific and technical communication.

Part 1: Analysis for the system of scientific and technological communication

Scientific and technical communication is one of communication behaviors of human, which was born when human civilization developed to certain extent. As a component of science and technology, it is called " blood circulation systems " of science-technology and society, which are the lifelines of economy and society. In the middle of the 20th century, the information and biology revolution marked the revolution of the modern science and technology. Meanwhile, there have emerged a lot of new features in the scientific and technological communication.
Scientific and technological communication is one form of information communication, whose activities include scientific and technological writing, publishing, news, education, popularization, translation, information exchange, consultation, library, exhibition, museums, data base, etc.

Knowledge and information of science and technology, through time and space crossover diffusion, realizes knowledge sharing among different individuals, transforms private knowledge into society-sharing knowledge.

Instead of a combination of various methods and channels, system of scientific and technical communication is a unified organism, whose elements consist of communicator, content, media and receiver. They are interrelated and interacted, forming a structure of layered classes and gradations.

. The functions of scientific and technical communication include: (1) to stimulate knowledge transformation and development of science and technology; (2) to train science and technology professionals , enhance people's qualification of science and technology ; (3) to accelerate the transformation of scientific and technological achievements, benefit the development of economy and society; (4) to strengthen international communication and cooperation, carry forward human civilization .

It is hoped to get long-term, expected, and positive effects. We must pay special attention to the behaviors of stealing the name of science but actually doing non-science and even against- science. Also, we must look at the system of scientific and technological communication as a subsystem of the grand social system. There are obstacles in the communication process, so it becomes necessary to remove them, to get ride of useless information and to select effective information.

Part 2: The mechanism of information selection

The information is extremely rich in modern society. It assumes the tendency of "knowledge explosion" and "information sea", which give rise to serious interference in the communication process, such as unnecessary, out-of-date, antiquated, false, rubbish and filthy information, virus information, etc. So we must select effective and beneficial information.

The process of information selection includes information collecting, receiving, handling, treating, storing, retrieving, spreading, etc. It requires to differentiate, classify, analyze, compute, sort, code, label and organize the information to make them increment, so as to acquire maximum economic and social effect. People's cognition, emotion and will, which relate to background of knowledge, interest, favor, habit and economic situation, etc., play an important role in the selecting process.

The communicator and receiver follow different principles. Of that the communicator complies with the rules of being efficient, objective, systematic, directed, matching, standardized, safe, etc. while the receiver obeys the law of selection, which includes selectively receiving, selectively understanding, selectively memorizing and selectively practicing, selects the needed information using the minimum effort principle to. Besides usefulness, efficiency and effect, convenience, safety, being economical should also be considered.

There are couple of ways of information selection, namely, independent selection and passive selection. There are also a lot of tools for information selection, e.g. newspaper, magazine, book, broadcast, television, data base, network, etc. Some institutes of information services provide services on science and technology, which makes the information service professional and industrialized.

Part 3: The valuation and selection of the achievements of science and technology

One of the most important objectives of scientific and technical communication is to communicate and spread the achievements of science and technology. Science and technology have value and use value, or theoretical value and practical value, e.g. objective value and implement value, as well as truth value, education value, culture value, etc.

There are two kinds of valuations to science and technology, namely, the valuation from the scientific and technical community, and the valuation from the society. More precisely, valuation is shown in the publishing, differentiating, identifying, quoting, rewarding and encouraging, etc. The

achievements of science and technology are communicated and spread through valuation and selection. As property right of knowledge about the achievements of science and technology gets protected, technological monopoly should also be avoided.

The information about science and technology, reversely, affects the development of science & technology. So it is necessary to select properly contents, not only the information and knowledge of science & technology, but also the problems related to science - technology and society, in the communication process, and to face up with the challenge raised by post-modern science.

In modern society, science & technology and production form an entirety. Scientific research has benefited technological improvement, which drives economic development. The transformation of the achievements in science and technology involves in the process of commercialization and industrialization. So it is necessary to establish
a channel between science - technology and society through scientific and technological communication.

Part 4: The scientific and technical education, popularization and public selection

The scientific and technical education is a necessary condition to put the system of science & technology into permanent operation. It plays an important role in communicating the knowledge, method and spirit of science & technology, and in training professionals. We must carry on the quality, intelligence, innovation and lifelong education. We need to combine the scientific and technological education with humanism education, recognize the science & technology as a cultural process, pursue the unity of truthfulness, goodness and beauty.

The scientific and technological popularization towards public, along with the mass media, is very important. It consists of news, publish, broadcast, television, data base, network, etc. The communication of science & technology to the public via the mass media requires a modified approach to the traditional presumptive models of communicative style. Conventional models of scientific and technical communication are based on implicit but unexamined assumptions that the most effective and important means of transmission of scientific and technical information are efforts aimed at the attentive segments of the population through specialized and detailed formats. Based on the theory of uses and gratification approach, we should select properly.

People's qualification of science & technology in our country is poor, so we must take actions to promote. Attempts to reach inattentive audiences with scientific and technological information are customarily unsuccessful or have been deemed unnecessary altogether. The proposed model submits that not only are endeavors to communicate scientific ideas to the disinterested populace of overriding importance but can be quite successful if production styles are altered to reflect more "interest-motivating" designs. A new thrust toward capturing the attention of disinterested audiences before attempting to directly disseminate scientific ideas is proposed.

Part 5: The globalization and selection of scientific and technological information

The flow of information makes the world become an "earth village". The organic whole trend of the globe is clear. There exists serious unbalanced state on international information communication, so as to some "rich information countries" and some "poverty information countries" emerge.

Scientific and technical information and knowledge occupy important places in the global communication, in which culture plays a role as "filter" and "catalyst". There is a need to introduce some foreign scientific and technological books to our country. Based on our conditions, we should translate and introduce the reams of information technology, biology technology, energy technology, material technology, and synthetic, cross subjects, etc. Modern culture relates closely with science & technology and education. There are many kinds of selections as tradition and background differ. We should maintain vigilance to the "culture imperialism " and avoid the "culture departmental selfishness".

Scientific and technological communication relates closely with international competition power. On the times of knowledge-economy, national innovation systems are extremely important. The national innovation systems circle relations of production, consist of knowledge innovation, technological innovation, institutional innovation, managerial innovation, it is a kind of wholly synthesized innovation. The system of knowledge communication contains not only educational institution, but also the mass communication media. They are the same important on communication with production of knowledge. The system of knowledge communication acts as a bridge connecting knowledge innovation and knowledge application, also, it is the key factor of knowledge innovation and technological innovation. Establishing an effective network of scientific and technical communication is significant to the construction of national innovation systems, and to the realization of the strategy about rejuvenating China by science and education, and the strategy of sustained development, which is the sole correct selection.

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99 The Philosophical Foundations of Informational Ecology

Published

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Information ecology is a concept relative to intelligent agents. It's not about the ecology of information itself, but the ecological system that the intelligent agents exist as an informational way and process, produce, create information.
The information ecology consists of four levels: the level of information network is the basic level of matter and energy of information ecology; the level of information flow is the information processing level of information ecology; the level of information production is the evolution level of information

ecology; and the level of information creation is the dynamic level of information ecology. Reciprocity is the radical characteristic of information ecology as well as information. The basic characteristic of natural ecology is physical; the basic characteristic of social ecology is relational; and the basic characteristic of information ecology is reciprocitical. The basic principle of information ecology development in human society is the interaction between information symmetry and asymmetry. The basic difference between information ecology and natural ecology is that the natural ecology is naturally formed, and the information ecology is basically intelligent agent-made. In the era of information civilization, information ecology is not only based on the natural ecology and social ecology, but also plays more and more important roles in natural ecology, especially in social ecology. The key to natural ecology is the natural balance; the key to social ecology is social harmony; and the key to information ecology is mutual arousing in the process of information based on information circulation.

100 The universe is an information ecosystem

Published

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The universe is a constantly evolving information ecosystem, which originates from the information as the energy (the essence of information is energy), thus forming the material, life, spirit and other elements of the universe.There are only two kinds of basic objective existence, such as information (energy) and limiting particle, which constitute the myriad things in universe. Information is the representation of energy. Information and energy are both non material and objective existence. They have identity.The information of subjectivity is also composed of quantum sequences.Humans consume a lot of energy in thinking, which also proves the identity of information and energy.Simple information does not exist and is only possible through the medium of energy. Information and energy constitute the two sides of an entity, which embodies the identity of information and energy. The fact of the interconversion between matter and energy also establishes a connection between.them. Information is the origin of matter.In terms of objectivity, matter itself is a set of information (energy) and substance is information aggregation according to the equation of mass energy conversion,.In terms of subjectivity, mankind can only understands the material world through information. While human being is going far to uncover the mystery of matter, our understanding of matter is limited to the information presented by itself. Matter shows the quality, time, space, and these three aspects are also derived from information. The concepts of time and space in human's understanding are just the results of interaction of subjective and external information. Therefore, information displays space and time emerges in the process of information. Time is a successive state of information.
This article unifies the nature, the information (energy), the society, the spirit through the information origin theory, the limiting particle theory, the main body program theory. Thus it is called unified information theory.

101 Towards Information Ecosystem for Urban Planning——The Application of Video Data

Published

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1. Introduction

Urban planning is a subject which is highly relying on basic information. The main typical urban planning process consists of Survey, Analysis, Planning and Implementation. Over decades' urban researchers usually focus on the process of "Planning" and "Implementation", while less effort has been made in the "Survey" and "Analysis" part. In the meantime, most of the work only deal with one of the processes with other ones unconcerned. How to deal with the urban planning task as a whole, and achieve global optimization is crucial for modern urban planning. Information ecology is the study of interrelations among episodes of information conversion and their environment for better performance. Information ecology has been widely applied in the field of E-Commerce and Education to achieve global optimization, but has not yet been adopted in the field of urban planning. It is of great significance to examine the information unbalance in urban planning from the perspective of information ecology, which is helpful to the extensive collection and efficient use of information, and to accomplish more scientific, rigorous and effective planning.

This work will adopt the ecological methodology to guide the research on urban planning. Specifically, the Information Eco-System of planning will be modeled and analyzed, and the special attention will be paid to the information unbalance problem of urban planning. Finally a solution will be given with additional discussion.

2. The problem of Urban Planning Information Eco-system

2.1 Information Eco-system Model of Urban Planning

The whole urban planning process as an ecological system is referred to the conversion of" survey – analysis– planning- implementation". In the beginning the information of objects in urban (e.g. residents, roads, streets, lands et al.) are collected by surveying and investigating. Then selected information are analyzed to form urban knowledge. With the support of the urban knowledge, researchers and managers could make a proper planning. The planning strategy would guide the urban construction and management, which is called planning implementation. Finally, the planning would affect the objects in urban. More walkable streets, more convenient instruction, more efficient transportation would make better urban life. Unfortunately, there is some important parts are missing in urban planning system. Consequently, the lack of information collection break the balance of the whole urban planning ecological chain and make the planning less successful.

2.2 Unbalance of the ecological chain—— Lack of human information

The basic information of cities can be divided to two types——unhuman information and human information. The former contains road, land, infrastructure, et al., those are changed relatively slowly. The latter is mainly focused on the activity and mobility of residents, those are changed very rapidly and it is hard to track, measure and acquire. By the meantime, nowadays it is generally acknowledged that "human" has become the core of modern urban planning, instead of land or other entity objects. Modern urban projects which focused on residents' quality of life need more human information than ever.

Urban researchers have had to gain limited human information for decades because of limited sources, the disadvantaged technology and method. For example, the Chinese censes of the whole nation was taken every ten years. Many planning relied on data that cannot precisely reflect the present situation. The outdated and inaccurate data make the planning quantitative analysis unscientific and improper.

2.3. Solution

For urban eco-system, optimizing information collection method is the key to achieve system balance. Using multisource data to analyze and measure human activity is one of the most important way. Over past few years more and more urban researchers have started to use many kinds of big/open data to make more efficient quantitative analysis on the urban project. Long et al. use mobile phone signal data to measure the population density at the street level. The same author applied smart card data and taxi traces to measure human mobility and activity. These big/open data-based urban studies have proposed new methods and significantly improved the urban planning quantitative analysis.

However, those data still cannot provide enough information to support quantitative analysis in micro scale. For example, the result of street population distribution via mobile phone data can't reflect the ground truth. Firstly it allocate all the people in a certain area into each street, which means people in the land are counted as ones on the streets but in fact they are not on the streets. Secondly it omit the group of people without mobile phone. Usually they could be kids under 10 and part of the aged. In micro scale, those deviation may lead to a bad or wrong conclusion.

3. Towards Information Ecosystem for Urban Planning——The Application of Video Data

3.1 A proposed scheme——Street Vibrancy Assessment based on Video Data

Street Vibrancy is a typical urban planning element. It is an important topic which can measure the urban living quality. In street vibrancy quantitative research, in order to collect human mobility and activity information, some studies use field survey data and others use mobile phone data.

Video data on the other hand, has many advantages. Firstly, compared with the conventional data it can get continuous record for much longer time. Secondly, it directly records the ground truth instead of using indirect data to speculate, avoiding braised results. Thirdly, it can provide more accurate details about the survey target especially in micro scale. The multi-dimensional data could get a better description about human activity and mobility.

Here we propose a scheme called "Street Vibrancy Assessment based on Video Data". It has three steps.

Step 1: The whole research is set around a residential zone which contains numbers of streets. Firstly at least one camera are put on each street. The video should record the whole situation of the street cross-section for at least one week. The video data is analyzed by intelligent video analyze technology to get the different kinds of information, such as pedestrian flow and activity and emotion, e.g. Chosen information are put into a calculation formula to calculate a value to stand for street vibrancy. The higher the value, the better the street vibrancy.

Step 2: First of all, the street vibrancy value can be used to monitor the street. If compared with other similar ones the value is very low, or the value suddenly changes and the change is very unusual, it will give an automatic warning to remind the urban manager that maybe some streets need optimized.

On the other hand, each street has different constituent elements such as street cross-section type, sidewalk width, land use function, vehicle traffic situation et al. With the results above, the correlation could be found between the value and the constituent elements by regression analyze. The correlation will help the urban researcher to find out the main optimizing problems, to determine which one should be focused on, the cross-section or the function diversity or something else. Then, based on the basic information analyzing, strategies could be proposed after comprehensive analyzing.

Step 3: After the planning and the implementation has been done, the street vibrancy value should become better. Put the former value and the present value together, the implementation effectiveness of the street optimization could be charged.

3.2 Implementation detail and discussion

There are many kind of video analyzing technologies to achieve different kind of pedestrian appearance. In our proposed model, we define the street vibrancy Y as follows:

$Y=a_1X_1+a_2X_2+a_3X_3+\ldots+a_nX_n$

Where X_i stands for pedestrian appearance, a_i is a parameter which indicates the pedestrian appearance influent the vibrancy. The values of parameters could be proposed by experience, then determined by analytic hierarchy process.

It should be noticed that there is not always positive correlation between pedestrian appearance and the street vibrancy value. For example, the pedestrian flow indicates the account of people on the street, it is not "the more, the better.". If somewhere are very crowded, like one pushing another, very hard to move, then it is obviously that the whole street is not a public space full of vibrancy, which means on this situation the street vibrancy value of this street is low while the pedestrian flow is high.

All relative constituent elements should be considered as street vibrancy impact factors. Here we list some, sidewalk cross-section type, commercial type (land use function), function density, function diversity, sidewalk width, sidewalk length, vehicle traffic situation. For example, (1) According to different function parades, streets could be classified into 4 or more types: A-buildings (walls)-sidewalk-roadway, B-buildings (door open)- sidewalk-roadway, C- walls-sidewalk-roadway, D- walls-green bell-sidewalk-roadway…. (2) The commercial type of the stores right along the streets is also important, because a grocery, a fruit store, or a restaurant is totally different from a carwash.

Further analysis could be like below:

13.

14.

The results above can support many further research to guide the planning of enhancing street spatial quality, especially in micro scale, such as street walkability, quality of walking activity, street built environment.

102 Towards Information Ecosystem for Urban Planning—The Application of Video Data

Published

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In this study we present a new ecosystem for urban planning which highly depended on a variety of basic information. From information ecology view, the urban planning process could be seen as an ecological chain with the conversion of "survey –analysis– planning- implementation". Over decades' urban researchers usually focus on the conversion of "planning" and "implementation", while less effort has been made in the "survey" and "analysis" part. Most of works only collect limited data from which little information can be obtained describing human activity. In order to improvde the information ecosystem for urban planning, we first introduces "Street Vibrancy Assessment based on Video Data" into urban planning, focusing on the understanding of human activity. Compared with

other data, video data is relevant more accurate and more reliable at micro-scale. Baed on video data, an urban planning case is designed and discussed. In such case, the human mobility and activity parameters based on video data are analyzed and fed into a specific calculation model to get the external representation of street vibrancy. The correlation between the external representation and the constituent elements of the street vibrancy are exploited afterward for the assessment. Finally the assessment results can be used to guide the "planning" and "implementation" of the urban planning ecosystem.

103 Why Transdisciplinary Framework is Necessary for Information Studies?

Published

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As information is a central unifying concept in science playing a crucial role in many disciplines, scholars have a propensity to go beyond Shannon's classical information theory and develop a unified theory of information (UTI). There is a faith among them that many hard problems involving purpose, function, meaning, consciousness and value can be solved, or be broken through in some aspect at least, with UTI.There are three strategies to develop UTI: pan-informationalism, methodological reductionism and transdisciplinary approach.

In this paper, I will argue against pan-informationalism and methodological reductionism and argue that transdisciplinary approach is much more promising. The difficulty to solve those hard problems is that the properties involved are hard to be incorporated into scientific theories, while a satisfied theory of information should explain these properties on the one hand and be consistent with those relevant scientific theories on the other hand. The problem of pan-informationalism is that it actually does not explain information except taking information a priori. In other words, it just names the difficulty rather than solves it. The problem of reductionism is that it leaves something out while this is what we want to explain.

Transdisciplinary approach takes every level and dimension seriously. Although each level and dimension cannot be reduced to others, it can converse to other levels and dimensions. Such conversion is not transformation in mathematical sense, which actually is a kind of reduction, but a perspective conversion like Gestalt switch. Specifically, information as a complex phenomenon comes across physical, individual and inter subjective level of the world; it has three dimensions: physical, referential and normative. Roughly, these levels and dimensions are one-to-one correspondence. A good way to study information should corporate these levels and dimensions into a coherent framework without taking information as the most primary or leaving something important out. Søren Brier's cybersemiotics and Terrence Deacon's model of nested hierarchy of information are such good transdisciplinary frameworks. These frameworks provides an ecology for information.

104 从多个方面探究信息及其科学研究的生态特征

Published

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本文旨在从多个方面探究信息及其科学研究的生□特征。其方法是：首先，探索信息本身的概念及其相互关系蕴含的原理、规律和法则，进而，探寻信息科学的作为新□学科一系列基本特征，最后，揭示信息及其科学研究的生□特征及其在整个科学体系内部的独特地位。其结果是：信息及其存在的基本□律凸显，信息科学研究的社会生□特征分□在学科建构、定义甄□、学术研究、应用研究以及载体选择等诸方面的体现，即：多学科、多样化、多领域、多行业、多元化。其意□是：在信息生□□及其配套的方法论、形式化和方法体系上获得新的突破，具体表□□，信息□象的分□与归属□方面的判定有了其科学依据，信息本质的一系列基本关系、□构和原理各个层次甄□有章可循。

105 Should apocalyptic AI scenarios be taken seriously?

Published

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Can it be taken for granted that humans will remain in control in a situation where a breakthrough in artificial intelligence (AI) has led to our no longer being the foremost creatures on our planet in terms of general intelligence? This question lies at the heart of arguments put forth in recent years by philosopher Nick Bostrom, computer scientist Stuart Russell, physicist Max Tegmark and others -- arguments that raise dire concerns about such scenarios. Others claim that such concerns are a useless (or even dangerous) distraction. I will attempt a cool-headed and balanced evaluation of whether apocalyptic AI scenarios are worth paying attention to.

106 The General Theory of Information as a Unifying Factor for Information Studies: The noble eight-fold path

Published

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Abstract: We analyze advantages and new opportunities, which the general theory of information (GTI) provides for information studies.

The general theory of information (GTI) is a novel approach, which offers powerful tools for all areas of information studies. The theory has three components:

- The axiomatic foundations
- The mathematical core
- The functional hull

In Section 2, we give a very brief exposition of the axiomatic foundations of the general theory of information. The mathematical core is presented in (Burgin, 1997; 2010; 2011; 2011b; 2011c; 2014) and some other publications. In Section 3, we demonstrate advantages and new opportunities, which the general theory of information (GTI) provides for science in general and information studies, in particular.

The axiomatic foundation consists of principles, postulates and axioms of the general theory of information.

- *Principles* describe and explain the essence and main regularities of the information terrain.
- *Postulates* are formalized representations of principles.
- *Axioms* describe mathematical and operational structures used in the general theory of information.

There are two classes of principles:

v *Ontological principles* explain the essence of information as a natural and artificial phenomenon.

v *Axiological principles* explain how to evaluate information and what measures of information are necessary.

At first, we consider ontological principles.

There are three groups of ontological principles:

- *Substantial ontological principles* [O1, O2 and its modifications O2g, O2a, O2c] define information.
- *Existential ontological principles* [O3, O4, O7] describe how information exists in the physical world
- *Dynamical ontological principles* [O5, O6] show how information functions

Ontological Principle O1 (the *Locality Principle*). It is necessary to separate information in general from information (or a portion of information) for a system *R*.

In other words, empirically, it is possible to speak only about information (or a portion of information) for a system. This principle separates local and global approaches to information definition, i.e., in what context information is defined.

The Locality Principle explicates an important property of information, but says nothing what information is. The essence of information is described by the second ontological principle, which has several forms.

Ontological Principle O2 (the *General Transformation Principle*). In a broad sense, *information* for a system *R* is a capacity to cause changes in the system *R*.

Thus, we may understand information in a broad sense as a capacity (ability or potency) of things, both material and abstract, to change other things. Information exists in the form of *portions of information*.

The Ontological Principle O2 is fundamental as it intimately links information with time. Changes to *R*, when they occur by reception of information, are defined here to be the result of a causal process. Causality necessarily implies that the related effect happens after its cause. The Ontological Principle O2 leaves open the question whether the potential causal changes may or must be irreversible.

The Ontological Principle O2 unifies dynamic aspects of reality because information in a broad sense projected onto three primal components of reality – *physical reality, mental reality* and *structural reality* - amalgamates the conceptions of *information, physical energy* and *mental energy* with its special form, *psychic energy,* in one comprehensive concept.

Being extremely wide-ranging, this definition supplies meaning and explanation to the conjecture of von Weizsäcker that *energy might in the end turn out to be information*, as well as to the aphorism of Wheeler *It from Bit* and to the statement of Smolin that the three-dimensional energetic world is the flow of information.

Mental energy is considered as a mood, ability or willingness to engage in some mental work and is often related to the activation level of the mind. The concept stems from an "energy of the soul" introduced by Henry More in his 1642 *Psychodia platonica*.

Psychic energy has become an essential component of several psychological theories. At first, the concept of *psychic energy,* also called *psychological energy*, was developed in the field of psychodynamics by German scientist Ernst Wilhelm von Brücke (1819-1892). Then it was further developed by his student Sigmund Freud (1856-1939) in psychoanalysis. Next step in its development was done by his student Carl Gustav Jung (1875-1961).

Mental energy is innate for any mentality, while psychic energy is related only to the human psyche.

The next principle is

Ontological Principle O2g (the *Relativized Transformation Principle*). *Information* for a system *R relative to the infological system* IF(*R*) is a capacity to cause changes in the system IF(*R*).

The concept of infological system plays the role of a free parameter in the general theory of information, providing for representation of different kinds and types of information in this theory. That is why the concept of *infological system*, in general, should not be limited by boundaries of exact definitions. A free parameter must really be free. Identifying an infological system IF(*R*) of a system *R*, we can define different kinds and types of information.

Here are examples from popular information theories:

In Shannon's information theory (or more exactly, a theory of communication), information is treated as elimination of uncertainty, i.e., as a definite change in the knowledge system of the receptor of information. In the semantic information theory of Bar-Hillel and Carnap, information causes change in knowledge about the real state of a system under consideration. In algorithmic information theory, information about a constructive object, e.g., a string of symbols, is characterized by construction of this object, while information in one object about another one reflects changes in the systems of construction algorithms.

Taking a physical system *D* as the infological system and allow only for physical changes, we see that information with respect to *D* coincides with (physical) energy.

Taking a mental system *B* as the infological system and considering only mental changes, information with respect to *B* coincides with mental energy.

Taking a cognitive system *C* as the infological system and considering only structural changes, information with respect to *B* coincides with information *per se*.

As a model example of an infological system IF(*R*) of an intelligent system *R*, we take the system of knowledge of *R*. In cybernetics, it is called the *thesaurus* Th(*R*) of the system *R*. Another example of an infological system is the memory of a computer. Such a memory is a place in which data and programs are stored and is a complex system of diverse components and processes.

The concept of an infological system shows that not only living beings receive and process information. For instance, it is natural to treat the memory of a computer as an infological system. Then what changes this memory is information for the computer.

Ontological Principle O2a (the *Special Transformation Principle*). *Information in the strict sense* or *proper information* or, simply, *information* for a system *R*, is a capacity to change structural infological elements from an infological system IF(*R*) of the system *R*.

There is no exact definition of infological elements although there are various entities that are naturally considered as infological elements as they allow one to build theories of information that inherit conventional meanings of the word *information*. For instance, knowledge, data, images, algorithms, procedures, scenarios, ideas, values, goals, ideals, fantasies, abstractions, beliefs, and similar objects are standard examples of infological elements. Note that all these elements are

structures and not physical things. That is why, we use structural infological elements *per se* for identifying information in the strict sense.

This allows giving an esthetically eye-catching description of information:

Information is energy in the Platonic World of Ideas

Ontological Principle O2c (the *Cognitive Transformation Principle*). *Cognitive information* for a system *R*, is a capacity to cause changes in the cognitive infological system IFC(*R*) of the system *R*.

An infological system IF(*R*) of the system *R* is called *cognitive* if IF(*R*) contains (stores) elements or constituents of cognition, such as knowledge, data, ideas, fantasies, abstractions, beliefs, etc. A cognitive infological system of a system *R* is denoted by CIF(*R*) and is related to cognitive information.

After we outlined (defined) the concept *information*, let us consider how information exists in the physical world.

Ontological Principle O3 (the *Embodiment Principle*). For any portion of information *I*, there is always a *carrier C* of this portion of information for a system *R*.

The substance *C* that is a carrier of the portion of information *I* is called the *physical*, or *material*, *carrier* of *I*.

Ontological Principle O4 (the *Representability Principle*). For any portion of information *I*, there is always a *representation C* of this portion of information for a system *R*.

Ontological Principle O5 (the *Interaction Principle*). A transaction/transition/transmission of information goes on only in some interaction *of C* with *R*.

Ontological Principle O6 (the *Actuality Principle*). A system *R* accepts a portion of information *I* only if the transaction/transition/transmission causes corresponding transformations in *R*.

Ontological Principle O7 (the *Multiplicity Principle*). One and the same carrier *C* can contain different portions of information for one and the same system *R*.

Now we give a list of axiological principles.

Axiological Principle A1. A measure of information *I* for a system *R* is some measure of changes caused by *I* in *R* (for information in the strict sense, in IF(*R*)).

Note that it is possible to take the quantity of resources used for inflicting changes caused by information *I* in a system *R* as a measure of these changes and consequently, as a measure of information *I*.

Axiological Principle A2. One carrier *C* can contain different portions of information for a given system *R*.

Axiological Principle A3. According to time orientation, there are three types of measures of information: 1) potential or perspective; 2) existential or synchronic; 3) actual or retrospective.

Axiological Principle A4. According to the scale of measurement, there are two groups, each of which contains three types of measures of information: (1) qualitative measures, which are divided into descriptive, operational and representational measures, and (2) quantitative measures, which are divided into numerical, comparative and splitting measures.

Axiological Principle A5. According to spatial orientation, there are three types of measures of information: external, intermediate, and internal.

Axiological Principle A6. Information *I*, which is transmitted from a carrier *C* to a system *R*, depends on interaction between *C* and *R*.

Axiological Principle A7. Measure of information transmission from a carrier *C* to a system *R* reflects a relation (like ratio, difference etc.) between measures of information that is admitted by the system *R* in the process of transmission and information that is presented by *C* in the same process.

First, the general theory of information gives a flexible, efficient and all-encompassing definition of information. In contrast to other definitions and descriptions used before, this definition is parametric

allowing specification of information in general, as well as information in any domain of nature, society and technology.

Even more, the new definition taken in broad context make it possible to unite the conceptions of information, physical energy and psychic energy in one comprehensive concept. Being extremely wide-ranging, this definition supplies meaning and explanation to the conjecture of von Weizsäcker that *energy might in the end turn out to be information* as well as to the aphorism of Wheeler *It from Bit*.

This shows that the general theory of information provides means for a synthesis of physics, psychology and information science playing the role of a metatheory for these scientific areas.

At the same time, the new definition characterizes proper information when the general concept is specified by additional principles. The construction of an infological system allows researchers to exactly delineate information in the area of their studies.

Second, the general theory of information explains and makes available constructive tools for discerning information, measures of information, information representations and carriers of information. For instance, taking a letter written on a piece of paper, we see that the paper is the carrier of information, the text on it is the representation of the information contained in this text and it is possible to measure the quantity of this information using Shannon entropy or algorithmic complexity.

Third, the general theory of information provides efficient mathematical models. There are models of three types: information algebras, operator models based on functional analysis and operator models based on category theory. Functional representations of information dynamics preserve internal structures of information spaces associated with infological systems as their state or phase spaces. Categorical representations of information dynamics display external structures of information spaces associated with infological systems. Algebraic representations of information dynamics maintain intermediate structures of information spaces. These models allow researchers to discover intrinsic properties of information.

Fourth, the general theory of information supplies methodological and theoretical tools for the development of measurement and evaluation technologies in information studies and information technology. Moreover, any science needs theoretical and practical means for making grounded observations and measurements. Different researchers in information theory have developed many methods and measures. The most popular of them are Shannon's entropy and algorithmic complexity. The general theory of information unifies all these approaches opening new possibilities for building efficient methods and measures in areas where the currently used methods and measures are not applicable.

Fifth, the general theory of information offers organization and structuration of the system of all existing information theories.

However, it is important to understand that this unifying feature and all advantages of the general theory of information do not exclude necessity in special theories of information, which being more specific, can go deeper in their investigation of properties of information and information processes in various areas. For instance, syntactic information theories, such as Shannon's theory, are very useful in the area of communication. Algorithmic information theories, such as the theory of Kolmogorov complexity, are very useful in the area of automata, computation and algorithms. There are also semantic, pragmatic, economic, semiotic and other special information theories, each of which is directed at investigation of specific properties of information, information processes and systems.

Sixth, the general theory of information explicates the relevant relations between information, knowledge and data demonstrating that while knowledge and data are objects of the same type with knowledge being more advanced than data, information has a different type. These relations are expressed by the Knowledge-Information-Matter-Energy Square:

information is related to knowledge (data) as energy is related to matter

In particular, it is possible to transform knowledge or data into information as we can transform matter into energy.

Seventh, the general theory of information rigorously represents static, dynamic and functional aspects and features of information. These features are modeled and explored by algebraic, topological and analytical structures of operators in functional spaces and functors in the categorical setting forming information algebras, calculi and topological spaces.

Eighth, the general theory of information explicates and elucidates the role of information in nature, cognition, society and technology clarifying important ontological, epistemological and sociological issues. For instance, this theory explains why popular but not exact and sometimes incorrect publications contain more information for people in general than advanced scientific works with outstanding results.

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107 IEEE P7000 - The first global standard process for addressing ethical concerns in system design

Published

Sarah Spiekermann

[1] Vienna University of Economics and Business

This keynote will give an introduction to IEEE P7000, the first standard IEEE is ever going to publish on ethical issues in system design. As co-chair of IEEE P7000 I am going to inform the audience about what this standard will be all about. In a nutshell: engineers, technologists and other project stakeholders need a methodology for identifying, analyzing and reconciling ethical concerns of end users at the beginning of systems and software life cycles. The purpose of IEEE P7000 is to enable the pragmatic application of this type of Value-Based System Design methodology which demonstrates that conceptual analysis of values and an extensive feasibility analysis can help to refine ethical system requirements in systems and software life cycles. It will provide engineers and technologists with an implementable process aligning innovation management processes, IS system design approaches and software engineering methods to minimize ethical risk for their organizations, stakeholders and end users. In the course of the keynote I will also show how relevant values and system design ideas can be gained from using utilitarianism, deontological ethics and virtue ethics.

108 PHYSICAL UNCOMPUTABILITY

Published

JACK COPELAND

[1] University of Canterbury, New Zealand

The Physical Computability Thesis (PCT) states that the physical world is computable. Sometimes it is argued that a well-evidenced logical principle, the Church-Turing Thesis, entails PCT. But this reasoning is faulty. I argue that it is an open question whether PCT is true: even if the universe is finite, physics may turn out to confound PCT. What would a non-computable physics look like, and what would be the implications for scientists and engineers? I review potential countermodels to various formulations of PCT.

109 The biosemiotic emergence of referential information

Published

Terrence W Deacon

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Although molecules like DNA can be analyzed in terms of their intrinsic information content on the basis of their structural complexity, it is their role in regulating cell metabolism and preserving genetic inheritance that is central. It is a basic tenet of cellular molecular biology that the sequence of

nucleotides in a DNA polymer provides information contributing to the structure of proteins and their metabolic interactions and that DNA replication preserves and transmits this information across organism generations. In this respect one can describe DNA structures as being "about" protein structures and indirectly about cell function with respect to a probable environment. It is not merely that we as observers have made this referential assessment. It is intrinsic to cell function and evolution. But there is nothing intrinsic to nucleic acid polymers that makes them intrinsically referential. How a molecule like DNA or RNA could have acquired this property of being "about" other molecules and their interrelationships remains mysterious.

In this presentation I will describe a molecular thought experiment that demonstrates how dynamical constraints embodied in a simple molecular system can become spontaneously offloaded onto a molecule's structural constraints such that this structure separately preserves and re-presents the dynamical constraints that are critical for reconstituting the containing molecular system should it become disrupted. Three variants on this model system provide unambiguous examples of three canonical referential relationships that roughly correspond to iconic, indexical, and symbolic referential relationships.

This analysis can help to formalize the relationship between physical-chemical, informational, and semiotic theories of life, as well as provide clues to the origin and nature of molecular genetic information.

110 The Digital Revolution

Published

Bo Dahlbom

[1] University of Gothenburg

Digital technology is changing society and industry, but how big is the change and how fast will it come? Can we speak of a digital revolution comparable to the industrial revolution? Does it make sense to speak of data as the new oil? Will av world with Internet of Things, Artificial Intelligence and Big Data be so different as to warrant the talk of a digital revolution? What are the important challenges facing us, and how do we make the most of the new technologies?

111 Why robots must have synthetic emotions? The role of emotions in the artificial cognitive systems

Published

Jordi Vallverdu

[1] Universitat Autònoma de Barcelona

Not only we are attending to the exponential implementation of robotic platforms into several fields but also has arisen a public debate about the several challenges of this robot revolution. Among the long list of possible debates, there is one especially important: do must robots have emotions? Beyond the classic approaches related to affective computing which help to design better Human-Robot Interactions (henceforth, HRI), the presence of emotions into robotic systems is considered in a new light. Taking into consideration artificial cognitive architectures, should emotions, or a kind of

synthetic emotions, be a fundamental part of these machines? We know that emotional values and mechanisms determine and shape the whole experience and rationing human processes, and it could affect/help/modify robotic ones. From an individual or a social perspective, the emotional skills of our robots can define a new scenario for the HRI processes as well as for the internal robotic revolution.
From three different perspectives and disciplines, Anthropoogy, Engineering and Cognitive Philosophy, we will discuss these ideas in more detail, thanks to the collaborations of Lola Cañamero (University of Hertfordshire, UK), Rodolphe Gelin (Softbankrobotics, France), and Kathleen Richardson (De Montfort University, Leicester, UK).

112 Benjamin and the plague of post-truth

Abstract pending approval

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Abstract
We will focus our attention here over some ethical relations between information, truth and freedom. From the start, we know that it is not easy to define truth and freedom; on the other hand, it is not difficult to establish what they are not: lie and oppression. Fascism is an extreme example of what truth and freedom can never be. We articulate Benjamin's concept of history, Camus' metaphor of the plague and the Thomist concept of truth to better criticize the phenomenon of post-truth, perhaps a rebirth of fascist information practices.

Extended abstract
Veritas est adaequatio rei et intellectus
(Thomas Aquinas)

In his 1940 essay *On the Concept of History,* Walter Benjamin states: "The tradition of the oppressed teaches us that the 'emergency situation' in which we live is the rule […] We must arrive at a concept of history which corresponds to this […] and our position in the struggle against Fascism will thereby improve.[i]
In a letter (1955) to Roland Barthes, Albert Camus defended his romance *La Peste* against the accusation of the former that it was "dehors de l'histoire".[ii] Camus answered that *La Peste* was not only about the recent historical phenomenon of Fascism, but about the permanent historical risk of its rebirth, that should lead us to be aware. In this sense, *La Peste* reminds us that Fascism was not destroyed forever; it could rebirth, as the bacillus of the plague, because its inner evil potency was not destroyed once, and for all, if it ever could be, despite its provisory defeat in 1945.
Fascism was then the most recent extreme expression of the plague of oppression, an "emergency situation" about which "the tradition of the oppressed teaches us that [...] is the rule."
We will now confront Benjamin's concept of history, Camus' metaphor of the plague and the Thomist concept of truth with the notion of post-truth.

Our approach of Information Ethics relates it with the studies about the epistemological and political dimensions of information. Truth is an object of Information Ethics, if we only consider that the deliberate diffusion of false information is generally unethical. Truth is also an object of the studies about the epistemological dimensions of information, if we understand epistemology as a systematic reflection that aims to distinguish objective, realistic, rational knowledge, scientific or not, from

irrational opinions and beliefs. Finally, truth (whatever it is), opinions and beliefs, are expressions and instruments, often the apparent causes, of social disputes, and here lies their most evident political dimension.

If epistemology deals with true and false knowledge, politics deals with freedom and oppression, because all social power relations are, at the end, about freedom and oppression. We know that is not easy to define truth and freedom, but it is not too hard to state what they could never be: lie and oppression. Fascism is a good example of what truth and freedom can never be.

The rude and famous statement of Goebbels, that a lie, repeated many times, becomes true, expresses the core of the information ethical, epistemological and political problem of Fascism. A lie that becomes true in public opinion is ideology, in the bad sense of the word, as a false consciousness that rationalizes and legitimates human oppression; at its limits, as in the nazi case, but not only in this case, it legitimates even civilians physical elimination in terrifying big numbers, directly or not.

We propose that *post-truth*, the Oxford Dictionaries 2016th Word of the Year, should be thought through this lengths.[iii] Doing so leads us to rescue the Thomist notion of truth as the correspondence of things and understanding: *Veritas est adaequatio rei et intellectus* (we ad: information is what mediates truth and understanding).

It is useless to spend much time here discussing the limits of the Thomist definition of truth, if we only keep in mind the linguistic turn in 20th century philosophy over the performing, expressive, constitutive relations between language and any conceivable understanding of reality, even in a simplistic approach. We know now that language – and information, as activated language, as the actualization of its potency, as its materiality, as its medium – is not only referential, is not only an instrument of practical communication; it structures our sense of reality, even our unconscious.

For these reasons, we do not advocate that the old Thomist definition can solve the fundamental philosophic question of truth. We only argue that there is some truth in it. If we articulate this idea with Marx's notion of class struggle – the struggle for or against oppression – as the main drive of social history, then it gets closer to Benjamin's ethical, epistemological and political understanding of what history should be. For Benjamin, history must be a committed narrative of the factual events and effective reasons that disclose the fights for or against oppression, a discursive weapon for freedom.

The philosophy of the subject, from Descartes' *cogito* to Kant, replaced the traditional metaphysical ontological question about what is real with the epistemological problem about what we can know as the main problem of modern philosophy. This philosophy of the subject became hegemonic in academic philosophy since then,[iv] until the linguistic turn. Nevertheless, neither of them solved the ontological question.

We suggest that reminding the question about *what reality is* – of course without the pretension to solve it once, and for all –, articulated with the Thomist notion of truth as *adeaquatio rei et intellectus*, with Benjamin's Marxian conception of history and with Camus's metaphorical criticism on Fascism as a plague, is nowadays strategic, in ethical and political terms, if not in epistemological ones. Because, if all narratives have the equal right to establish the truth of social reality, if communication is only a performative game of information, no matter how it is determined by the social powers that structures its field, devices and tacit rules, we are weak in the fight against the rebirth of Fascism. Then, media and digital post-truth, the new powerful Goebbels (and their class allies), with their newspapers, television channels, algorithms, digital surveillance devices and bots, will win the discursive battle, and not only this one. It is a very serious information ethical challenge.

The bacillus of the fascist plague is nowadays rebirthing. It is growing, even in the most unexpected corners of "civilization", through unmeasurable forms and ways, mainly digital ways, repeating lies and false referential information that support the increasingly entropic capitalist reification processes in course, as forged beliefs, and sometime blind faith. From the concentration of fortunes – up to a point that few individuals own the same as billions of others – to the tragedy of war refugees, Trump's

marketing strategies to win US elections and the recent soft coup d'État in Brazil. The latter, we would like to register here, is destroying many important social conquests of the last decade – end of hunger, entrance of black men and women in universities etc. – and even of the last 70 years (workers' rights).

Fascism as a plague, taken in a metaphorical wide sense, as ultraviolence, irrationality, particularism, oppression, brutal extermination of human beings, stupid beliefs, always existed, everywhere. The most part of the poor of the world, as Benjamin denounced, always lived under an "emergency situation", under violence and abuse, but the modern hopes of western civilization to surpass evolutionarily this entropic power are perhaps weaker than ever in the last centuries.

Certainly all cultures, with their particular historical worldviews, faced and still face, expressed and still express, performed and still perform, discursively and extra discursively, the drama of good and evil, pleasure and pain, freedom and oppression, truth and lie, with all its gradient, complexity and contradictions. Our historical perspective, nevertheless, allows us to see or at least to glimpse the whole drama in a wider totalizing perspective and with an urgent commitment, because we are living in the void of any reasonable strategy or hope to surpass capitalist entropic developments, with their corollary of ultraviolence and mystification. We must not feel any longer satisfied with 1970's post-modern hipster perspective of the negation of the "grands narratives". The necessary criticism of them should not lead us towards a total refusal. On the contrary, we need, more than ever, new emancipatory and convincing "grands narratives". We need to enrich them with all kinds of particular cultural mediations, but we must also articulate these particular mediations in new emancipatory global programs.

Perhaps the main ethical contradiction of nowadays, in the information field, is the stand of post-truth, in all its bizarre varieties, as fragmentary expressions of ideology, as rationalizations of the multiple contemporary forms of belief and faith that support capitalism as a system with no way out. This problem and the ethical theorizations that ignore or avoid him are symptoms of the rebirth of the bacillus of the fascist plague.

For those among us who do not believe in mysticism, do we have any realistic, rational hope, pointing to a better future for humanity, even to reduce the calamities in course? The fact that calamities are the rule, as Benjamin remembers in other words, does not free each generation from its particular accountability.

The lack of any rational, realistic hope or strategy towards a common better life among human beings and the planet is a symptom of the rebirth of the plague. We should focus our praxis on this point. The celebrity of the notion of post-truth alerts us that the repetition of lies – bad information, dangerous beliefs ignoring widely even the most obvious references – went too far.

Conflicts of Interest: "The authors declare no conflict of interest." "The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results".

[i] Available online: https://www.marxists.org/reference/archive/benjamin/1940/history.htm (accessed on 19 May 2017).

[ii] Available online: https://etlettera.wordpress.com/2015/01/15/1s-es-l-lettre-dalbert-camus-a-roland-barthes-sur-la-peste-janvier-1955 (accessed on 19 May 2017).

[iii] Post-truth is "an adjective defined as 'relating to or denoting circumstances in which objective facts are less influential in shaping public opinion than appeals to emotion and personal belief'." Available online: https://en.oxforddictionaries.com/word-of-the-year/word-of-the-year-2016 (accessed on 19 May 2017).

[iv] See Ilyenkov, Evald. *Dialectical Logic*. Available online: https://www.marxists.org/archive/ilyenkov/works/essays/ (accessed on 19 May 2017).

113 Phenomenological conception of being and its meaning in understanding human beings in the digital age.

Abstract pending approval

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In Western societies, the rapid development of new information and communication technologies (ICT) and globalization has changed the ways of living and also working during the past decades. The post-industrial era has created new challenges to the society, as less and less work is conducted in a traditional manner. [1-3.] The development has led to the rise of knowledge-based economies, where information and knowledge are both the input and the outcome of the work [4, 5]. In my previous studies, I have examined how to understand and study human beings and interaction especially in the work life [6-10].

In my research, I have proposed an alternative way to conceptualize and examine human beings and being, based on hermeneutic phenomenology of Hans-Georg Gadamer [11-14] and Martin Heidegger [15]. The phenomenological conception of the human being differs substantially from the subject presumed in views, which reflects more cognitive or socio-cognitive views of a human being, whose mind and body are separate [see e.g. 16, 17]. A key aspect in the hermeneutic phenomenology of Heidegger is understanding the temporality of being, as the past, present, and future are continuously present: *"In the metaphysical tradition stemming from Plato and Aristotle, Being has been understood as presence (Anwesenheit, which contains the word 'Wesen' which means 'essence', the Greek ousia), understood as static permanence. Heidegger, on the other hand, sees human existence as essentially taking place in time, spread out between past and future and radically limited by death. Being must be understood in terms of time."* [18] (pp. 246–247.) The phenomenological view based on this notion provides a consistent basis for understanding human being and their actions, including the interpersonal relations and the context. This is possible, because the phenomenological approach inseparably connects the creator to the context and concentrates on human beings experiencing and living their lives. I aim at examining and the meaning of this kind of an approach in the world developing new digital means and services, which may also question the anthropocentric view of the world.

The development of sustainable conditions for working in the digital age is an important question, and worth discussing further. The understanding of being based on hermeneutic phenomenology offers also means to discuss the questions of information ethics more broadly. Currently, I investigate knowledge-creating interaction in the research and development project *Cloud Computing as an Enabler of Large Scale Variable Distributed Energy Solutions* (BCDC Energy), which aims at introducing a new type of a digital marketplace for clean energy trading in Finland (see www.bcdcenergy.engl). That project is funded by the Strategic Research Council of Finland, and its aim is also to provide new knowledge to the decision-makers in collaboration with the public sector. BCDC Energy consists of five research groups from the fields of Energy Economics, Computer Science and Engineering, Information Systems Sciences, Meteorology, and Information Studies. In addition, the project has strategic partners and an Advisory Board, consisting of private firms. [19.] This context provides views on discussions in the themes concerning information ethics and sustainable digital solutions, as the project aims at developing human beings' understanding of their own capacities to act both as consumers and producers of energy in the digital markets.

My approach relates to the research which pursues alternatives to the more cognitive approaches by acknowledging the interactive nature of human information behavior. Moreover, I strive to provide

alternatives for socio-cognitive approaches, which are still attached to the idea of human beings being separable from the context [20].

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The Future of Work

Published

Bo Dahlbom

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It all started with a short report by Oxford-researchers Carl Frey and Michael Osborne (2013), "The future of employment: How susceptible are jobs to computerisation?" which was interpreted to say that in the next 20 years half of all current jobs will disappear. There will be massive unemployment and societies will have to introduce "universal basic income" and prepare for a world with increasing divisions and social conflicts between elites and unemployed masses. In this debate we will look closer at the arguments for this bleak future, ask us what science can tell us about the future, consider different scenarios for the future of work, and maybe even question the importance of work.
The topic is difficult and complex but fortunately we have secured a panel with exceptional competence – the panel is all of you. We will use digital technology to organize a crowd based debate, a "crowdbate", and use the intelligence of the crowd to throw fresh light on the future of work.

114 Information and Meaning in Deterministic Chaos: A Blochian Perspective

Published

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Recently, in his 2012 PhD thesis, Craig Hammond has given interesting insight into a possible relationship of Ernst Bloch's philosophy of the utopian shining forth of future projects on the one hand and the modern theory of deterministic chaos and fractal geometry on the other.[1] Concentrating in particular onto the Blochian concept of the Lived Moment, the emergence of information and meaning is discussed within this context. The idea is to find an onto-epistemic basis for the foundation of human reflexion centred on both rational and irrational discourse strategies within the objective as well as subjective frameworks of given world-views.

[1] Towards a neo-Blochian theory of complexity, hope, and cinematic utopia. Lancaster University.

115 Interactive Matter: The Free Flow of Information, and the shift of moral and ethical responsibility in the future digital world society

Published

David Simon-Vermot[1], Nikunja Ebner[2]

[1] University of Basel
[2] Nikunja Art Studio

Internet Dataflow, exchange of information in the digital but also in the analog biological world is the crucial and central element, developed in the evolution of nature, bringing about the "digital society". Yet the question arises, how this new form of society will look like: Within the current discourses concerning digital development also critical notions regarding a "digital society" are articulated, as among others by Jaron Lanier, one of the pioneers of the internet.
Fundamentally the understanding has to grow, that intelligence and its evolution is a natural process, linked to the "evolutionary impulses of nature" and thus not standing above the natural laws: All development in nature holds an organic element of non-control and openness towards the system created, a kind of "self-destructive" element, which allows on one hand evolution (see also: emergency theory) and on the other hand the possibility of extinction of those branches of nature's organic development that become futile.
"Any order is ultimately in interaction with chaos and only thus evolving. Otherwise it is extinct" (nikunja).
Thus the question of how the future society deals with the digital intelligence, which enables technological developments, but also the cultural and spiritual evolution of mankind as such, is directly linked to the question, how and by what authorities the flow of digital information is being *generated, sustained, guaranteed and controlled*. This question is so important, that it may decide on the future of humanity: If new societal developments and a collective evolution takes place or if this branch of the "evolution of nature" fails and thus will be extinct.
According to the theory and principles of *Interactive Matter*, a new perception of matter, the universe and evolution as such would dawn: Evolution and natural process do not happen on a linear time-line but in a multi-field phenomenological environment, which moves away from an assembly/combination of positions and values, to an understanding and application of transposition and *Interactive Matter*, as a *trans-physical, trans-social and trans-medial reality*.
On Interactive Matter

Interactivity usually is defined by an effect, or the succession of effects. They are perceived binary, linear and on one timeline. In the course of the last 20 years Swiss--French Artist Nikunja developed the artistic and philosophic concept of *Interactive Matter* as a fundament for artistic, natural and spiritual evolution and relates to the comprehension of interaction as matter to be creatively formulated and experienced. *Interactive Matter* is perceived as a multilayered dynamic field environment in a static condition of time and volume between zero and infinite, simultaneously macro-- and micro--cosmic. Nikunja's artwork allows the direct experience of *Interactive Matter* as spreading between analog and digital reality.
Interactive Matter is the totality of tension, space, rejection, and attraction emerging in the present between two or multiple objects, subjects, materials, ideas, causalities, histories, media, universes, worlds, personalities, etc. on a physical, psychological and spiritual level.

On History as read Evolution

The illusionary perception of "history" as evolution on a linear timeline, with the idea of a "travel" from worse to better, from primitive to complex, as the ideal of civilisatory and biological evolution, principally comes from the scientific practice, that one conclusion leads to another and thus one may read into that an evolutionary logical development; only nature and the universe do not fully correspond to the human mind and its analytical logic, which in its simplicity can only exist by excluding options "beyond the module of the applied system/discipline". This does not mean, that the analytical instrument and mindset is to be neglected: Linear History as a concept and as a tool to approach complex developments is indeed helpful - but is frequently being misused to determine and defend established power structures and their social applications. Yet at the same time, the post-modern notion of a fragmented history also reinforces the acceptance of the status-quo, as this fundamental distrust in the idea of societal progress tends to generate a passive – often resignative – attitude.[1]

As such History can be – and often is – either a tool of utter conservatism or one of passive acceptance – and is thus irrelevant for the readability of evolution of humankind, the universe or any organism or event in biology, sociology, philosophy, art and science, as long as it is understood as a *static and authoritative concept*.

Evolution in digital society

To allow evolution in a digital society, the flow and generation of information needs a space of no-control, a principle of freedom, "Split Authority" (nikunja) and "Autonome Zone"[2] which allows the continuous evolution of the system. As hackers evolved from a menace to the system to the guarantees of its security and development, society as such needs to accept the strange, foreign, even the self-destructive as an evolutive element: Not only in its analog but also in its digital systems. This politics of the "Opened Circle" is a necessary element for evolution and survival, as can teach us the practices and conditions in the original African societies at the origin of manhood and its philosophy of UBUNTU (means kindness):

"Utmost respect had to be given to the stranger, visiting the community, since (s)he will allow us to adapt to unknown condition and thus allow survival! " (ubuntu)

If, on the contrary, the fear of this political, social and cultural application leads to the desire of "total control" of the flow and the generation of information, a "repressive, fascist, Oedipus Rex – system" (nikunja) will be established, making any evolution, may it be digital or analog, impossible: As in nature, the continuous degeneration by the procreation inside of the same family leads to failure, destruction and extinction.

A possible key to the necessary evolution away from such stagnating and oppressive concepts (the present states of capitalism, democracies, the concept of nations - all at their beginning also positive concepts) may be seen in the awareness and consciousness of *Interactive Matter*, where the free-flow of information beyond a dominating ruling authority implies a shift of the *guaranteeing authority* of the moral and ethical values in society: Whereas so far, historically and politically, fundamental moral, ethical and spiritual values had been necessarily guaranteed by a *ruling authority* from the chief and shaman in tribal and clan organized societies up to the disastrous implication of "ideals" by ideological fascist and communist systems, religious organizations, racist states and ideologies, etc. in the 20th Century with its devastating wars and millions of deaths, clearly demonstrating the complete failure of these systems as such for any longer evolution, now this guaranteeing authority and thus responsibility is clearly shifting in the democratic societies to *the subjective environment and awareness of the individual*.

To allow this necessary evolution of freedom and moral responsibility in the individual, humankind needs to take the chance to *free the flow and exchange of information from economical and political power interest*, renew the democratic system away from a party-system, and determine a form of general distribution of the generated fortune (for example the worldwide universal income for any

human being, a true task for a real *social world bank* as mere distributor), for otherwise the generation of fortune by the colonization and theft of intelligence by non-and trans-governmental bodies will lead to the above described disaster of the "Closed Circle".
The concept of *Interactive Matter* as a concept of *social awareness* and of *trans-personality* by *the digital as expanded analogon* provides the possibility to enlarge the understanding of democracy and develop new political and electoral processes.
Thus the vision for the "future digital society" is *the trans-national one world society*, transcending finally the disastrous effects of the post-colonial periods, born from aristocratic greed's and still continued by the greed of the contemporary monetary aristocracy, misusing the systems of nation and currency and hindering a healthy creative progressive evolution.
Governments would be mere bodies of community services and not generative bodies of power, ideology and fortune.
Will it be paradise? No, but this situation will allow finally humanity and the individual human being to grow into a constant creative body and spiritual transcendence beyond firm systems, allowing constant evolution of human intelligence, technology and physical matter, may it be generated by digital or analog means.

[1] In relation to postmodernism see: Liberal Democracy as the End of History, Fukuyama and Postmodern Challenges, Christopher Hughes, New York: Routledge, 2012. [2] TAZ – Ontological Anarchy, Poetic Terrorism, Hakim Bey, Brooklyn: Autonomedia, 2003 (1985). S.95.

116 The Return of Metaphysics in the Theory of Subjective Pregnances

Published

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In his work on what he called "Semiophysics" at the time (1988), René Thom introduced the cognitive viewpoint into physics by trying to develop a science of meaning on the line of his "catastrophe theory" which was essentially a theory of physical morphogenesis. The basic intention was to reconcile modern mathematics and physics with the traditional conception of natural philosophy. The recent developments in quantum physics and their philosophical interpretations lead back to this basic idea. It is thus shown how the formalized language of mathematics cannot only be combined with spatio-temporal aspects of the physical world, but can also serve the definitory precision of concepts such as matter and information, respectively.

117 Information as a construct

Published

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Information is an answer to a question of some kind. That reflects the fact that to be aware of an information one has to be prepared for its acceptance. The acceptance of an information is not a trivial act, it is the result of a conflict in which an individual meets the world. It is the process of coming to terms with the brute world.
First comes the wish that something be such and such, then recognition of the different state of affairs in reality which has to be changed and finally reconciliation with some unchangeable facts. The distinction between the wish, the fact that has to be changed and the unchangeable fact is not stable. It often depends on one's power, perspective and presuppositions that are however necessary as they reflect involvement and interest in the world. The development of modern science, which breaks our common understanding and shows that the everyday world as we normally understand it can look like very differently, is just one example. However, science always thinks it has come to a final true description of the world and doesn't concede how relative its stance can be. As an argument in the support of the constructivist claim in science we can state the Kuhn's conception of scientific revolutions, Duhem Quine thesis or Wittgenstein's rule following theory which all stress the importance of background assumptions.
In human history various theories have been developed that claim to have found a universally valid differentiation of these three principles or at least they show limits to them. Man's wishes are limited because e.g. of his nature, what can be changed is limited by the rules governing the world and some stable parts of the world can't be changed at all. That division can have power consequences. Thinking is always related to power. Understanding and expressing something as unchangeable means the person doesn't have power to change it and doesn't even try. Defining something as something implies that other objects don't belong into this category and must be treated differently.
We can also express the problem of conforming to the powerful prevailing limits and fighting with the world as differentiation between identity and non-identity. Identity means accepting the state of affairs, non-identity fighting against it. In the communication theory there are two concepts of information communication. There is the transmission model of communication and the constructionist model of communication. In the transmission model information is sent from a sender to a receiver. This theory views communication including information recognition as a means for sending and receiving information. The proponents of the other model claim that meaning is reflexively constructed, maintained and negotiated in the process of communication. Communication is in their opinion a social practice that transforms the communicators, their identities, reality framings etc. This is close to Bateson's concept of information as difference that makes a difference.
Realizing the limits and obstacles refers to a sort of compliance with the world. However, it is just the first step of the liberation and emancipation process which can't lead to a full emancipation, but to the formation of a new conditional meaning.
Information technologies allow easy distribution and communication of information. One of the expected advantages of this situation was the constraint of bureaucracy necessary for the governing of the state. However the expectations have not been fulfilled and we are facing more bureaucratic practices in the support of security, fair treatment etc. that lead to increased emphasis on conformation.

The easy availability of information was intended to free man from his limited perspective, but man hasn't used the chance yet and spends his time searching unimportant amusing content.
Information should originally have informed us about the world, but we rather use it to leave the world and spend our lives in virtual environments.
Information should have explained the world, but now causes its intransparency as the world is very complicated and complex. That is different to non-identity mentioned above. The intransparency means that man is deprived of his contact with the world as he can't influence anything and becomes passive.

118 On a Higher Dimensional Convergence of System Theory and Transcendence in the Digital Realms

Published

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In order to think of DIGITALISATION FOR A SUSTAINABLE SOCIETY this contribution examines the sources of system theory and digital technologies by tracing them back to foundational principles of civilizations, their constitutional societal orders and belief systems:
Large-scale social changes followed from the adoption of new media such as the establishment of digital technologies and the introduction of new branches of science such as system theory. Both may be regarded from a media theoretical meta-assumption of a closed system which acts on an equilibrium of thoughts and concepts with a distinguished rule: whenever one element vanishes from certain cultural emanations, it pops up in another branch of civilization (arts - sciences - technology - religion).
The present article /talk shall reflect perceptual circumstances, cognitive rearrangements and knowledge transfer which lead to a) system-theory and the aim for a "logico-mathematical science of wholeness" as claimed by the theoretical biologist Ludwig von Bertalanffy (1901–1972) who introduced "general system theory" (GST) and b) the invention of the world wide web (www) as a parallel establishment of a virtual whole, the digital copy of the real world.
RELIGION and TECHNOLOGY are two aspects of a magic position, a couple which always appears together. In this dual regard geometry features on the one side "a world-creation-technology and on the other side as sacred expression of the „holy whole". Neolithic figures and patterns of transcendence in medieval mosques and architectural elements of gothic cathedrals are most evidently witnessing this double feature.
Thus geometries provide tools for modeling the world; cf. Bertalanffy's follower, the designer Buckminster Fuller (1895 -1983) called his strategy to reveal „Nature's Coordinate System" Synergetics. Bertalanffy himself recognized the need for a „gebilde" to think about relations in complex systems. He defined the principle of the organized system as an "open system" and introduced the notion of "flux equilibrium" which may be compared with the concept of fluxus by astronomer Johannes Kepler (1571-1630). This geometrical concept concludes the intention of the creational principle, not as arbitrary motion, but creational motion which is the underlying principle of emergence. For this description prior to the development of digital graphics no descriptive geometry was available. Here we assume that also the introduction of system theory may be seen in connexion with the lack of suitable geometrical objects for modeling complex systems, due to the development of higher mathematics, carried out with focus on abstract, logical inquiries of geometry, whereas the training of the appropriate outlook has been neglected. Geometry as original tool for reasoning

about ontologic positioning which enables logic compositions of relations for investigations on phenomena in nature became more and more obsolete since it was replaced by purely abstract algebraic geometry. Here it will be argued that the „useless" abstract geometry was replaced by different kinds of reasoning such as gestalt-theory and system-theory.— How are they related and where is the dual of magic position identifiable?
The magic position pair aspect includes also to think of mythological and metaphysical aspects connected with the technological functions of the internet. Here a brief revision of the contemporary realization of the ancient Greek Deus ex Machina shall be given in regard to different religious belief systems including particular dreams of mankind previously attributed to the gods, - such as „ubiquitousness", the „eternal life" and „the all-seeing-eye".
Finally the newly developed digital 3D animated geometry based on the Penrose Pattern as 2D slice of the 5-dimensional space - which Henri Poincaré considered as appropriate for Group Theory - shall be presented as depiction system of dynamic relations and interference in motion up to higher orders. This complex interacting digital geometry model of higher dimensional spaces which works like a a machine matches Poincaré's model of the universe and reconnects with the previously generally admitted idea of the all permeating quintessence. Here it shall be proposed for applications to visualize complex systems.

119 Stonier´s definition for kinetic and structural information revised

Published

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When viewing differences that make differences from an evolutionary perspective, information is not just communication. When one has won the fight with the many different definitions of entropy and finally understood that what corresponds to information of communication theory is best viewed as a tendency for equilibrium distribution functions in matter, one knows only a half. Knowing that Shannon´s formula relates a distribution function between set elements to the amount of decision-events necessary helps, but questions remain. What influences this amount? If the set evolved, how could decision-events not follow the tendency to equalize obeying the maximization of statistical entropy? How could relations stabilize? The set´s information is a non-equilibrium distribution´s cause. In physics, if some properties which deviate from equilibrium depend on spatial configuration, such properties are said to be in a field; and they represent a potential energy if they provoke forces in interactions. Stonier thought that the cause of non-equilibrium distribution functions in stable configurations and material structures is only one kind of in-forming influence; and that it is inherent in the structure. He called it *structural information* and discerned it from what he called *kinetic information*. This is the other cause of non-equilibrium distributions and it names the externally introduced information which leads to a non-stable situation triggering work to be done. This is what makes Stonier´s definition of information difficult to grasp: Energy which is physically potential energy, as it is stable inside a certain conformation, is stable because of structural information; and it is converted over several steps of non-stable states back into energy which can´t do any work. The state stabilized by structural information became in-stable because kinetic information was added. This sounds unfamiliar.

But one has to consider the context before contradicting. Stonier chose the example of a steam engine for the process described above. In this context, the idea that information is needed to *directedly* destabilize makes more sense: The machine has a characteristic structure which exists due to a stable configuration which can be trailed until one arrives at the atom and molecule relationships inside its crystal lattice micro structure. The structural information of the machine enables it to provoke an instable situation which will produce work; i.e. it enables it to introduce kinetic information into the gas-boiler-piston-part of its structure. Not all of its structural information is needed to introduce the kinetic information needed to provoke the non-equilibrium situation for work production. Some of the structural information serves other functionalities like holding the gas inside the system or other forms of self-maintenance. On the one hand this distinction Stonier made sounds quite plausible. Information changes organization and thermodynamic improbability affords information. Provoking a non-equilibrium situation which leads to the production of work -which is an organized process in Stonier´s terms-, therefore demands for information. What provokes the change to non-equilibrium in the steam engine is externally introduced information which directly causes the production of work. Is it really plausible? What discerns the inducer of non-equilibrium from the keeper of stability inside the machine´s molecular structure?
The stabilizing non-equilibrium inside the crystal lattice micro structure is kept for a long time and at constant energy by structural information. The work-producing non-equilibrium between itself as a whole and its colder environment is not maintained for a long time; and it will result in a heat flow to the surroundings which involves a change in energy. Nevertheless the structural setup of the machine´s material as well as the setup of all parts of it viewed in relation to its surroundings both have to be interpreted as distribution functions between particles. The fact that the semi stable state of "machine in temperature gradient to external particles" produces work during restructuring does not change the type of information compared to the stable state "the metal atoms inside the micro-structure crystal lattice keep the set of relations which produce the macrostate of the steam machine". Both states are dependent on temporally invariant relations between particles. So what enables the steam machine to produce work? It is its structural information, the structural information which this generates inside a reference frame which includes the machine as well as its surroundings and a trigger to generate the "needed" change to the structural information. The fact that the trigger can change the state of the system and some of its structural information does not turn the trigger itself into information, at least not in the way Stonier claims for this example. The capacity to trigger the production of work does not make the information kinetic. It still is a form of Stonier´s structural information and a change to structural information, what a heating fire causes in the steam machine. The fact that one of the information types – the "keeper" is acting on a long-term scale while the other type "the inducer" is acting comparatively short until the production of work is the only means to return to a stable state. But mathematically different scales for one and the same quantity do not justify a differentiation.
Our approach is a bit different: Structural information needs to define invariance in relations between particulate objects and the invariance is not due to a thermodynamic equilibrium situation. Thereby the duration of the deviation from thermodynamic equilibrium plays no role. Neither does the fact whether work is going to be produced or not. Information is a quality with some kind of store and it influences selective processes respectively processes comprising decision-events leading to relations. Therefore it has to play a major role in all evolutionary processes, not just in biologic evolution. We agree with Stonier that evolutionary systems can only be understood when two classes of stores or sources for in-formation of relations are considered. Where we do not fully agree with Stonier is regarding his definition for kinetic information. It is right that some structures allow the direct production of non-equilibrium states due to characteristic relations between particles carrying characteristic properties, while other structures contribute nothing to slow down the process of establishing thermodynamic equilibrium. But in both cases the information defines spatial relationships and is not directly dependent of time. More than that, inside stable structures time

could seem to stand still, since energy as well as observable form is conserved. A second type of information, non-structural information would need to carry a kind of temporal non-equilibrium, a pattern of change in time. Let us once more look at Stonier´s steam engine example: Which selective influence that induces time dependent changes and which defines the serial sequence of events could play a role as an inducer of the process of reorganization? Could this influence be stored in some medium? It might be difficult first, to compel one's mind to think in that way. Humans are used to think focused on material and structural aspects. In the steam machine example (aside from structural information) it is the fire which triggers thermal non-equilibrium with the machine´s surroundings. Could a fire give any information? It could transfer heat. Heat introduced into a stable organized structure disorganizes that structure. But as Lambert showed, organization itself is a subjective term; what matters physically is the distribution between different energy levels. As broader the distribution curve, i.e. the more randomly the energy is distributed between available levels, the larger the entropy. Therefore the fire introduces a change in the distribution function, the distribution function of kinetic energies. But wait. It introduces a change of kinetic energies? Here is a connection with changing time, since kinetic energy implies changing velocities. Fire denotes a set of electromagnetic wave functions with different frequencies and characteristic observable properties considering e.g. the capacity to trigger chemical reactions etc. Viewed as single temporally stable units, fire´s electromagnetic radiation waves of different frequencies are characterized by distinctive temporal patterns. Let us consider another example, where the influence of temporal patterns causes changes in material structures exactly because of its pattern´s characteristic sequence of events in time: Inside a human ear, there exist structures which – due to their structural information – possess a strong sensitivity for sound waves of a certain spectrum. When gas molecules which carry a distinctive temporal pattern (sequence) of dense and less dense regions arrive inside the human ear, their information can be recognized as a signal, as music, as speech etc. Here intuitively the term information is justified. What is the difference to the fire inside the steam engine? The temporal pattern is organized. But what does this mean? The human ear can also register a beat of random superposed frequencies and distinguish it as noise. Noise is no information? This is common consensus, but is it justified? Isn´t this distinction between the kinetic information which defines an organized music and the randomly combined wave functions which define the noise again a subjective judgment which has no relevance for physical general effectiveness? I will discuss this question in my talk and present an approach to define structural and kinetic information in a way that a framework to study the evolution of information processing systems can be established.

120 Mediatized Capitalism: searching for the individual's algorithmical identities through reflexivity

Published

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Description of the research problem

Are the profiles of attention/interpretation/intention of individuals algorithmically auto-induced under Mediatized Capitalism?

Theoretical framework

From the hype of web 2.0 paradises, the world seems to be running on data. People have bowed in cascades to the magnificent "disguised as free" exchange. Instead of inter-defined social situations

individuals are mostly "running after the" never-ending fluxes of today's social configuration. Experience is being restructured through material and immaterial processes, in an overwhelming part - in social production and partly also in social reproduction - autonomous of fleshy creators. In neoliberalism, capitalism becomes not simply another media (Fuchs, 2007), capitalism is the media, and mediatization becomes the pivot of social ordering, strongly decreasing the demos' transformative action possibilities.

Acknowledging the mediated construction of reality that the becoming of a datafied/interconnected materiality and ecosystem imports to the social ordering of the quotidian (Couldry and Hepp, 2017). And, drawing upon a view of the present endless cross-contamination and endless refeedings of society's communicative processes (Hall, 1982), the emergence of a new code is perceived in the social configuration we live by/in/on. A roaring code that rarifies and reifies our social realities, from sender, through channel, to receiver; from production, through distribution, to consumption. Communication became too noisy: "my message" is everyone else's noise, as the messages for all the others are my noise and my deafness. Listening is almost impossible. Communication returns to its historic unidirectionality, not allowing for any hysteric feedback loops: it is a specialty of some who can gather literacies, access and resources, the medium ends up with the messages and the exclusive participation of a few. Voice for the vast majority is rarified. Lastly, communication tries to modulate the social practices and representations of recipients, reifying conventions of legitimacy, colonizing attentions and guiding intentions, and closing us in refeeding each flux and facilitating the unending iterations of the process. This "Information and Communication Overload" "blinds" individuals to alternative ways of being and doing. Our senses become thus colonized, leaving us only with the ability to "think it trough" in our "inner conversations" in refeeding the system.

With communication being the settler of realities' ordering, but also the deranger of the social, more than ever before, the individual becomes both as pivotal as negligible. Though numbed by the speed and complexity of this new order - where listening, seeing and talking becomes very difficult - people, nevertheless, "smell things". Looking beyond individuals representations and actions becomes unavoidable - into their cognitive working and processing (Archer, 2012) (Jenkins, 2004); into which figurations (Hepp, 2014) impend upon them and the importance/questioning individuals give/make to such figurations, in the process of reframing the world. Rather than which Media Effects are determining what, we must analyze what "digestion" with which absorptions/eliminations/reframings result from the intense Media Reflections on individuals "habitus": what rearrangement occurs in individuals' cognitive system and with which consequences to society (Scott, 2011) (DiMaggio, 2003)?

Methodological framework

An interdisciplinary methodology with a deeper contribution from the observed individuals is here proposed. Simply put, we want to know what "hits" people daily, what grabs their attention, what public issues and private troubles (Mills, 1959) they work daily with, through which mitigations and operabilities.

For this purpose we will align with a mixed methods approach: first, individuals' quotidian will be auto-characterized (Socratic Questioning) in three non-intrusive phases: 1 diary of the daily "hits"; 1 exo-classification sheet of the "hits"; 1 endo-classification sheet of personal reflexivity on the "hits". This methodology will promote reflexivity in successively contemplation, analysis, and comprehension.Thus, we will mobilize tools from Pedagogy and Psychology, while operationalizing Sociological and Communicational frameworks and concepts. During the same period of time under which subjects are observed, we will proceed with a systematic construction of a database of media trends (all media, new and old). The last source of triangulation will be the fixation of the life histories of the individuals under analysis. This approach will allow for the dismembering of the "inner conversations" and reflexivity, thus for a clearer view of the alterations in individuals' cosmovisions and reworkings of the "individually operable".

An understanding of how/why the intensity of the mediatization of the social is catalyzed/contradicted by individuals and with which inner/outer readjustments in validating operable figurations and ways of acting is thus achieved. This is of extreme relevance for it is individuals' pivotness, as an inexorable gate of Mediatized Capitalism, which primarily keeps feeding the new order.

Expected contributions and results achieved so far

No findings yet. The project is near the end of research design.
This project theoretical contribution rests in a rereading of present times as those of a Mediatized Capitalism. We bridge to major processes of social ordering that came to its maximum strength with the becoming of todays' fully and deeply interconnected social configuration - the process of mediatization, deepened into "deep mediatization", and the process of capitalism, deepened with neoliberalism. Both symbiotically growing and spreading one on the other through society.
Also, theoretically, we propose a reanalysis of media embedding with society at large, and, consequently, propose a revaluation of the Media Effects paradigm and all its instances in favour of a conception of the dominance of a Media Reflections paradigm, with a prominence of more micro-relational processes rather than macro-structural ones.
Methodologically we will mobilize a novel interdisciplinary approach with technical contributions from Pedagogy and Psychology and conceptual contributions from Sociology and Communication Studies. In addition, we bring individuals fully to the fore.
Only through this integration of theoretical and methodological can we characterize and understand the centrality of individuals in the reconfiguration of today's societies.

121 Predicting pregnancy complications in low resource contexts (A case study of maternal healthcare in Uganda)

Published

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1.Introduction

Background

Every day in 2015, about 830 women died from pregnancy or childbirth-related complications around the world, with 99% of the deaths reported from developing countries (WHO, 2015). Maternal deaths result from complications of pregnancy, complications of childbirth and postpartum complications (Kassebaum et al., 2014). Despite improvement activities, the United Nations' fifth Millennium Development Goal (MDG 5) of a 75% reduction in the maternal mortality ratio (MMR; number of maternal deaths per 100 000 livebirths) between 1990 and 2015 has not been met. Worldwide, the number of maternal deaths dropped only by 43% (WHO, 2015).

Uganda has a maternal mortality ratio of 343 per 100,000 live births with a 53% reduction between 1990 and 2013 (WHO, 2014). Uganda shows a slow progress in the reduction of maternal mortality, with only a 2.8% annual decline (WHO, 2015). The slow progress is explained by limited access to healthcare and shortage of medically trained health professionals that can provide maternal and child healthcare services (Nabudere et al., 2011). The public healthcare system includes national and regional hospitals and a tiered system of health centers (HCs), consisting of HC II at the parish level, HC III at the sub-county level and HC IV at the county level (MoH, 2012). The HCs use a referral

system where patients are transferred to the next level from a health center that cannot provide adequate healthcare services.

While only 13% of Uganda's population is urban (World Bank, 2010) the distribution of resources for healthcare, particularly specialized health professionals, is skewed toward urban areas. In fact, this leads to a very limited access to high quality healthcare in rural, remote, and hard-to-reach areas (MoH, 2012). In order to strengthen and extend the maternal healthcare workforce to rural areas, Uganda has employed a task shifting strategy (WHO, 2007). The strategy enables healthcare professionals such as doctors and specialized clinicians to move tasks to less trained and qualified health practitioners, such as nurses and community health workers organized in village health teams in rural areas (VHTs) (WHO/PEPFAR/ UNAIDS, 2008).

In the task shifting strategy, the VHTs are the first point of contact for pregnant women and face the task to predict pregnancy complications but, they cannot accurately predict pregnancy complications (Okuga et al., 2014) making it difficult to achieve the MDG5 goals. In order to achieve the goals, with the task shifting strategy, it requires an effective and efficient maternal healthcare system with adequate resources and capabilities. Information Systems research has led to the development of computer-based health information systems that support healthcare professionals, nurses and hospital administrative staff in daily activities, hence leading to increased quality and efficiency of patient care (Haux, 2006). Developing a health information system in developing countries is difficult due to the "organizational complexity, fragmentation, lack of coordinated organizational structures and unrealistic ambitions" (Asangansi and Braa, 2010). It has been noted that the adoption and use of eHealth interventions in developing countries is challenged with poor physical infrastructure such as poor transport network, unreliable power supply, low ICT illiteracy and poor data management structures (Wilson, 2000; Asangansi and Braa, 2010). For instance, electronic health (eHealth) interventions such as predictive models aimed at predicting pregnancy risks (Kleinrouweler et al. 2016) cannot be used by the VHTs and mid-level healthcare workers. Explanations for not using the models are that they are too complex for daily use in clinical settings because they require computer support (James, 2001; Payne et al., 2014).

Mobile Health (mHealth) extends the health information infrastructure to the villages and provides an opportunity to strengthen the healthcare systems in developing countries (Braa and Purkayastha, 2010). mHealth does not only support people in rural areas with limited access to healthcare but also supports people in urban areas and in developed countries to access care while on the move (Varshney, 2014). Given the potential benefits of mHealth, strengthening the work of VHTs and mid-level community health workers may require a mobile solution that is coordinated with the backbone systems to support maternal healthcare processes at different levels of the healthcare system.

Full utilization of mHealth in developing countries is challenged by technical issues such as costs of the mobile phones, installation, and mobile network infrastructure, mobile application usability issues and sociopolitical issues such as communication patterns and lack of power (Braa and Purkayastha , 2010; Braa and Sanner, 2011). There is still limited research on how sustainable mobile health information can be effectively deployed and scaled (Braa and Purkayastha, 2010). There is need to research on the challenges and needs for a sustainable and scalable mHealth solution in application domains such as clinical decision support, monitoring, evaluation and patient tracking, and electronic health records (Sanner et al., 2012) and on how such solutions can reduce financial costs to patients (Silva et al., 2015).

This research proposes a study on how to design a system that supports efficient predictions of pregnancy complications in low resource settings.

Objectives

The main objective of the research is to investigate the role of IT in value co-creation for predictions of pregnancy complications in low resource settings. Specific research objectives include:

- To explain factors that enable co-creation of value to predict pregnancy complications in low resource settings

- To describe the relationships between IT and value co-creation in predicting pregnancy complications
- To recommend guidelines on how to design IT that enables value co-creation in predicting pregnancy complications in low resource settings

Research question(s)

In order to design systems that support health practitioners in the rural areas to identify, prevent and manage pregnancy complications, we need to understand the human, technology and contextual factors in terms of structures and processes that may affect the use of the designed system. Therefore, the overall research question would be:

"How can IT support value co-creation in predicting of pregnancy complications in low resource settings?"

To answer this overall research question, we need to answer the following specific research questions:

- Which factors enable value co-creation in predicting pregnancy complications in low resource settings?
- In what ways can IT facilitate value co-creation in predicting pregnancy complications in low resource contexts?
- In what ways can IT be designed to enable value co-creation in predicting pregnancy complications in low resource contexts?

Contribution and significance

The practical contribution is to improve maternal healthcare in Uganda specifically through improved predictions of pregnancy complications in order for Uganda to meet the MDG5. Furthermore, the research supports the task shifting strategy by increasing access to quality care in low resource settings. The theoretical contribution is to identify how social capital theory and the service innovation framework enhance the use of IT to co-create value in the low-resource setting.

2. Literature

Value co-creation in the service-dominant (S-D) lens is defined as "the processes and activities that underlie resource integration and incorporate different actor roles in the service ecosystem" (Lusch and Nambisan, 2015).

The task shifting strategy presents challenges of inadequate access to quality maternal healthcare services in the rural communities. The quality of healthcare is not only achieved through service delivery but also through improved healthcare outcomes or the value obtained from the healthcare service delivery process (McColl-Kennedy et al., 2012). Improved healthcare outcomes require innovative ways of healthcare service provision. Michie et al. (2003) indicates that treatment plans and related health care activities do not only include interactions with health professionals but rather extends to the individual lifestyle and beliefs. Evidence has shown that involvement of the patients in their treatment creates value as they actively seek and share information with health professionals, friends, family, support groups and colleagues to redesign their treatment programs (McColl-Kennedy et al., 2012) and prevent diseases through proper diet and exercises (Groves et al., 2013).

Models and frameworks have been developed to improve healthcare outcomes in low-resource settings. Mburu (2014) developed a conceptual model for designing and deploying mHealth solutions for low-resource settings and tested it in maternal healthcare. The model was aimed at narrowing the gap between design of mHealth solutions and the use context. However, the model is inclined to processes between the healthcare provider and the patient and limits patients-patients or patients-family relationships. This limits research that focuses on other processes that support prevention and management of complications in rural settings with limited healthcare professionals. In this situation, the model is suitable for use in the traditional healthcare system that makes the healthcare provider at the center of healthcare and hence leads to limited quality of healthcare outcomes or reduced value.

Higa and Davidson (2017) developed a model that uses the S-D logic perspective for value co-creation in rural under-resourced settings. The model focuses of three actors including the patients, family or friends and healthcare providers who integrate resources to co-create value which is in this case, improving chronic disease health outcomes. The resources considered in the model include social capital in form of social support from family and friends, eHealth resources to facilitate service delivery and eHealth resources that enhance patient engagement in health behavioral changes. The model assumes that the resources are readily available and that the actors are willing and available to exchange services despite acknowledging that the different actors are situated in both formal and informal institutions that may limit their interactions. Higa and Davidson suggest further research on the contributions on different actors and how limitations faced by actors to access and integrate services.

The models and frameworks indicate the need to consider a social-technical approach when designing IT solutions that lead to improved health outcomes. The models also emphasize the need to consider the fit between the technical factors such as infrastructure, systems and the social factors such as the environment, individual characteristics and culture. Therefore, I will use a socio-technical approach to design a system that integrates social and technical factors.

3. Method

To design IT innovations in healthcare, there is need to adopt the transdisciplinary approach in the research process. Pohl and Hadorn (2007) indicates that through transdisciplinary research, researchers understand the complexity of the problems as they analyze the life-world and scientific perceptions of the problem. This analysis can be achieved if different stakeholders in life-world participate in identifying and structuring the problem (Hadorn et al., 2008). This collaborative effort enables to bridge the gap between knowledge production in academia and knowledge required to solve a societal problem (ibid).

Community input into the research process requires an understanding of who to involve in the research process (Davis and Wagner, 2003). Community input can be used to either guide the research process or as a means of gathering empirical evidence for the research process (Gaber, 2016). Pike (1967) presents two perspectives of gathering community data which include emic and etic perspectives. He states that the emic perspective requires understanding the "lived experiences of the community members" while the etic perspective focuses on the "observations made by people outside the community". In addition to the two perspectives, Gaber (2016) identified two other perspectives that include the emic-etic and etic-emic perspectives which are expressed as "insider-outsider vista" and "outsider-insider vista" respectively. He explains the emic-etic community perspective as being provided by advocacy groups who are members of the community and have worked with a community issue for some time hence, have an insider view. At the same time, such members work with other members in the advocacy groups who provide them with etic awareness view. The etic-emic community perspective is provided by community organization representatives with etic and emic contacts for different community issues (Gaber, 2016)

Qualitative research that uses an interpretive approach aims at understanding the emic perspective of the people through the meanings they attach to their experiences rather than focusing on facts (Hennink et al., 2011). Therefore, in the interpretive approach, particularly during data collection and interpretation, "the study participants reflect their subjective views of their social world while the researcher brings subjective influences to the research process" (ibid).

I will adopt the qualitative research approaches such as case study and ethnographic action research in my research process. This is because the approaches help to understand the interactions between people, technology and the organization. Such interactions inform theory development or solutions to the problem (Klein and Meyers, 1999). I used a case study research approach to conduct an exploratory and qualitative study in the Ugandan context to get an initial understanding of the maternal healthcare system. This helped me to identify some of the current problems facing the

maternal healthcare system in Uganda for instance, the organizational, technical and human resource challenges. Data was collected through conducting interviews with the village health teams, midwives and healthcare professionals. The results from the study were analyzed using "the service innovation framework with the Service-Dominant (S-D) lens" (Lusch and Nambisan, 2015).

Given the fact that Sweden is among the countries with the lowest mortality rates, I plan to conduct a comparative study in Sweden to understand the best practices in maternal health care system and opportunities that can be transferred to the Ugandan context. A case study research design will be used to conduct this study. The data will be collected from midwives, midwife healthcare managers and IT managers in Gothenburg, Sweden. Midwife healthcare managers and IT managers will be interviewed and in addition, a survey will be sent out to the midwives. Further still, observations will be made at one of the healthcare clinics in Gothenburg to confirm the results from the interviews. The collected data will be analyzed using the S-D lens.

The Ethnographic action research enables the researcher to focus beyond individual ICT to include the entire structure of communication and information in people's way of life (Tacchi et al., 2003). The approach provides IS researchers with insights into the human, social and cultural aspects of IS information development and application (Harvey and Myers, 1995). Ethnographic research will enable me to see "what people are doing as well as what they say they are doing" (Myers, 1999) through participant observation (Baskerville and Myers (2015). Through ethnography I will observe how VHTs interact with the pregnant women and the midwives during the pregnancy process.

Analyzing results from the research studies will be done with reference to the social capital theory (Lewis et al., 2013) and service innovation framework (Lusch and Nambisan, 2015). Analysis from the studies will enable me to design requirements for the use of IT to support value-co-creation in predicting pregnancy complications. I will evaluate the design guidelines using quality attributes of usability, reliability and organizational fit.

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122 The Floating Island Project: Self-Organizing Complexity

Published

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Summary:
The Floating Island Project and the collaboration between the French Polynesia government and the Seasteading Institute reflect our increasing embracement of interconnectedness in a complex world. Where emerging events that have the capacity to radically transform human societies blossom in a bottom-up way through networks of direct collaboration among diverse components of a social system. Networks, dynamism, diversity, harmony and local interactions….It seems that human politics is finally shifting towards what nature long ago became an expert at. By recognizing information processing tendencies and clustering in human interactions, we can learn how to harness the social and environmental complexity of the economically and culturally diverse environment the Floating Island will have. Nature can teach how to navigate space faster, cheaper and more comfortably. But, most importantly, it can also help us create the effective environments for solutions to spontaneously emerge. This is now possible with better information processing in political technologies. With a politics closer to nature. A politics of harmony.

The Floating Island Project is a floating city that will be built from scratch in the waters of French Polynesia, after the Seasteading Institute[1] signed an agreement Memorandum of Understanding with the French Polynesia government at the beginning of 2017 to create a special economic zone with political autonomy, in exchange of joint efforts in combatting the effects of global warming which are making some pacific islands to sink and propelling the economy of the region.
My research studies the role of network technologies in the emergence of the Floating Island Project and its mechanisms of self-organization from the perspective of complexity science. For example, the role that the internet has played in bridging geographically distant political and business actors and creating a network of multiple layers with nodes all across the world. Similarly, how the internet allowed the Floating Island to be conceived by providing a means to survey the community

interested in inhabiting the floating city and also by crowdsourcing investment. In other words, the ways in which network technologies have facilitated the self-organization of political interactions.
In addition to this, I resort to ethnographic research, digital ethnography and semi-structured interviews to conceptualize the role that the internet might also play in the future of the project, as it is envisioned as a Silicon Valley in the Pacific (Quirk, 2017, Seasteading, 2014), that aims at increasing the diversity and helping the environment with practical projects in association with information-based economies. It is important to note that even the infrastructure of the settlement has internet at its core, as many of the interested individuals in becoming reseadents noted as an important decision-making point before moving to the Floating Island that high internet speed was a requirement (Seasteading, 2014). Hence, the research also examines the role that the internet and network technologies play in the future interactions of the Floating Island. This includes considerations around automation, artificial intelligence and the Internet of Things, data dashboards for decision-making, technological self-organization of information systems in public places.
On a conceptual level the ontology of complexity drives the research on the Floating City. Complexity sheers light on how to contribute to guide the political organization of Floating City and its interactions with host nations in ways that mutually benefit them and maximize their autonomy, at the same time that provides a harmonic global environment for seasteadsComplexity has examples of approaching cities as evolutionary and far-from-equilibrium complex systems (Bryn, 1998) (Batty, 2008). My research studies the self-organizing mechanisms from where the Floating City Project is emerging. For instance, the role of the Seasteading Institute in acting as a dissipative system that, in the words of Harvey and Reed (1994), imported energy from the immediate environment and transformed into complex internal structuration.
Some authors claim that it is not possible to try and anticipate the rules of a seastead before its creation and that the way seasteads organize should base on trial and error experience (Taylor, 2010). However, a reading from complexity sciences would state that when it comes to complex systems where outcomes depend on nonlinear interactions among components in multiple levels of a system the arrow of time of thermodynamics places a crucial role. Hence trial and error in the face of bringin what coyld be seen as utopia to reality is a very big risk. In this case complexity can provideas the basis to conceptualize how to guide the self-organization of the Floating City in ways that can harness the economic, cultural, technological and political complexity of the island.
There is a relation between the possibility for societies, in this case a floating city, to self-organize and the quest of transcending hierarchies of power associated to the nation-state, increasing the relevance of local interactions. The research explores heterarchical topologies for decision-making using network technologies and contextualizes the discussion in association to the concept of forking in open-source environments. However, it addresses the complex interactions that play a role in the emergence of the Floating Island Project. Seasteading is seen as a response to harnessing complexity. The literature review shows that although complexity theory can explain the phenomenon, there is a gap in the literature of complexity and politics when addressing this emergent and libertarian phenomenon in politics. The reason being that most authors who work in this intermediate space do not address libertarianism, anarchism nor polycentric laws, despite that they are closer to complexity than the language of policy and the nation-state used by them. The research aims at stressing that the floating city could as a fork of nation-states and that the politics of network technologies of open source can help to understand the phenomenon. Additionally, that politics of freedom are still relevant nowadays. I will Milton Friedman´s conception of
The construction of the floating island is relevant in at least three domains. Firstly, from the technological point of view, as it can only be developed innovating in the creation of seasteads and given that it might be planned to become a node of internet companies as influential as Silicon Valley (Seasteading Institute, 2014). Secondly, from an ontological and theoretical perspective of complexity science, where complexity finds in the creation of this seasted an object of study that perfectly embodies the principles characteristics and behaviors of a complex phenomenon. And thirdly, from a

political point of view that places what seemed as an old utopian anarchic ideal of transcending the nation-state into contemporary practices of radical politics executed with elegant diplomacy involving an existing nation and crowned on the benefits of libertarian markets.

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[1] Described as "The Seasteading Institute is a nonprofit think-tank working to provide a machinery of freedom to choose new societies on the blue frontier."

123 Transdisciplinarity and Information Systems. IT Governance in the digitalisation of healthcare

Published

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The term disciplinarity seems not to have a commonly accepted definition but it relates to a specific field of academic study. The free dictionary defines disciplinarity as the state of being disciplinary. Disciplinary is an adjective related to the branch of learning or knowledge. When talking about a discipline, it is not merely a body of knowledge but also a set of practices by which the knowledge is acquired, confirmed, implemented, preserved, and reproduced.
Post (2009) argues that questions of disciplinarity seek criteria for validating the "eccentric" angle of vision of a particular "intellectual" community in terms of its methodology, subject matter, curriculum or its shared purpose. Disciplinarity involves the education, certification, hiring, and promotion of university professors. Questions of disciplinarity express apprehension about the subordinate status of a "colonized discipline" (James, 1995). Minati and Collen (1997) using the systemic perspective describe disciplinarity as phases or forms of human activity to seek, develop, and produce knowledge. They state that disciplinarity is demonstrated in four forms; singular, multiple, inter-relational, and boundary breaking pursuits.
Universities possess incentives to engage in interdisciplinary approaches in circumstances where the problems resist a solution within the parameters of traditional disciplinary perspective. Many of the universities worldwide have research agendas that keep changing and to be able to meet this changing agenda calls for transformation of knowledge practices on top of complementary changes in the internal organisation of universities and in the composition of external disciplinary institutions.

124 Ethical Considerations in Cloud Computing Systems

Published

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Cloud computing is a new generation of computing systems, increasingly developing as a promising solution to deal with the explosion of computing complexity and data size. One of the main concerns to shift from traditional computing systems to Cloud is ethics. In many cases, ethical issues depend on particular applications and circumstances. However, we intend to identify ethical issues of Cloud, inherent in the fundamental nature of the technology rather than specific circumstances. There are multiple technological criteria affecting ethical issues in Cloud, such as security; privacy; compliance and performance metrics. Along with the technological criteria, a set of rules and regulations called *Terms and Conditions* (T&C) effects on ethics in the Cloud. T&C is an agreement specifying the rights and obligations of users, Cloud providers and third parties. In this ongoing research work, we aim to firstly investigate the main technological criteria affecting ethics in Cloud, while at the same time, we provide a discussion to indicate that how each of these criteria influences ethics, secondly to consider the relationship between the T&C rules and ethics, and finally to have a quick look at ethical issues in Cloud versus traditional web-based applications.

125 Ethical risks of pursuing participatory research as an industrial doctoral student

Published

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In this essay, I discuss ethical risks of pursuing participatory research as an industrial doctoral student. I particularly focus on two facets. First, ethical questions that may arise as a consequence of the dual character of the work format, i.e. being both an academic student and a practitioner in the field of study. Second, ethical consideration in relation to a participatory research method in which the researcher recognises his or her role as a change agent within the system, but studies the system as a whole. I conclude that there might be several ethical risks associated with such research, of which the doctoral student should be conscious and transparent.

126 Exploring interaction design with information intense heavy vehicles

Published

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Abstract

This research proposal describes a Ph.D. research project in interaction design with information intense heavy vehicles. The research aims to explore the use of mixed reality interaction and visual presentation using see-through interfaces and symbolic metaphors, to enhance the interaction for operators working with these types of Machines.

1. Introduction and motivation for research

As systems, for example, vehicle systems, get increasingly autonomous and information intense, the information exchanged with the user, i.e. the operator, are increasingly becoming a designed interaction. This in relation to the interaction earlier being a result of the machine behavior and mechanical operation. Thus, there is a need for a proficient interaction design to establish an efficient, environmentally conscious and successful operation.

Also, as machines get connected, more information will be communicated from and between machines. And as higher levels of autonomy will be introduced, the activities and purpose of the operator will likely also transform into more managerial than operational, affecting the interaction with the machine and the need for information.

Furthermore, there is even a risk that new functionality is added that increases mental load and draws operators attention, thus potentially increasing the risks of failure as well as compromises human safety [1]. One example of such is the Llanbadarn Automatic Barrier incident report where a train passed a crossing with the bars raised. One reason why this happened was because the operator was occupied with the driver machine interface and therefore missed the crossing indicator [2].

Using mixed reality interaction, thus blending information with the surrounding area, have the potential to enhance situational awareness.

The aim of this research is to explore interaction with information intense heavy vehicles and find means for user experiences and efficient interaction between the operators and the industrial mobile machines; for example, agricultural machines and construction machines. The research combines software engineering and interaction design together with an industrial perspective (the researcher is an industrial Ph.D. student).

Increasing efficiency of machines and utilization of information can also positively impact a sustainable society. For example through less fuel consumption or a more precise and limited soil fertilizing. Also, reports claim that excessive movements are made, for example, to look out of the machine in certain angles with covered sight [3], resulting in injuries. A good design of the interaction, including placement of the interaction devices can increase operator wellbeing and sustained operation. It can also improve information detection and intake, for example, when the information is within the visual attention area and less time is required to refocus on a display placed at the side in the cabin and then back into the surroundings [4].

This type of research can impact the coming future of even more information intense and autonomous machines, as major OEMs are, possibly, more than ever seeking to information to provide higher levels of productivity and efficiency [5], [6].

2. A summary of background and related work

Different types of transparent interaction systems and augmented interfaces, that keep the user visual attention close operation, are currently an area of state-of-the-art interest [7]. The field itself is not new, head-up displays have, for example, been used for a long time in specific areas, aerospace being one early adopter. But new commercial products have made the technology increasingly available and widespread.

In automotive applications, in particular cars, the use of head-up displays have been extensively researched and used. The information needed in industrial applications is however different than to cars, as it is not only about transportation but also about the production process performed by the vehicle.

Also in the heavy machinery industry, head-up display technology have been evaluated, indicating possible benefits in ergonomics, information intake and productivity [8], [9]. These test has however mainly focused on taking production information currently visualized on displays, and replicating this in the field of vision of the operator. Focusing less on renewed ways to present production information, as well as mediation of additional information.

Another alternative would be head-worn displays, that can be used to present information within the field of view of a user, regardless of the head rotation [10]. But these technologies require extra steps before being able to operate or exit the vehicle, as well as the risk of dropping of losing the visualization devices. Smart devices such as mobile phones and tablets can also be used to display information about machine status, production, or settings. Within or at a distance from the machine. Mobile devices can also be used in augmented solutions, for example, in mobile see-through interfaces where information is overlaid on the display of the device [11], [12].

Additionally, the way to present information in information intense and increasingly autonomous vehicles are an area of research. In farming, Sørensen et.al mention that acquisition and analysis of information still proves a demanding task" [13], and the availability of data does not warrant the understanding or usefulness of the data to the user [14]. This is also indicated by the Designing Interactive Systems conference (DIS) workshop on metaphors for interaction with autonomous systems [15].

3. A description of the proposed approach/solution

The proposed solution is to use mixed reality to present information in the line of sight of the operator, when he/she is looking out through the cabin windows. This would let the operator's attention to be closer to the outside world, compared to when the operator has to look away at screens for information intake. It would also provide a larger screen area for information presentation.

The approach will be to practically explore interaction design and technology by producing visualization concepts and prototypes.

Furthermore, the research seeks to find a common language of interaction that can be used by diverse vendors or practitioner in several industrial machinery contexts. Such as a uniform symbol language that can be used in many types of applications and handle different levels of criticality.

Audio and tactile feedback are also to be considered, but the visual channel will be in focus.

5. A brief discussion on the applied research methodology, including how the solution is going to be evaluated

According to Fällman [16], Zimmerman et. al. [17], Höök et al. [18], Schön [19] and others, interaction design research can be performed through design practice. Sennet [20] even argues that understanding is impaired when we separate practice from theory. The result of the practice can be expressed in many forms, for example, sketches [21], through artefacts and systems [22]. A strong concept is the exploration of possibilities as well as the reflection on design, its artefacts and possible future outcomes [19], [23].

The practice will result in designs and prototypes. As access to real working vehicles is a limited source, evaluation of the concepts and prototypes will mainly be made through simulators and qualitative interviews. For mature concepts, the target is to do quantitative user evaluation with a bigger sample set.

5. Expected contributions and results so far

The work until this stage has centered on gaining understanding and create a foundation for the coming work. It has focused on selected stakeholders (operators [24], designers and developers [25]) and methods for understanding, process, and practice. Among others it has:

- Provided means to evaluate operator's daily interaction with machines, with minimal interruption of work, using eye tracking. This work included a qualitative study of operator's attention at different vehicle types [4].
- Studied of the role of user understanding in the creation of autonomous vehicles [24].
- Ideated on different ways for a stakeholder in the lifetime of an industrial vehicle [26].
- Realized a mixed reality simulator made with audio and visuals [27]. To be extended with see-through (HUD) style visualization.

So far the effort has resulted in a licentiate degree [28] and a number of publications. The plan ahead is to use this experience in the second phase of the research, from where it is expected to result in a number of possible interaction design concepts. These, in turn, will contribute to the understanding of information exchange between software intensive heavy vehicles and its operators, its scenarios and technologies, its use, its challenges, and possibilities.

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127 Synthesis of Extremely Large Time-Triggered Network Schedules

Published

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Context

Time-Triggered switched Ethernet networks are increasing in size and complexity as they are planning to be deployed in large industrial networks such as mega-factories, and projected to be used in the future in smart cities. Traffic in time-triggered networks follows an offline schedule designed before hand that contains the transmission times of all the time-triggered frames through the links in the network. However, synthesizing this schedule means a major challenge when adapting time-triggered network in a larger scale. Schedule synthesis is a well known NP-complete problem with complexity driven by the network size and the number of frames it contains. State-of-the-art

schedulers have been capable of synthesizing such schedules in a reasonable amount of time, but, they start to present scalability issues and are not able to cope with the size and complexity introduced by future applications.

In addition, applications are starting to require wireless capabilities in some areas of its networks, introducing a mixture of wired and wireless communication in the same network. Wireless communication also increases the complexity in schedule synthesis as the difference in transmission speeds between wired and wireless links is too significant to apply typical complexity reduction techniques, such as raster [1].

Research Goals

The goal of this research is to provide a new approach that is able to overcome the scalability issues of current schedule synthesis approaches before the deployment of the network. In general, a good strategy in engineering to cope with large problems is to use divide and conquer approach. In the case of schedule synthesis, we divide the schedule in smaller schedules, called segments, in which every segment will be a non-overlapping time interval of the complete schedule. Once all segments are defined, we allocate as many frames as we can using a state-of-the-art scheduler and concatenate them to obtain the final schedule. In our case, we apply Satisfiability Modulo Theories (SMT) solvers [3], that are able to find the satisfiability of a set of constraints and, if exists, provide an example of such satisfiability, in our case, frames allocated in a segment. However, some of the frames are dependent between them, and present inter-segment constraint that go beyond single segments. These inter-segment constraints bring a challenge to our approach as each segment is scheduled independently and there are no mechanism to satisfy constraints outside the segment being scheduled. To overcome this limitation, we release the SMT solver of such constraints, and handle them in our algorithms with the selection of frames and the addition of some extra constraints in each segment in order for the inter-segment constraints to be satisfied.

Results Obtained

We evaluated our approach using the topology of a network deployed to provide free Internet to a large touristic area and creating synthetic time-triggered traffic. This network, that we call Actual, consist in 81 end systems that exchange information between them through 44 switches and 248 links. Then, we created two new larger networks, Large, that consists is 5 times bigger than the Actual network, and Very Large, which is 11 times bigger. We provided between 5.000 and 50.000 synthetic frames to these networks and synthesize its schedules with our approach using the SMT solver Yices 2.4 [2] to allocate frames into the segments.

For the Actual size network we can schedule 5.000 frames in one minute and up to 50.000 frames in less than one hour. This is a huge performance and scalability improvement, as state of-the-art synthesizers could only schedule up to 1.000 frames in 20 minutes for smaller networks that the used in our evaluation. The synthesis time for Large and Very Large networks increases due to its larger complexity, but the synthesizer is still able to find valid schedules. It is important to note that the increase in synthesis time for networks with more frames is almost linear instead of exponential. This allows us to, if it is needed, to schedule networks with even more frames without experiencing scalability issues, which was the main problem of previous approaches.

Next Steps

Instead of keep pursuing an increase of performance in the schedule synthesis, we would like to abstract and automatize the process of constraint selection for the segments. In our research, we found that the selection of constraints, the number and how to add extra constraints in every segment has a great impact in the performance of the synthesizer. We would like to automatize this problem with the use of machine learning to find better segments and constraints division. This may allow us to use our approach to solve scheduling problem outside Time-Triggered networks if they are formulated as SMT constrained problems. It also have a good impact in our performance, as it could allow us to find segments that can be scheduled in parallel.

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128 The automotive domain - From Multi-disciplinarity to Trans-disciplinarity

Published

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129 The Misconception of Ethical Dilemmas in Self-Driving Cars

Published

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Self-driving, also called fully autonomous or driverless cars are in focus in many domains, such as engineering, computer science, human-computer interaction and ethics. From an engineering and scientific perspective, technical problems are challenging, but are solved one step at a time. When it comes to ethics, it seems that many discussions run into a dead end. In a constructed ethical dilemma there is per definition no solution: whatever you do, the result will be bad.
The trolley problem, which is an ethical thought experiment [1], is a commonly used example of an unsolvable ethical dilemma: The self-driving car drives on a street with high speed. A group of people suddenly appears in front of the car. The car is too fast to stop before it reaches the group. If the car does not react, the whole group will be killed. The self-driving car could however evade the group by entering the pedestrian way and consequently killing a previously uninvolved pedestrian (Option A). Replacing the pedestrian with a concrete wall, which in consequence will kill the passenger of the self-driving car, is another option (Option B). Varying the personas of people in the group, the single pedestrian or the passenger can be used to alter the experiment. The use of personas allows including an emotional perspective [2], such as, e.g., stating that the single pedestrian is a child, a relative, very old, very sick or a brutal dictator, who killed thousands of people.
Even though the scenarios are similar, the responses of humans, when asked how they would decide, differ [3]. The problem is that the question asked has a limited number of possible answers, which are all ethically questionable and perceived as bad or wrong. Therefore, a typical approach to this problem is to analyze the scenarios by following ethical theories, such as e.g., utilitarianism, other forms of consequentialism or deontological ethics. For example, utilitarianism would aim to minimize

casualties, even if it means to kill the passenger, by following the principle: the moral action is the one that maximizes utility (or in this case minimize the damage). Depending on the doctrine, different arguments can be used to prove or disprove the decision.

Applying ethical doctrines to analyze a given dilemma and possible answers can only be done by humans. How would self-driving cars solve such dilemmas? There are a number of publications that suggest to implement moral principles into algorithms of self-driving cars [3]–[6]. We find that this does not solve the problem, but it reassures that the solution is calculated based on a given set of rules or other mechanisms, moving the problem to engineering, where it is implemented.

It is worth to notice that the engineering problem is substantially different from the hypothetical ethical dilemma. While an ethical dilemma is an idealized constructed state that has no good solution, an engineering problem is always by construction such that it can differentiate between better and worse solutions. A decision making process that has to be implemented in a self-driving car can be summarized as follows. It starts with an awareness of the environment: Detecting obstacles, such as a group of humans, animals or buildings, and also the current context/situation of the car using external systems (GPS, maps, street signs, etc.) or locally available information (speed, direction, etc.). Various sensors have to be used to collect all required information. Gaining detailed information about obstacles would be a necessary step before a decision can be made that maximizes utility/minimizes damage. A computer program calculates solutions and chooses the solution with the optimal outcome. The self-driving car executes the calculated action and the process repeats itself.

The process itself can be used to identify concrete ethical challenges within the decision making by considering the current state of the art of technology and its development. In a concrete car both the parts of this complex system and the way in which it is created have a critical impact on the decision-making. This includes for instance the quality of sensors, code and testing. We also see ethical challenges in design decisions, such as whether a certain technology is used because of its lower price, even though the quality of information for the decision making would be substantially increased if more expensive technology (such as sensors) would be used.

Since building and engineering of self-driving vehicle involves various stakeholders, such as software/hardware engineers, sales people, management, etc., we can also pose the following questions: does the actual self-driving car have a moral on its own or is it the moral of its creators? And who is to blame for the decision making of a self-driving car?

Prototypes of self-driving cars are already participating in public traffic among human-driven cars [7]. Therefore it is important to investigate how self-driving cars are actually built, how ethical challenges are addressed in their design, production and use, and how certain decisions are justified. Discussing this before self-driving cars are officially introduced into the market, allows taking part in the setting and definition of ethical ground rules. McBride states that "Issues concerning safety, ethical decision making and the setting of boundaries cannot be addressed without transparency" [8]. We think that transparency is only one factor, as it is necessary to start further investigations and discussions. In order to give a more detailed perspective on the complex decision making process, we propose to create a conceptual ethical model that connects the different components, systems and stakeholders. It will show interdependencies and allow pinpointing ethical challenges. Focusing on important ethical challenges that should currently be addressed and solved is an important step before ethical aspects of self-driving cars can actually be meaningfully discussed from the point of view of societal and individual stakeholders as well as designers and producers. It is important to focus not on abstract thought experiments but on concrete conditions that influence the behavior of self-driving cars and their safety as well as our expectations from them.

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130 Roles for morphology in computation

Published

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The morphological aspects of a system are the shape, geometry, placement and compliance properties of that system. On the rather permissive construal of computation as transformations of information, a correspondingly permissive notion of morphological computation can be defined: cases of information transformation performed by the morphological aspects of a system. This raises the question of what morphological computation might look like under different, less inclusive accounts of computation, such as the view that computation is essentially semantic. I investigate the possibilities for morphological computation under a particular version of the semantic view. First, I make a distinction between two kinds of role a given aspect might play in computations that a system performs: foreground role and background role. The foreground role of a computational system includes such things as rules, state, algorithm, program, bits, data, etc. But these can only function as foreground by virtue of other, background aspects of the same system: the aspects that enable the foreground to be brought forth, made stable/reidentifiable, and to have semantically coherent causal effect. I propose that this foreground/background distinction cross-cuts the morphological/non-morphological distinction. Specifically, morphological aspects of a system may play either role.

131 The inner and external world are two dynamical systems coupled by attention

Published

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I will present a memory model that can account for many aspects of the presence of an inner world, ranging from object permanence, episodic memory and planning to imagination and reveries. It is modelled after neurophysiological data and includes many parts of the cerebral cortex together with models of emotion and arousal systems. Attention plays a crucial role as the interface between the inner and the external world and directs the flow of information from sensory organs to memory as well in the opposite direction as top-down influences on perception. The internal and external world can be seen as two dynamical systems that can be coupled or decoupled in different ways depending on the state of the organism and the task at hand.

The implemented model includes three interacting neural networks that roughly correspond to the ventral, dorsal and prefrontal areas of the cortex. The first component is the identification-network that learns different stimuli as collection of stimulus properties. It operates as a content addressable memory and recalls complete patterns based on partial inputs. The second component is the localization-network. It is similar to the identification-network except that its activity is constrained by a winner-take-all-rule implementing the constraint that binds each input pattern to one particular location, thus avoiding the binding problem. In addition to coding for different locations, this component increases the storage capacity of the identification-component and avoids spurious attractors. The attractors of the identification+localization components stores attended stimuli together with their locations. The final component is a 'prefrontal' working memory. It operates as a k-winners-take-all network and allows memories 'stored' in working memory to be more easily recalled than other memories.

In addition, there are slower predictive associations that works over time to predict the next state based on the current one. When allowed to run freely, these temporal associations will make the complete system transition between stable attractors over time in a way akin to day dreaming, effectively implementing a default state network. However, the memory system can also be put to use in a goal directed way. By allowing a general arousal system to increase the gain modulation, the system will instead replay experienced sequences to produce recall of episodic memories. This property can be used instrumentally for vicarious trial-and-error by allowing the sequence to run until a goal is reached, which will activate a value system. Several such forward sweeps can be used to select the course of action that leads to the highest expected value.

132 The Role of Morphology in Intentional Agency and Social Interaction

Published

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The role of morphological 'computation' in embodied cognition is usually addressed from the perspective of individual agents, i.e. how do an agent's bodily materials, movements, etc contribute to its cognitive processes. But the body of course also plays a crucial role in many social interactions, not least the communication/recognition of intentions between interacting agents. The talk how this affects human-machine interactions in cases where the interacting agents' morphologies are radically different (e.g. people interacting with cars) as well as cases where morphologies have superficial similarities (e.g. human-humanoid interaction), but the underlying bodily processes are fundamentally different.

133 (Un-)Biasing the Morphologies of Affect for HRI Purposes

Published

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1. From Bodies to Bodies

One fundamental aspect of Human-Robot Interactions is the role of the morphologies of both humans and machines. Basically, humans are naturalistically oriented towards the social interaction with other humans, as wrote Aristotle in his classic *Politics*: "Man is by nature a social animal; an individual who is unsocial naturally and not accidentally is either beneath our notice or more than human. Society is something that precedes the individual. Anyone who either cannot lead the common life or is so self-sufficient as not to need to, and therefore does not partake of society, is either a beast or a god". Considering it as the long result of an evolutionary process, we can find the several cognitive mechanisms make possible these processes (Adolphs, 2003; Bechtel, 2001; Frith & Frith, 2007; Lieberman, 2012). Some of them, like constantly face-looking patterns allow some biased, like pareidolia or the faces convey primal information for our social life, which make possible to see faces into toasts, rocks or forests (Kato & Mugitani, 2015; Liu et al., 2014).

The constant analysis of morphological aspects is related to mating (Jaffé & Moritz, 2010; Wade, 2010), fly-or-fight responses (Bubic, von Cramon, & Schubotz, 2010), social coordination (Lieberman, 2000) or emotional interaction(Casacuberta & Vallverdú, 2015). This affects primarily the visual (Cavanagh, 2011) and metacognitive processes related to it (Kirsh, 2005), but must be understood as a multidimensional processes which involves several senses. Finally, there is also the influence of cultural values into basic informational sensory processes, as shows the cultural psychologist (Nisbet, 2003).

Taking into account that fact that human morphologies run a social role, and that affection or emotion are fundamental aspects of the eco-cognitive and social processes, I want to remark some important aspects fundamental to be taken into account during the design of good HRI systems and environments.

2. Moral Morphologies as Social Prejudices or Cognitive Bias?

Although 19th Century psychomorphologists or physiognomists like Cesare Lombroso were wrong about the causal relationship between face shape and (usually wrong) moral behaviour, the truth is that human beings tend to correlate some morphologies with moral and/or emotional content (Mazzarello, 2011; Stepanova & Strube, 2009). Here, bad guys are usually dark, angry, with some deformity or extreme trait (big nose, big ears, small head,...), weird cinematic body movement,…like we can find in most of popular cinema and Walt Disney's villains characters(Gould, 2008). Obviously there are not only biologically determined aspects related to this process, but the role of cultural values must not be undervalued:

Beyond the debates between continuous and categorical models of human caption of emotions, the outstanding fact is that morphology affects how we define the emotional output or even main character of an agent (Martinez & Du, 2012). Therefore, the morphology of the robot is one among a long list of *emotional affordances* I've described elsewhere in previous research (Vallverdu & Trovato, 2016), but at the same time the morphology has an outstanding role because determines a long set of related characteristics of the agent.

3. Emotional Morphologies for HRI

According to the previous data it is obvious that besides of considering the functional design of a robot, several socio-cognitive aspects related to their morphology must be taken into account: gender (Slepian, Weisbuch, Adams, & Ambady, 2011), related language semantics (Gendron, Lindquist, Barsalou, & Barrett, 2012), social context (Hertwig & Herzog, 2009; McHugh, McDonnell, O'Sullivan, & Newell, 2010), body gestures/cinematic (Castellano, Villalba, & Camurri, 2007), among a long list. It is very important for example, that most of previous studies have been related to visual and linguistic HRI interactions, while others extremely important, like touch or olfactory have been almost neglected, basically due to the high complexity of these processes. These aspects are not only basic for a more deep relationship between humans and robots in classic domains (service, military, industrial, care), but also for new ones (like the taboo one of sexual robotics (Levy, 2007), surely one the niches with great expected revenues and implementation according current data on sexual surfing and related interests through the Web and Social Networks). As a conclusion of this section, I must to affirm that the study of the emotional affective aspects embedded into robot morphologies arises as a multidisciplinary research as well as a multidimensional process that goes beyond the basic description of size, shape, colour or texture, requiring more variables: temperature, cinematic speed, temporal flow and adjustment to a naturalistic emotional gestures dynamics, among other ones.

4. The Challenge of Dynamically Augmented Morphologies: Transhumanism or Adaptable robotics.

There is a final idea to be discussed here: human agents are starting to modify severely their cognitive and bodily limits (up to date just as a repairing/prosthetic process or as fashionable gadgets) and this process will modify severely how the natural analysis of morphological phenomenology is performed. At the same time, we can find robots into the market with variable morphologies (combining biped walking with four-legged translation or even wheels; with adjustable body characteristics), something that can confuse the human interacting with the robot. While we do not have a clear control of current morphological aspects involved into HRI, a new set of challenges is in front of us.

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134 Eco-Cognitive Computationalism From "Mimetic Minds" to Morphology-Based Enhancement of "Mimetic Bodies"

Published

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Eco-cognitive computationalism sees computation as active in physical entities suitably transformed so that data can be encoded and decoded to obtain fruitful results. When physical computation is seen in the perspective of the ecology of cognition it is easy to understand Turing's ideas concerning the emergence of information, cognition, and computation in organic, inorganic, and artefactual agents. Turing's speculations on how the so-called "unorganized brains" are transformed in organized "machineries" are very important. Brains are of course continuous systems that can be treated as discrete systems able to perform "discrete" computations, so that we can describe the possible states of these brains as a discrete set, with the motion occurring by jumping from one state to another. Turing clearly says: "The cortex of an infant is an unorganized machinery, which can be organized by suitable interference training. The organization might result in the modification of the machine into a universal machine or something like it. […] This picture of the cortex as an unorganized machinery is very satisfactory from the point of view of evolution and genetics" (Turing, *Intelligent machinery*, 1948). This intellectual perspective first of all clearly depicts the evolutionary emergence of information, meaning, and of the first rudimentary forms of cognition, as the result of a complex interplay and simultaneous coevolution, in time, of the states of brain/mind, body, and external environment. At the same time it furnishes the conceptual framework able to show how thanks to an imitation of the above process the subsequent invention of the Universal Practical Computing Machine is achieved, as the externalization of computational capacities in those artefactual physical entities that compute for some human or artefactual agents: those computers that in this perspective offered by Turing I called "mimetic minds". It is in this framework that we can limpidly see that the recent emphasis on the simplification of cognitive and motor tasks generated in organic agents by morphological aspects implies - in robotics -- the need not only of further computational mimesis of the related performances - when possible - but also the construction of appropriate "mimetic bodies" able to render the accompanied computation simpler, according to a general appeal to the "simplexity" of animal embodied cognition.

135 Computing with Nature

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Computing with Nature†

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Abstract: Natural and morphological forms of computing have diverse conceptualizations. This paper presents an alternative view on morphological computing based on a slightly generalized form of a Turing machine in which one-way action of head on tape is replaced by mutual interaction. This generalized (symmetric) Turing machine can serve as a component of a multi-level complex computing system in much closer analogy to living objects which tend to form systems of very high level of complexity (with levels starting at molecular level, through cellular one to organismal level, or possibly to the level of population or eco-system.

Keywords: Morphological computation; Natural computation; Hierarchic information systems; Interactive computation; Dynamics of information;

Unconventional forms of computation (i.e. computation essentially different from and not reducible to the computation described by the theoretical model of an a-machine introduced by Alan Turing in his famous 1936 paper [1]) generated emotions comparable with those in discussions of life after life. In both cases the central concept of heated disputes, computation or life, remains vague. Also, in both cases the source of strongest contention is in the mystery of consciousness, especially in the context of the question about the role of natural processes and mechanisms responsible for its phenomenal experience. Questions of the type "Is the Brain a Digital Computer?"[2] stimulated hot discussions in the 1990's, but they are no more in the center of attention not because they were answered, but it is now not so clear what computer is and what exactly is the role of the brain in cognition.

Fortunately the time of definite answers to indefinite questions and their furious defense seems to be over. This is why so important are maybe less ambitious, but more clearly formulated research programs focused on problems which when answered can help in dealing with the ultimate questions.

One of the fields of this type of research and accompanying it philosophical reflection is a question about the relationship between computing and natural processes. We have to accept the need for rather intuitive understanding of the expression "natural processes" and "computing", the concepts whose understanding is rather a goal of the study, not a point of departure. The noun "nature" and adjective "natural" are subjects of many controversies and attempts to answer them open entire field of inquiry, which due to the restricted format of the present short paper is excluded from consideration. The same applies to "computing" which more and more frequently is discussed in the context of "hypercomputing" [3] or "unconventional computing". Thus, the idea of "natural computing" involves double difficulty, but this does not diminish its attractiveness for research and

reflection. Sometimes, when computing is understood in conventional way (modeled by Turing machine or automaton) and the focus is on its implementation in living organisms the reference to natural computing seems perfectly justified [4,5].
Research on natural computing is already very diverse. Two main directions are in some sense leading in the opposite directions. One direction explores processes in nature, especially in living objects or their populations which can be used to implement conventional forms of computation or which exhibit behavior which can be interpreted as such computation. Advanced forms of such research have for instance objectives of the development of molecular or cellular robotics [6,7]. The other direction is to search for processes in nature which can provide examples of unconventional forms of computation, for instance reversible computation [8-10]. The directions are opposite in the sense that one assumes already existing conventional model of computation and looks up for their implementation in nature, the other explores nature in the search for new forms of computation.
Morphological computing (in its diverse ways of understanding) is at the cross-section of these two directions. Its diverse forms have in common interest in morphological characteristics of the computing systems. Thus, we can consider computing understood as transformation of acellular slime mould *Physarum polycephalum* within the wide spectrum of morphological patterns in response to changes in environment [4]. But the concept of morphological computation has consequences and applications in much broader context, for instance when human "extended or embodied cognition" is considered in its natural form of organismal morphology. It becomes increasingly clear that the attempts to understand cognition are hindered by the simplifying idealization expressed by the simile of a "brain in the vat".
My own approach to naturalization of computation presented here is different, possibly more abstract and motivated rather by more general reflection on both natural processes and on computation without the assumption that either one has more primary status. Probably the closest affinity in my research interests is with the studies carried out by Kenichi Morita on reversible computing [10]. My original research questions were derived from the observations on similarities and differences between theoretical computing devices such as a Turing machine and actual physical systems studied in physical sciences [11]. Some of these questions were as follows:

Why conventional computation is irreversible, while processes of simple physical systems are always reversible? Irreversibility (breaking time-reversal symmetry) is coming with increased complexity and is manifested in systems far from equilibrium. If the Turing machine computing operates at the lowest level of complexity, why is it irreversible?

Reflection on implementations of computation in natural or physical systems is usually expressed in terms of causality. However, the concept of causality is absent in formalisms of physical theories. It is more a (doubtful) philosophical concept used in interpretation of physical theories or just a convenient expression to describe components of a system ("The revolution of Earth around Sun is caused by gravitational force of the mass of Sun" – the obvious physical nonsense as Earth is not revolving around Sun). The questioning of the cause as physical concept goes back at least to Bertrand Russells essay from 1917: "All philosophers, of every school, imagine that causation is one of the fundamental axioms or postulates of science, yet, oddly enough, in advanced sciences such as gravitational astronomy, the word 'cause' never occurs…"[12]. Naturalized computation should be described in terms of interaction not cause.

More careful reflection on the way Turing derived the description of his a-machine shows that the description involves some arbitrary elements probably coming from the original vision of the "human computer" performing calculation. There is no reason to insist that the entire content of the instructions has to be located in one central place with primary control function (head) and that the head has to have more active role in the computation than the tape.

Natural systems are typically of a complex hierarchical architecture. Natural computation should be generalized to make multilevel simultaneous computation possible.
This paper is devoted to the study of consequences of these questions.

Conventional computing with a Turing machine can be described in the following way:

Figure 1. Conventional computation with Turing's a-machine, but with modified morphological characteristics of the system [11].
Slight modification (generalization) makes the machine (s-machine) symmetric in the sense that the roles of the head and tape are equivalent and that the action of the head on tape is replaced by the interaction of the head and tape. It is a generalization, because when we make a non-physical assumption that only head is acting on tape, we return to the conventional Turing a-machine described at Fig. 1.

Figure 2. Symmetric Turing machine in which head and tape are interacting and the distinction in the names of these components is purely conventional [11].
Compounding of computational systems is based on the fact that at each level we can distinguish to levels in the information system: global (e.g. structure or configuration of characters on the tape) and local (e.g. selection of a character for a particular cell.

Figure 3. "Simple" computing system (s-machine)
Now we can consider a compound computational system in which head of one level can be a tape of another ("lower" level) and tape of this level can be a head of another level.

Figure 3. Compound computing system of hierarchical, vertical architecture.

Conflicts of Interest: The author declares no conflict of interest.

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136 Eco-Cognitive Computationalism From "Mimetic Minds" to Morphology-Based Enhancement of "Mimetic Bodies"

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Extended abstract

Eco-cognitive computationalism sees computation as active in physical entities suitably transformed so that data can be encoded and decoded to obtain fruitful results. When physical computation is seen in the perspective of the ecology of cognition it is easy to understand Turing's original ideas concerning the emergence of information, cognition, and computation in organic, inorganic, and artefactual agents. Turing's speculations on how the so-called "unorganized brains" are transformed in organized "machineries" are very important. Brains are of course continuous systems that can be treated as discrete systems able to perform "discrete" computations, so that we can describe the possible states of these brains as a discrete set, with the motion occurring by jumping from one state to another. Turing clearly says: "The cortex of an infant is an unorganized machinery, which can be organized by suitable interference training. The organization might result in the modification of the machine into a universal machine or something like it. […] This picture of the cortex as an unorganized machinery is very satisfactory from the point of view of evolution and genetics" [1]. This intellectual perspective first of all clearly depicts the evolutionary emergence of information, meaning, and of the first rudimentary forms of cognition, as the result of a complex eco-cognitive interplay and simultaneous coevolution, in time, of the states of brain/mind, body, and external environment. At the same time it furnishes the conceptual framework able to show how thanks to an imitation of the above process the subsequent invention of the Universal Practical Computing Machine is achieved, as the externalization of computational capacities in those artefactual physical

entities that compute for some human or artefactual agents: those computers that in this perspective offered by Turing I called "mimetic minds".
Turing on the emergence of information, cognition, and computation in organic, inorganic, and artefactual agents. Aiming at building intelligent machines Turing first of all provides an analogy between human brains and computational machines. In [1] he maintains that "[...] the potentialities of human intelligence can only be realized if suitable education is provided". The concept of unorganized machine is then introduced, and it is maintained that the infant human cortex is of this nature. The argumentation is indeed related to showing how such machines can be educated by means of "rewards and punishments". *Unorganized machines* (and also *paper machines*) are listed among different kinds of existent machineries:
- *(Universal) Logical Computing Machines* (LCMs). A LCM is a kind of discrete machine Turing introduced in 1937 that has an infinite memory capacity obtained in the form of an infinite tape marked out into squares on each of which a symbol could be printed. The importance of this machine resorts to the fact that we do not need to have an infinity of different machines doing different jobs. A single one suffices: it is only necessary "to program" the universal machine to do these jobs.
- *(Universal) Practical Computing Machines* (PCMs). PCMs are machines that put their stored information in a form very different from the tape form. Given the fact that in LCMs the number of steps involved tends to be enormous because of the arrangement of the memory along the tape, in the case of PCMs "[...] by means of a system that is reminiscent of a telephone exchange it is made possible to obtain a piece of information almost immediately by 'dialing' the position of this information in the store" [1]. Turing adds that "nearly" all the PCMs under construction have the fundamental properties of the Universal Logical Computing Machines: "[...] given any job which could have be done on an LCM one can also do it on one of these digital computers" [1] so we can speak of Universal Practical computing Machines.
I will take advantage in my presentation of the concept of unorganized brain (and machine) to stress the historical/epistemological interest of Turing's discoveries. Unorganized Machines are largely random in their constructions. Infant brains too can be seen as unorganized machines and are organized through education. Brains very nearly fall into this class [discrete controlling machinery – when it is natural to describe its possible states as a discrete set] and there seems every reason to believe that they could have been made to fall genuinely into it without any change in their essential properties. However, the property of being "discrete" is only an advantage for the theoretical investigator, and serves no evolutionary purpose, so we could not expect Nature to assist us by producing truly "discrete brains". Education in human beings can model "education of machinery" "Mimicking education, we should hope to modify the machine until it could be relied on to produce definite reactions to certain commands". A graduate has had interactions with other human beings for twenty years or more and at the end of this period "[...] a large number of standard routines will have been superimposed on the original pattern of his brain" [1].
Computing machine as the "externalization" of computational capacities in artefactual physical entities that compute for some human or artefactual agents. Research in distributed cognition established that we humans delegate cognitive (and epistemic, moral, etc.) roles to externalities and then tend to "adopt" and recapitulate what we have checked occurring outside, over there, after having manipulated – often with creative results – the external invented structured model. A simple example: it is relatively neurologically easy to perform an addition of numbers by depicting in our mind – thanks to that brain device that is called visual buffer – the images of that addition thought as it occurs concretely, with paper and pencil, taking advantage of external materials. Mind representations are also over there, in the environment, where mind has objectified itself in various semiotic structures that mimic and enhance its internal representations. Turing adds a new structure to this list of external objectified devices: an abstract tool, the (Universal) Logical Computing Machine (LCM), endowed with powerful mimetic properties. The creative "mind" is in itself extended and, so to say, both internal and external: the mind is semiotic because transcends the boundary of the

individual and includes parts of that individual's environment, and thus constitutively artificial. Turing's LCM, which is an externalized device too, is able to mimic human cognitive operations that occur in that interplay between the internal mind and the external one. Indeed Turing already in 1950 maintains that, taking advantage of the existence of the LCM, digital computers (as external physical appropriate objects) can be constructed, and indeed have been constructed, and they can in fact mimic the actions of a human computer very closely. In the light of my perspective both (Universal) Logical Computing Machine (LCM) (the theoretical artifact) and (Universal) Practical Computing Machine (PCM) (the practical artifact) are mimetic minds because they are able to mimic the mind in a kind of universal way (wonderfully continuing the activity of the so-called "disembodiment of the mind" and of semiotic delegations to the external materiality our ancestors rudimentary started).
Computational mimesis of morphological aspects, mimetic bodies, simplexity. It is in the framework I have just described that we can limpidly see – naturally extending Turing's perspective - that the recent emphasis on the simplification of cognitive and motor tasks generated in organic agents by morphological aspects implies - in robotics ¬- the need not only of further computational mimesis "*à la* Turing" of the related performances - when possible - but also the construction of appropriate "mimetic bodies" able to render the accompanied computation simpler, according to a general appeal to the "simplexity" of animal embodied cognition.
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137 Models at play: Using dynamic field theory to understand looking and learning in dyadic interactions

Published

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Although cognitive and social development are often studied in isolation, many researchers have demonstrated convincingly that cognition and the social environment are inseparable components of development. For instance, the social context plays a crucial role in many facets of cognitive development. Critically, the mechanisms by which social interactions impact cognitive development remain poorly understood. Here, we present a dynamic field model that elucidates the neural and behavioral mechanisms by which social interactions contribute to developmental changes in cognition and *how these influences are reciprocal in nature*.
The goal of our work is to understand the mechanisms by which parental responsiveness impacts the social and cognitive development of term and preterm infants. We present an autonomous dynamic field model that looks about its environment containing multiple virtual objects. This neural system encodes and forms memories for the objects being looked at and captures the looking and memory formation abilities of typically developing and preterm infants *and* adults. We present several simulation experiments in which a parent model *and* preterm infant model share the same virtual world. We illustrate that a simple Hebbian learning process within the neural and behavioral systems of the parent and infant models is responsible for changes in how the infant model performs in a memory task and how the models learn to interact with each other.

138 Cognitive Distributed Computing and its Impact on Information Technology (IT) as we know it

Published

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As the scale of computations become large and as both people and machines demand communication, collaboration and commerce at the speed of light, rapid fluctuations in the demand for computing performance and fluctuations in available resource pools, both make it necessary to respond fast and readjust the computation structures and associated resources so as to not disrupt the user experience or the service transaction. Current Information Technologies from their memory-starved, server-centric, low-bandwidth origins from von Neumann's stored program control implementation of the Turing Machine are evolving with new architectures to meet the demand for scale and speed. In this paper we discuss the evolution of current IT to cognitive IT, where computing processes become self-aware of their resource requirements in real-time and seek to adjust them from a global knowledge of available resource pools and their provisioning processes. This is transforming the current state of the IT as we know it to a cognitive IT.

139 Cognitive Computing Architectures for Machine (Deep) Learning at Scale

Published

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The paper reviews existing models for organizing information for machine learning systems in heterogeneous computing environments. In this context, we focus on structured knowledge representations as they have played a key role in enabling machine learning at scale. The paper highlights recent case studies where knowledge structures when combined with the knowledge of the distributed computation graph have accelerated machine-learning applications by 10x or more. We extend these concepts to the design of Cognitive Distributed Learning Systems to resolve critical bottlenecks in real-time machine learning applications such as Predictive Analytics and Recommender Systems.

140 Self-managing distributed systems and globally interoperable network of clouds

Published

Giovanni Morana

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While self-managing IT has been the target of every enterprise since the introduction of autonomic computing, it has eluded us till recently. While there has been much progress in using autonomic computing to model, configure, monitor and control the external world outside of the computing processes, today, IT management consumes 70% of the IT budget to keep the applications available, secure and compliant with regulations. For every dollar spent on software development, another $1.38 is spent on managing and maintaining it. Every time a fault occurs, one has to stop, isolate it, diagnose it and fix it and it requires an army of experts from different disciplines to do it. This becomes an impossible task when large scale, and fluctuations both in workload demands and available resource pools are involved. In this paper we describe a new approach that brings finally self-managing properties to applications and workflows using a new computing model. Using this approach, we have reduced IT complexity and created an interoperable global network of clouds that can be used to support self-provisioning workloads with auto-scaling, auto-failover and live migration without disrupting user experience.

141 Singularities and Cognitive Computing

Published

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We consider arguments for the technological and economic singularities from the perspective of Artificial Intelligence (AI) and Machine Learning (ML) perspectives, and argue that cognitive computing is a promising response to the economic singularity.

142 State of the Art of Information Technology Computing Models for Autonomic Cloud Computing

Published

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Abstract: In the paper we present several models of computation for autonomic cloud computing. In particular, we justify that for autonomic cloud computing if we require perfect self-reflection, we need models of computation going beyond Turing machines. To approximate self-reflection, models below Turing machines are sufficient. The above claims are illustrated using as an example the DIME Network Architecture.

143 Foundations of an Information Based Psychology

Published

Fodor Miklós

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The science of psychology has become fragmented due to its multiple roots, diverse methodologies and premises. Using simple information related notions like input and output, combined with recursive systems' view a powerful theory is presented, based on what classic psychology notions like self, consciousness or emotions are re-defined and are brought to a common ground. If accepted by the research community, the approach could also grow into a unifying thinking frame for social sciences (sociology, history, political sciences, economics etc.). In addition to cognitive science's efforts it aims to integrate our knowledge about both cognition and groups, personality, genders etc.

144 Knowledge processing as structure transformation

Published

Rao Mikkilineni[1, 2], Mark Burgin[3], Samir Mittal[4]

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As big enterprises and consumers communicate, collaborate and conduct commerce almost at the speed of light using voice, data and video, information explosion (a term first used in 1941, according to the Oxford English Dictionary) has created a need for its accumulation, processing and integration to create "knowledge." Knowledge processing, in turn, allows us to use the information to make strategic decisions and improve the efficiency of the processes involved. Therefore, knowledge processing systems, their theory and practice are receiving renewed focus. These systems include processes and activities such as cognition, knowledge production, learning, knowledge acquisition, reasoning, management and application. In this paper we discuss how knowledge processing can be viewed as manipulation of various knowledge structures and their transformation. We argue that efficient organization of knowledge processing has to be based on structure transformations of data represented in a symbolic form.

145 Lessons from Biology: Genes, Neurons, Neocortex and the New Computing Model for Cognitive Information Technologies

Published

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In this paper we analyze our current understanding of genes, neurons and the neocortex and draw a parallel to current implementations of cognitive computing in Silicon. We argue that current information technologies have evolved from the original stored program control architecture implementing the Turing machines which allowed us to model, configure, monitor and control any physical system using a Universal Turing Machine model. However, large scale of distributed computations and their tolerance requirement to fluctuations have created new challenges. We suggest that a new agent based computing model extension to the current Turing machine meets this challenge and provides a path to cognitive self-learning and self-managing systems.

146 Symbolic Information In Computing Devices

Published

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The extended abstract demonstrates how mathematical modeling reveals new information about physical symbols on the computer. A system of models based on Mark Burgin's named set theory uncovers a uniform pattern of data relations hidden in the relational database. It is called the Aleph data relation. Its parent/child relationship is self-similar to a tree structure. The discovery of Aleph paves the way for transforming relational data into decision trees automatically. The system of models that led to this discovery also provides our first glimpse into a deeper, more balanced view of 0's and 1's on the computer. When modeling the migration of the Aleph in a decision tree over four different states, each graphic depiction is different because each one responds to different feature in the setting. However, when the model in each state focuses solely on the Aleph's physical symbols and their parent/child relationship its composition remains intact over time and space. With this mathematical evidence, the author concludes that a deeper mathematical system holds the Aleph and its symbols together. With this in mind, the author proposes a theory on digital symbols based on these models. He believes that all digital symbols on the computer are composed of two meta-symbols: 1) physical-values and 2) constructed-types. The computer system employs these meta-symbols to manipulate strings of zeroes and ones, in a linguistic fashion, as types and tokens.

147 Transfer of genetic information: an innovative model

Published

Karl Javorszky

[1] I am the son of my parents.

Nature's Little Accounting Tricks

The sentence '*this* has been defined *such*' brings forth differing consequences in the technical sciences and in the humanities. The former will arrive at rules that regulate how the concept defined fits within the system of other concepts in a clean fashion, free of contradictions. In the latter, one will immediately question the social power of the ruling class, and investigate, what advantages have been achieved, and for whom, by de-legitimising alternative concepts to the definition imposed, and whether the elite presently ruling still maintains the credibility of monopolising the interpretation of phaenomena observed. The former will achieve a system of explanations that is logically homogenous and free of conflicts; the latter thrives on conflicts and works with the dialectic of alternatives.

Nature, of course, keeps her calm with respect to this controversy among humans. She just keeps doing her things, in her own fashion. We, as humans, are left with no choice other than having to *align our understanding*, and efforts of understanding, of what, and according to which rules, Mother Nature does, *to the facts observed*. The facts show that Nature ignores some of our definitions, and appears to work according to rules that do not obey some of our definitions. The insights resulting from not understanding some of Nature's processes will lead us to experiencing cognitive dissonance and some resistance in following avenues of thoughts that lead us outside of the system of what has been termed traditionally as 'rational thinking', insofar as rational thinking means following age-honoured systems of definitions.

As a psychologist, one cannot – and will not want to – avoid thinking in a fashion that accepts the existence of logical conflicts and of contradictions. One of the explanations, why classical Greek tragedies are of an immortal cultural value is, that in these each participant acts according to well-reasoned and impeccable logic: that is, no one is at fault – or "logically wrong" – by pursuing his goals: the situation makes the conflict unavoidable.

Not shying away from dealing with logical conflicts opens up wider perspectives in dealing with Nature's machinations. Once one is ready to disregard traditional definitions, one is free to construct explanatory models that do describe Nature in a simple, easy and comprehensive fashion and deliver the penny that drops while one cries "Aha!".

Specifically, if one disregards the definition of commutativity and observes that $(a,b) \rightarrow c$ is indeed different to $(b,a) \rightarrow c$, and one also overcomes the dichotomy *(commutative)* ↔ *(sequential)*, one has passed important milestones in understanding the nuts and bolts of how the combinatorics of the interplay between the *sequenced* DNA and the *commutative* organism actually functions.

My lecture invites the audience to work with new ideas. The trouble lies in accepting cognitive dissonance regarding to the eternal truth of definitions and in understanding that definitions are man-made and can well turn out to have been time-honoured, sensually seductive but nevertheless false. The shock the audience will experience is comparable to the shocks our forefathers had experienced while being confronted with the ideas that the Earth is not flat, and, later, that it circles the Sun: both assertions having been fundamental definitions of truth.

The new idea is presented by using irrefutable arguments that show some properties of *cyclic permutations*. We use some properties of natural numbers to show that ordering and reordering

logical tokens – actually, instances of *a+b=c* – allows us to recognise patterns that show *where* is *what*, and *when*. The numbers are beyond any discussions of being right or wrong, they are just numbers. What we can read out of the numbers can open the eyes, and give rise to discussions about whether the concept is practically applicable and how. It certainly seems useful as a tool of explaining how the transfer of genetic information is engineered by Nature. This lecture is an exercise in *forensic accounting* and will unveil some of the cute little accounting tricks Nature uses while managing the business of genetics (and of the memory and of pattern recognition and of learning, to point out the most obvious applications of the principles of information management).

148 Conceptual Computing Model *(A= (f(m), I))*

Published

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[1] Freedom Software

Abstract: Biomimetics is the examination of nature, its models, systems, processes, and elements to emulate or take inspiration from, in order to solve human problems. The term Biomimetics comes from the Greek words bios, meaning life, and mimesis, meaning to imitate. Applications of Biomimetics have led to innumerable advances in science and engineering. The Computer Science field is no exception. The von Neumann Architecture, on which modern computers are based, took significant inspiration from the brain. The human mind represents the pinnacle of natural creation when it comes to logical processing of information. Conceptually, computer systems are information processors, like our minds. As a consequence of Biomimetics principles, computer systems can be significantly improved by mimicking the conceptual model used by the mind: overall complexity, mathematical foundation, encapsulation, decoupling, scalability, interoperability, and realistic correspondence.

Keywords: computing models; concepts; information processing

Introduction & Motivation

The main contribution is the specification of the *Turing-complete* Conceptual computing model mimicked from the mind. A mathematical formulation for the model is described. It has been recommended that in order to fully describe the proposed model, we will need to rely on conceptual models studied by several disciplines including psychology, philosophy, and cognition (see Related Work). They will be mentioned when appropriate. *Relevant ideas such as realism (realistic correspondence), reductionism, and Occam's razor have had a prominent impact on science and scientific models [30, 29, 35]*; specifically, in the field of computer science where researchers have leveraged them before. Philosophical realism states that reality exists independent of the observer and that the *truth of a representation or model is determined by how it corresponds to reality (The Correspondence Theory of Truth[30])*. There are several key aspects that serve as motivation for *reductionism* [52]. Among them: ***a)*** *Unification of science.* ***b)*** *Minimization of terms and concepts used by theories in order to encourage theoretical simplicity and eradicate redundancy (Occam's razor). This aspect should make science more accessible and easier to learn (learning curve).* ***c)*** *Filling in of gaps and elimination of contradictions between theories.*

The issues associated with information technologies and solutions based on traditional models of computing have been studied by several authors [26,36,14,13,20]. The list of limitations includes the following. Consider the following quotes: "We can note in passing that one of the ***biggest problems*** in the development of object-oriented SW architectures, particularly in the last 25 years, has been an enormous over-focus on objects and an under-focus on messaging (most so-called

object-oriented languages *don't really* use the looser coupling of ***messaging***, but instead use the much tighter *gear meshing of procedure calls* – this hurts ***scalability and interoperability***)." Alan Kay et al.

"the complex machinery of procedure declarations including elaborate naming conventions, which are further complicated by the substitution rules needed in calling procedures. Each of these requires a complex mechanism to be built into

the framework so that variables, subscripted variables, pointers, file names, procedure names, call-by-value formal parameters, and so on, can all be properly interpreted."[26].

The implementation of traditional multithreaded/distributed information technologies and solutions is a complex endeavor, costly, and hampered by risks [26,14,13,4,5,15]: a) Complexities dealing with distributed information technologies [13, 14, 15, 20]. b) Complexity dealing with multithreaded information technologies. c) Mathematical foundations associated with traditional software/information technologies are often "complex, bulky, and not useful" [26]. "Another important shortcoming is their lack of useful mathematical properties and the obstacles they present to reasoning about programs" [26].

In his paper titled "Can Programming Be Liberated From the von Neumann Style?", Backus described several of the multiple issues associated with traditional models of computing [26]. Such issues are still relevant today. Several of them have been mentioned in this section. Several authors have also suggested the need for new models more adaptable, flexible, reliable, interactive, and natural – founded on information processing and natural computation [36, 29].

"This essay presents several ideas that combined result in a new view of natural, interactive computing as *information processing*, with *broad consequences* relevant for not only computer science and closely related fields of physics, mathematics and logic but even for traditionally non-mechanizable fields of biology, cognitive sciences and neuroscience. We have still much to learn from *nature* and especially from naturally intelligent *information processing* systems such as humans and animals which will bring about *new models of computation and intelligence* [*A=(f(m),I)/C*]." Gordana Dodig-Crnkovic [36]

Mathematical Model (Information Machine)

"The truth that the ultimate *laws of thought are mathematical in their form*, viewed in connexion with the fact of the possibility of error, establishes a ground for some *remarkable conclusions*. If we directed our attention to the scientific truth alone, we might be led to infer an almost exact parallelism between the intellectual operations and the movements of external nature." George Boole (!) [1].

"My contention is that machines can be constructed which will simulate the behavior of the human mind very closely." Alan Turing

There are three main concepts involved as part of the mathematical computing model. The mathematical formulation is very intuitive, based on abstractions that everyone can relate to and readily grasp.

Information Machine (A): An automatic machine able to perform computations via the information primitive which defines the machine's single function (or purpose). The machine A is defined by a two-tuple A= (*processInformation(message)*, I). A is Turing complete. It can also be expressed as ***A= (f(m), I)***, where *f* represents any computable function.

incoming information is processed in the forms of messages (m), also called information packets or chunks (IC). A message (m) is expressed by a n-tuple m = (b1, … , bn) where b1, … , bn are symbols in a finite set of symbols (alphabet (∑)).

$\epsilon \sum$; i ϵ [1.. n].

$\sum^*$

To be rigorous, ∑ needs to be included as part of the machine definition: ***A= (f(m), I, ∑)***. For the sake of simplicity, it is usually excluded. Information itself (I) can be classified into two categories: conceptual (C) and non-conceptual. The following definitions apply to conceptual information.
: conceptual information expressed by a single language Construct, C = (a1,a2, … ,an) where a1,a2, … ,an are information associations.
is an association of the form (xi, yi), meaning that xi is equal or associated to yi (xi = yi) where xi and yi are defined as follows.
- xi = (b1, …, bn); $b_i \in \sum$; i ϵ [1 .. n], or xi represents a concept as defined by C.
- yi = (b1, …, bn); $b_i \in \sum$; i ϵ [1 .. n], or yi represents a concept as defined by C.
In summary, the model consists of following main concepts: information, messaging, and processing of information as defined by a single mathematical function (*f(m)*). It should become obvious why information is the fundamental concept behind the model. A complex problem has been reduced, via conceptualization, to a complete and streamlined set of implementable concepts part of a straightforward mathematical model (Turing complete). Messaging is tightly intertwined with the concept of information. Through the concept of messaging, information is transferred and the machine is able to interact with its physical environment. To visualize the natural concepts involved, you may want to think about the human mind and the associated entities. Obviously, since the model attempts to mimic the mind, there is a realistic *one-to-one* correspondence. As usual, nature is leading the way in terms of a paradigm for computing and information processing: *conceptual paradigm*. One straightforward implementation of the Information Machine is via an encapsulated and decoupled component or object, consisting of a single method with a single parameter (message)[2, 4, 5, 9]. The method may return information in the form of a concept (C). A component/object that implements the Information Machine abstraction is called a Live or Animated component (see Implementation Considerations) [2, 4, 5, 9]. It can be visualized as a computer (mini-computer) since both have equivalent processing power.
From a conceptual perspective, it should be clear from observation of reality that the same three concepts leveraged by the Turing-complete information machine apply to the mind, in agreement with realism and The Correspondence Theory of Truth [30]. The information machine represents a *model* of the mind. It should be stated that scientific *models* do not need to be exact in order to be valid, but approximately true (see Models in Science [30]). Multiple valid models of the same natural phenomena are also feasible. Consider the weather models, for instance. Regardless of how closely the proposed mathematical *model* mimics the conceptual mind, it is *Turing complete*; also presents a wide range of measurable qualities applicable to information technologies (see Model Evaluation and Metrics [9]).On the other hand, it should be emphasized that realism (i.e. realistic correspondence) is a key aspect while evaluating scientific models.
Additional aspects related to realistic correspondence between the proposed mathematical model and the conceptual mind have been studied and documented in more detail (see Physical Foundation [9] and Related Work). Most of such aspects, mainly related to cognitive architectures, are substantial and beyond the scope of this paper, which focuses on the computing model (information machine) and its mathematical specification (*A=(f(m),I)/C)*.

Consequences
The consequences and qualities associated to the Conceptual computing model are derived from its mathematical foundation. Applications and components built based on the model inherit such qualities [9,4,5,2]. It should be obvious why information is the model's fundamental concept which does not come as a surprise since we are dealing with *information* technologies. Every aspect should be viewed from the standpoint of information.
Simplicity and Occam's razor: the conceptual model is straightforward – Turing-complete information machine (***A= (f(m),I))***, single information primitive, and single Concept construct to represent information (C). The Conceptual model is perhaps the simplest one, yet Turing complete.

All redundant abstractions and primitives add complexities and are unnecessary. Consider the simplification in terms of the number of concepts, components, and single primitive required for implementation: most entities in the world around us need to be realistically represented as concepts (C) because they are unable to process information (passive entities). The approach and associated mathematical formulation reduce (i.e. *conceptualize*) the universe of *information* technologies to a streamlined set of implementable concepts: information, messaging, and information machine.

"William of Occam opposed the proliferation of entities, but only when carried beyond what is needed --procter necessitatem! … But computer scientists must also look for something *basic* which underlies the various models; they are interested not only in individual designs and systems, but also in a *unified theory* of their ingredients." Robin Milner [29]

Completeness: the Conceptual approach is based on a Turing-complete information machine (*A=(f(m),I)*), and single language construct (Concept) [4,9]. Turing completeness has been demonstrated via formal proof (see Information Machine and Turing Completeness). Therefore, it can be used for the complete conceptualization and implementation of *arbitrary* information technologies.

Encapsulation. The Conceptual model and associated abstractions improve encapsulation. Component functionality, information (I), and processing mechanism are encapsulated into a single entity. They should not be artificially modeled as separate objects or components. It should be fairly obvious that the information machine (*A= (f(m),I)*) is a fully encapsulated and independent entity.

Coupling. Decoupling is improved by the Conceptual model. Component functionality, processing/treading mechanism, and messaging mechanism are decoupled. Each one can be modified independently without impacting the others. Again, it should be fairly obvious that the information machine (*A=(f(m),I)*) is fully decoupled from its environment. The Conceptual model does not present the web of interdependencies required by traditional APIs based on "gear meshing of procedure calls".

Interoperability: the Conceptual model helps improve interoperability [9,4,5,2]. The concept construct of the form C = {(x1, y1), … , (xn, yn)} can be freely transferred between systems and components regardless of technologies, languages, protocols, and data representation. The same principle applies to any arbitrary concept (C). In a sense, the concepts construct (C) is a fluid abstraction that can be interchanged between heterogeneous technologies, systems, components and applications. A process, based on the Turing-complete Conceptual computing model, can transparently incorporate components (*A=(f(m),I)*) and applications that use multiple technologies, languages, platforms, protocols, and so forth.

Scalability: As discussed by Alan Kay et al, technologies and models based on gear meshing of procedure calls present drawbacks in terms of scalability (see Introduction & Motivation). On the other hand, the Conceptual computing model does not present scalability limitations; client component, server component, and communication mechanism are decoupled. Servers can be upgraded one by one without an impact on the client application and the rest of the infrastructure. Once all the servers have been gradually upgraded, clients can be upgraded to take advantage of the new software functionality. As a consequence, an infrastructure based on the Conceptual model can scale well and handle an arbitrary number of servers and clients 24/7. This application of the proposed approach assumes that the new software version relies on backward-compatible messaging.

Realistic correspondence: there is an accurate correspondence between the Conceptual model and the way information is transferred and processed in the real world (The Correspondence Theory of Truth[30]). In particular, the *unified* model attempts to mimic the mind's conceptual framework. Artificial abstractions/primitives are redundant and may exhibit complexity, limitations, and/or inefficiencies (like gear meshing of procedure calls). Notice the faithful correspondence between the mathematical model and reality. All the relevant concepts are included: information (concept construct (C)), messaging, and processing of information. All of them cooperate in harmony and

unity. The Conceptual computing model is also in close correspondence with or supported by leading psychological, cognitive, and philosophical theories of the mind (see Related Work).
"It is necessary to remark that there is an ongoing synthesis of computation and communication into a unified process of *information processing*. Practical and theoretical advances are aimed at this synthesis and also use it as a tool for further development. Thus, we use the word computation in the sense of *information processing* as a whole. Better theoretical understanding of computers, networks, and other information processing systems will allow us to develop such systems to a higher level. " Mark Burgin [36]

Implementation Considerations

The separation between the involved concepts (model) and their implementation needs to be emphasized, which is a common characteristic found in related approaches [46], [11]. Thus, multiple valid implementations (i.e. realizations) of the same Turing-complete mathematical model are feasible. As a specific example, a Turing machine represents a mathematical model that can have multiple realizations.
One straightforward software implementation of the Turing-complete information machine *(A=(f(m),I))* is via an encapsulated object or component consisting of a single method with a single parameter (message). Such component/object is called a Live or Animated component [2, 5, 9]. As an example, the following software snippet uses Java/Android for implementation. The appendix includes a complete example.

```
public Class AnimatedComponent  {
    /* Process component messages */
    public Object processMessage (Object message) {
      Object reply;
       // Add logic to process the message here. Intuitively, any function or procedure can
be    implemented.
      //Optionally, auxiliary internal methods (private) may be invoked from this
      // single information primitive implementing messaging.
      ...
      // Return a reply (output)
      return (reply); } }
```

Due to Turing-completeness, the Live/Animated component is able to implement any computable function or algorithm (*f(m)*). Therefore, Live/Animated components can be leveraged to implement arbitrary information technologies. For instance, the group of components required to provide comprehensive distributed capabilities: distributed access, messaging, and security.

Information Machine and Turing Completeness

This section discusses the proposed mathematical model and demonstrates its Turing-completeness. A Turing machine is specified as a 7-tuple $M= (Q,\Gamma,b,\Sigma ,\delta,q_0, F)$. Given an arbitrary Turing machine, let us demonstrate that an equivalent information machine (*A=(f(m),I)*) can be built based on the information primitive *f(m)*. To be rigorous, ∑ needs to be included as part of the machine definition: *A= (f(m),I,∑)*. For the sake of simplicity, it is usually excluded.
The machine tape can be implemented as an array, vector, or any other comparable data structure. It is part of the information (I) stored in the machine's memory subcomponent. The machine's transition table, current state, initial state, and set of final states are also part of (I).

```
// Pseudocode implementation based on the information primitive (f(m)).
// The message (m) consists of a single symbol.
void processInformation (symbol) {
  Transition transition;   // Consists of next state, symbol to be written,
                           // and tape movement ('L' or 'R')
```

```
  // Transition table being replicated.
   transition = transitionTable[currentState, symbol];
  // The following two operations on the machine tape mimic the ones implemented
  //  by a Turing machine
  updateTape(transition.symbol);      // Update the machine tape
  moveHead (transition.movement); // Move the head
  currentState = transition.nextState ; // Part of the information stored in the
                                        // machine's memory
}
```

For any arbitrary Turing machine (M), an equivalent information machine (A) can be built, which demonstrates that *A= (f(m),I)* is Turing complete. As a consequence, and based on the Church-Turing thesis, any computable function or algorithm can be computed by using the information machine (A). *f:∑*à ∑** is a generalization of *processInformation(symbol)* applicable to messages (information chunks) of finite length (∑*), as opposed to a single symbol. Animated/Live components represent a software implementation of Turing-complete information machine. In other words, Animated/Live components based on the information primitive (*f(m)*) can be used to implement any arbitrary computer technology, protocol, language, and/or framework including secure, distributed, and fault-tolerant technologies. There is an alternative approach to demonstrate Turing completeness (see Information Machine and Turing Completeness [9]). Intuitively, for any computable function (*f'(m)*) of your choosing, an information machine or corresponding Animated/Live component can be built (*A= (f'(m),I)*) to compute it.

Evidence, Evaluation, and Metrics

A reference implementation of the Conceptual computing model has been produced which demonstrates its applicability and qualities in a tangible fashion (tangible evidence). An evaluation of the model and its reference implementation has been performed in qualitative and quantitative terms (see Model Evaluation and Metrics [9]). Several production quality applications have been built based on the reference implementation of the Conceptual model. Tangible research results based on the Conceptual approach have been published earlier [4, 5, 2]. Turing completeness has been demonstrated via formal proof (see Information Machine and Turing Completeness).

Related Work

The study of the conceptual mind is a multidisciplinary endeavor. Multiple related disciplines have made significant contributions: psychology, neuroscience, computer science, mathematics (logic), and philosophy. *Relevant ideas such as realism (realistic correspondence), reductionism, and Occam's razor have had a prominent impact on science and scientific models [30, 29]*: specifically, in the field of computer science where researchers have leveraged them before. Clearly, these ideas have significant relevance to the realistic computing model being presented.

The Conceptual approach represents a *mathematical computing model (Turing complete)*. Multiple models of computing have been proposed [26]: operational, applicative, and von Newmann models (see Model Evaluation and Metrics [9]). Through the years, additional approaches of parallel computation have been proposed [45]: PRAM (parallel random-access machine), BSP (Bulk synchronous parallelism), and LogP. Related mathematical models of concurrency have been proposed: Actor Model, Process Algebras, and Petri Nets [7, 29]. All of these models of computing have a distinctly different mathematical foundation. There are conceptual differences as well, in terms of degree of realistic correspondence, abstractions, simplicity (Occam's razor), single information primitive, applicability (focus/ problem area), natural inspiration (Biomimetics), and overall goal of

mimicking the mind's framework/model for information processing (see appendix on Related Models and Approaches [9]).

The Turing-Complete Conceptual model can be applied to the implementation of arbitrary computing/information technologies. Due to its versatility and wide applicability, it can be compared to a large variety of related models which is challenging because of diversity and number. However, due to size constraints, it is not feasible to completely cover all of them within this section. For a complete discussion, please check reference 9. It should be stated that all related models, technologies, reuse approaches, and architectural styles are distinctly different because of their mathematical foundations (i.e. model). As a general rule of thumb, if the technology, approach or architectural style is not based on the proposed Turing-complete mathematical formulation *(A=(f(m),I)/C)*, then it is clearly different. Furthermore, if the underlying model consists of more abstractions than the ones proposed (3), there is redundancy that should be 'shaved away' according to reductionism/Occam's razor and the concepts exhibited by the natural mind. Redundant abstractions bring forth unnecessary complexity. In agreement with Occam's razor, reductionism, Biomimetics, and the Turing-complete Conceptual computing model, all *information* models, technologies, approaches, and architectural styles can be reduced (unified/simplified) to the concepts part of the model: *information*, messaging, and information processor/machine (*A=(f(m),I)).*

As mentioned before, the Turing-complete Conceptual model is in correspondence with and/or supported by well-known theories and related disciplines [9, 30, 25, 31, 32, 21, 53]: computational theory of mind (CTM), The Language of Thought Hypothesis (LOTH), cognitive psychology, psychology, psychological associationism, Unified Theories of Cognition (UTC), Physical Symbol System Hypothesis (PSSH), and philosophical conceptualism/realism. References 9 covers the realistic correspondence between the mathematical model and the conceptual mind in more detail, as part of the cognitive area, which is substantial and beyond the scope of this paper (see Cognitive/AI Architecture and appendix on Related Theories, Studies, and Research[9]).

A Conceptual computing model is a broad subject applicable to a wide variety of information technologies and problem areas (due to Turing completeness). It is not feasible to cover all the relevant information and supporting evidence within a single document. Thus, this document includes *multiple cross references*. If a specific area of interest seems to be missing information, I would recommend you to review the references. Reference 9 provides a more detailed picture of the overall effort. It covers information that had to be excluded or condensed due to size constraints. In particular, comparisons with related models and approaches are discussed (see appendix on Related Models and Approaches [9]). Reference implementation of the model, formal demonstrations (Turing completeness), detailed evaluation/metrics, code examples, and additional implementation/technical consideration are also discussed in detail.

Author Contributions: Ed Galvis and Daniel Galvis coauthor the Turing-complete Conceptual computing model *(A = (f(m), I))*.

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149 Addressing the role of Information in Synthetic Biology

Published

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Introduction

It is known that living things are a type of dissipative systems. A very special class, because they manage to stay far from thermodynamic equilibrium for reasons that are internal to these systems. Living systems are good enough at capturing energy from their environment and dissipating that energy as heat. But in the middle, self-organizes, they survive and replicate themselves.

It is in this sense that my proposal is based on the assertion that all these phenomena are possible only if we think that biological information is a key property of life.
The proposal presented, asks researchers to rethink about a new conceptual framework, thus our proposal confronts the question: What are the possible causes that led the origin of life? Most of us know the importance of understanding molecular components and its interactions. However, it is also vital to find out how these chemical compounds were able to produce a dynamic self-organization minimally complex.
On the other hand, it seems that information has become a key concept in many areas of biology such as evolution, ecology, molecular biology, among others. Likewise, it is suggested that many of the most fundamental biochemical processes, within living systems, involve the transfer and processing of information.
Consequently, the concept of temporality is crucial in order to approach and adequate understanding related to the emergence of biological systems. As it is already known, these systems owe their appearance to certain very specific conditions, and I state the importance of approaching biological phenomena with concepts such as processes, timing, irreversibility, information, meaning and other associated notions [1-3].
But the main problem is we do not have yet a universal definition of biological information, clearly addressed and differentiated from, the term used in physics or computer science, for instance.
Our study itself will be focused in the relationship between biological information and biological organization [4].

Methods

My first task will be find ways to measure and quantify how much information is created in the dynamics of some protocellular models found in literature [5].
Moving on to the subject of synthetic protocells, it is important to be aware that not all protocell models would be capable of creating, transmitting and receiving information. It seems reasonable to think that the essence of synthetic protocells doesn't necessarily offer an extensive diversity of forms of encoding information [6].
Our final task will be to analyze and measure, with these results, changes of biological information within the evolution of bacterial quorum sensing (QS) and find out what could be accomplished by design and implementation of artificial QS devices taking into account this property [7-8].

Results and Discussion

My general idea is that biological information is one of the principles that make possible the emergence of prebiotic world: the dawn of life on Earth may have been caused by early emergence of biological information. This prior emergence of biological information doesn't necessarily refer to self-replication of information-coding polymers.
My proposal is to address this key property from the perspective of its origins.
I therefore offer a theory suggesting that biological information could be a causal factor responsible for self-organization phenomena and other fundamental properties of life. I contend that this model of minimal complexity could allow discovery of underlying patterns and principles of life [9-11].
Furthermore, my approach connects the ontology processes with the analysis of biological phenomena, from the perspective of complex networks theory [12]. Living systems are essentially a molecular dynamic network phenomenon.
This particular dynamic of molecular self-organizing networks, should contain information that has been created, transmitted and processed.
On the other hand, we find that living systems are able to carry and process a variety of information using the same signaling cascade, for example, in the presence of various agonists [13].
Given the factual evidence above, I am able to state with confidence that biological information holds a very unique feature, which is being inherently context-dependent, and something important to point out here is, that these different forms of transferring information, apparently share

something in common: they are all related to the "fluctuations" found in the ways they are transmitted.
If I am on the right track, a form to detect and measure the transmission of biological information as fluctuation (any form of fluctuation) could be done through transfer entropy [14].
This gives me a great deal of confidence in my ability to accomplish the same goal with the Quorum-Sensing Systems.
Since there are at least three identified main Quorum-Sensing Networks; Gram Positive, Gram Negative and one I refer as Universal. I will continue working on my research to decode and understand the transmission of language present in molecular mechanisms [15].
With this end in mind, the first step is to build robust QS circuit diagrams, and to achieve this I will use the computer-aided design software tool for Synthetic Biology and use the quorum-sensing signalling peptides database.

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150 Conceptual Computing Model *(A=f(m), I))*

Published

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Abstract—Biomimetics is the examination of nature, its models, systems, processes, and elements to emulate or take inspiration from, in order to solve human problems. The term Biomimetics comes from the Greek words bios, meaning life, and mimesis, meaning to imitate. Applications of Biomimetics have led to innumerable advances in science and engineering. The Computer Science field is no exception. The von Neumann Architecture, on which modern computers are based, took significant inspiration from the brain. The human mind represents the pinnacle of natural creation when it comes to logical processing of information. Conceptually, computer systems are information processors, like our minds. As a consequence of Biomimetics principles, computer systems can be significantly improved by mimicking the conceptual model used by the mind: overall complexity, mathematical foundation, encapsulation, decoupling, scalability, interoperability, and realistic correspondence.

1. INTRODUCTION & MOTIVATION

The main contribution of this abstract is the specification of the *Turing-complete* Conceptual computing model mimicked from the mind. A mathematical formulation for the model is described. It has been recommended that in order to fully describe the proposed model, we will need to rely on conceptual models studied by several disciplines including psychology, philosophy, and cognition (see Related Work). They will be mentioned when appropriate. *Relevant ideas such as realism (realistic correspondence), reductionism, and Occam's razor have had a prominent impact on science and scientific models [30, 29, 35]*; specifically, in the field of computer science where researchers have leveraged them before. Philosophical realism states that reality exists independent of the observer and that the *truth of a representation or model is determined by how it corresponds to reality (The Correspondence Theory of Truth[30]).* There are several key aspects that serve as motivation for *reductionism* [52]. Among them: ***a)*** *Unification of science.* ***b)*** *Minimization of terms and concepts used by theories in order to encourage theoretical simplicity and eradicate redundancy (Occam's razor). This aspect should make science more accessible and easier to learn (learning curve).****c)*** *Filling in of gaps and elimination of contradictions between theories.*

The issues associated with information technologies and solutions based on traditional models of computing have been studied by several authors [26,36,14,13,20]. The list of limitations includes the following.

Consider the following quotes: "We can note in passing that one of the ***biggest problems*** in the development of object-oriented SW architectures, particularly in the last 25 years, has been an enormous over-focus on objects and an under-focus on messaging (most so-called object-oriented languages *don't really* use the looser coupling of ***messaging***, but instead use the much tighter *gear meshing of procedure calls* – this hurts ***scalability and interoperability***)." Alan Kay et al.

"the complex machinery of procedure declarations including elaborate naming conventions, which are further complicated by the substitution rules needed in calling procedures. Each of these requires a complex mechanism to be built into the framework so that variables, subscripted variables, pointers, file names, procedure names, call-by-value formal parameters, and so on, can all be properly interpreted."[26].

The implementation of traditional multithreaded/distributed information technologies and solutions is a complex endeavor, costly, and hampered by risks [26,14,13,4,5,15]: a) Complexities dealing with distributed information technologies [13, 14, 15, 20]. b) Complexity dealing with multithreaded information technologies. c) Mathematical foundations associated with traditional software/information technologies are often "complex, bulky, and not useful" [26]. "Another important shortcoming is their lack of useful mathematical properties and the obstacles they present to reasoning about programs" [26].

In his paper titled "Can Programming Be Liberated From the von Neumann Style?", Backus described several of the multiple issues associated with traditional models of computing [26]. Such issues are still relevant today. Several of them have been mentioned in this section. Several authors have also suggested the need for new models more adaptable, flexible, reliable, interactive, and natural – founded on information processing and natural computation [36, 29].

"This essay presents several ideas that combined result in a new view of natural, interactive computing as *information processing*, with *broad consequences* relevant for not only computer science and closely related fields of physics, mathematics and logic but even for traditionally non-mechanizable fields of biology, cognitive sciences and neuroscience. We have still much to learn from *nature* and especially from naturally intelligent *information processing* systems such as humans and animals which will bring about *new models of computation and intelligence* [*A=(f(m),I)/C*]." Gordana Dodig-Crnkovic [36]

2. Mathematical Model (Information Machines)

"The truth that the ultimate *laws of thought are mathematical in their form*, viewed in connexion with the fact of the possibility of error, establishes a ground for some *remarkable conclusions*. If we directed our attention to the scientific truth alone, we might be led to infer an almost exact parallelism between the intellectual operations and the movements of external nature." George Boole (!) [1].

"My contention is that machines can be constructed which will simulate the behavior of the human mind very closely." Alan Turing

There are three main concepts involved as part of the mathematical computing model. The mathematical formulation is very intuitive, based on abstractions that everyone can relate to and readily grasp.

Information Machine (A): An automatic machine able to perform computations via the information primitive which defines the machine's single function (or purpose). The machine A is defined by a two-tuple A= (*processInformation(message)*, I). A is Turing complete. It can also be expressed as ***A= (f(m), I)***, where *f* represents any computable function.

15. incoming information is processed in the forms of messages (m), also called information packets or chunks (IC). A message (m) is expressed by a n-tuple m = (b1, … , bn) where b1, … , bn are symbols in a finite set of symbols (alphabet (∑)).
16. $\epsilon \sum$; i ϵ [1.. n].
17. $\sum^*$

To be rigorous, ∑ needs to be included as part of the machine definition: ***A= (f(m), I, ∑)***. For the sake of simplicity, it is usually excluded. Information itself (I) can be classified into two categories: conceptual (C) and non-conceptual. The following definitions apply to conceptual information.

18. : conceptual information expressed by a single language Construct, C = (a1,a2, … ,an) where a1,a2, … ,an are information associations.
19. is an association of the form (xi, yi), meaning that xi is equal or associated to yi (xi = yi) where xi and yi are defined as follows.

- xi = (b1, …, bn); $b_i \epsilon \sum$; i ϵ [1 .. n], or xi represents a concept as defined by C.
- yi = (b1, …, bn); $b_i \epsilon \sum$; i ϵ [1 .. n], or yi represents a concept as defined by C.

In summary, the model consists of following main concepts: information, messaging, and processing of information as defined by a single mathematical function (*f(m)*). It should become obvious why information is the fundamental concept behind the model. A complex problem has been reduced, via conceptualization, to a complete and streamlined set of implementable concepts part of a straightforward mathematical model (Turing complete). Messaging is tightly intertwined with the concept of information. Through the concept of messaging, information is transferred and the machine is able to interact with its physical environment. To visualize the natural concepts involved, you may want to think about the human mind and the associated entities. Obviously, since the model attempts to mimic the mind, there is a realistic *one-to-one* correspondence. As usual, nature is leading the way in terms of a paradigm for computing and information processing: *conceptual paradigm*. One straightforward implementation of the Information Machine is via an encapsulated and decoupled component or object, consisting of a single method with a single parameter (message)[2, 4, 5, 9]. The method may return information in the form of a concept (C). A component/object that implements the Information Machine abstraction is called a Live or Animated component (see Implementation Considerations) [2, 4, 5, 9]. It can be visualized as a computer (mini-computer) since both have equivalent processing power.

From a conceptual perspective, it should be clear from observation of reality that the same three concepts leveraged by the Turing-complete information machine apply to the mind, in agreement with realism and The Correspondence Theory of Truth [30]. The information machine represents a *model* of the mind. It should be stated that scientific *models* do not need to be exact in order to be valid, but approximately true (see Models in Science [30]). Multiple valid models of the same natural phenomena are also feasible. Consider the weather models, for instance. Regardless of how closely the proposed mathematical *model* mimics the conceptual mind, it is *Turing complete*; also presents a wide range of measurable qualities applicable to information technologies (see Model Evaluation and Metrics [9]).On the other hand, it should be emphasized that realism (i.e. realistic correspondence) is a key aspect while evaluating scientific models.

Additional aspects related to realistic correspondence between the proposed mathematical model and the conceptual mind have been studied and documented in more detail (see Physical Foundation [9] and Related Work). Most of such aspects, mainly related to cognitive architectures, are substantial and beyond the scope of this paper, which focuses on the computing model (information machine) and its mathematical specification (*A=(f(m),I)/C)*.

3. Consequences

The consequences and qualities associated to the Conceptual computing model are derived from its mathematical foundation. Applications and components built based on the model inherit such qualities [9,4,5,2]. It should be obvious why information is the model's fundamental concept which does not come as a surprise since we are dealing with *information* technologies. Every aspect should be viewed from the standpoint of information.

Simplicity and Occam's razor: the conceptual model is straightforward – Turing-complete information machine (*A= (f(m),I))*, single information primitive, and single Concept construct to represent information (C). The Conceptual model is perhaps the simplest one, yet Turing complete. All redundant abstractions and primitives add complexities and are unnecessary. Consider the simplification in terms of the number of concepts, components, and single primitive required for implementation: most entities in the world around us need to be realistically represented as concepts (C) because they are unable to process information (passive entities). The approach and associated mathematical formulation reduce (i.e. *conceptualize*) the universe of *information* technologies to a streamlined set of implementable concepts: information, messaging, and information machine.

"William of Occam opposed the proliferation of entities, but only when carried beyond what is needed --procter necessitatem! … But computer scientists must also look for something *basic* which

underlies the various models; they are interested not only in individual designs and systems, but also in a *unified theory* of their ingredients." Robin Milner [29]

Completeness: the Conceptual approach is based on a Turing-complete information machine (***A=(f(m),I))***, and single language construct (Concept) [4,9]. Turing completeness has been demonstrated via formal proof (see Information Machine and Turing Completeness). Therefore, it can be used for the complete conceptualization and implementation of *arbitrary* information technologies.

Encapsulation. The Conceptual model and associated abstractions improve encapsulation. Component functionality, information (I), and processing mechanism are encapsulated into a single entity. They should not be artificially modeled as separate objects or components. It should be fairly obvious that the information machine (*A= (f(m),I)*) is a fully encapsulated and independent entity.

Coupling. Decoupling is improved by the Conceptual model. Component functionality, processing/treading mechanism, and messaging mechanism are decoupled. Each one can be modified independently without impacting the others. Again, it should be fairly obvious that the information machine (*A=(f(m),I)*) is fully decoupled from its environment. The Conceptual model does not present the web of interdependencies required by traditional APIs based on "gear meshing of procedure calls".

Interoperability: the Conceptual model helps improve interoperability [9,4,5,2]. The concept construct of the form C = {(x1, y1), … , (xn, yn)} can be freely transferred between systems and components regardless of technologies, languages, protocols, and data representation. The same principle applies to any arbitrary concept (C). In a sense, the concepts construct (C) is a fluid abstraction that can be interchanged between heterogeneous technologies, systems, components and applications. A process, based on the Turing-complete Conceptual computing model, can transparently incorporate components (*A=(f(m),I))* and applications that use multiple technologies, languages, platforms, protocols, and so forth.

Scalability: As discussed by Alan Kay et al, technologies and models based on gear meshing of procedure calls present drawbacks in terms of scalability (see Introduction & Motivation). On the other hand, the Conceptual computing model does not present scalability limitations; client component, server component, and communication mechanism are decoupled. Servers can be upgraded one by one without an impact on the client application and the rest of the infrastructure. Once all the servers have been gradually upgraded, clients can be upgraded to take advantage of the new software functionality. As a consequence, an infrastructure based on the Conceptual model can scale well and handle an arbitrary number of servers and clients 24/7. This application of the proposed approach assumes that the new software version relies on backward-compatible messaging.

Realistic correspondence: there is an accurate correspondence between the Conceptual model and the way information is transferred and processed in the real world (The Correspondence Theory of Truth[30]). In particular, the ***unified*** model attempts to mimic the mind's conceptual framework. Artificial abstractions/primitives are redundant and may exhibit complexity, limitations, and/or inefficiencies (like gear meshing of procedure calls). Notice the faithful correspondence between the mathematical model and reality. All the relevant concepts are included: information (concept construct (C)), messaging, and processing of information. All of them cooperate in harmony and unity. The Conceptual computing model is also in close correspondence with or supported by leading psychological, cognitive, and philosophical theories of the mind (see Related Work).

"It is necessary to remark that there is an ongoing synthesis of computation and communication into a **unified** process of *information processing*. Practical and theoretical advances are aimed at this synthesis and also use it as a tool for further development. Thus, we use the word computation in the sense of *information processing* as a whole. Better theoretical understanding of computers, networks, and other information processing systems will allow us to develop such systems to a higher level. " Mark Burgin [36]

4. IMPLEMENTATION CONSIDERATIONS

The separation between the involved concepts (model) and their implementation needs to be emphasized, which is a common characteristic found in related approaches [46], [11]. Thus, multiple valid implementations (i.e. realizations) of the same Turing-complete mathematical model are feasible. As a specific example, a Turing machine represents a mathematical model that can have multiple realizations.

One straightforward software implementation of the Turing-complete information machine *(A=(f(m),I))* is via an encapsulated object or component consisting of a single method with a single parameter (message). Such component/object is called a Live or Animated component. As an example, the following software snippet uses Java/Android for implementation. The appendix includes a complete example.

```
public Class AnimatedComponent {
/* Process component messages */
public Object processMessage (Object message) {
Object reply;
// Add logic to process the message here. Intuitively, any function or procedure can be implemented.
//Optionally, auxiliary internal methods (private) may be invoked from this
// single information primitive implementing messaging.
...
// Return a reply (output)
return (reply); } }
```

Due to Turing-completeness, the Live/Animated component is able to implement any computable function or algorithm (*f(m)*). Therefore, Live/Animated components can be leveraged to implement arbitrary information technologies. For instance, the group of components required to provide comprehensive distributed capabilities: distributed access, messaging, and security.

5. Information Machine and Turing Completeness

This section discusses the proposed mathematical model and demonstrates its Turing-completeness. A Turing machine is specified as a 7-tuple $M= (Q,\Gamma,b,\Sigma ,\delta,q_0, F)$. Given an arbitrary Turing machine, let us demonstrate that an equivalent information machine (*A=(f(m),I)*) can be built based on the information primitive *f(m)*. To be rigorous, ∑ needs to be included as part of the machine definition: $A= (f(m),I,\sum)$. For the sake of simplicity, it is usually excluded.

The machine tape can be implemented as an array, vector, or any other comparable data structure. It is part of the information (I) stored in the machine's memory subcomponent. The machine's transition table, current state, initial state, and set of final states are also part of (I).

```
// Pseudocode implementation based on the information primitive (f(m)).
// The message (m) consists of a single symbol.
void processInformation (symbol) {
Transition transition; // Consists of next state, symbol to be written,
// and tape movement ('L' or 'R')

// Transition table being replicated.
transition = transitionTable[currentState, symbol];
// The following two operations on the machine tape mimic the ones implemented
// by a Turing machine
updateTape(transition.symbol); // Update the machine tape
moveHead (transition.movement); // Move the head
currentState = transition.nextState ; // Part of the information stored in the
// machine's memory
}
```

For any arbitrary Turing machine (M), an equivalent information machine (A) can be built, which demonstrates that *A= (f(m),I)* is Turing complete. As a consequence, and based on the Church-Turing thesis, any computable function or algorithm can be computed by using the information machine (A). *f:∑*à ∑** is a generalization of *processInformation(symbol)* applicable to messages (information chunks) of finite length (∑*), as opposed to a single symbol. Animated/Live components represent a software implementation of Turing-complete information machine. In other words, Animated/Live components based on the information primitive (*f(m))* can be used to implement any arbitrary computer technology, protocol, language, and/or framework including secure, distributed, and fault-tolerant technologies. There is an alternative approach to demonstrate Turing completeness (see Information Machine and Turing Completeness [9]). Intuitively, for any computable function (*f'(m))* of your choosing, an information machine or corresponding Animated/Live component can be built (*A= (f'(m),I))* to compute it.

6. Evidence, EVALUATION, and Metrics

A reference implementation of the Conceptual computing model has been produced which demonstrates its applicability and qualities in a tangible fashion (tangible evidence). An evaluation of the model and its reference implementation has been performed in qualitative and quantitative terms (see Model Evaluation and Metrics [9]). Several production quality applications have been built based on the reference implementation of the Conceptual model. Tangible research results based on the Conceptual approach have been published earlier [4, 5, 2]. Turing completeness has been demonstrated via formal proof (see Information Machine and Turing Completeness).

7. Related Work

The study of the conceptual mind is a multidisciplinary endeavor. Multiple related disciplines have made significant contributions: psychology, neuroscience, computer science, mathematics (logic), and philosophy. *Relevant ideas such as realism (realistic correspondence), reductionism, and Occam's razor have had a prominent impact on science and scientific models [30, 29]*: specifically, in the field of computer science where researchers have leveraged them before. Clearly, these ideas have significant relevance to the realistic computing model being presented.

The Conceptual approach represents a *mathematical computing model (Turing complete)*. Multiple models of computing have been proposed [26]: operational, applicative, and von Newmann models (see Model Evaluation and Metrics [9]). Through the years, additional approaches of parallel computation have been proposed [45]: PRAM (parallel random-access machine), BSP (Bulk synchronous parallelism), and LogP. Related mathematical models of concurrency have been proposed: Actor Model, Process Algebras, and Petri Nets [7, 29]. All of these models of computing have a distinctly different mathematical foundation. There are conceptual differences as well, in terms of degree of realistic correspondence, abstractions, simplicity (Occam's razor), single information primitive, applicability (focus/ problem area), natural inspiration (Biomimetics), and overall goal of mimicking the mind's framework/model for information processing (see appendix on Related Models and Approaches [9]).

The Turing-Complete Conceptual model can be applied to the implementation of arbitrary computing/information technologies. Due to its versatility and wide applicability, it can be compared to a large variety of related models which is challenging because of diversity and number. However, due to size constraints, it is not feasible to completely cover all of them within this section. For a complete discussion, please check reference 9. It should be stated that all related models, technologies, reuse approaches, and architectural styles are distinctly different because of their mathematical foundations (i.e. model). As a general rule of thumb, if the technology, approach or architectural style is not based on the proposed Turing-complete mathematical formulation

(*A=(f(m),I)/C*), then it is clearly different. Furthermore, if the underlying model consists of more abstractions than the ones proposed (3), there is redundancy that should be 'shaved away' according to reductionism/Occam's razor and the concepts exhibited by the natural mind. Redundant abstractions bring forth unnecessary complexity. In agreement with Occam's razor, reductionism, Biomimetics, and the Turing-complete Conceptual computing model, all *information* models, technologies, approaches, and architectural styles can be reduced (unified/simplified) to the concepts part of the model: *information*, messaging, and information processor/machine (*A=(f(m),I)).*
As mentioned before, the Turing-complete Conceptual model is in correspondence with and/or supported by well-known theories and related disciplines [9, 30, 25, 31, 32, 21, 53]: computational theory of mind (CTM), The Language of Thought Hypothesis (LOTH), cognitive psychology, psychology, psychological associationism, Unified Theories of Cognition (UTC), Physical Symbol System Hypothesis (PSSH), and philosophical conceptualism/realism. References 9 covers the realistic correspondence between the mathematical model and the conceptual mind in more detail, as part of the cognitive area, which is substantial and beyond the scope of this paper (see Cognitive/AI Architecture and appendix on Related Theories, Studies, and Research[9]).
A Conceptual computing model is a broad subject applicable to a wide variety of information technologies and problem areas (due to Turing completeness). It is not feasible to cover all the relevant information and supporting evidence within a single document. Thus, this extended abstract includes *multiple cross references*. If a specific area of interest seems to be missing information, I would recommend you to review the references. Reference 9 provides a more detailed picture of the overall effort. It covers information that had to be excluded or condensed due to size constraints. In particular, comparisons with related models and approaches are discussed (see appendix on Related Models and Approaches [9]). Reference implementation of the model, formal demonstrations (Turing completeness), detailed evaluation/metrics, code examples, and additional implementation/technical consideration are also discussed in detail.

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151 Information as a complex notion with Physical and Semantic information substituting for Real and Imaginary constituents

Published

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Shannon's Information theory was devised to improve communication systems performance and to assure an efficient and reliable message exchange over a communication channel. In this contexts, the question "what is information" per se has never been asked and was irrelevant to the engineering problems under consideration. The newly invented notion of "information measure" has served the design tasks pretty well. That led to a long lasting improper mixing and merging between notions of "information" and "information measure", which, in turn, made the relations between notion of "information" and notions of "data", "knowledge", and "semantics", blurred, intuitive and undefined.

However, recent advances in almost all scientific fields put an urgent demand for an explicit definition of what information is; especially, what is meaningful information that dominates today the contemporary life science research. To meet this demand, I have proposed a new definition of information, which in its last edition sounds like this:
"Information is a linguistic description of structures observable in a given data set".

Here, I would like to provide some auxiliary arguments justifying this definition: Shannon's Information Theory was devised to be used in communication systems, where the transmitted

message is always shaped as a linear one-dimensional string of signal data. Even a TV image was once transmitted in a line-by-line scan fashion. However, human brain perceives image as a single two-dimensional entity. Providing an information measure for a two-dimensional signal is a problem not foreseen by the Information Theory. Therefore, I have wittingly chosen a digital image to explore my "what information is" definition.

A digital image is a two-dimensional set of data elements called picture elements or pixels. In an image, pixels are placed not randomly, but, due to the similarity in their physical properties, they are naturally grouped into some lumps or clusters. I propose to call these clusters **primary or physical data structures**.

In the eyes of an external observer, the primary data structures are further grouped into more larger and complex agglomerations, which I propose to call **secondary data structures** (structures of structures). These secondary structures reflect human observer's view on the grouping of primary data structures, and therefore they could be called **meaningful or semantic data structures**. While formation of primary (physical) data structures is based on objective (natural, physical) properties of data, the subsequent formation of secondary (semantic) data structures is a subjective process guided by human conventions and habits.

As it was said, **Description of structures observable in a data set should be called "Information".** In this regard, two types of information must be distinguished – **Physical Information and Semantic Information**. They are both language-based descriptions; however, physical information can be described with a variety of languages (recall that mathematics is also a language), while semantic information can be described only by means of natural human language. (More details on the subject could be find in [1]).

The segregation between physical and semantic information is the most essential insight about the nature of information provided by the new definition. Indeed, most of the present-day followers of Shannon's Information Theory speak predominantly about Integrated Information Theory, Generalized Information Theory, United, Unified, Integral, Consolidated and so on "Informations", cherishing the idea that semantic information can be seen as an extension of Shannon's information and in some way be merged with it. Shannon personally has always distanced himself from such an approach and has warned (in 1956): "In short, information theory is currently partaking of a somewhat heady draught of general popularity. It will be all too easy for our somewhat artificial prosperity to collapse overnight when it is realized that the use of a few exciting words like information, entropy, redundancy, do not solve all our problems", [2].

Although my definition of information as a complex notion composed of Real and Imaginary parts (in our case Physical and Semantic information) undoubtedly highlights the information duality, the mainstream information processing community persistently tries to treat them jointly.

From the point of view of my definition, all known today "informations" such as Shannon's, Fisher's, Renyi's, Kolmogorov's, and Chaitin's informations – they all should be seen as physical information incarnations. Categorically, semantic information cannot be derived or be drawn from physical information. Despite of this, people persistently try to do that again and again.

Only from the point of view of my definition, the ambiguous relations between data and information, knowledge and information, cognition and information, could be clarified and made distinct. Floridi's question "is information meaningful data?" now has to be answered decidedly: **No!** Information does not have any deal with data! Semantic information (semantic interpretation) is ascribed to

physical information, and not to the data that carries it. The relations between knowledge and information could also be now expressed more correctly: **knowledge is semantic information memorized in the system**. Cognition (intelligence, thinking) is also become undeniably explicated: **Cognition is the ability to process information**, [4].

Only from the point of view of my definition, which declares and affirms the duality of information, one can understand and explain the paradigm shift, which we witness today in all fields of science: from a Computational (that is, Physical information processing (data processing) based) approach to a Cognitive (that is, Semantic information processing based) approach. None can deny this ubiquitously discerned paradigm shift: from Computer vision to Cognitive vision, from Computational linguistics to Cognitive linguistics, from Computational biology to Cognitive biology, from Computational neuroscience to Cognitive neuroscience, and so on – the list can be extended endlessly.

Only from the point of view of my definition, information descriptions are reified as text strings written in some language with a case-appropriate alphabet. That is, information now must be seen as a material entity, not a spiritual or a psychic impression, but a solid physical substance (information as a thing – once that has been a very debated topic). That requires an urgent revision of many well established notions and information processing practices (in brain-, neuro-, bio-, and many other life sciences).

I hope my humble opinion would be helpful when the time will come to face these issues.

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152 INFORMATION PHILOSOPHY, DOCUMENT AND DNA:The “document man” and the biobanks

Published

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1 Introduction: information, document and gene

Since the nineteenth century, concern with a worldwide knowledge organization records, mainly focused on bibliographic studies, clearly recognizes that order presupposes control, and control presupposes a digitilisation of facts, things and subjects. The search for a universal bibliographic control, which will have the Belgian Paul Otlet as its maximum expression, will always be confused with a world project of spirits rise in the political and epistemological level, as well as a panoptic project of concentration, vigilance and security of the State. The unfolding of nineteenth-century ideas at the level of an information philosophy reveals the most urgent discussions of contemporary dilemmas: the production, ordering, and surveillance of genetic records, recognized as "human documents," sources of information about not only the subject in its singularity, but the plurality of the notion of "humanity."

The information philosophy current, identified in part as “neodocumentalist”, affirms the "documentary" condition of informational argumentation. It is a relation based on the debate between "material" and "immaterial". This is one of the central positions of Frohmann (2011, 2009, 2004) and other influential theorists on the current. Among the influences of this thought, we find objectively the ideas of Foucault (2010, 2002, 1970) and Wittgenstein's (1992a, b, 1979), in a clear demarcation of the philosophy of ordinary language.

Dialogues with the philosophy of language place the "neodocumental" perspective in direct approximation with the Heideggerian approach. There is too hear a the relationship between being and language, present in Rafael Capurro's information philosophy. The Capurro approach establishes a central force for language with the constituent element of human relations, especially when we observe the real from the information.

The unfolding of these neocumental and Capurro approaches leads us to one of the most flagrant empirical determinations of the debate on philosophy, ethics and society in the contemporary world, the condition of DNA and biobanks. Admittedly a moral dilemma for the twenty-first century, we have put into focus some central elements that underlie a gene ethics from the philosophy of information - and definitively establishes the man as document.

2 Document and language: preambles to DNA as document

In Lund's view (2009), the modern question of the document as a record of bureaucratic movements - of the modern state and its institutions - adds up two other aspects of its meaning: its condition of proof - that object that holds the truth of Declarations -, which led to the notion of authenticity gaining great relevance; Its "informational" condition, that is, of renseignement, or object that provides information - which, in a way, recovers the previous educational conception of the document.

The importance of the document to the modern world will be reflected in the relationship between society and science. In the nineteenth century, the word "documentation" gains great prestige among scientists and the various branches of management. From then on, the quality of the scientific work and the efficiency of the market depends on adequate and accurate documentation. It was not

enough, in Lund's view (2009), merely the combination of logical arguments. It was necessary for the scientist to prove empirically - what it would mean to "demonstrate documentary" - the process and results of his research. This will be the setting for the birth of the first theory of the document, born with Paul Otlet - dealt with by Lund (2009) as a professional document theory.

Bernd Frohmann (2004, 2011) places himself in the field of Documentation and gives more or more importance to the study of the document - and, more than this, the materiality of the instruments of knowledge.

"Documentation recognizes as urgent an imperative to study ancient, medieval, or early modern documentary practices as those that feature electronic documents. What we do with electronic documents, how such practices are configured, and what they do to us are eminently worthy of study. But the digital form of contemporary documents creates no special philosophical imperatives, since the concept of documentary practices was there all along." (Frohmann, 2004, p. 406)

Frohmann (2011, p. 59) criticizes the naive vision that approaches the document as mere driver of information. The researcher developed the concept of "documenting", which refers to the capacity and power of the document in its arrangements with other elements of networks, or assemblages, "to generate marks, signs, or traces". According to the researcher, his focus on the materiality of documents is inspired by documentary movements from the turn of the nineteenth to the nineteenth, especially in the works of Paul Otlet and Suzanne Briet, who, in his view, insisted on the focus of material objects as documents, citing Famous example of the Briet antelope. (Frohmann, 2011, p. 57).

From the so-called angeletics, Rafael Capurro (1988) seeks a science of messages and messengers, both within the framework of the message-building phenomenon and in the context of action / sharing of the message (Smith, 2000). His interest, according to Smith (2000), would be to find a unified means of understanding information and understanding the role of information at the heart of human life and global society. It is the attempt of a unified definition to clarify the rationale of the concept of information.

In other words, Capurro (1988, 2008) proposes an information theory that is sustained in the theory of the message. It relates to the view that seizes the information society as a "message society" that evolves technologically and culturally. Information is taken as a message that makes a difference, either as a form or as a kind of offering of meaning. For the Capurrian vision, this theory refers both to the Greco-Latin notion of information, and to the communication perspective.

3 The DNA as a document

The term biobank came about in the late twentieth century. The earliest identified employment of the term is from 1985 (GODEC, 186), however, it was only in the second half of the 1990s that biobanks started to be developed in the way they are currently done.

This movement began in Iceland in 1996, when the US company deCode, created a biobank in the country, with high commercial interests. These intentions led to various protests by the Icelandic population and strict legislation was created (Árasonas, 2007, p. 2). Experiences of the introduction of the Icelandic biobank have served as a basis for lawyers, businessmen, researchers and governments around the world.

The emergence of biobanks became constant after the implementation of the Icelandic biobank, however, the growth of these spaces intensified after the release of the complete results of the human genome project in 2003. This project intensified the genetic research and made possible the existence of Large-scale DNA sample repositories.

One of the earliest definitions of biobanks was formulated in 2000 in Iceland and considers biobanks as "a collection of biological samples that are permanently preserved" (ICELANDIC BIOBANKS ACT, 2000 apud RIAL-SEBBAG, CAMBON-THOMSEN, 2010). However, biobanks do not store any kind of biological samples, these institutions are known to store exclusively human biological samples, as the Norwegian health institute points out: "A biobank is a collection of human biological material" (NORWEGIAN INSTITUTE OF HEALTH, 2012).

The term human biobanks usually refers to collections of samples of human body substances (e.g. tissue, blood, DNA) which are linked to personal data and socio-demographic information about the donors of the material. They have a dual nature as collections of samples and data (ETHIKRAT, 2004).
By this definition it is possible to identify, which are the types of biological samples stored, in addition, it is evidenced that biobanks are not mere repositories of human material, but rather spaces for the study and production of scientific information, besides of course, a repository of onformation of the individuals from which the samples were taken.
Due to the fact that they are large information repositories that foster research, biobanks are already considered as indispensable sites for the production of knowledge. For the Deutsches Biobanken-Register "Biobanks are a key prerequisite for modern medical research. By linking samples and clinical data they make it possible to clarify the causes and the course of diseases." (DEUTSCHES BIOBANKEN-REGISTER, 2017).
Biobanks are basically distinguished by the number of samples stored and the criteria for sample acquisition. One of the largest biobanks in the world is the UK Biobank which has collected DNA samples from about 500,000 British citizens, such biobank, as well as the Estonian biobank and the Qatar Biobank are known as poplation-based (Kelley et al, 2007), for storing samples of citizens of a specific country in large quantities. But there are biobanks with very specific acquisition criteria such as the Chernobyl Tissue Bank, which stores samples of people who were exposed to radiation during childhood (CHERNOBIL TISSUE BANK, 2017).
In this way, it is possible to perceive that the samples are the central element in, since they are the informational and DNA physical evidences, constituting the main source of biobanks research resources.
Briet is in the canonical tradition of Information Science the first to present the notion of "living documents". For her, far beyond form, the document may be something that was not created by man and does not consist of a medium where information was entered. Obeying the criteria established by Oltet, the document is something that transmits information and works as evidence, and is also something that can generate other documents.
Jean Meyriat, as pointed out by Ortega and Lara (2010), is one of the disciples of Otlet and Briet's work on the document concept. In this way, Meyriat developed a kind of complement to the works of Otlet and Briet in dealing with the purposes of understanding document as object.
Meyriat points out that there are two types of document, one that is clearly a document (*document par intention*), since it is a product developed by man to perform this function, and an object that has come to be considered document (*document par attribution)*, even if it was not created for it, and, due to to any need or circumstance, has become informative. In this sense, Meyriat approaches the condition pointed out by Otlet so that something can be considered a document: the object in question has a function of evidence.
The author states that any object can be considered a document, even if it was not created for it, since it configures a source of information and support for a message. However, Meyriat points out that a document is really only document when used as such, that is, the author does not treat the documents in a binary way (Meyriat, 1981).
This assertion is based on the fact that the will of the creator of the document is not sufficient to sustain it as such. If a document by intention is used for an purpose that is not related to the transmission of information, this object will not be a document, because it will always be necessary to obtain information from the object in question. Thus, even when it comes to a document by intention, that is, anything created to have the function of document, the will of the creator of the document is not sufficient to guarantee that it will be used as a document (Meyriat, 2001, p. 144-145).
Thus, we can understand that Meyriat does not restrict the product of human activity by man-made items, but maintains that any item that undergoes human intervention and is used as a source of information, having the character of evidence, can be considered a document by attribution.

In addition to the document itself, Meyriat shows that a document by assignment needs to legitimize an institution to become a document. The author also states that documents are generated and legitimized by a techno-social system, that is, documents are the fruits of an era and the structures in which its creators (Meyriat, 2001, pp. 151-152).

If, as pointed out by Marteleto and Couzinet: "It is necessary to rethink the document as a permanent polymorphous object" (Marteleto, Couzinet, 2013, p.7), it is possible to consider that such biological samples as documents insofar as they will serve as support for documentary evidence for the generation of other documents composed of written records and whose primary function is to be a document, that is, human biological samples have the necessary functions to be characterized as documents, since they present evidence .

4 "Document man": ethics "for" a library of records of human biovestiges

The current condition of biobanks touches, objectively, the views of the neodocumental perspectives and of Rafael Capurro. In other words, the information philosophy, in the Frohmann and Capurro view, linked to a philosophy of the document and to an intercultural ethics of information.

Frohmann (2000) shows us that a contemporary ethics linked to informational dilemmas depends on the consolidation of a critique of cyber ethics, that is, the relation between cybernetics and morality. In dialogue with Rafael Capurro, Frohmann (2000) identifies a post-cybernetic dialectic between bodies and bytes. The author states that the question of materiality constitutes a centrality for the construction of a true ethical plan of criticism of informational dilemmas.

The algorithms as parts in the cybernetic plane of the human body are parts of this same body. We are in a material plane where the subject is the case, and not the machine.

"Whatever is special about information ethics derives from the speci¢city of the information services provided to speci¢c publics. It is therefore analogous to legal ethics, medical ethics, dental ethics, or the ethics of plumbers. Like these other ¢elds, much of what is unique to it consists in applying ethical principles to the speci¢c services it provides. These applications should, I suggest, be driven by an ethics of acknowledged dependence, and a materialist information theory. Once we abandon the animal world for the spectral terrain of angels, where pure information £ows from spirit to spirit, we may gain the satisfaction of inhabiting an ethical zone belonging just to us, but we lose the virtues we need to grapple with serious ethical issues". (Frohmann, 2000, p. 434-435)

The subject's perspective emerges as a "material" expression of culture. Ethics is, therefore, a movement of relations between bodies in a cultural context, including the web. It is an ethics that conceives the subject-document, the man-document, but always in the condition of the "other", of the otherness.

"The ethics of alterity, opposed to a transcendental ethics, "ethics of the Lord´s eyes", from the Lord´s point of view, or, still, the "ethics of the angels" (incapable of conceiving and knowing the presence and the power of the presence of a certain Wall), now becomes an "intercultural ethics of information", capable not only of recognizing that the Wall is there, but of looking for ways of "knocking it down" - if not physically, in its symbolic structure altogether, presenting new possibilities for multiple worlds that exist in each culture. In this context *poiesis* presents itself: the maker of discourses, the poet, "expelled" from the city in a platonic transcendental ethics, and brought back into the scene by Rhetoric and by Aristotelian Poetics, has a voice. Homer, the city´s poet, "pops up" then in the German library thinking the world through words." (Saldanha, 2016, p. 261)

In the sense of the intercultural ethics of Rafael Capurro's and Frohmann's information philosophy structured in the philosophy of the document, the dimensions of alterity and culture stand above a centrality of the "human" as the mark of a universal ethics. Against the universalism of a common ethic, respecting the different materialities, that is, the expressions of life of the subjects in each community, ethics in the genetic plane is, under these philosophies, centered on the condition of the subject-documented in its contextuality.

5 Final remarks

The "libraries of people" are therefore houses recognized as spaces of central ethical tension, where the condition of human alterity must prevail, not of centrality. The biobanks and the condition of the documentary man place us before the limits of barbarism and of a possible humanism. The plurality proposed by Capurro and Frohmann allows us, in our view, to construct the necessary dialogue on the permanent removal of the risks of a barbarism related to the "non-human" uses of "human beings", that is, to prevent Wiener's cybernetics, Applied to the development of biobanks, is no longer a possibility of expansion of life and becomes a weapon for its extinction.

The language of DNA understood as the ability to know the most distinct sub-elements that define the subject in its biological expression can not overlap the cultural subject, that is, the document-man is a historical subject. However, as a document, such subject is susceptible of uses and reuses, according to each socio-historical intentionality.

Biobanks are currently such a borderline condition: the intense production of studies and records on human beings tends to create multiple repositories of human data. These repositories can constitute safeguard reserves of specific cultural problems or turn into core weapons for political struggles and military uses, allowing biomassacres. The histories and philosophical lessons of interculturality and documentality can serve as fundamental ethical models to resolve the risks of such barbarism represented by the second case.

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153 Information Taxonomy

Published

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Abstract

Information appears in a diversity of types and kinds and their mutual relationships are not always easily understood. To organize this huge collection into a system, it is essential to classify information with respect to various criteria thus developing a *multiscale information taxonomy*, in which each dimension is a specific *aspect information taxonomy*. We construct such a multiscale information taxonomy based on the general theory of information (Burgin, 2003; 2004; 2010) and making use of its principles and technical tools.

It is important to understand that taxonomies are not auxiliary tools in science but they also function as scientific frameworks, when scientifically grounded and validated. For instance, the biological taxonomy of Carolus Linnaeus (Carl Nilsson Linnæus, Carl von Linné) is a theoretical framework of biology from which structural laws of biology can be discerned that organize and generate knowledge in a similar way as Newton's laws organize and generate knowledge of physics.

Here we follow taxonomic traditions of both Carl von Linné (1707-1778) and logician Charles Sanders Peirce (1839-1914) in the view of information science. On the one

hand, the results of our research connect new information science and technology with classical science, demonstrating intrinsic links between information theory and profound results of Carl von Linné. On the other hand, these results show unity in achievements of scientists working in different contexts and on different research fields such as biological classification of Carl von Linné, chemical classification of Mendeleev, semiotic classifications of Peirce, classifications of subatomic particles in Standard Model of contemporary particle physics (by Glashow, Weinberg, Salam, Higgs), taxonomy of computation previously developed by present authors (Burgin and Dodig-Crnkovic, 2015) and classifications in information science presented here. We begin with a brief exposition of methodological principles of taxonomy construction and then apply these principles to the development of basic information taxonomies. Here we describe only some of them due to the space restrictions.

Principles of taxonomy construction

Having a multiplicity of objects, it is necessary to induce organization because it can help to study, understand and utilize this multiplicity. Organization is achieved by structuration of the multiplicity. An efficient technique of structuration is construction of taxonomies, classifications, typologies and categorizations. Let us consider the process and basic principles of taxonomy construction.

Taking a multiplicity of objects *M*, we explicate objects' properties molding aspects or amalgamated features of *M*. Then we elucidate a criterion for each aspect. This allows us to form a scale for measuring/evaluating each aspect. Such a scale together with the corresponding criterion allows us to build specific aspect taxonomy. Combining together all aspect taxonomies, we obtain a multiscale taxonomy of the multiplicity *M*.

In the contemporary methodology of science, there are three types of scientific laws: classificational, equational and implicational laws. Scientists traditionally consider only two latter types as laws of nature although the first type also reflects important regularities in nature and society.

An *equational law* has the form of an equation, for example, of a differential equation as many laws in physics, chemistry, ecology or economics.

An *implicational law* has the form of an implication "If *A*, then *B*". For instance, if ΔABC is a right triangle, then its sides satisfy the equation $c2 = a2 + b2$. It is a mathematical law called the Pythagorean theorem. Implicational laws are prevailing in mathematics and logic.

A *classificational law* has the form of a classification, typology or taxonomy. The biological taxonomy of Linnaeus and triadic logic typologies of Peirce are examples of classificational laws.

Similar in character but complementary to classification laws are generative laws. While classification starts with huge multiplicity of objects that via classification process form much simpler and more logically organized structures, generative laws start with few simple structures and by application of a few simple rules lead to variety of objects and their mutual relationships.

Given the contemporary state of the art of information theory and practices with a huge variety of concepts and their mutual relationships, which resembles contemporary Tower of Babel, taxonomy presents a way to bring order and possibility of communication between different approaches to information. Taxonomies provide

suitable knowledge frameworks in which qualitative laws of information science can be formulated.

Basic taxonomies of information

Existential taxonomy

We begin with the uppermost level of the taxonomic arrangement, which includes a huge diversity of types, kinds, sorts, categories and classes of information. On this level, we build the existential taxonomy.

As information is an omnipresent phenomenon (Burgin and Dodig-Crnkovic, 2011), it is crucial to start its classification on the global level of the whole world. This thesis implies the conjecture that the structure of the world affects existence of forms of information, which correspond to this structure. The large-scale structure of the world can be seen as represented by the Existential Triad of the World (Burgin, 2012):

- *Physical or embodied (object-based)* information
- *Abstract or structural (sign-based)* information
- *Cognitive or Mental (interpretant-based)* information

This stratification corresponds to the phenomenon studied by the general theory of information and called information in a broad sense (Burgin, 2010). In the Physical (material) World, information is implemented as matter/energy, in support of the conjecture of von Weizsäcker that energy might in the end turn out to be information (Weizsäcker, 1974) (we should add: for an agent. Energy is both information for an agent, as well as basic precondition for an agent's existence.

The above existential information triad constitutes *layered informational architecture* in cognitive agents that parallels computational architecture described in (Burgin and Dodig-Crnkovic, 2015). So we could also call it *architectural taxonomy of information.*

The existential triad of (Burgin, 2012) continues the tradition of Plato triad (material, ideas/forms, mental), which can also be related to the Peirce's triad of (object, sign, interpretant), and t) and Poppers structural triad (physical world, knowledge, mentality). In a more fine-grained classification, for each of the three basic existential levels, one finds, as follows, parallel to (Burgin and Dodig-Crnkovic, 2015):

Physical or embodied (object-based) information
1.1 Physical information (as quantum information)
1.2 Chemical information (as in chemical forms)
1.3 Biological information (information in a cell)

Abstract or structural (sign-based) information
2.1 *Subsymbolic* information - data/signals
2.2 *Symbolic* information - data structures
2.3 *Hybrid/mixed* subsymbolic and symbolic information.

Cognitive or Mental (interpretant-based) information
3.1 *Individual* (informational network of the brain)
3.2 *Group* (informational networks of individuals)
3.3 *Social* (informational networks of groups)

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154 Information, Constraint and Meaning from the pre-biotic world to a possible post human one. An Evolutionary approach

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The presentation proposes to complement an existing development on meaning generation for animals, humans and artificial agents by looking at what could have existed at prebiotic times and what could be a post-human meaning generation. Meanings do not exits by themselves. The core of the approach is based on an existing model for meaning generation: the Meaning Generator System (MGS). The MGS is part of an agent submitted to an internal constraint. The MGS generates a meaningful information (a meaning) when it receives information that has a connection with the constraint. The generated meaning is used by the agent to implement an action (external or internal) aimed at satisfying the constraint. The action can be physical, biological or mental. The purpose of the presentation is to widen the MGS approach in order to reach a coverage for information, constraint and meaning starting at a pre-biotic level and going up to a possible post-human one. We begin by presenting the MGS for animals, humans and artificial agents with the corresponding

constraints (https://philpapers.org/rec/MENCOI). We then look at what could have been a local constraint at a pre-biotic far from thermodynamic equilibrium level (https://philpapers.org/rec/MENMGF-2) and propose a possible post-human status by an evolution of the anxiety management processes (https://philpapers.org/rec/MENPFA-3 , https://philpapers.org/rec/MENCOO). Such approach makes available links between information science and physics, evolution, anthropology, semiotics and human mind. Continuations are proposed.

155 Novel Approach: Information Quantity for Calculating Uncertainty of Mathematical Model

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Novel Approach: Information Quantity for
Calculating Uncertainty of Mathematical Model
Extended abstract
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Almost all the readers remember the idea of our distant ancestors, according to which our Earth is surrounded by a glass dome with stars and planets reinforced on it. However, Democritus tried to explain to the masses the simple truth that the Earth is just a small particle in a vast universe, but Aristotle's picture was closer to those in power, so it lasted thousands of years.

Everything comes to an end, and modern science, totaling only 500 years, has made a real revolution in the consciousness of human individuals. Today without genetics, Big Ben, information theory, quantum electrodynamics and the theory of relativity, it is difficult to imagine the realization of flights into space, genetic engineering, nuclear power plants and, simply in theory, the era of relative abundance.

Now it is possible due to the widely used method of modeling in recent decades. It is based on accounting for a huge number of variables, the use of powerful computers and modern mathematical methods. That is why, in the scientific community the prevailing view is the more precise the instrument used for the model development, the more accurate the results. For example, 3,000 parameters are used for the program "Energyplus" elaborated by US department of Energy. However, energy simulation results can easily be 50–200% of the actual building energy use.

What can be done in order to overcome the apparent contradiction? In this case, the theory of similarity comes to the rescue. Applying the theory of similarity is motivated by the desire to generalize obtained results in the future for different areas of physical applications. In the study of the phenomena occurring in the world around us, it is advisable to consider not individual variables but their combination or complexes which have a definite physical meaning. Methods of the theory of similarity based on the analysis of integral-differential equations and boundary conditions, allow the identification of these complexes. In addition, the transition from dimensional physical quantities to dimensionless variables reduces the number of variables taken into account. But this is not enough to simplify the calculations.

Human intuition and experience suggests the simple, at first glance, truth. For a small number of variables, the researcher gets a very rough picture of the process being studied. In turn, the huge number of accounted variables can allow deep and thorough understanding of the structure of the phenomenon. However, with this apparent attractiveness, each variable brings its own uncertainty

into the integrated (theoretical or experimental) uncertainty of the model or experiment. In addition, the complexity and cost of computer simulations and field tests increases enormously. Therefore, some optimal or rational number of variables that is specific to each of the studied processes must be considered in order to evaluate the physical-mathematical model.

In this case, the theory of information came to the aid of scientists. It happened because of the fact that simulation is an information process in which a developed model receives information about the state and behavior of the observed object. This information is the main subject of interest in the theory of modeling.

The model is a framework of ideas and concepts from which a researcher/observer interprets his intuition, experience, observations and experimental results. It includes physical structure-model and mathematical structure-model. Physical model is expressed as a set of natural law's inherent to the recognized object. It interprets a mathematical model, including its assumptions and constraints. Mathematical model is a set of equations using symbolic representations of quantitative variables in a simplified physical system. It helps modeler to understand and quantifies physical model, thus enabling the physical-mathematical model to make precise predictions and different applications.

The process of formulating a physical-mathematical model can be called processing information when the information and/or its initial representations about the object under study do not change, but new information is created. Physicists and engineers receive information about the observed process and can develop scientific laws and analyze natural phenomena or technical processes only on the basis of this information.

In other words, the observer knows about a particular phenomenon only if this object has a name in the observer's mind, and in his mind there are data that represent the properties of the object. It should be emphasized that any observer or group of scientists is not ideal, because, otherwise, they should be able to potentially acquire endless knowledge.

Thus, scientists came to the brilliant idea of quantifying the uncertainty of a conceptual model based on the amount of information embedded in the model and conditioned only by the selection of a limited number of variables that must be taken into account. This idea is based on thermodynamic theory, concepts of Mark Burgin's general theory of information. It includes two axioms.

The first is that general knowledge of the world is significantly limited by the act of choice a System of Primary Variables. Whatever people know, all scientific knowledge, depends only on information framed by SPV. As an example of SPV, SI (International system of units), or CGS (centimeter-gram-second) may be offered. The number of dimensional variables included in SPV is finite. SPV is a set of variables (primary and, designed on their basis, secondary), which are necessary and sufficient to describe the known nature laws, as in quality physical content and quantitatively.

Secondly, the number of variables considered in the physical-mathematical model is limited. The limits of the description of the process are determined by the choice of the class of phenomena (*CoP*) and the number of secondary parameters considered in the mathematical model. *CoP* is a collection of physical phenomena and processes described by a finite number of primary and secondary variables that characterize certain features of the observed phenomenon from the qualitative and quantitative aspect.

For example, for the combined processes of heat exchange and electromagnetism, it is useful to use the primary SI dimensions: length L, M is weight, T is time, Θ is temperature, and I is electric current, i.e. $CoP_{SI} \equiv LMTQI$. In thermodynamics, the basic set of primary dimensions often includes L, M, T, and the thermodynamic temperature Θ, that is, $CoP_{SI} \equiv LMT\Theta$. If SPV and *CoP* are not specified, then the definition of "information about the phenomenon being investigated" loses its validity, and the information quantity can increase to infinity or decrease to zero. Without SPV, the simulation of the process is impossible. As noted by the famous French physicist Brillouin, "You cannot get anything out of nothing, even observation." You can interpret SPV as the basis of all available knowledge that people can have about the surrounding nature at the moment.

To this we should add that the researcher chooses variables for the model describing the observed object, based on his experience, knowledge and intuition. These variables can fundamentally differ in nature, qualitatively and quantitatively, from another group of variables selected by another group of scientists. Such, for example, happened when studying the motion of an electron, like particle or wave. Therefore, it is possible to consider the choice of a variable as a random process, and accounting a particular variable will be equally probable. This approach completely ignores the human evaluation of information. In other words, a set of 100 notes played by chimpanzees, and a melody of Mozart's 100 notes in his Piano Concerto No.21-Andante movement, have exactly the same amount of information.
It's perhaps a surprising fact that basing on the above mentioned assumptions you can get a very simple, from the point of view of mathematics, formula for calculating the uncertainty of a mathematical model describing the observed phenomenon. And this uncertainty determines a limit on the advisability of obtaining an increase of the measurement accuracy in conducting pilot studies or computer simulation. It is not a purely mathematical abstraction and it has physical meaning. This relationship testifies that in nature there is a fundamental limit to the accuracy of measuring any observed material object, which cannot be surpassed by any improvement of instruments and methods of measurement. The value of this limit is much more than the Heisenberg uncertainty relation provides and places severe restrictions on the micro-physics.
The proposed method was used to analyze the results of measurements of the Boltzmann constant and the gravitational constant published in the scientific literature during 2005-2016. The results are in excellent agreement with the CODATA recommendations (Committee on Data for Science and Technology).

156 Structures and Structural Information

Published

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Everything has a structure and this structure makes things such as they are. This was declared by Aristotle for material things and demonstrated in the general theory of structures developed in (Burgin, 2012; 2016) for the whole generality of existing and possible objects. This is the core reason of importance of structural information, which provides and/or changes knowledge about structures.
As Brinkley writes, "implicit in the word "structure" is not only the concept of elementary units or parts, but also the interdependence and relationships of those parts to form a whole and it can thus be argued that modern science has adopted a structural approach to understanding the natural world, in which parts are defined and the interactions among them are explored" (Brinkley, 1991; 1999).
Structural information is the core of structuralism, the heart of structural realism and the basic essence of structural informatics.
The goal of this work is to study structural information based on the general theory of information (Burgin, 2003; 2004; 2010; 2011), research of Feistel and Ebeling (Feistel and Ebeling, 2011; 2016; Ebeling and Feistel, 2015; Feistel, 2016) and works of other authors in this area. The goal is developing more comprehensive and advanced knowledge about structural information.
It is possible to comprehend structural information in different ways. For instance, Bates (2005) treats structural information as "the pattern of organization of matter and energy," while Reading (2006)

defines it as "the way the various particles, atoms, molecules, and objects in the universe are organized and arranged."
At first, we consider the approach developed in the general theory of information. The general theory of information discerns information in the broad sense (Ontological Principle O2) and information in the strict sense (Ontological Principle O2a).
Structural information is information in the strict sense being defined as a capacity to change the subsystem of knowledge in an intelligent system.
This definition allows getting key properties of structural information. Let us consider some of them.

Correctness of structural information about a system depends on correctness of knowledge produced by this information (Burgin, 2016). As we know, some knowledge can be more correct, better representing the essence of the system, while other knowledge is less correct, providing a worse representation of the fundamental nature of the system.
Here are two examples.
Example 1. For a long time, people believed that the Earth was flat, i.e., had the structure of a plane.
Then scientists found that the Earth had the structure of a ball.
Then scientists assume that the Earth had the structure of a geoid.
Example 2. For a long time, people believed that in the structure of the Solar system, the Sun rotated around the Earth.
Then scientists found that the Earth rotated around the Sun and the orbit had the structure of a circle.
Then scientists assume that the Earth rotates around the Sun and the orbit had the structure of an ellipse.
2. As a rule, *structural information about a system is not unique*.
Many researchers believe that each (at least, a natural) system has a unique structure. At the same time, according to the general theory of structures (Burgin, 2012), any system has several structures. For instance, the structure of a table on the level of its parts is essentially different from the structure of this table on the level of molecules as well as from the structure of this table on the level of its parts such as legs. In essence, material systems, which people can see with their eyes and touch with their hands, have structural information on different levels.
3. Structural information about a system is inherent to this system.
Indeed, as it is stated above, structure makes things such as they are. Naturally, structural information reflects this identity of things although structural information about different systems and objects can be similar.
4. Processes in a system can change structural information about this system.
Indeed, the evolution (development) of a system can produce an essentially new structure when the system is changed, even becoming another system. For instance, butterflies have the four-stage life cycle. In it, winged adults lay eggs, which later become caterpillars, which later pupate in a chrysalis, while at the end of the metamorphosis, the pupal skin splits and a butterfly flies off.
5. Structural information about a system describes this system to a definite extent of precision, i.e., *structural information can be more precise and less precise*.
For instance, the Copernican model (structure) of the Solar System is more precise than the Ptolemaic model (structure) of the Solar System. Another example comes from mathematics where mathematicians are striving to find the decimal structure of the number p with higher and higher precision.
6. For complex systems, it is possible to consider structural information on different levels and various scales.
For instance, it is possible to treat the structure of a human being on the level of visible parts, on the level of its functional systems, on the level of inner organs, on the level of cells, on the level of chemical compounds or on the level of molecules.

7. Structural information about a subsystem of a system is not always a part of the structural information about this system.
For instance, when we consider an organism as a system of its visible parts, the structure of its nervous system is not a part of this structure.
8. The process of conversion of structural information about a system into knowledge about this system is, in essence, structuration of this system.
Note that the general theory of information provides other possibilities for defining structural information. For instance, it can be information that changes the system of beliefs of an intelligent system.
At the same time, Feistel and Ebeling suggest the vision of structural information, in which structural information may no longer be restricted to changing just "*knowledge in an intelligent system*", and may more generally be defined as the capacity of a physical system, the "carrier of structural information", to cause changes in a second physical system, the "receiver of structural information" (Feistel and Ebeling, 2011; 2016; Ebeling and Feistel, 2015; Feistel, 2016).
Indeed, people get information about different objects in the form of raw data. Only after reception of this information, the brain converts these data into knowledge and this knowledge is often about the structure of studied objects.
If in particular, the receiver is the same system as the carrier but at some later point of time, reversible microscopic dynamics described by the Liouville equation is universally understood as "conserving [microscopic] [structural] information" (Hawking, 2001; Zhang et al., 2013). In contrast to this, irreversible macroscopic dynamics is commonly associated with a loss of [macroscopic] [structural] information, directly related to the growth of thermodynamic entropy (Feistel and Ebeling, 2011; 2016; Ebeling and Feistel, 2015; Feistel, 2016). In the sense of Planck (1966) who wrote that "a macroscopic state always comprises a large number of microscopic states that combine to an average value", macroscopic structural information represents a portion of the microscopic structural information of a given system.
Structural information available from a carrier depends on the receiver determining what portion of this information is actually received. If, for example, the receiver is a thermometer and the carrier is liquid, then all information received is the temperature of the liquid. Structural information can be extracted from a given system by "measurement" when e.g. a sensor is used as a receiver. Structural information can be quantified if it is comparable to the structural information of a reference system, such as the length scale of a mercury thermometer.
A numerical value being the result of a comparison between the same kinds of structural information available from two different systems, such as by counting their parts, is a "measurement result". Numbers represent information in the symbolic form, or as "symbolic information". The meaning of symbolic information is subject to convention (such as what "reference" system is used) and is no longer a portion of the structural information of the carrier, such as printed symbols on a sheet of paper. Very different structural information carriers can carry the same symbolic information. Symbolic information is restricted to the realm of life (Feistel and Ebeling, 2011; 2016; Ebeling and Feistel, 2015), such as in the form of genetic DNA molecules or human knowledge, and emerged from structural information in the course of evolution by a transition process regarded as *ritualisation*.

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157 A Model of Complexity for the Legal Domain

Published

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*The complexity of the universe can only be defined in terms of the complexity of the perceptual apparatus. The simpler the perceptual apparatus the simpler the universe. The most complex perceptual apparatus must conclude that it is alone in its universe.*Abstract

The concept of complexity has been neglected in the legal domain. Both as a qualitative concept that could be used to legally and politically analyse and criticize legal proceedings and as a quantitative concept that could be used to compare, rank, plan and optimize these proceedings. In science the opposite is true. Especially in the field of Algorithmic Information Theory (AIT) the concept of complexity has been scrutinized.

In this paper we first have a quick look at AIT to see what it could mean in this phase of our research in the legal domain. We conclude that the there is a difference between problem complexity and solution complexity. In this paper we therefore start to develop a model of

complexity by describing problem complexity in the legal domain. We use a formal model of legal knowledge to derive and describe the parameters for the description of the problem complexity of cases represented in this formal model. Further research will focus on refining and extending the formalization of the model of complexity, the comparison of problem and solution complexity for several legal cases using available algorithms and on the validation of the combined model against concrete cases and lawyers' and legal organizations' opinions about their complexity.

1. Complexity in the legal domain

The concept of complexity is hardly developed in the legal domain. Most of the descriptions of concepts related to complexity in legal literature refer to vagueness (intension of concepts), open texture (extension of concepts), sophistication (number of elements and relations) and multiplicity of norms (concurring opinions) - in most cases even without explicit reference to the concept of complexity. Complexity arises in all these cases from the existence and competition of alternative perspectives on legal concepts and legal norms.[1] A complex concept or norm from a scientific point of view is not necessarily a complex concept or norm from a legal point of view. If all parties involved agree, i.e. have or choose the same perspective/opinion - there is no legal complexity, i.e. there is no case/the case is solved. In science more exact definitions of complexity are common and applied. Complexity is associated with i.a. uncertainty, improbability and quantified information content. Despite this discrepancy between the legal domain and the domain of science, in the legal domain complexity is as important as in other knowledge domains. Apart from the obvious human interest of acquiring and propagating knowledge per se, complexity has legal, economic, political and psychological importance. Legal, because a coherent concept of complexity helps to analyse and criticize legal proceedings, in order to clarify them, to enable a justified choice of the level of expertise needed to solve legal cases, and to reduce unnecessary complexity (an example of reducing complexity by compression is given in the next paragraph); Economic, because complexity increases costs and measuring complexity is a precondition for the reduction of these costs (can help in designing effective norms, implementing them effectively, calculating and reducing the costs of legal procedures (cf. White, M.J., 1992), planning the settlement of disputes and other legal proceedings, etc.); Political, because legal complexity can be an instrument to exert power and can increase inequality; Psychological, because complexity increases uncertainty. A validated model of complexity in the legal domain can help to promote these interests. (Cf. Schuck, P.H., 1992; Ruhl, J. B., 1996; Kades, E., 1997).

How to develop a model of complexity in the legal domain (methodology)

In this paper we will try to bridge the gap between the intuitive definitions of complexity in the legal domain and the more exact way of defining complexity in science. We will do that on the basis of a formal model of legal knowledge (the Logic of Reasonable Inferences and its extensions) that we introduced before, that was implemented as the algorithm of the computer program Argumentator and that was empirically validated against a multitude of real life legal cases. The 'complexities' of these legal cases proved to be adequately represented in the formal model. In earlier research we actually tested the formal model against 430 cases of which 45 were deemed more complex and 385 less complex by lawyers.

A first result was that the algorithm (Argumentator) when provided with case facts and legal knowledge was able to solve 42 of the more complex cases and 383 of the 385 less complex cases in exactly the same way as the legal experts did (including the systematic mistakes made by these experts). A second result was that the algorithm when instructed to do so improved the decisions in 30 (66%) of the 45 more complex cases and in 104 (27%$) of the 385 less complex cases. This result confirms the relative complexity of the first 45 cases. The selection of these 45 cases thus provides us with the material from which criteria for the definition of complexity in this paper could be derived. These criteria are translated to quantitative statements about the formal representation of the cases. Further research will focus on the fine tuning of this quantitative model by comparing its results with new empirical data (new cases and opinions of lawyers about the (subjective) complexity of cases). Finally the ability of the fine-tuned model to predict complexity in new cases will be tested. A positive result can be applied to reduce the aforementioned costs of processing of complex legal knowledge.

2. Models of complexity in science

There are many different definitions of complexity in science. The aim of this research is to develop a measure of complexity for formal representations of legal knowledge and their algorithmic implementations. In this abstract we will therefore refer to definitions of complexity from Algorithmic Information Theory (AIT), which studies the complexity of data structures (representations of knowledge in a computer). In AIT the complexity of data structures is equated with its information content. Complexity is postulated to decrease proportionate to the degree of (algorithmic) compressibility of the data structure. To assess the usefulness of AIT for our practical purpose, i.e. the design of a quantitative model of complexity of legal knowledge, we studied some publications from the domain of AIT. We read that complexity is approached as Algorithmic Probability (c.f. Solomonoff's a priori probability), i.e. the higher the probability that a random computer program outputs an object, the less complex this object is considered to be. We read that complexity is approached as Algorithmic Complexity (c.f. Kolmogorov's descriptive complexity), i.e. the shorter the code needed to describe an object (string), the less complex this object is considered to be. This is an interesting approach since it seems to offer a concrete measure for the complexity of certain objects (e.g. of legal problems) and it associates with the concept of compressibility which we are able to transpose as simplification (as opposed to sophistication) to the legal domain. Finally we read about Dual Complexity Measures (c.f. Burgin, 2006), which relates AIT to more complex problem structures and distinguishes the complexity of the system described (the problem and its solution) from the complexity of the description (the algorithm used to describe the problem and its solution). A common and essential aspect of these approaches is the compressibility of the object as a measure of its complexity. In all these cases the computer program is considered to be an explanation of a (more or less complex) object (or data structure). My conclusion is that these approaches will be useful when trying to prove certain characteristics of the model of complexity in the legal domain, once developed, but not primarily for the design of the model. We will have to describe the formal model and the algorithm (explanation) first. Just to get a practical insight in the concept of compressibility we did apply the idea of compressibility to some legal cases (see example below). However, many of the

characteristics of legal cases that make them 'complex' according to lawyers are not directly related to compressibility. Moreover, often the most simple 'palaver' in the legal domain is meant to be incomprehensible and therefore misses the (semantic and relational) patterns that are needed to be compressible. Our conclusion is that this concept only partially covers the problem in the legal domain. We are eager to discuss this with our colleagues in the mathematical domain.

An example of operand compression using logical equivalence in the legal domain

Objects regulation U.1. appendix III Decree Indication Chemical Waste reads:

'Waste products are **not** considered as chemical waste [cw] if they are objects [o] that have attained the waste phase of their lifecycle [wp], **unless**:

1. This has happened **before** they have reached the user [ru];
2. This has happened **after** they have reached the user [ru] and they are

1. transformers .. [1] .. 10. mercury thermometers. [10]'

De logical structure of this legal provision is:

not cw is implied by o and wp and not ((not ru) or (ru and (1 or .. or 10)))

Logically equivalent with this formalisation of the provision is the formula:

not cw is implied by o and wp and ru and not (1. or .. or 10)

which is a compression of the original provision.

Interestingly enough the retranslation of this equivalent formula to natural language is:

'Waste products are **not** considered as chemical waste if they are objects that have attained the waste phase of their lifecycle and they have reached the user and they are not 1. transformers .. 10. mercury thermometers'.

Although this example illustrates that compression can be beneficial because it improves the readability of the regulation, it does not reduce its actual complexity which - in practice - is related to different opinions about the meaning of concepts like 'Waste products'.

3. A formal model of legal knowledge (reasonable inferences)

The first step in developing a model of complexity in the legal domain is to describe the formal characteristics of legal knowledge that are related to the essence of complexity in this domain, i.e. the competition of opinions. In a previous publication (de Vey Mestdagh and Burgin, 2015) we introduced the following model that allows for reasoning about (mutually exclusive) alternative opinions and that allows for tagging the alternatives, e.g., describing their identity and context:

Our knowledge of the world is always perspective bound and therefore fundamentally inconsistent, even if we agree to a common perspective, because this agreement is necessarily local and temporal due to the human epistemic condition. The natural inconsistency of our knowledge of the world is particularly manifest in the legal domain (de Vey Mestdagh et al., 2011).

In the legal domain, on the object level (that of case facts and opinions about legal subject behavior), alternative (often contradicting) legal positions compete. All of these positions are a result of reasoning about the facts of the case at hand and a selection of preferred behavioral norms presented as legal rules. At the meta-level meta-positions are used to make a choice for one of the competing positions (the solution of an internal conflict of norms, a successful subject negotiation or mediation, a legal judgement). Such a decision based on positions that are inherently local and temporal is by definition also local and temporal itself. The criteria for this choice are in most cases based on legal principles. We call these legal principles metaprinciples because they are used to evaluate the relations between different positions at the object level.

To formalize this natural characteristic of (legal) knowledge we developed the Logic of Reasonable Inferences (LRI, de Vey Mestdagh et al., 1991). The LRI is a logical variety that handles inconsistency by preserving inconsistent positions and their antecedents using as many independent predicate calculi as there are inconsistent positions (Burgin and de Vey Mestdagh, 2011, 2013). The original LRI was implemented and proved to be effective as a model of and a tool for knowledge processing in the legal domain (de Vey Mestdagh, 1998). In order to be able to make inferences about the relations between different positions (e.g. make local and temporal decisions), labels were added to the LRI. In de Vey Mestdagh et al. 2011 formulas and sets of formulas are named and characterized by labelling them in the form (A_i, H_i, P_i, C_i). These labels are used to define and restrict different possible inference relations (Axioms A_i and Hypotheses H_i, i.e. labeled signed formulas and control labels) and to define and restrict the composition of consistent sets of formulas (Positions P_i and Contexts C_i). Formulas labeled A_i must be part of any position and context and therefore are not (allowed to be) inconsistent. Formulas labeled H_i can only be part of the same position or context if they are mutually consistent. A set of formulas labeled P_i represents a position, i.e. a consistent set of formulas including all Axioms (e.g., a perspective on a world, without inferences about that world). A set of formulas labeled C_i represents a context (a maximal set of consistent formulas within the (sub)domain and their justifications, c.f. the world under consideration). All these labels can be used as predicate variables and if individualized to instantiate predicate variables and consequently as constants (variables as named sets). Certain metacharacteristics of formulas and pairs of formulas were finally described by labels (e.g., metapredicates like Valid, Excludes, Prefer) describing some of their legal source characteristics and their legal relations which could be used to rank the different positions externally. The semantics of these three Predicates (Valid, Exclude and Prefer) are described in de Vey Mestdagh et al. 2011. These three predicates describe the elementary relations between legal positions that are prescribed by the most fundamental sets of legal principles (i.e. principles regarding the legal validity of positions, principles regarding the relative exclusivity of legal positions even if they do not contradict each other and principles

regarding the preference of one legal position over another). It was also demonstrated that the LRI allows for reasoning about (mutually exclusive) alternatives.

In (de Vey Mestdagh and Burgin, 2015) we showed that labels can be used formally to describe the ranking process of positions and contexts. With that the thus extended LRI allows for local and temporal decisions for a certain alternative, which means without discarding the non-preferred alternatives like belief revision does and without using the mean of all alternatives like probabilistic logics do. This extended the LRI from a logical variety that could be used to formalize the non-explosive inference of inconsistent contexts (opinions) and naming (the elements of) these contexts to a labeled logical variety, in which tentative decisions can be formally represented by using a labelling that allows for expressing the semantics of the aforementioned meta-predicates and prioritizing (priority labelling). In (de Vey Mestdagh and Burgin, 2015) we illustrated the use of these labels by examples.

In the next paragraph we will use the extended LRI to identify the quantitative parameters of complexity in the legal domain.

4. A formal model of the complexity of legal knowledge (parameters for a reasonable calculation of complexity)

The processing of legal knowledge takes place in successive phases. Each phase is characterized by its own perspectives and associated parameters of complexity. Roughly, first the different parties in a legal dispute take their positions, then the positions are confronted and a decision is made and finally the decision is presented. The complexity of the dispute differs from phase to phase. Again roughly, from intermediate (the separate positions), to high (the confrontation and decision making), to low (the decision itself). The separate positions are basically consistent and their contents can each be processed within a separate single logical variety. When the dispute starts complexity increases, because the shared axioms of the dispute have to be calculated and the positions are by definition mutually inconsistent and several calculi within the logical variety have to be used to calculate the joint process of the dispute and to decide between different hypotheses within the dispute. Ultimately the decision principles included in the different positions have to be used to rank the different consistent solutions. The dispute ends by presenting the highest ranking consistent (local and temporal) decision, representing a concurring opinion or a compromise. The complexity of this result is reduced again, because it can be (re)calculated within a single consistent variety. Below we will describe these phases in more detail and the related parameters of complexity in terms of the formal model introduced above.

In a certain case the complexity of the case can be quantified on the basis of the case elements and relations presented by all parties. The processing takes place in five phases:

At the start of legal knowledge processing the case can be described as:

- A number of sets n (the number of parties involved) of labelled formula $H_{i,l}$ representing the initial positions of each of the parties in a legal discourse, i.e. $hypotheses_i$ of $parties_l$ about the (alleged) facts and applicable norms in a legal case;

The next step is:

- Determining the intersection between these sets $H_{i,l}$ which defines A_i representing the agreed case facts and norms and determining the union of all complements which defines H_i; (A_i, H_i) represents the initial case description.

The third step is:

- Calculating all possible minimal consistent positions P_i that can be inferred from (A_i, H_i) applying a logic e.g. the LRI a logical variety that allows each position to be established by its own calculus. If these calculi differ this adds to the complexity of the problem. In earlier publications we assumed all the calculi to be the same (predicate calculus).

The fourth step is:

- Calculate all maximal consistent contexts (cf. possible consistent worlds) C_i on the basis of (A_i, H_i, P_i).

The last step is

- Make a ranking of these contexts on the basis of the application of the metanorms (decision criteria) included in them. A formal description and an example of this process are comprised in (de Vey Mestdagh and Burgin, 2015).

Each step in this process is characterized by its own parameters of complexity. In legal practice different procedures are used to determine and handle (reduce) complexity in these different phases.

In the first phase a direct, static measure of complexity is commonly applied. The number of parties and the number of Hypotheses. This is a rough estimate of the number of different positions (interpretations, perspectives, interests).

In the second phase a direct, relative measure of complexity is commonly applied. The number of A_i and its relative size to H_i. The larger the relative size of A_i the less complex a case is considered to be, because there is supposed to be more consensus.

In the third and fourth phases all positions P_i and contexts C_i are derived:

Given the resulting set of labelled formula (A_i, H_i, P_i, C_i) representing the legal knowledge presented in a certain case, the problem complexity of this set can be defined as follows:

1. The subset A_i (agreed case facts and norms) is by definition included in each P_i and C_i so its inclusion as such is not a measure for complexity as it reflects absolute consent;
2. The elements of the subset H_i are by definition not included in each P_i and C_i so the relative size of the inclusion of its elements is a measure of complexity as it reflects relative consent. If there is more conformity there is less complexity. It is even possible that certain elements of the subset H_i are not included in any P_i and C_i. The number of these 'orphaned' elements can also contribute to the complexity of a case, because they represent antecedents without

consequent or consequents without antecedents (a decision is proposed without justification). Orphaned elements can be the result of incompletely presented positions or - worse - be smoke screens;

3. The relative size of the fraction of subset A_i in (A_i, H_i) - relative to the fraction of A_i in other cases - is a measure of complexity as it reflects the size of shared (consented) knowledge in a legal dispute. This holds even if the size of A_i is manipulated by one or more of the parties involved (as a winning strategy or for billing reasons), because the other parties have to take the A_i into consideration.
4. The relative size of the fraction of subset H_i in (A_i, H_i) - relative to the H_i in other cases - is a measure of complexity as it reflects the size of disputed knowledge in a legal dispute. This holds even if the size of H_i is manipulated by one or more of the parties involved (as a winning strategy or for billing reasons), because the other parties have to take the H_i into consideration.
5. The relative size of the subset P_i (relative to the P_i in other cases) is a measure of complexity as it reflects the number of different minimal positions that can be taken logically in this specific case. The size of P_i can only be manipulated indirectly (through the respective sizes of A_i and H_i).
6. The relative size of the subset C_i (relative to the C_i in other cases) is a measure of complexity as it reflects the number of different consistent contexts (possible decisions) that can be distinguished in this specific case.

In the fifth phase ranking of the contexts takes place.

The number of rankings depends on the inclusion of metanorms in the respective contexts. Metanorms that are agreed upon are part of A_i, metanorms that are not agreed upon are part of H_i. The process of applying the metanorms is fully recursive, since the objects of the metanorms are other (meta)norms, which are themselves also part of (A_i, H_i). This means that the determination of the complexity of the application of the metanorms is included in the previous phases. In this phase only the resulting number of rankings is established and can be considered to be an independent measure of complexity.

5. Validation of the model of complexity

The model of parameters for a reasonable calculation of complexity of legal knowledge as described in the previous paragraph is based on prior theoretical and empirical research into the complexity of legal knowledge (de Vey Mestdagh, 1997, 1998). A total of 430 environmental law cases have been formally represented in the formal model of legal knowledge introduced in paragraph 3 (the extended LRI) and their relative complexity has been established on the basis of legal expert judgements. The opinion of the experts was that 45 cases were of a complex nature and 385 of a less complex (more general) nature. This has been verified by applying an expert system to these cases that was enabled (provided with more complete data and knowledge) to improve on the human judgements in the 430 cases. The test results have shown that in the complex cases 66% of the human judgements were improved by the expert system (of which 20% full revisions), while in the general cases only 27% of the human judgements were improved by the expert system (of

which only 2% full revisions). The complex cases are characterized by higher counts of the parameters distinguished in the previous paragraph.

Further validation research is needed to refine the model of parameters for a reasonable calculation of complexity of legal knowledge as described in the previous paragraph. The relative weight of the counts of the parameters described will be varied against the available dataset of legal cases. The results will also be correlated with other variables that are available to gain further insight in possible parameters of complexity. Examples of these variables are: number of submitted documents, length of procedure, number of appeals, spending power of the parties involved, level of expertise of the lawyers involved, etc.

6. Conclusion and further research

In this paper we have explored the concept of complexity in the legal domain. A first conclusion is that the concept has not been studied explicitly in the legal domain. Only indirectly as a qualitative concept (vagueness, open texture, etc.) and hardly ever as a quantitative concept. However, a quantitative model of complexity in the legal domain has - apart from its scientific meaning per se – legal, economic and political implications. It will allow us to improve the quality and efficiency of legal proceedings. Algorithmic Information Theory offers several approaches to the quantification of complexity that inspired the approach chosen in this paper. It induced the thought that a distinction between problem complexity and resolution complexity is necessary and that a model of complexity based on the formal representation of legal knowledge should be the first step in developing a model of complexity in the legal domain. In this paper we give a description of a formal representation of legal knowledge (the extended Logic of Reasonable Inferences) and we describe the quantitative parameters of complexity for this model. The result we would like to call Reasonable Complexity, because it is based on the LRI and because it inherits its relative, perspective bound character. Complexity is specifically relative to the number of perspectives combined in the knowledge under consideration. Further research will focus on extending the model of complexity to resolution complexity, using - amongst others – available algorithms (i.a. Argumentator, a computer program we developed to implement the LRI). It will also use an available dataset of 430 environmental law cases that have been described and analysed before and that have already been represented in Argumentator.

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[1] Cf. H.L.A., Hart, who uses the concept of discretion to characterize hard (complex) cases, in The Concept of Law, New York, Oxford University Press, 1994; and R. Dworking, who distinguishes easy from hard cases using the concept of principled interpretation, in Law's Empire, Cambridge, Mass., Belknap Press, 1986; Although fundamentally differing in their opinion about the sources of the decision criteria, they both acknowledge the alternative perspectives that play a role in deciding complex cases (the judge's discretion in the light of the parties alternative perspectives vs. the judges principled interpretation in the context of the parties alternative perspectives).

158 Application of Information Theory Entropy as a Cost Measure in the Automatic Problem Solving

Published

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Abstract: We study the relation between Information Theory and Automatic Problem Solving to demonstrate that the Entropy measure can be used as a special case of $-Calculus Cost Functions measure. We hypothesize that Kolmogorov Complexity (Algorithmic Entropy) can be useful to standardize $-Calculus Search (Algorithm) Cost Function.

159 Approach to Ethical Issues Based on Fundamental Informatics: "School Days With a Pig" as a Clue

Published

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Approach to Ethical Issues Based on Fundamental Informatics: "School Days With a Pig" as a Clue1. Introduction - "School Days With a Pig" From 1990 to 1992, there had been a practical educational trial in an elementary school in Japan which is to raise a young pig for eating. The aim of this trial was to make children realize the importance of life or food, but the method which mixes up companion animals and domestic livestock caused an ethical sensation. The trial was made into a movie named "Buta ga ita kyôshitsu / School Days With a Pig" (2008). In this article, I would like to discuss "School Days With a Pig" and explore the difference between companion animals and domestic livestock from the viewpoint of fundamental informatics (FI). FI is the information theory proposed by Toru Nishigaki (2004, 2008) based on neo-cybernetics which is a developed version of cybernetics originated by Heinz von Foerster and superimposed on autopoiesis theory of Maturana and Varela.2. A System Composed of Communications between Children and a Pig In the beginning of "School Days With a Pig", children treated a pig as a pet, and soon became friends or classmates with the pig. We can say with fair certainty that communications between children and the pig composed a "communication system". From the viewpoint of FI, the communication system can be seen not only an autopoietic system (APS), but also an upper level HACS (Hierarchical Autonomous Communication System). In this case, the systems of lower level HACS are mental systems of children and a pig. They are also autonomous (autopoietic) systems while they can be seen as heteronomous (allopoietic) systems from the viewpoint of the upper level HACS. This hierarchical view can be derived from a shift of the viewpoint of an observer. Information transmission can be understood by this HACS model. Although each APS is closed system and cannot "transmit" information in principle, information "seems to be" transmitted as long as an upper level HACS works continuously. In FI, all kinds of information transmission are grasped as this kind of fiction. Therefore, there is no need to say whether the "real" information transmission between children and a pig exist or not.3. Communication System and Ethical Norms In FI, ethical norms are understood as a kind of "media" which guides the continuance of communications. For example, academic communications are regulated by ethical norms like "as a scholar, set up a theory for truth, not for money, power, love, etc." Communication systems operate smoothly by virtue of these kinds of media. A sense of ethics is generated when the members of a community share the ethical norms consciously and practically. Note that information content itself is not primarily connected to ethical problems. From neo-cybernetic point of view, information is self-generated inside a system, for each system is operationally closed. We cannot say whether the information itself is ethical or not as if it exists objectively. What is important here is the continuance of communications. It is not likely that a communication system composed of communications between children and a pig has as clear ethical norms as those of human-social systems. However, as long as such a communication system continuously operates, we can assume that there are some ethical norms like "behave as a classmate" which work with the system. At least, from the viewpoint of upper level HACS, lower systems can be seen as ethically expected actors that contribute equally to the operation of upper level HACS. In this sense, each of the lower systems can be seen even as a moral actor.4. Conversion

into Non-Communicational Sign Interpreter and Abandonment of Ethical Norms From the viewpoint of FI, the problem which children faced amidst discussion and criticism is derived from an informatic difference between seeing a grown pig still as a classmate and as food, pork, in daily lives. That is, we usually do not construct a "communication system" together with pork. From informatic viewpoint, pork is regarded just as "signs" and humans are just "sign interpreter". There is no ethical relationship between humans and pork. Therefore, if children eat the pig as pork, they must abandon the ethical norms related to the pig that they had held until then. They must stop to be a moral actor as classmates and kill the pig that had been an equal existence to them. Children themselves would understand this situation as "unethical", which is even equal to "murder". Livestock breeder generally do not construct a "communication system like classmates" with livestock. They treat many animals at the same time, they don't give them names, and the period of relationship is limited at a minimum, for about half a year, or at least for one year. In this way, they protect themselves ethically. In contract, the children in this trial communicated to the only one animal, gave it a unique name, and raised it for 900 days long. In the end, the grown pig was sent to a meat treatment center. Although each APS is closed and the external world can only give some stimuli to trigger the activities of APS, this trial could be observed as particular stimuli because of the destruction of a communicational actor. Because of this particularity, this practice can be criticized as "unethical". However, that is originally intended by teacher-side. This situation or relationship is the "sacrifice" from the viewpoint of children and the "self-victim" from the viewpoint of the pig, and that causes children to have feelings of the unavoidable tragedy concerning life and eating and a kind of sacredness within a living thing which is to be eaten.5. Conclusion Considering on ethical issues, being a communicational actor or to be a lower system of HACS should be distinguished from just being a non-communicational sign interpreter. When we see the living things as companion animals, we are in the former style, while we see them as food or domestic livestock, we are in the latter style. We can assume ethical norms when a higher system of HACS continually works as a communication system. This argument based on informatics can be a starting point for developing new argument on ethical issues, not in terms of difference of intelligence or importance of lives, but in terms of the possibility of construction of communication system.ReferencesToru Nishigaki. The Wisdom to Bridge the Gap between Lives and Machines: An introduction to Fundamental Informatics-. "For the Establishment of Fundamental Informatics on the Basis of Autopoiesis: Consideration on the Concept of Hierarchical Autonomous Systems"-. "The ethics in Japanese information society: Consideration on Francisco Varela's The Embodied Mind from the perspective of fundamental informatics" Ethics and Information Technology, Springer Netherlands, Volume 8, Number 4, Nov. 2006, pp.237-242

160 Can Cybersemiotics solve the problem of informational transdisciplinarity?

Published

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A transdisciplinary theory for cognition and communication has at least to be described from the following paradigms 1. An objective information processing view or info-mechanicism because it fits the findings and demands of the natural and technical sciences; 2. A social constructivist view, because it fits the findings and demands of the social sciences focusing on communication and

culture; 3. A systemic cybernetic view as it relates to general system theory's emergent evolution theory, Bateson's pattern that connects all living beings and the autopoietic nature of living organisms, which makes them resistant to the transference of objective information; 4. A Peircean semiotic paradigm including biosemiotic, because it has a realist hermeneutical concept of meaningful communication with a phenomenological foundation encompasses all living beings. But, each approach has its transdisciplinary shortcomings. Is it possible consistently to integrate these approaches into a transdisciplinary framework that integrate phenomenological and hermeneutical aspect in for instance Peircean semiotic logic with cybernetic and systemic autopoietic emergentist process-informational view of which Cybersemiotics is one attempt?

161 Cuts, Qubits, and Information

Published

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In his search for the 'essence' of continuity, Richard Dedekind (1872) discovered the notion of *cut*. Epistemologically speaking, a cut produces a separation of a simply infinite system into two parts (*Stücke*) such that all the elements of one part are screened off all the elements of the other. The distinct continuity of a two-state quantum system is encapsulated in the notion of *qubit*, the basic 'unit' of quantum information. A qubit secures an infinite amount of information, which, however, appears to be only penetrable through 'sections' of classical bits. Whereas Dedekind's cuts dwell on the discrete of number theory, the theory of nature is primarily concerned with continuous transformations. In contrast with Dedekind's line of thought, could the notion of information be derived from a 'principle' of continuity?

1. The 'Phenomenon' of the Cut

Dedekind's main concern was to clean the science of numbers from foreign notions, such as measurable quantities or geometrical evidence. Hence, the real challenge was to extract a purely arithmetic and perfectly rigorous definition of the essence of continuity from the discrete of rational numbers.

The *vexata quaestio* of "continuity and irrational numbers" originated with the Pythagorean discovery of *incommensurable* ratios. In the eyes of Pythagoreans, however, it was the divergence between the harmony of geometrical forms and the "atomism" of numbers to be disturbing. The early Pythagoreans "did not really distinguish numbers from geometrical dots. Geometrically, then, a number was an extended point or a very small sphere" (Kline 1972: 29). By contrast, in Dedekind's view, "numbers are free creations of the human mind; they serve as a means of apprehending more easily and more sharply the difference of things" (1888: 791).

Amazingly, Dedekind extracted the essence of continuity from *cuts*. Considering that every point produces a separation of the straight line into two parts such that every point of one part lies to the left of every point of the other, Dedekind recognized the special character of continuity in the converse, *i.e.* in the following principle:

If all points of the straight line fall into two classes such that every point of the first class (*Klasse*) [A_1] lies to the left of every point of the second class [A_2], then there exists one and only one point which produces this division of all points into two classes, this severing of the straight line into two portions. (Dedekind 1872: 771)

What is precisely determined is primarily the *division* itself [1]. Hence, whenever we have a cut (A_1, A_2) produced by no rational number, we can create a new number, an *irrational* number, which we regard as completely defined by this cut (Dedekind 1872: 773). So the system of real numbers is obtained by filling up the gaps in the domain of rational numbers and making it continuous; "*taking the object that fills each gap to be essentially the gap itself*" (Stillwell 2010).

Dedekind's notion of 'cut' raises distinguishability on to a higher level – from (integer) numbers to classes, from elements to properties – taking into account not solely the relations of one individual number to another, but also the relations between (infinite) sets of elements. As Dedekind emphasized, if "one regards the irrational number as the ratio of two measurable quantities," then this manner of determining it is already set forth in the clearest possible way by Euclid. But a presentation "in which *the phenomenon of the cut in its logical purity* is not even mentioned, has no similarity whatever to mine, inasmuch as it resorts at once to the existence of a measurable quantity, a notion which (...) I wholly reject" (Dedekind 1888: 794).

2. From Atoms to Qubits

While Dedekind's axiom of continuity guarantees the logical purity of real numbers, physics needs measurable quantities to unravel the continuity of nature into elements. It is noteworthy that the Pythagorean arithmetical atomism as well as the Democritean physical atomism were stuck on 'continuity.' Since the harmony of (natural) forms ought to be expressed by (whole) numbers, there was no way to fill the gap between the finite and the infinite. If the discovery of incommensurable ratios meant the departure of geometric constructions from arithmetic operations, Zeno's paradoxes made it clear that *motion* is not attainable by summing up an infinite series of discrete *states*.

It is a great achievement of quantum theory to have read the divide between measurable quantities and continuous transformations as a dialectic contrast and to have made it the source of physical meaning.

2.1. *Ghost fields*

Interestingly, a '*quantum* Zeno effect' was first noticed by John von Neumann (1932): a sequence of measurements frequently performed on a quantum system can slow down or even halt the evolution of the state. As a consequence of the quantum Zeno effect, in a

classical interference experiment [2], when a photon emerging from a Mach-Zehder interferometer informs that a 'which-path' measurement was set on its way, the probability that no measurement was actually performed (*i.e.*, no photon-observer *interaction* took place) could be stretched to the limit of 1.

The debate on the impact of 'null-result' measurements on the behaviour of quantum systems or, more generally, on the nature of *quantum interference* urged the search for a more 'sensible' description of physical reality. It is well known that Einstein, Podolsky, Rosen's celebrated essay (1936) was supposed to highlight the conflict between the completeness of the quantum physical description of physical reality and Heisenberg's *uncertainty relations*, but in fact it drew attention to a form of 'non-locality' underlying quantum physics. When measurements are performed on certain *pairs* of particles, the values of the same physical quantity for the two separated particles appear *instantly correlated*. Seemingly, the failing attempts to find a reasonably 'realistic' (*via* experiment) explanation of quantum interference effects led Einstein to coin the term 'ghost fields' (*Gespensterfelder*) for quantum waves.

2.2. *Perspectives on distinguishability*

Rather than questioning non-locality, quantum correlations enlighten a notion of *non-separability*, called 'entanglement.' As Schrödinger (1935) observed, two quantum systems interact in a way such that only the properties of the pair are defined. Consider for instance the spin components. Although any individual particle holds a set of well-defined values, once two particles get entangled in a pair, the spin of one particle and that of the other go in the *same* direction or in *opposite* directions; 'being the same' or 'being opposed' are clearly properties concerning two objects. Accordingly, quantum theory forges pure *relational* properties, which do not work for individual systems.

As for a measurement on a single particle, it also involves a correlation be- tween two 'subjects': the system and the observer. Any physical system numbers a set of characteristic 'potential' features. To become 'temporarily real' (*observable*), any of these features is bound to a feasible system-observer interaction. In this perspective, any measurement brings about a special 'relational property' of the pair (cf. Rovelli 1996). To the extent that measurement can be viewed as an interaction where a certain perspective on one observable determines the distinct value to be ascribed to the observable, it requires to refine the very notion of 'distinguishability.' In order to satisfy this requirement, quantum theory introduces *complex probability amplitudes*, which size the angular separation between alternative possibilities and must be *squared* to generate probabilities.

Thus, the classical tenet that measurement unveils a property *of* the system must be revised. It is wrong to attribute a feature to a quantum system until a measurement has brought it to a close by an act of irreversible amplification (cf. Wheeler 1982).

2.3. *The "Elementary Quantum Phenomenon"*

"One who comes from an older time and is accustomed to the picture of the universe as a machine built out of 'atoms' is not only baffled but put off when he reads [...] Leibniz's

conception of the ultimate building unit, the monad" (Wheeler 1982: 560). What Leibniz wrote about the "monad", Wheeler observed, is more relevant to what he called "quantum phenomenon" than to any- thing one has ever called an 'atom'. The very word 'phenomenon', according to Wheeler, is the result of a long lasting debate between Bohr and Einstein about the logical self-consistency of quantum theory and its implications for *reality* : "No elementary phenomenon is a phenomenon until it is a registered (observed) phenomenon." But Leibniz's monad has neither extension, nor shape, hence it is *not* observable.

A monad is a *simple substance and a unity of perceptions*. As a unity of perceptions, it contains the whole universe. As a simple substance, it is not a 'tangible' thing, but rather the 'perceiving faculty' itself. Indeed perception performs the inner constant change, and also, as a function of correlation, enables monads to *express* each other:

This interconnection or accommodation of all created things to each other, and each to all the others, brings it about that each simple substance has relations that express all the others, and consequently, that each simple substance is a perpetual *living mirror* of the universe. (*Monadology* 56; Leibniz 1989)

How to draw 'meaningful' perceptions – *i.e.*, natural phenomena – from an impenetrable faculty of perceiving, from the infinite unity of each monad? More than to the 'quantum phenomenon', the characteristic features of the monad apply to the *qubit*.

Like a monad, a qubit, which is the basic unit of quantum information theory, involves an infinite multitude. As a two-state quantum system, it can be prepared in a coherent superposition of two distinguishable states. It follows that there is no way to extract information from qubits other than by measuring them with 'yes-no' questions.

3. The Essence of Information

In the 'artificial' construction of a theoretical model – be it the Euclidean geometry or the universal computer – one starts with distinct elements and ponders how to achieve the connecting structure. In the attempt to figure out the intelligence of nature, one starts with the structure and tries to analyze it into elements. At its heart, stands the ultimate inner principle of 'existence': a principle of *metamorphosis*.

Reversing the Euclidean perspective, in his search for a general *geometric characteristic*, Leibniz pursued the 'inner principle' of geometry:

Imagine taking two points in space, hence conceiving the indeterminate straight line through them; one thing is that each point is regarded individually as single, another thing is that both are regarded as simultaneously existing; besides the two points, something else is needed for seeing them as co-existent in their respective positions. When we consider one of the two points as if we took its position and looked at the other (point), what the mind determines is called *direction*. (Leibniz 1995: 278)

Time enters geometry and generates the concept of space: "Space is the continuity in the 'order of co-existence' according to which, given the co-existence relation in the present

and the law of changes (*lege mutationis*), the co-existence relation in any given time can be defined."

For Leibniz, the whole universe is encapsulated in every monad from the very beginning, and the simple substance of monad coincides with the continuity principle of the disclosure of itself. Therefore, every monad must be also endowed with an original faculty of *representing*, which makes it able to match the variety of phenomena. To deliver 'information' about the universe, perceptions must become *observable* in the guise of phenomena.

Now, like a straight line, each perception needs two *co-existent elements* to be determined by an external observer. Thus, all measurable quantities (*i.e.*, the basic constituents of physics) must come into existence as *pairs*. This imposes one constraint on natural phenomena: given the infinity of perceptions, the number of natural elements must be the logarithm to the base two of that infinity. In this sense, Pythagoras correctly drew the geometry of nature from whole numbers. On the other hand, Leibniz insightfully saw the infinite multitude of natural forms as *related to* the different points of view of each monad.

In Leibniz's world, however, there is no conflict between the continuity of the simple substance and the distinguishability of perceptions, because each monad is a "*living mirror* of the universe." By contrast, in the (quantum) physical world, distinct points of view influence the spectral decomposition itself. The 'substance' of nature is captured by a unitary transformation, but physical *knowledge* rests upon *cross-ratios* between distinct perceptions. Thus, the essence of information springs from *correlations*.

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Notes

[1] Any separation of the domain of rational numbers into two classes, A_1 and A_2 , such that every number of one class is less than every number of the other, defines a *real* number.

[2] Think of photons set going through a Mach-Zehnder interferometer. After encountering the first beam-splitter each photon can choose between two mutually exclusive paths to reach the second beam-splitter.

Keywords
Continuity, cuts, perception, correlations

162 Ecological Approach to Theoretical Information Studies

Published

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The most significant background for information studies is the interaction between subject and object. Within the framework, information is an ecological process, namely information ecology process. However, due to the influence of the methodology featured with "divide and conquer", information studies has been broken to number of isolated pieces, losing the real, and the most important, significance of information process. Therefore, a new approach named Ecological Approach (methodology) is presented in the paper. As the consequence of ecological approach application, a number of important results about information studies have been revealed, demonstrating the importance of the new approach (methodology).

163 Extending Information Theory to Model Developmental Dysfunction

Published

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A combination of directed homotopy topological and Morse theoretic methods can significantly extend control and information theories, permitting deeper understanding of ‘developmental' pathologies afflicting a broad spectrum of biological, psychological, socioeconomic, machine, and hybrid processes across different time scales and levels of organization. Such pathologies emerge as phase transitions driven by synergistic forms of environmental insult under stochastic circumstances, causing `comorbid condensations' through groupoid symmetry breaking. The resulting statistical models should be useful for the analysis of experimental and observational data in many fields.

More explicitly, developmental process -- ontology -- is ubiquitous across vast biological, social, economic, and machine realms. Rosen (2012) characterizes this as ‘...anticipatory behavior at all levels of... organization'. Maturana and Varela (1980) see cognition permeating biology. Atlan and Cohen (1998) invoke a ‘cognitive paradigm' for the immune system that generalizes to wound healing, blood pressure regulation, neural dynamics, and so on (Wallace 2012). West-Eberhard (2003; 2005) sees ontology as a matter of ‘choice' at developmental branch points. Traffic flow involves repeated ‘ontological' choices by atomistic vehicles at road junctions, as well as during ordinary passage in heavy traffic (Wallace 2016a Ch.9). Indeed, machine cognition quite generally requires repeated choice of response to environmental cues (Wallace 2016a). A firm responding to market pressures must, at least annually, reconfigure product lines and marketing strategies, also a cognitive process (e.g., Wallace 2015 and references therein). Democratic state actors confronted by changing patterns of threat and affordance must, at least during elections, repeatedly choose among the different patterns of response made available by the contending parties and candidates. Active warfare involves constantly repeated choice at all levels of organization leading up to, and during, combat operations.

All developmental phenomena are, however, subject to patterns of failure and dysfunction. These range from neurodevelopmental disorders such as autism and schizophrenia (Wallace 2016b) to collapse of vehicle flow in traffic jams (Kerner and Klenov 2009), and catastrophes of governance like Brexit, or the US occupation of Iraq. Here, we attempt to extend results from information and control theories to statistical tools useful in understanding developmental failure.

The underlying model of development is that a system begins at some initial ‘phenotype' So confronting a branch point Co leading to two (or more) possible subsequent ‘phenotypes' S1 and S2, where new branch points C1 and C2 will be confronted, and at which choices must again be made, and so on.

Two of the three essential components of this model are intrinsically linked.

The first component is that of directed homotopy, in the sense of Grandis (2009) and Fajstrup et al. (2016). That is, there are equivalence classes of paths leading from ‘phenotype' S_{n} to S_{n+1}, as defined by the branch conditions C_{n}. A group structure -- the so-called ‘fundamental group' -- is imposed on a geometric object by convolution of loops within it that can be reduced without crossing a hole (e.g., Hatcher 2001). An algebraic topology of directed homotopy can be constructed from the composition of paths that constitutes a groupoid (Weinstein 1996), an object in which a product need not be defined between every possible object, here the equivalence classes of possible linear paths. As Weinstein (1996) emphasizes, almost every interesting equivalence relation on a space B arises in a natural way as the orbit equivalence relation of some groupoid G over that space. Instead of dealing directly with the orbit quotient space B/G$as an object in the category of sets and mappings, one should consider instead the groupoid G itself as an object in the category of groupoids and homotopy classes of morphisms. An exactly similar perspective involves use of the

homotopy and homology groups of algebraic topology to characterize complicated geometric objects (Hatcher 2001).

The second component is recognition that choice at developmental branch points involves active selection of one possible subsequent path from a larger number that may be available. This is often done, in the sense of Atlan and Cohen (1998), by comparison of 'sensory' data with an internalized -- learned or inherited -- picture of the world, and upon that comparison, an active choice of response is made from a larger number of those possible. Rosen (2012) invokes `anticipatory models' for such processes. Following the Atlan/Cohen model, choice involves reduction in uncertainty, and reduction in uncertainty implies the existence of an information source that we will call `dual' to the underlying cognitive process. Wallace (2012) provides a somewhat more formal treatment.

What is clear is that the dual information source or sources associated with developmental process must be deeply coupled with the underlying groupoid symmetries characterizing development. As development proceeds, the groupoid symmetry becomes systematically richer.

As Feynman (1996) argues, information is not 'entropy', rather it can be viewed as a form of free energy. Indeed, Feynman (1996), following Bennett, constructs an idealized machine that turns the information within a message into useful work.

Second, groupoids are almost groups, and it becomes possible to apply Landau's symmetry breaking/making arguments to the dual information sources characterizing developmental process (Pettini 2007). In that theory, phase transitions are recognized in terms of sudden shifts in the underlying group symmetries available to the system at different temperatures. High temperatures, with the greatest available energies, have the greatest possible symmetries. Symmetry breaking occurs in terms of the sudden nonzero value of some `order parameter' like magnetization at a sufficiently low critical temperature.

For a road network, for example, the `order parameter' would be the number of road turnoffs blocked by a traffic jam. The temperature analog is an inverse function of the linear vehicle density (Kerner and Klenov 2009; Wallace 2016a).

The third component of the model looks in detail at the embedding regulatory apparatus that must operate at each branch point to actively choose a path to the desired 'phenotype'. This requires exploration of the intimate connection between control and information theories represented by the Data Rate Theorem (Nair et al. 2007).

In a sense, the underlying argument is by abduction from recent advances in evolutionary theory: West-Eberhard (2003, 2005) sees development as a key, but often poorly appreciated, element of evolutionary process, in that a new input, whether it comes from a genome, like a mutation or from the external environment, like a temperature change, a pathogen, or a parental opinion, has a developmental effect only if the preexisting phenotype can respond. A novel input causes a reorganization of the phenotype, a `developmental recombination' in which phenotypic traits are expressed in new or distinctive combinations during ontogeny, or undergo correlated quantitative changes in dimensions. Developmental recombination can result in evolutionary divergence at all levels of organization.

Most importantly, perhaps, West-Eberhard characterizes individual development as a series of branching pathways. Each branch point is a developmental decision, a switch point, governed by some regulatory apparatus, and each switch point defines a modular trait. Developmental

recombination implies the origin or deletion of a branch and a new or lost modular trait. The novel regulatory response and the novel trait originate simultaneously, and their origins are inseparable events: there cannot be a change in the phenotype without an altered developmental pathway.

Thus, there are strong arguments for the great evolutionary potential of environmentally induced novelties. An environmental factor can affect numerous individuals, whereas a mutation initially can affect only one, a perspective having implications, not only for evolutionary economics, but across a full spectrum of ubiquitous `developmental' phenomena: even traffic streams `evolve' under changing selection pressures, and, indeed, such pressures act at every level of biological, social, or economic organization, as well as across rapidly expanding realms of machine cognition.

That is, just as the Atlan/Cohen 'cognitive paradigm' for the immune system generalizes across many different systems (Wallace 2012), so too does the West-Eberhard model of development: repeated branching under the control of an embedding regulatory apparatus responding to environmental cues is widely observed. Here, we apply a control theory formalism via the Data Rate Theorem, and using information theory, invoke the dual information source necessarily associated with regulatory cognition. The intent is to examine developmental disorders, in a large sense, over a spectrum that ranges from cellular to socioeconomic and emerging machine levels of organization, and across time scales from those of biological evolution to extremely rapid machine response.

The main focus is on exploring the influence of environmental insult on developmental dysfunction, where insult itself is measured by a projected scalar `tangent space' defined in terms of the invariants of a complicated `fog-of-war matrix' representing interacting environmental factors. The synergism between control and information theories via the Data Rate Theorem, and the extensions using topological and `free energy' Morse Theory methods, provide a new theoretical window into the dynamics of many developmental processes, via the construction of statistical models that, like more familiar regression procedures, can be applied to a broad range of experimental and observational data.

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164 Information — Semantic Definition or Physical Entity?

Published

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Although the term "information" is discussed in a lot of publications since decades, a generally accepted definition of information does not exist. The prevailing discourse focuses on semantic and technical definitions, but with the rising vision of quantum computing also physicists are more interested in understanding information. But still today semantic definitions seem to be stronger than physical concepts. The reason might be the experience, that information pervades all scales, from the quantum level to a railway signal. This fact can be addressed easier semantically, than by a physical entity. In a similar case like the entity "energy" it took nearly two centuries to receive a fundamental and finally accepted definition.Derived from that experience with the term "energy", the present

approach is looking for a definition of the smallest part of information. Based on such a simple entity, formalisms are needed to describe more complex information structures within higher scales. Finally such a definition has to be compatible to semantic definitions of information. The quest for the smallest information starts with an analogy to the pixel.Today's ubiquitous concept of a pixel is based on its technical use to characterize visual media technologies like scanners, displays and printers by their capability to represent information. The definition of a pixel addresses it's to key features: (1) It is defined as smallest addressable piece of information in that specific context of technology. (2) As additional requirement by the visual application a pixel has to be specified as small as it remains indistinguishable by the human eye. For the eye the single pixel does not exist, but an observer will be able to recognize structures of multiple pixels. And a wide variety of different structures with different functions may arise out of these individually invisible pixels. For this artificial and fully controllable, but real system of pixels we can discuss basic features of emergence. Focus of these considerations is not the semantic understanding of pattern generation, but the characterization of the process. The example of pixels offers an opportunity for an abstract formulation of emergence and its relation to information.The observations of the interdependencies at this macroscopic emergent situation can be used for the further argumentation by reducing the size of the pixel. Scaling down though different levels of so called "mega evolution", we finally can look out for candidates for the smallest information.The current debate among physicists offers quantum dots, the Minkowski space-time cell and black holes as smallest physical entities. Also if keeping the Bremermann limit and Landauer's principle in mind, a kind of an ontological gap remains if these smallest physical phenomena are taken as physical pixels, representing something like pure "information".One hypothesis to bridge this ontological gap will be presented. Based on the emergent understanding of information it is assumed that there must be a smaller informational entity below the physical limit. The ontological, or better mathematical argument for this assumption is discussed. In an admittedly hypothetical manner we can define in this sub-physical approach the smallest form of information –the initial pixel– and an elementary emergent process. A modern understanding in mathematics inspirits the idea for this approach, as it can be found in the Homology Type Theory (HoTT). There mathematics is not a fixed, steady logical structure, only explore able by a human brain. Mathematics itself might be an infinite process, independently from human understanding. And information has to be identified as a concept, which has to be a constitutive element of mathematics.This paper is not able to proof this hypothesis by physical arguments; this will be a task for further investigations. But it offers a feasible explanation for the semantic part of information and a linkage from the very basic but simple definition of information towards complex appearances.The idea of this paper is not to offer a final solution but to trigger a discussion about further needs to receive a clarification of the obstacles.

165 Information analysis of Foundation of Information Science (FIS) information exchange

Published

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INTRODUCTION

Information Science (IS) is a relatively new science that emerged after the Second World War, influenced by Bush's (1945) ideas, from the perspective of managing scientific information (Wersig & Neveling, 1975) or, according to some theorists, Otlet's (1934) thinking about documents and documentation. The first formulation of Information Science's modern concept, occurred during two meetings at the Georgia Institute of Technology (1962). Following these two meetings its interdisciplinary character started to get recognized, but not explicitly, by most authors. In particular, in Brazil, this issue has been debated epistemologically (Pinheiro, 2009). Although documenting and retrieving information was its initial motivation, IS has grown and now studies Information in categorized contexts, for example in the US, by Asis&t's Special Interest Groups (SIGs) and in Brazil by Ancib's Working Groups. According to the classification of the areas of knowledge of the National Counsel of Technological and Scientific Development (CNPq), Information Science is an Applied Social Science. The historiography of the area has elicited perspectives and approaches that today place IS into a new sociological and humanistic approach, in which pragmatism and fields, such as Philology and Philosophy, play a relevant role in the epistemological re-discussion of IS.

The Foundations of Information Science (FIS - http://fis.sciforum.net/), an informal endeavor promoted by Michael Conrad and Pedro Marijuan, has been an attempt to "rescue the information concept out from its classical controversies and use it as a central scientific tool". In this way, from the point of view of the FIS, Information Science is a more comprehensive domain, that is, it is one of the four main pillars of science, together with the Physical, Biological and Social sciences. This long-term project, which began in 1992, discusses its ideas in a permanent electronic mailing list established since 1997 and in biannual conferences (Madrid 1994, Vienna 1996, Paris 2005, Beijing 2010, Moscow 2013, Vienna 2015 and Gotemburg 2017). The board of the FIS initiative is composed of a multidisciplinary group of 18 members (http://fis.sciforum.net/fis-board/) and the FIS mailing list has 351 members as of April 10, 2017. Yan Xueshan analyzed the content of the FIS messages from 1997 to 2007, extracting and discussing the approaches of the list members on topics of "Information Concepts", "Physical Information", "Bioinformatics", "Information society", "Other Information" and "Information Science" (Yan, 2016, pp. 587-638).

The results of this research show that Information Concept and Information in Physics are the two most discussed topics in the FIS List. It is also known that it is not possible to define Information uniquely, because it depends on the context (R Capurro & Hjørland, 2003; LOGAN, 2014). The possibility of a consensus could come through a non-reductionist theory that unifies the concepts of information (Rafael Capurro, Fleissner & Hofkirchner (1997). In addition, Bais & Farmer (2007), who describe the central role of information in thermodynamics, statistical mechanics, chaos theory, computer science, quantum theory and astrophysics, have reviewed the concept of information in the context of Physics.

OBJECTIVE

The objective of this research is to perform a quantitative analysis of FIS's mailing list messages with the purpose of 1) classifying them into topic groups; 2) evaluating their evolution over time; and 3) identifying their main authors. A total of 5,375 messages exchanged between December 1997 and November 2016 were considered.

METHODOLOGY

The FIS list is an electronic forum for email exchange hosted by servers at the University of Zaragoza, Spain, where the list's moderator, Pedro C. Marijuán, works. All messages used as data source for this analysis are available in three sites: Site 1 (1997-2007): http://fis-mail.sciforum.net; Site2 (February 2006-present): https://www.mail-archive.com/fis@listas.unizar.es/maillist.html; and Site 3 (April 2014 – present): http://listas.unizar.es/pipermail/fis/ . Site 1 is a static repository, Sites 2 and 3 are updated daily, outside and inside the university server, respectively. Sites 1 and 2 were downloaded using HTTrack Website Copier software, and all 5,375 FIS mailings, between December 6, 1997 and November 29, 2016, have been saved on a local computer. Each message is stored individually as an html file, but the message's index, containing title, upload date and author, is displayed on one page on Site 1 and 16 pages on Site 2. Site 3 was not used in this search because of overlap with Site 2 messages.

The methodological procedures of this research were carried out in four steps:

Step 1: Export to Excel - The content of each message index was exported to an Excel spreadsheet which included four columns: message subject, author, date of posting, and html file name.

Step 2: Message Classification - A Discussion Topic was assigned to each message, based on the 50 topics available at http://fis.sciforum.net/fis-discussion-sessions/ (accessed November 29, 2016). The classification was based on content analysis of the first message of each thread and extended to their responses. We identified 19 additional new topics during this analysis, resulting on a total of 69 topics.

Step 3: Grouping topics - Similar topics were grouped together. We added the topic: "Administrative" for administrative messages, usually authored by the list moderator; "Announcement" for communications related to conferences and call for papers; and "Other Topics" for some messages that did not fit into any of the Grouped Topics.

Step 4: Compilation of results – We used Excel data analytical tools, mainly Pivot Table, for extracting and tabulating quantitative data that, together with content analysis, served as the basis for the interpretation of the results.

RESULTS

The 5,375 messages posted on the FIS mailing list between December 6, 1997 and November 29, 2016 were classified into 32 Grouped Topics, as shown in Table 1.

Table 1: Foundations of Information Science 5,375 messages classified into 32 Grouped Topics from 1997 to 2016.

Rank - Grouped Topic - 1997-2001 - 2002-2006 - 2007-2011 - 2012-2016 - Total
- All Topics (Number, %) - 407 (8%) - 2,096 (39%) - 1,178 (22%) - 1,694 (32%) - 5,375

1 - Information and Physics - 36 - 585 - 98 - 359 - 1,078
2 - Announcement - 119 - 331 - 171 - 203 - 824
3 - Definition of Information - 17 - 190 - 168 - 239 - 614
4 - Social Information - 79 - 57 - 64 - 144 - 344
5 - Biological Information - 52 - 140 - 21 - 31 - 244
6 - Information and Neuroscience - 0 - 11 - 85 - 117 - 213
7 - Information and Meaning - 3 - 112 - 85 - 8 - 208
8 - Administrative - 22 - 79 - 62 - 22 - 185
9 - Science - 7 - 20 - 68 - 74 - 169
10 - Phenomenology - 0 - 0 - 0 - 167 - 167
11 - Information and Economic - 0 - 95 - 24 - 12 - 131
12 - Information Theory - 0 - 5 - 114 - 8 - 127
13 - Information and Philosophy - 12 - 44 - 0 - 64 - 120
14 - Information and Logic - 0 - 0 - 102 - 9 - 111
15 - Semiotics - 0 - 19 - 0 - 75 - 94
16 - Consilience - 0 - 91 - 0 - 0 - 91
17 - Information and Chemistry - 0 - 43 - 43 - 0 - 86
18 - Informaion Science - 6 - 0 - 39 - 30 - 75
19 - Information and Ethics - 0 - 66 - 0 - 0 - 66
20 - Bibliometry - 0 - 58 - 0 - 0 - 58
21 - Information and Knowledge - 0 - 18 - 34 - 0 - 52
22 - Ecological Economics and Information - 0 - 45 - 0 - 0 - 45
23 - Scientific Commuication - 0 - 0 - 0 - 44 - 44
24 - Information and Mathematics - 0 - 0 - 0 - 36 - 36
25 - Information and Music - 0 - 35 - 0 - 0 - 35
26 - Information and Natural Languages - 33 - 0 - 0 - 0 - 33
27 - Information and Art - 0 - 26 - 0 - 0 - 26
28 - Information, Communication and Life - 0 - 0 - 0 - 26 - 26
29 - Other topics - 9 - 11 - 0 - 4 - 24
30 - Consciousness - 12 - 0 - 0 - 11 - 23
31 - Information and Symetry - 0 - 15 - 0 - 0 - 15
32 - Information and Computing - 0 - 0 - 0 - 11 - 11

The most discussed Grouped Topic was "Information and Physics" which included the following topics: Information & Physics (1998), Information Physics (2002), Entropy and Information: Two Polymorphic Concepts (2004), Quantum Information (2006), The Nature of Microphysical Information: Revisting the Fluctuon Model (2010) and Quantum Bayesianism (QBism) - An interpretation of quantum mechanics based on quantum information theory (2014). The recurrence of the subject over the years and the number of messages (1078) indicate that information in the context of Physics is important to FIS list members.

The question "What is information?" appears on the FIS homepage (http://fis.sciforum.net/), so it was not surprising that "Definition of Information" occupied an important position in the ranking, here found to be in third place. There were three long discussions in 1999, 2015 and 2016, representing approximately 11% of all 5,375 messages. This topic also permeates the messages of other topics, since the concept of information is

usually defined and/or questioned before the discussions. The definitions themselves and epistemological questions are discussed in the messages and one of the consensuses is that the concept of information is context dependent.

Surprisingly, "Information Science" was randked in18th place, an apparent contradiction to the list name and purpose.

The other lower ranking grouped topics were, most of the time, chosen according to the specialties of the leaders of the discussions.

Table 2 shows the 10 most productive authors on the FIS mailing list, the number of their documents indexed in the Scopus database, and their respective areas of interest retrieved from official sites and authors' CVs.

Table 2: List of the 10 most productive authors in the Foundation of Information Science (FIS) list, number of messages posted on FIS list and documents indexed by Scopus

Author - Number of messages on FIS list - Number of documents indexed by Scopus - Areas of interest
Pedro C. Marijuan - 871 - 34 - Information Sciences, Biology, Neuroscience
Loet Leydesdorff - 394 - 344 - Physics, Biology, Philosophy, Bibliometrics
Stanley N Salthe - 339 - 57 - Biology, Philosophy, Physics
John Collier - 220 - 27 - Philosophy, Biology, Information Theory, Systems Theory
Joseph Brenner - 202 - 20 - Theory and Philosophy of Information, Logic, Physics
Jerry LR Chandler - 178 - 27 - Chemistry, Biochemistry, Genetics, Complex Systems, Physics, Medicine
Karl Javorszky - 176 - 1 - Philosophy, Epistemology, Psychology
Rafael Capurro - 156 - 19 - Philosophy, Ethics, Information in social contexts
Søren Brier - 125 - 29 - Philosophy of science, Cybersemiotics, Biology
Steven Ericsson-Zenith - 118 - 0 - Biophysics, Computation, Bioengineering, Theory of Mind, Cosmology, Logic, Semiotics
Totals - 2779 - 558 -

The areas of interest comprise a multidisciplinary network that involves the discussions of the list in diverse contexts and points of view. In fact, the top 10 authors participated, on average, in 72% (23 of 32) of the Grouped Topics.

The number of co-authorships among the 36 main authors (not all listed in Table 2) is small. In fact, of 2,165 documents indexed in the Scopus database for these authors, only eight were produced together. Therefore, belonging to the FIS list does not seem to promote collaboration among its members.

Diversity of areas of interest and low number of co-authorships suggest that the cross disciplinary collaboration of FIS list takes place at the level of multidisciplinarity, the first of the three levels defined by Pombo (2004). This can be evaluated in future work that analyzes the relationship between threading and interdisciplinarity (Zelman & Leydesdorff, 2000).

Unfortunately, since it is customary for FIS members to change the message subject when replying to a message, it will be challenging to count specific threads, which is essential for this type of analysis. One solution would be to suggest to the group of list participants that they preserve this "metadata" (i.e., message subject) to facilitate future research. In this sense, analyses of co-authorship and co-citation among group members, thus grouped, could reveal signs of interdisciplinarity.

We hope, with this communication, to pave the way for a deeper and more systematic study of the contents of the FIS-list messages, in order to index them so that their discussions serve as a basis for future research.

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Keywords
Information Science; Foundation of Information Science; Mailing List; Interdisciplinarity

Comments on Information analysis of Foundation of Information Science (FIS) information exchange

166 Information Dynamics, Computation and Causality in Reprogramming Artificial and Biological Systems

Published

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In this talk, I will explain how algorithmic information theory, which is the mathematical theory of randomness; and algorithmic probability, which is the theory of optimal induction, can be used in molecular biology to study and steer artificial and biological systems such as genetic networks to even reveal some key properties of the cell Waddington landscape, and how these aspects help in tackling the challenge of causal discovery in science. We will explore the basics of this calculus based on computability, information theory and complexity science applied to both synthetic and natural systems.

167 Physical information systems

Published

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Information is usually studies in terms of stings of characters, such as in the methods described by Shannon (1948), which applies best to the information capacity of a channel, and Kolomogorov and

Chaitin, which applies best to the information in a system. Variations on the Kolmogorov approach, called Minimum Description Length by Jorma Rissanen (1978), and Minimum Message Length by C.S. Wallace and his associate, David Dowe (1968, 1999) as a Bayesian minimum message length. These work most easily for strings, but can be adapted to statistical distributions. The basic idea of both, though they differ somewhat in method, is that the most compressed for of the information in something is a measure of its actual information content, an idea I will clarify shortly. This compressed form gives the minimum number of yes, no questions required to uniquely identify some system. I will presuppose this is reasonable.

Collier (1986) introduced the idea of a physical information system. The idea was to open up information from strings to multidimensional physical systems. Although any system ca be mapped onto a (perhaps continuous) string, it struck me that it was more straightforward to go directly to multidimensional systems, as found in, say biology. Even DNA has a tertiary structure that can be functionally important, and thus contains information, though I did not address this issue in my article. A later article (2003) showed the hierarchical nature of biological information, and was more specific about the cohesion concept I used in 1986 to refer to dynamical unity.

The basic idea is to use statistical mechanics to describe an informational entropy that can self-organize in a way similar to chemical systems, and apply it to speciation, development, and other biological processes. Although notions such as temperature and free energy have no obvious correlates in evolutionary biology, it is possible to use the organizational and probabilistic aspects of entropy and information to introduce a notion of biological entropy. This is not necessarily the same as thermodynamic entropy, and the exact relation is open to question. What we do need, though, is that the underlying microstates are not correlated relative to the information at higher levels except for their general properties, so they act effectively randomly with respect to those levels. Traditionally, for example, variations in DNA have been thought to be random. Biological systems depend on available free energy, but it is there organization, passed on as information in hereditary processes that is most important. So they are primarily information systems.

Biological information is subject to two sorts of variation producing new information. First, potential information (information at the lower level) can be converted into stored information (expressed at a higher level), creating new expressions in the individual or new stable structures in a species, perhaps yielding a new species. The second sort of new information is produced by alterations to the genetic structure resulting in new information of one of the four possible types. Both types of new information add new possibilities, in the first case for development and environmental interaction, and in the second case, since it may involve the creation of potential information, for future expression as well. The increase in possibilities is generally faster than they are filled up, producing an information negentropy, or order at the higher level. This permits both order and complexity to increase together. Thus, there are two entropies important in biological systems, the entropy of information and the entropy of cohesion. The information of a system in a particular state is the difference between the maximum possible entropy of the state and its actual entropy. The entropy of information is the amount of information required, given the information of the state, to determine its microstructure. In other words, the entropy of information represents the residual uncertainty about the physical system after the ordering effect of the information contained in the biological system is subtracted.

A physical information system is a system containing stored information whose properties depend only on properties internal to the system. Stored information is like Shannon-Weaver information, except that like bound information it is physically real. It exists whenever there are relatively stable structures which can combine lawfully. These structures are the elements of the information system. The stored information of an element cannot be greater than its bound information (or else either lawfulness or the second law of thermodynamics would be violated), but the actual value is determined by its likelihood of combination with the other elements. The information content of a physical combination of elements (an "array") is the sum of the contributions of the individual

elements. For example, the nucleic acids have a structure which contains a certain amount of bound information (they are not just random collections of atoms), and can interact in regular ways with other nucleic acids (as a consequence, but not the only one, of their physical structure). The stored information of a given nucleic acid sequence is determined by the a priori probability of that sequence relative to all the permitted nucleic acid sequences with the same molecules. The bound information, which will be greater, is determined by the probability of the sequence relative to all the random collections of the same molecules. (Nucleic acids, of course, have regular interactions with other structures, as well as to themselves in three dimensions, so the restriction of the information system to just nucleic acid sequences is questionable. We can justify singling out these sequences because of their special role in ontogeny and reproduction.) The lawful (regular) interactions of elements of an information system determine a set of (probabilistic) laws of combination, which we can call the constraints of the information system (see Shannon and Weaver 1949: 38) for a simple example of constraints). Irregular interactions, either among elements of the information system or with external structures, represent noise to the information system.

The elements of an information system, since they are relatively stable, have fixed bound information. It is therefore possible to ignore their bound information in considering entropy variations. The elements are the "atoms" of the system, while the arrays are the states. The stored information of an array is a measure of its unlikelihood given the information system. The entropy (sensu Brillouin 1962) of this unlikelihood equals the entropy of the physical structure of the array minus the entropy of the information system constraints. This value is negative, indicating that the stored information of an array is negentropic. Its absolute value is the product of the redundancy of the information system and the Shannon entropy. This is just Gatlin's (1972) stored information. Array entropy so calculated reflects more realistically what can be done with an information system than the Shannon-Weaver entropy. In particular, random alterations to an array make it difficult to recover the array.

This definition of array entropy is inadequate, since it is defined in terms of properties not in the system, namely the entropies of the constraints and the structure constituting the array. The entropy of a system is usually defined in terms of the likelihood of a given macrostate. Two microstates are equivalent macrostates if they have same effect at the macro level (ignoring statistical irregularities). If we assume that all states must be defined internally to the system, the above analysis of arrays does not allow any non-trivial macrostates; each macrostate has just one microstate. This forces a definition of entropy in terms of elements not in the system, or else a "cooked" definition, like Shannon-Weaver entropy. A satisfactory definition of array entropy must be given entirely in terms of the defining physical properties of the information system elements. Such a definition can be given by distinguishing between actual and possible array states.

By assumption, the elements of the system are relatively stable and combine lawfully to form arrays. Possible maximal arrays of elements are the microstates. The macrostates are the actual array states. The microstates of an array are the possible maximal arrays of which it is a part. The information and entropy of a macrostate are defined in the usual way in terms of probabilities of microstates. In abstract information systems this definition degenerates, since arrays can be arbitrarily large. In realistic information systems, though, there is an upper limit on possible array size (though it might be somewhat vague). In organisms the maximum array size is restricted largely by the lengths of the chromosomes. In species it is restricted to the maximum number of characteristics of a member. (There must be such a maximum, since the amount of genetic information is finite.) The array information is a form of bound information, but also has an entropy defined only in terms of the information system characteristics. The external entropy of the null array is the entropy of the constraints on the information system. The external entropy of a maximal array is the base line from which the internal entropy can be measured. It can be called the entropy of the information system. The size of the information system is the difference between these two entropies:

[1] Size=H(constraints)-H(system).

The external entropy of an array is the internal entropy plus the entropy of the information system, equal to the entropy of the constraints minus the array information:
[2] H(external)=H(internal)+H(system)=H(constraints)-I.
The internal entropy of information systems is an extension of the classical statistical entropy of thermodynamic systems. It treats information systems as closed with respect to information but open to matter and energy, whereas mechanical systems are closed if they allow energy to flow in and out of the system, but not matter. The internal entropy of an array is determined by the physically possible ways it could be realized, just as the entropy of a thermodynamic state is determined by its possible microstates. The internal entropy is no less physical than the thermodynamic entropy, unlike the sequence or configurational entropy of Shannon-Weaver information. Array information is a special case of message information, just as bound information is a special case of free information. In this sense it is not anthropomorphic to speak of a biological code or a chemical message.
Codes can be hierarchical. Units concatenated out of elements of a lower level can form natural elements of a higher level. An example is the hierarchy of characters, words and sentences. Sequences of characters terminating with a special character, like a space, comma or period, form possible words. Sequences of words terminated by a period or other sentence terminator form possible sentences. Not all possible words are words, nor are all possible sentences sentences. Otherwise the hierarchy would be trivial. Words are distinguished from non-words by having a meaning or grammatical function, and sentences are distinguished from non-sentences by being grammatical. Because these properties of words and sentences are useful, words and sentences tend to outnumber other character strings. Some non-words and non-sentences are present in the language, however, which are potentially words or sentences, since they would be so if they fell into common use.
Brillouin (1962: 55) points out that a more efficient code for English would exploit the fact that not all potential words are words by encoding words so as to permit fewer non-words. The information required per character could be reduced by a factor of more than two, yet the same amount of information could be conveyed by the same number of characters. An even larger reduction could be achieved by eliminating potential sentences, and even more, no doubt, by eliminating unverifiable sentences. This would not only make language learning difficult, but would also reduce the likelihood of change in the language.
Using Brooks-Wiley (1986) terminology, the distinguished set of higher level messages contain the stored information of the information system, while the variants contain the potential information. The stored information is what distinguishes a system from other systems. In physical information systems the basis of the individuation must be some physical property.
I will finish by discussing the levels relevant to biological information systems, and how the possibility of self-organization in this system is relevant to evolution.

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168 Regeneration of Information: A Model-Theoretic Approach

Published

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Regeneration is an operation whereby an organism restores a segment that has been severed from one of its limbs. Analogs to this process can be found in non-biological contexts, such as restoration. When an area in a painting has faded or been damaged, experts apply a variety of techniques in their efforts to restore the original work. Image processing provides yet another context; faced with a photograph from which a portion is missing, we can use a number of methods for its restoration. Another example, very relevant to vision, can be found in the eye's "filling in", or completion, of missing visual information. In order to describe what takes place in regeneration, we use words such as "extrapolation" or "interpolation" to indicate what we mean. This does not yet approach formal analysis, however, nor any methodical investigation of the operation.

1. Informal Motivation

In my paper I wish to propose a definition for a certain type of regeneration, and will do so in general terms of the concept of model theory. More specifically, I wish to apply here an analysis of expansion of functions in mathematics and definitions of the process of natural expansions to the study of regeneration in general (Buzaglo 2002). I will propose several requisite concepts and point out a number of basic characteristics and questions.

The type of regression that I intend to treat can be found in the following example. Consider the natural numbers with addition and multiplication. It is important that they be given as a set on which functions are defined, and that they conform to certain laws. Now, "erase" an In the new situation, let us assume that 1 + 7 do not equal 8 and becomes, in effect, undefined. We have obtained a model in which the function of addition is partially defined. Something in this model is "flawed" and yet it is, nevertheless, given to repair. Should we wish to retain the commutativity of addition in the world without 1 + 7 we will have no choice but to expand upon 1+ 7 to equal 8.

Note that this provides no proof of the fact that 1 + 7 are 8 but rather an expansion of the function's scope of definition. The distinction is clear. While in the case of proof we seek to

determine the truth value of the claim defined, here we face a situation in which a function is used to define something that previously was undefined.

We can also erase 7 +1 and it will still be possible to repair the model, only that in this case we shall not approach the law of commutativity but the law of associativity. Erasing the second equation requires that we seek an alternative avenue for regeneration. It is likely that should we continue to erase the model will still be reparable and restorable, but should we erase a sufficiently large part it will be impossible to restore the model to its previous state. This is what we will also find in the case of biological regeneration. We know that if we sever a small piece of a lizard's tail that the lizard will succeed in restoring it, but sever a large enough piece and the restoration will fail. There are also levels in regeneration: While there are organisms with the wondrous capacity to restore different limbs, mammals have limited abilities of regeneration. So it is with the restoration of images: If we have the beginnings of a drawing of a hand and additional parts of the image we will, to a certain extent, be able to complete it. If we have removed a small spot of color, it seems that there are not too many means of restoring it. Something similar is shared by the image and the mathematical model. So it is with music; if we omit a note there are many ways to replace it. In any case, so it is in certain musical styles.

1. A Formal Definition

These analogies hint at the connection between the mathematical case of the restoration of functions and the restoration of an image. In view of this, let us try to abstract and define the regeneration of a function, and then to complete the list of requisite definitions.

The removal of an object from the domain of a function's definition requires no special effort. We need but to accept the existence of models with partial functions. The more important question is that of the idea that the model knows how to regenerate itself. The model looks into itself, as it were, and finds a certain constancy which enables it to restore itself. Here I would like to implement a concept of natural expansion, or forced expansions that have been studies in (Buzaglo 2002). Let us take the complement of a function where the model imposes a definition. I am thinking here of the expansion of the power function on 0:

1. $2^0=1$

This is forced by the rule B:

1. $2^x:2^y=2^{x-y}$

In this case we will write that the rule B. imposes the expansion.

However - and this simple though meaningful - this is exactly what we are doing in the case of restoring 1 + 7 = 8

where here in the role of B we use the commutative law C:

1. x + y=y + x

With this in mind we indroduced the following notation "F(L,h(a)=b)" means the law L forces the expansion h(a)=b. Thus, in the examples above:

"F(B, 2^0=1)" is true in the appropriate model and "F(C, 1+7=8)" is true in another model.

Given a model M for a first order language L that includes functions and identity, we can expand L with expressions of the form "F(K, h(t)=s) where "h( )" is a function symbol and t, s are terms and define:

M ⊨F(K,h(a)=b)

A rigorous definition is given in (Buzaglo 2002, p.) but informally we explain that there is an expansion of the domain of h( ) that saitsfy K, and that any manner of expanding the model so that it will retain K must necessarily be consistent with h(a)=b.

Now we may define the main concept:

Definition: Partially Regenative at h(a)=b

Let model M for language L which includes the expression "h( )" and wherein h(a)=b. We will say that the model is partially regenerative at point a and function h ( ) if, following the removal of a from the domain of the definition of h, there is a Law C, that imposes h(a)=b anew.

More specifically:

M⊨ h(a)=b

M' is the model after erasing a from the domain of h( ).

And there is a sentence C

M'⊨F(C,h(a)=b).

One may limit, in advance, those statements that impose expansion, and say that C is a universal law. From here onward we will simplify and assume this unless otherwise stated.

On this basis, we can add various definitions. Some of them are given to definition in a very natural way. The model is partially regenerative on a subset of a model A and not only at a point h(a)=b. Another way is to strengthen the way the model restore itself.

Definition: Universally Regenerative at h(a)=b

M is partially regenerative at h(a), and all the possible ways to restore h(a), by a universal law are compatible with h(a)=b.

In the paper I wish to explore the potential of the definition above. There are two channels we can follow: we can either study the logic of regeneration in the usual way we study constructions and concepts in model theory, or we may look at cases of regeneration and extract from them possible guidelines for this exploration. The interesting part is, of course, where these strategies converge. In the following I will start with few steps in each direction.

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Comments on *Regeneration of Information: A Model-Theoretic Approach*

169 Sustaining Digital Adaptation

Published

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Introduction

In response to "Digital Darwinism", people, organisations and society need to adapt to the different characteristics of digital information. Successful adaptation requires an understanding of the nature of information and the information ecosystems (just "ecosystems" when the context is clear) that develop under a range of selection processes. Ecosystems develop conventions that determine the pace, quality and friction with which information is processed. These conventions are embedded in the structure and communications of ecosystems and the entities that comprise them; we call them Interacting Entities (IEs)—these include people, computer systems, animals, organisations or parts of organisations.

Ecosystem inertia means that these ecosystem conventions cannot often respond fast enough to digital change. Digital information offers the potential of faster pace and reduced friction, but to achieve these, and also build in the necessary information quality, ecosystems may require extensive change to respond to different and diverse interactions.

To make these changes sustainable, they need to be compatible with the changing selection pressures resulting from digital change. IEs need to be dextrous to respond fast enough to the environment (the term "dextrous" avoids confusion with the specific meaning of the term "agile" in the example used below). This paper considers the impact of digital change using an analysis of the structure and flexibility of IEs in information ecosystems and shows how to sustain digital adaptation. The ideas are applied throughout the paper to an IT department (as an IE) to highlight recent ideas about software and systems engineering (Agile and DevOps—so-called because it forges a much closer relationship between Development and Operations) in a digital environment.

Selection and Information Ecosystems

IEs interact with their environment through channels—they sense the environment and decide how to act. The interactions of an IE and their impact on outcomes determine the ability of the IE to thrive (or not)—they define the selection pressures on the IE. Favourable outcomes will enable IEs to create derived IEs (eg children, updated software product versions, changed organisations) through some development process. In this way, interactions determine how IEs evolve in ecosystems. The activity of other IEs (eg competitors) impacts the interactions available to an IE (and vice versa) especially when resources are scarce.

Information enables IEs to link the current environment state with potential outcomes and the actions potentially able to provide these outcomes. So, IEs deal with descriptive, predictive and prescriptive information and the connections between them.

Information ecosystems develop their own conventions for sensing, processing and acting using these different types of information. These conventions support different ranges of information measures (pace, friction, quality) that result from trade-offs driven by the selection pressures.

Complex IEs include different components (IEs in themselves) that exhibit different conventions. For example, businesses have Sales and Marketing, Finance, HR and IT departments. Each contains a mix of the ecosystem conventions of the business and those of the particular discipline. Each may contain smaller components; for example, an IT department may contain separate Development and Operations components. Selection pressures may apply differently to the different components of an IE.

We can categorise the selection pressures on IT organisations in the following terms:

- business selection pressures ("quality" in terms of the alignment of IT with business strategy);
- user selection pressures ("quality" in terms of system and service quality and reliability);
- efficiency selection pressure ("friction");
- responsiveness selection pressure ("pace").

If an IT organisation does not deliverable favourable outcomes for its organisation in response to these pressures then there may be a range of implications. The business may not be able to deliver its strategy or operations efficiently and effectively. For the IT department, people may lose their jobs, the department may be reorganised, budgets may be changed or "shadow IT" (IT managed from outside the IT department) may spread.

IE patterns and components

The success (or not) of an IE is influenced by its pattern and the ecosystem conventions it instantiates. This includes the components it has, how they are structured and their ability to support different types of interaction.

There are two important dexterity measures: flexibility and extensibility. Flexibility is measured in terms of the number of different interaction types that a pattern can support without change. Extensibility measures what level of resource (eg money) is needed to support other interaction types—how easy it is to change the IE.

Patterns for organisations are described in terms of an operating model that defines facets like: interaction channels, governance bodies (decision-making groups of people), performance management, processes, organisation design (structure and roles) and culture. All of these also set the internal selection pressures on staff and suppliers and they define how effectively the external selection pressures are translated into internal selection pressures—a mismatch between the two is a source of poor performance.

The interaction channels determine which others IEs an organisation can interact with and how. They determine how effectively an organisation can sense the environment and act. The flexibility of an interaction channel is determined by its reach and whether the IEs at the other end use it. The requirement to create new channels (eg a new web site) causes inertia. Flexility is supported by the ability to change interactions easily as part of existing processes (eg to post new content rather than re-create a web site).

Governance bodies have a fundamental role in delivering dexterity because they decide much of what will be done (eg financial approval to proceed with changes). The degree to which they do so depends on their terms of reference, the information available to them (and the degree to which it captures friction, quality and pace), the attendees and the frequency with which they meet.

The degree to which performance management supports flexibility is determined by the objectives defined, how they are assessed and the degree to which they reflect the selection pressures. Performance management can drive unanticipated behaviours when people "game" the measures or when the measures do not reflect the external selection pressures. Matching external selection pressures accurately is difficult to achieve, especially as they change. Performance management can reinforce discipline ecosystem conventions at the expense of external selection pressures. And, compared with the minute-to-minute impact of culture, performance management can be a blunt, infrequent tool to create internal selection pressures.

An organisation design aligned with functions (eg Development, Operations) can prioritise discipline ecosystem conventions over the market. By contrast, market orientation can (without care) ignore elements of good functional practice. However, with a functional design it is more difficult to align internal selection pressures with external selection pressures.

Processes support flexibility only if they are designed to do so and the implementation accurately reflects the design. Anyone who has called a poor quality call centre will understand the impact of inflexible processes and the constraints imposed by underlying systems. Process flexibility often demands flexible access to information rather than the limitations imposed by many systems.

Culture is the often unrecognised driver of success because it operates continuously (unlike many of the other facets) and so it provides ever-present selection pressures. It has been defined as "The specific collection of values and norms that are shared by people and groups in an organization and that control the way they interact with each other..". In other words it is at the core of ecosystem conventions in organisations. However, it can be difficult to change.

We can summarise these points in the following way: the facets create inertia when they are driven by friction and quality at the expense of pace. Often the facets are defined infrequently and changed only in response to major problems (often in a way that decreases pace). But culture is an insidious presence and it can determine the extent to which the others will enable dexterity.

For IT organisations, the prevailing operating models and conventions have been defined by the implementation of IT Infrastructure Library (ITIL) processes and phases of outsourcing, amongst other factors. As conventions have developed over decades, many issues have developed that indicate a mismatch in external and internal selection pressures, for example:

- unnecessary working practices developed in response to particular events and never discarded in the light of changed circumstances;
- "watermelon" performance—green (good performance) on the outside, according to service reports perhaps, but red (poor performance) on the inside as perceived by business users;
- missing interactions—in which the IT organisation does not interact sufficiently on (for example) strategic questions;
- mismatched measures—in which pace and quality were traded-off against perceived reductions in friction (ie cost-driven) or quality was traded off against perceived pace (ie delivery on time whatever the consequences);
- retreat into silos—in which selection pressures have focused separately on individual components rather the whole, respecting the discipline ecosystem rather than that of the organisation as a whole and causing difficulties and gaps between components.

Digital information

"Digital Darwinism" is caused by fundamental changes to external selection processes. Digital information enables the same outcomes to be achieved in new ways with reduced friction and also enables new outcomes to be achieved; it stimulates a faster rate of change in the environment and a consequent requirement for IEs to increase their responsiveness. Increasingly, digital technology (including examples like machine learning) enables new approaches to information quality.

Digital technology has created numerous new channels and sources of information (eg the world-wide web, social media) through new devices. Digital information supports different types of information—initially the focus was on descriptive information (eg customer address) but increasingly also predictive information (eg propensity to buy) and prescriptive information (eg automated action).

Under the influence of Moore's Law, digital technology has driven down friction by several orders of magnitude. As friction has been driven down, so increases in pace have been enabled—it has been possible to interact much more frequently and more responsively.

Quality was one of the initial casualties of reduced friction. Quality is too hard to assess routinely unless there is a very good reason so "quality by proxy" is the norm. Such norms have not yet been established for many new channels and quality has been assumed rather than proven. However, machine learning, amongst other approaches, can improve quality in particular domains by enabling types of prediction not available to people (relying, for example, on the analysis of very large amounts of data).

Sensing the environment has also changed dramatically. A proliferation of channels and information volume ("big data") without understood levels of quality provides a new challenge in terms of measuring meaningful events in the environment (ie determining signal to noise). However access to so much data, with new tools (eg sentiment analysis), can provide much faster understanding.

In response to digital change, many organisations suffer from inertia and can no longer respond quickly enough. Recently, improving pace—the ability to respond fast and accurately to the environment—has been the focus for many organisations as part of their digital transformation.

Change and dexterity

The challenge for organisations is to become more dextrous—with a pattern that makes them responsive to change. Flexibility and extensibility are key measures of dexterity. But the nature of the change needs to be clearly understood—it is important to sense the environment and determine the external selection pressures with sufficient certainty to be able to define the required internal selection pressures and operating model required.

IT has traditionally applied internal selection processes based on traditional engineering practices. But these were not designed to deal with the pace of digital change. Digital Darwinism requires:

- a short cycle time—the ability to turn new requirements into IT services quickly;
- the ability to deliver many releases in a shorter time than previously.

Established ecosystem conventions are not compatible with these requirements and new ways of working—Agile and DevOps—have developed specifically to meet the challenge of overcoming the conventions. They use automation but also apply lean ways of working originally developed by Toyota and now used extensively in services as well as manufacturing. Lean ways of working embed principles that link internal selection pressures and external selection pressures.

Changing the pattern sustainably

Changing organisations is not easy. The impact of ecosystem conventions is that old ways of working are deeply embedded in all aspects of the operating model, stifling change. In making a change there are two factors to consider: what pattern is required and how can internal selection pressures be encouraged to stay aligned with external selection pressures as they change?

The new pattern may require new components and, to overcome the ecosystem differences of components, new relationships between them. Each component may also require a new mix of the ecosystem conventions of the business and that of the particular discipline; or entirely new ecosystem conventions may need to develop. In particular, it is important to identify the elements of the operating model that will inhibit the change.

How would these ideas apply to an IT department? Each of the facets of the operating model may need to change overall and with respect to the different components. The Development and Operations components, often with different cultures and practices, present one of the largest challenges.

The implementation of lean techniques matches the internal selection pressures used within the IT department with the external selection pressures and applies them at a much more detailed scale. As the name implies DevOps is about Development and Operations departments working closely together despite their different cultures; DevOps has been defined as the application of lean ways of working to IT, supported by automation. Lean ways of working are an important factor making the cultural changes needed. DevOps builds on the following lean principles:

- the "voice of the customer"—in response to the business and user ("quality") selection pressures;
- continuous removal of waste—in response to the efficiency ("friction") selection pressure;
- flow and value stream management—in response to the responsiveness ("pace") selection pressure;
- culture—combining responses to the selection pressures in day-to-day interactions with people rather than intermittently.

Combining these with automation (to support development, integration, testing and deployment) can provide large changes in both pace and quality and maintain the alignment of internal and external selection pressures.

Comments on *Sustaining Digital Adaptation*

170 The Difference That Makes a Difference for Conceptualization of Information

Published

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Abstract. Information is a subject of multiple efforts of conceptualization leading to controversies. Not frequently sufficient effort is made to formulate the concept of information in a way leading to its formal mathematical theory. Discussions of conceptualizations of information usually are focusing on the articulation of definitions, but not on their consequences for theoretical studies. This paper compares two conceptualizations of information exploring their mathematical theories. One of these concepts and its mathematical theory were introduced in earlier publications of the author. Information was defined in terms of the opposition of one and many and its theory was

formulated in terms of closure spaces. The other concept of information was formulated in a rather open-ended way by Bateson as "any difference that makes a difference". There are some similarities between Bateson's concept of information and that of MacKay. In this paper a mathematical theory is formulated for this alternative approach to information founded on the concept of a difference in terms of generalized orthogonality relation. Finally, the mathematical formalisms for both approaches are compared and related. In conclusion of that comparison the approach to information founded on the concept of difference is a special case for the approach based on one-and-many opposition.

Introduction

The concept of information is a subject of never ending discussions. The fact that these discussions do not lead to consensus generates a lot of anxiety among those who are engaged in the study of information, while this should be considered best evidence for the non-trivial character of this concept and as such be a source of joy. The actual problem is not in the variety of different definitions, but in the fact that many of them are deficient in logical rigor and that their mutual comparisons rarely go beyond the surface of verbal articulation. It seems that more attention is paid to the normative question what "should" be called information than to the issue of the explanatory power of the concept in the contexts of its use. There is nothing necessitating the choice of the particular definition of any concept and of course this applies to the concept of information too. Therefore, criteria for evaluation and comparisons of definitions can be found only in their consequences for the development of the theory of information understood as a complex of assertions regarding its characteristics, structure, properties and relations to other concepts.

This is exactly why so called information theory developed by Shannon is not a theory of information at all, but a theory of communication. Shannon never defined the concept of information in his great study of communication, which does not tell us anything about the structural characteristics or properties of information and even its quantitative characteristic in the form of entropy is problematic [1]. Actually, the word "information" in his famous article appears only few times and its only important occurrence (and probably last in entire text) is in the context of quantities that have form of entropy known from "statistical mechanics" and that "play a central role in information theory as measures of information, choice and uncertainty" [2]. Probably Shannon's unfortunate reference to "information theory" as if such theory existed already contributed to persisting confusion regarding what information theory is in spite of the continuing strong objections to its identification with Shannon's theory of communication [3].

Shannon's goal was to develop a mathematical theory of communication and therefore he cannot be blamed for not paying enough attention to the concept of information and its characterization. It is more problematic that frequently contributions to the discussion of information are equally vague regarding what exactly information is, how its concept can be described in a formal way and what we can assert about it. Competing voices about information are usually so incompatible (information as representation, information conceived through conduit metaphor, information in linguistic context, information as data in computation, etc.) that no comparison of the concepts involved is possible. Even more controversial are very strong claims, for which their authors do not provide any justification

(e.g. "no information without representation" used as a slogan by followers of MacKay's approach to information as "that which adds to a representation" [4]).

Not always, or even not frequently sufficient effort is made to formulate the concept of information in a way leading to its formal mathematical theory. Mathematical formulation is important, because mathematical theories of concepts can be easily compared through analysis of their theorems. This paper is exploring such comparison between mathematical theories of information for two conceptualizations of information. One of these concepts and the theory derived from it were introduced in earlier publications of the author. Information was defined by him in terms of the categorial opposition of one and many, as that which makes one out of many either by the selection or by structuralization [1,5]. Thus, this many can be made one by a selection of an element of the variety constituting the many, or by a structure which unify the many into one. Mathematical theory of such concept was presented and analyzed in many earlier publications of the author [6,7].

The other concept of information considered here is probably the most popular of all attempts in conceptualization of information was formulated in a rather open-ended way by Gregory Bateson in several of his publications from the 1970's [8]. But it was the glossary appended to his last book that made it a famous, commonly invoked slogan "information is any difference that makes a difference" [9]. This description of information is not a precise definition, but not just a game of words either. Of course, its popularity owes a lot to its polysemic, proverbial form and vernacular language. The lack of precision may increase its attractiveness, as everyone can find it consistent with own views. In particular, the use of the idiomatic expression "makes a difference" opens it to a variety of interpretations. It can indicate effectiveness, for instance in the sense of causation, or it can have a normative interpretation as an indication of importance. Actually Bateson apparently appreciated this ambiguity, as he dropped the ending "in some later event" suggesting the former interpretation from his "definition" as formulated in earlier papers ("information is any difference that makes a difference in some later event" [8]).

To be fair, we can find similar idiomatic expression in MacKay's study of information in the context of what he considered "operational" definition of information: "We shall find it profitable to ask: 'To what does information make a difference? What are its effects?' This will lead us to an 'operational' definition covering all senses of the term, which we can then examine in detail for measurable properties" [10]. He tries to answer the question about the effects of information, but not how information makes a difference. So his use of the idiomatic expression has the same intention as that of Bateson to avoid being bound by any commitment to a specific interpretation.

Bateson's way to information as "any difference that makes a difference" began already in 1951 in the spirit much closer to MacKay's representational view of information: "Every piece of information has the characteristic that it makes a positive assertion and at the same time makes a denial of the opposite of that assertion" [11]. But already at that time he recognized the role of differences: "In this sense, our initial sensory data are always 'first derivatives', statements about *differences* which exist among external objects or statements about changes which occur either in them or in our relationship to them. [...] What we perceive easily is difference and change – and difference is a relationship" [12]. In the

following years we can see that his view of information became increasingly general, but instead of lifting the level of abstraction and looking for more abstract conceptual framework, Bateson remained at the level of common sense concepts, but tried to formulate his description increasingly open-ended.

Why are Bateson's and MacKay's studies of information distinct among so many other attempts? They both are motivated by the interest in structural aspects of information, but try not to severe the connection to Shannonian theory of communication. Neither includes actual structural analysis of information or goes beyond purely declarative interest in structures, but both recognize the importance of structural characteristics of information. MacKay explicitly refers to the concept of a structure, for instance when he writes: "By representation is meant any structure (pattern, picture, model) whether abstract or concrete, of which the features purport to symbolize or correspond in some sense with those of some other structure" [13]. Also, he writes about Structural Information-Content as "The number of *distinguishable groups or clusters* in a representation [...] Thus structural information is not concerned with the *number* of elements in a pattern, but with the possibility of *distinguishing between* them" [14]. There is nothing here about what actually structure is, except some scattered common sense examples of "pattern, picture, model" and a vague statement that structure's presence is manifested by some grouping or clustering of elements and that this introduces possibility of making distinctions, i.e. to recognize differences.

Since neither Bateson, nor MacKay clarified the qualifying expression of "making difference" and the former intentionally leaves this qualification open-ended, in this paper the second, alternative to that of the present author approach to information is understood as founded on the concept of a difference without its qualification. It will be shown in the next section of the paper that this concept has a surprisingly rich philosophical consequences and interesting mathematical theory. Finally, in the third section the mathematical formalisms for both approaches are compared and related. The surprising conclusion of that comparison is that the approach to information founded on the concept of difference is a special case for the approach based on one-and-many opposition and its formalism in closure spaces.

Difference and Structure

The concept of difference (Latin *differentia*, Greek *diaphora*) assumed very early prominent position in philosophy along with those of a genus and species due to its role in Aristotelian logic (*Prior Analytics* $24^{a}16$ - $25^{a}13$) [15]. Differentia between species became a fundamental tool in defining universals. Aristotle gave it also an important role in the study of substance (*Metaphysics* $1037^{b}8$-$1039^{a}8$) [15]. However after the decline of the interest in Scholastic philosophy in the advent of the Scientific Revolution of the 17th century it was relegated to the secondary role of the negation of the equality or equivalence relations. There was more interest in what makes things similar than different.

One notable exception was the recognition by John Wilkins of the importance of difference in cognition and especially in matters related to cryptography in his 1642 book on the subject of cryptography *Mercury or the Secret and Swift Messenger*: "For in the general we

must note, that whatever is capable of a competent Difference, perceptible to any Sense, may be a Sufficient Means whereby to express the Cogitations. It is more convenient, indeed, that these Differences should be of as great Variety as the Letters of the Alphabet; but it is sufficient if they be but twofold, because Two alone may, with somewhat more Labour and Time, be well enough contrived to express all the rest" [16].

Bateson's description of information as "a difference that makes a difference" and MacKay's references to structural content of information clearly associated with differences are always considered as independent, original and unprecedented contributions to the study of information. Sometimes there are voices that at least chronological priority should be given to MacKay in the setting foundations for information in the concept of difference, which is disputable. However, they both must have been influenced by the dominating at the time philosophical and methodological structuralism. It is extremely unlikely that they both were unaware of the works of Herman Weyl [17], Jean Piaget [18], Claude Levi-Strauss [19] and stayed insulated from the philosophical discourse on the fundamental role of structures across all domains of human inquiry.

Furthermore, it is very unlikely that they were not familiar with the original source of the structuralistic methodology in the works of Ferdinand de Saussure, specifically in his 1916 book *Course in General Linguistics*. His general study of the language (after all the primary example of information system) was based on the idea of the transition from the traditional diachronic approach focusing on the derivations of linguistic forms from historically earlier ones to the synchronic methodology analyzing structural characteristics. But the structure of the language according to de Saussure is manifested in differences: "Everything that has been said up to this point boils down to this: in language there are only differences. [...] Language has neither ideas nor sounds that existed before the linguistic system, but only conceptual or phonic differences that have issued from the system. [...] Any nascent difference will tend invariably to become significant but without always succeeding or being successful on the first trial. Conversely, any conceptual difference perceived by the mind seeks to find expression through a distinct signifier, and two ideas that are no longer distinct in the mind tend to merge into the same signifier [20].

Mathematical Formalisms

We can proceed to mathematical formalisms of the two approaches to information. Thus, the author of this paper defined information as a resolution of the one-many opposition, or in other words as that, which makes one out of many. There are two ways in which many can be made one, either by the selection of one out of many, or by binding the many into a whole by some structure. The former is a selective manifestation of information and the latter is a structural manifestation. They are different manifestations of the same concept of information, not different types, as one is always accompanied by the other, although the multiplicity (many) can be different in each case.

Now we can interpret this definition within mathematical theory of closure spaces [21]. The concept of information requires a variety (many), which can be understood as an arbitrary set S (called a carrier of information). Information system is this set S equipped with the family of subsets M satisfying conditions: entire S is in M, and together with every subfamily

of $\mathbf{M}$, its intersection belongs to $\mathbf{M}$, i.e. $\mathbf{M}$ is a Moore family. Of course, this means that we have a closure operator defined on S (i.e. a function f on the power set 2^S of a set S such that:

(1) For every subset A of S, A is a subset of f(A);

(2) For all subsets A, B of S, if A is a subset of B, then f(A) is a subset of f(B);

(3) For every subset A of S, f(f(A)) = f(A)).

The Moore family $\mathbf{M}$ of subsets is simply the family f-Cl of all closed subsets, i.e. subsets A of S such that A= f(A). The family of closed subsets $\mathbf{M}$ = f-Cl is equipped with the structure of a complete lattice L_f by the set theoretical inclusion. L_f can play a role of the generalization of logic for not necessarily linguistic information systems, although it does not have to be a Boolean algebra. In many cases it maintains all fundamental characteristics of a logical system [22].

Information itself is a distinction of a subset $\mathbf{M}_0$ of $\mathbf{M}$, such that it is closed with respect to (pair-wise) intersection and is dually-hereditary, i.e. with each subset A belonging to $\mathbf{M}_0$, all subsets of S including A belong to $\mathbf{M}_0$ (i.e. $\mathbf{M}_0$ is a filter in L_f).

The Moore family $\mathbf{M}$ can represent a variety of structures of a particular type (e.g. geometric, topological, algebraic, logical, etc.) defined on the subsets of S. This corresponds to the structural manifestation of information and gives the expression "structural" explicit meaning. Filter $\mathbf{M}_0$ in turn, in many mathematical theories associated with localization, can be used as a tool for identification, i.e. selection of an element within the family $\mathbf{M}$, and under some conditions in the set S. For instance, in the context of Shannon type selective information based on a probability distribution of the choice of an element in S, $\mathbf{M}_0$ consists of elements in S which have probability measure 1, while $\mathbf{M}$ is simply the set of all subsets of S. Thus, this approach combines both manifestations of information, the selective and the structural.

Now we can consider the formalism for the general concept of difference. In mathematics this concept is usually called generalized orthogonality (with possible qualifications indicating its variations as "strong", "weak", etc.). The reason is that orthogonality in vector spaces equipped with scalar product is a good model of the relationship in a very general case.

The abstract orthogonality relation T is defined on a set S by the conditions [23,24]:

1. The relation T is symmetric,
2. For eery x in S: If xTx, then xTy for all y in S,

Of course, the second condition may seem strange. How anything can be different from, or orthogonal to itself. However zero vector in vector spaces with a scalar product is orthogonal to itself. Also, if we assume that the relation is irreflexive (no element is orthogonal to itself) the second condition is satisfied. Therefore there is no reason to object

such generalization when it merges several different mathematical concepts analogous to the common sense word "difference".

If the set S has an additional structure of a partial order, then we can enrich the theory of orthogonality in the following way.

We can consider more general structure of a partially ordered set (poset) P, with partial order < (inclusive!) with the so called strong orthogonality relation T defined by conditions:

1. The relation T is symmetric, i.e. For all x,y in P: If xTy , then yTx,
2. For every x in P: If xTx , then xTy for all y in P,
3. For all x,y in P: x<y *iff* T(y) is a subset of T(x), where T(x) = {z in P: zTx}

For instance Aristotelian syllogistics can be considered an example of such structure [22].

Conclusions

In the extended version of this paper a theorem is provided that shows in what way every orthogonality space is associated with a unique closure space. On the other hand we have specific properties for closure spaces to be derived from a generalized orthogonality relation. It turns out that only very narrow class of closure spaces can be associated with orthogonality relations. This shows that information formalized with the concept of difference understood as a very general orthogonality relation is a special case of information described in terms of closure spaces.

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Keywords

Concept of information, Difference, One-many opposition, Formalism for information theory

Comments on *The Difference That Makes a Difference for Conceptualization of Information*

171 The Social Obligations of the Cued Self in the Age of Advertising

Published

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The information age presents us with a gambit: present information transparency to level the asymmetries of information, "democratizing" the opportunities for people to act according to more informed, autonomous decisions; or to control and manipulate our inherent human vulnerabilities to further skew power towards increasing asymmetrical positive feedback loops benefitting the few. This paper examines contrasting notions of the self vis-à-vis (un)consciously curated environments as humans increasingly live in advertising-saturated environments.1

172 Habit as a connection between nature, mind and culture in C.S. Peirce's semiotic pragmaticism

Published

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Peirce's view of science and religion differs from the received view and therefore has interesting consequences for how we see the connections between the two. Peirce was like Karl Popper a fallibilist opposing the logical positivist epistemology of possibility of verification of scientific theories and models. The end of research in a certified truth is an ideal far away in the future. Furthermore he was not a physicalistic material mechanists but a process philosopher and an evolutionary synechist. This means that he thought that mind and matter was connected in a continuum and that matter has some internal living qualities, because he did not believe that the world is ruled by absolute precisely determinable laws that somehow existed before the manifest universe in time and space came to be. A further problem with the mechanicism of classical physics was that the time concept in Newton's theory of motion was reversible. Time had no arrow. But in Peirce's cosmogony change is at the basis as Firstness is imbued with the tendency to take habits and time therefore has an arrow and is irreversible and therefore what the laws manifested as the universe develop. This was unthinkable from a mechanical point of view. But Prigogine and Stengers (1984) – in there development of non-equilibrium thermodynamics based on Boltzmann's probability interpretation of thermodynamics – got irreversibility accepted as the basic process in physical ontology and in 2013 the recognized physicist Lee Smolin published the book *Time Reborn*, where he accepts Peirce's as well as Prigogine's views on the nature of time, change and law, which was a big change in foundational conception og physics. In contrast to Smolin and Prigogine Peirce also grounds his philosophical framework in phenomenology. He is inspired by German idealism and Naturphilosophie especially Hegel and Schelling though he is also a kind of empiricist. This makes him a kind of process objective idealist; but a very special one. In the tradition of Aristoteles, Hegel and Kant he worked out system of basic categories that had deep influence on his Cosmogony (CP: 6.32-33[1]).

173 Habits and Affects : Learning by an Associative Two-Process

Published

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In animal learning theory, the notion of habits is frequently employed to describe instrumental behaviour that is (among others): inflexible (i.e. slow to change), unconscious, insensitive to reinforcer devaluation (Dickinson 1985, Seger & Spiering 2011). It has also been suggested that learning using reinforcement learning algorithms somewhat reflects a transition from affect-based to more habit-based behaviour (Seger & Spiering 2011) where dual memory systems for affective working memory and standard (e.g. spatial) working memory systems exist (Davidson & Irwin 1999, Watanabe et al. 2007).

Associative Two-Process theory has been proposed to explain phenomena emergent from differential outcomes training. In this procedure, animals (sometimes humans) are presented with stimuli/objects that uniquely identify differential outcomes, e.g. a circle stimulus precedes the presentation of a food outcome, a square stimulus precedes the presentation of a toy outcome. Outcomes are, in turn, mitigated by specific responses, e.g. press the right button to obtain the food, press the left button to obtain the toy. Manipulating these stimuli, response, outcome contingencies reveals the two types of memory, i.e. one that concerns 'standard' working memory of stimulus-response associations, the other that concerns 'prospective' memory, that stimulus-expectation-response follows in a sequence.

The neural dynamic relationship between the purported dual memory structures may vary depending on the stage of learning at which the animal / human (agent) has arrived at. Previously it has been suggested (Lowe et al. 2014), and neural-computationally demonstrated, that a working memory route is critical in initial learning trials where the agent is presented sequentially with a given stimulus, action/behavioural options, and finally an outcome (e.g. rewarding stimulus or absence thereof). Subsequent trials lead to a dominance of affective (or otherwise prospective) memory that effectively scaffolds the learning of the outcome-achieving stimulus-response rules under conditions of relative uncertainty. Finally, during later stages of learning more 'habitual' responding may occur where the retrospective route becomes dominant and 'overshadows' the prospective memory.

In neural anatomical terms, candidate structures for implementing prospective memory include the orbitofrontal cortex (OFC), which is considered to enable fast, flexible and context-based learning (particularly important in studies of reversal learning, e.g. Delameter 2007). This is in contrast to the amygdala, which is considered less flexible, i.e. resistant to unlearning, but, nevertheless, critical to learning valuations of stimuli (Schoenbaum et al, 2007). Furthermore, the interplay between the basolateral division of the amygdala (BLA) and OFC may be crucial in differential reward evaluation (Ramirez and Savage, 2007). Passingham and Wise (2012) have suggested that medial prefrontal cortex (PFC) has a critical role in encoding outcome-contingent choice, whereas Watanabe et al (2007) have provided evidence for the lateral PFC integrating activation inputs from 'retrospective' (working memory) areas such as dorsal PFC and 'prospective' (outcome expectant) areas such as OFC and medial PFC.

A perspective of Urcuioli (2005, 2013) is that outcome expectancies (from prospective memory) provide a means to effectively classify stimuli. Action selection can then be simplified through exploiting affordances of the subset of those actions already associated with the outcome

expectancy classes. This is a reason why participants under certain forms of differential outcomes training can immediately select the unique action that leads to the desired outcome even though the stimulus-action (response) contingency has previously not been experienced: Subjects have already classified the stimuli according to a given outcome expectancy previously associated with an action.
In this work, I discuss the associative two-process model in relation to (standard) working memory and 'affective working memory' (Watanabe et al. 2007) as providing a means to classify stimuli. I refer to a number of animal learning paradigms that demonstrate the potential for reward and reward omission anticipation to be associated with reward-promoting behaviour (cf. Overmier & Lawry 1979, Kruse & Overmier 1982, Urcuioli 2013, Lowe et al. 2016, Lowe & Billing 2017) and neural computational aspects of the interplay of affective (prospective) and working (retrospective) memory that may yield more habitual behaviour. I show that, within an associative two-process context, habits can also be understood in terms of affective working memory – specifically in relation to reward acquisition expectation and reward omission expectation. Habits, in this context are considered behaviours that are inflexibly selected for in spite of reinforcer devaluation and their rigidity reflects the certainty / uncertainty of a particular rewarding outcome.
I discuss the implications for such learning of habits and affective mediations of behaviour particularly regarding memory and clinical conditions (e.g. alzheimer's) and learning children. This may be informing of new digitized solutions for intervention approaches with senior citizens and pedagogy in relation to children development.

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174 Ritual Artifacts as Symbolic HabitsMaximizing Abducibility and Recovering Memory

Published

Lorenzo Magnani

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The externalization/disembodiment of mind is a significant cognitive perspective able to unveil some basic features of abduction and creative/hypothetical thinking, its success in explaining the semiotic interplay between internal and external representations (mimetic and creative) is evident. This is also clear at the level of some intellectual issues stressed by the role of artifacts in ritual settings, in which also interesting cases of creative meaning formation are at play. Taking advantage of the concept of manipulative abduction, I will stress the role of some external artifacts (symbols in ritual tools). I contend these artifacts, and the habits they originate, can be usefully represented as memory mediators that "mediate" and make available the story of their origin and the actions related to them, which can be learned and/or re-activated when needed. This is especially patent in an anthropological perspective. Furthermore, symbolic habits – for example in psychoanalytical frameworks - can also be seen as memory mediators which maximize abducibility, because they maximize recoverability, in so far as they are the best possible expression of something not yet grasped by consciousness.

175 Role of Happiness as a Habitual Process

Published

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Philosophy itself is philosophizing to our experience of the world, life, or thought, and it is truly enriching our social, political, intellectual, and emotional existence. Although, philosophers have various views on a single issue, but they still share a common interest, i.e., a critic with the comprehensive thought of approach, and therefore, 'philosophy' is a *way to understand* our life (not a way of life). Similarly, our life is based on the various kinds of habits and rituals (prayer, meditation, yoga, worship many deities, speaking multiple languages and symbols for communicating with each other, eating various foods with different cultural practices, etc.) due to the religious practices and people love to do these procedures to continue their existing diversity of cultures. Take an example of 'Happiness'. For understanding the true nature of happiness, there are many philosophical debates on it from both the east and west perspectives, but their underlying motto is same, i.e., the continuous practice of *habits*. However, this paper will mainly focus on Aristotle's understanding of '*Eudaimonia*' (happiness) and the significant role of '*habits*' for flourishing a happy life.

176 A New Look at Habits using Simulation Theory

Published

Erik A. Billing

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Habits as a form of behavior re-execution without explicit deliberation is discussed in terms of implicit anticipation, to be contrasted with explicit anticipation and mental simulation. Two hypotheses, addressing how habits and mental simulation may be implemented in the brain and to what degree they represent two modes brain function, are formulated. Arguments for and against the two hypotheses are discussed shortly, specifically addressing whether habits and mental simulation represent two distinct functions, or to what degree there may be intermediate forms of habit execution involving partial deliberation. A potential role of habits in memory consolidation is also hypnotized.

177 From "Habits" to "Rituals"

Published

Raffaela Giovagnoli

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My contribution aims to show the common source of habits and rituals, namely the fact that they are grounded on the same logic or process of repetition even though they may have different functions. After a brief introduction into the philosophy of rituals, I propose an interpretation of rituals as cultural activity which is based on the same mechanism of habits but it is expressed in a we-form.

178 Religion, information and ritual: understanding difference in a sacred context

Published

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Religion is a fundamental part of the lived experience of the majority of humanity. This paper reports on the conceptualization of religion through an understanding of its relationship with information. The focus is on practice and ritual rather than belief. Information is here understood in terms of Bateson's definition of "the difference that makes a difference". The paper explores information in a ritual context in a variety of settings, as well as touching on work done regarding other uses of information by religious communities, such as church websites and learning environments.

179 Ritual Artifacts as Symbolic Habits Maximizing Abducibility and Recovering Memory

Published

Lorenzo Magnani

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The externalization/disembodiment of mind is a significant cognitive perspective able to unveil some basic features of abduction and creative/hypothetical thinking, its success in explaining the semiotic interplay between internal and external representations (mimetic and creative) is evident. This is also clear at the level of some intellectual issues stressed by the role of artifacts in ritual settings, in which also interesting cases of creative meaning formation are at play. Taking advantage of the concept of manipulative abduction, I will stress the role of some external artifacts (symbols in ritual tools). I contend these artifacts, and the habits they originate, can be usefully represented as memory

mediators that "mediate" and make available the story of their origin and the actions related to them, which can be learned and/or re-activated when needed. This is especially patent in an anthropological perspective. Furthermore, symbolic habits – for example in psychoanalytical frameworks - can also be seen as memory mediators which maximize abducibility, because they maximize recoverability, in so far as they are the best possible expression of something not yet grasped by consciousness.

180 The Movement of Habit: On Ritual and Activism

Published

Chryssa Sdrolia

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In one of the most distinctive readings of the concept of habit, Felix Ravaisson cut through its common association with passivity by posing the problem as one of distance: considered as conscious reflection, an inclination may be said to tend towards an end or object outside it; considered as habitual, however, an inclination may be said to be much closer to the actuality it seeks to reach. As the automatism of an inclination increases, the movement and the goal almost touch each other. The result is a type of immediate creation. Something comes to being, a fusion of the real and the ideal, of the personal and the impersonal without the necessary intervention of a consciousness to will it. As it proliferates, the habit creates a world by allowing a manifold of influences to coalesce as one consistent behaviour. We might, after Peirce, call this consistency a 'sign' or 'third', born of the junction of the potential and the actual. Or, to borrow from Spinoza, we may call it expression. Far from being merely passive, then, habit may be said to infinitely approximate a supreme form of spontaneity, not unlike the 'intelligent intuition' that Kant had reserved for God. In other words, habit sheds its connection with psychologism to become properly metaphysical. In this paper, I examine the usefulness of such a metaphysical concept of habit for an understanding of ritual and ritualistic practice, especially in the context of recent earth activism supported by indigenous spiritualist imaginaries. I explore how ritual, tied both to the habit of communicating with nature but also with the understanding that nature produces itself in its habits, opens up the possibility of actively shaping social and political realities by 'expressing' or 'signifying' a merger with the free and creative force of the cosmos.

181 Is the Internet-of-Things a burden or a leverage for the human condition?

Published

José María Díaz-Nafría[1, 2, 3], Teresa Guarda[3]

[1] Universidad de León (Spain)
[2] Munich University of Applied Sciences (Germany)
[3] National University of Santa Elena (Ecuador)

The very common Internet citizen has a very restricted autonomous capacity to move through the network which is becoming the ever stretching milieu where our lives take place. At the same time, the capacity to manage relevant information from ourselves and the environment we are living in

offers new avenues to deal with healthcare, sustainability issues and problems of many different kinds and significant social concern which were previously insufficiently attended. While the actual structure of the Internet, geared by big-data technologies, exhibits a network topology highly concentrated, the authors propose a *cyber-subsidiary model* which may solve the conundrum where the human condition seem to be trapped in a blind alley.

182 Transhumanism: A Progressive Vision of the Future or Liberal Capitalism's Last Ideological Resort?

Published

Christopher Coenen

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As an organised socio-cultural and increasingly politically active movement, transhumanism is a rather new phenomenon. It has its roots in those segments of US society in the 1970s and 1980s which – against the backdrop of wide-ranging expectations concerning the 'Space Age' – merged ideas and habits of the counter-culture of the 1960s with strong, often quasi-religious hopes for a future society shaped by science-fictionesque high-tech (Schummer 2009; McCray 2012). While this proto, or early transhumanist movement already evolved within some organisational networks of structures (e.g. the *L5 Society* which promoted the colonisation of extra-terrestrial space), organisations specifically dedicated to the promotion of transhumanism as an encompassing worldview emerged only in the 1990s. Since then, we have witnessed some organisational re-shuffles within the movement and recently the emergence of (small) political organisations of transhumanists, including some (very small) national political parties.

In order to adequately assess the current relevance of transhumanism, it would, however, be short-sighted if we only look at the organised movement in a narrow sense. Much of its current relevance is due to fact that is embedded in a much broader socio-cultural milieu which includes, for example, major figures of the IT industry. The propinquity to transhumanism displayed by influential networks in the IT industry and other powerful elements of digital capitalism (e.g. in US science policy) has been pointed out in policy-oriented and ethical discourses on various fields of science and technology (such as nanotechnology) for quite some time now. Since the late 2000s, we have witnessed, however, a surge of broader public interest in the question to what extent transhumanism plays a role in the visions of the future, or even in the short-term business strategies of key players in digital capitalism. As such, transhumanism is often deemed a radical variant of what has been termed 'Californian ideology' (Barbrook and Cameron 1996).

The surge in public interest has entailed a considerable amount of mass media reporting (e.g. McCracken and Grossman 2013), which in turn created some interest by policy makers in this topic; and we have also seen an increase of anarchist, socialist or ecologist critiques, for example in France (PMO 2015) and in Germany (Jansen 2015; Wagner 2015). On the other hand, some fashionable currents of the Left, such as accelerationism, have brought forward notions of progress and of emancipation through technology closely resembling some such transhumanist notions.

This brings us to another – and, as will be argued, crucial – aspect of transhumanism, namely the fact that the transhumanist movement of our times is in many respects deeply indebted, if indeed not merely epigonic, to thinkers in the last third of the nineteenth and the first third of the twentieth century which developed, even in some technical detail, genuinely transhumanist visions of the

future. For our discussion, this aspect is crucial because these thinkers tended to, or openly promoted socialist visions of the future in which the creation of a socialist world society is portrayed as the basis of a much larger endeavour of the human (and increasingly cyborgised, transhuman) species, namely the conquest of extra-terrestrial space by a civilisation in which the human intellect is embodied in technoscientific devices.

In the present paper, it is argued that, in order to answer the question raised in the title of this workshop – namely if transhumanism should be seen as a "proper guide to a posthuman condition" or deemed a "dangerous idea" –, we first have to ask in which visions of a future society transhumanism is embedded. While much of discourse on transhumanism since the late 1990s has focused on a perceived dichotomy of (ultra-)liberal and individualist, largely US-American transhumanism *versus* a variety of anti-individualist (conservative, ecologist or socialist) critiques of transhumanism, a historical perspective may allow us to better understand the multi-faceted ideological character of transhumanism. As has been argued (Coenen 2014), the increasing relevance of transhumanism in current discourse on science, technology and the future demonstrates that global players in today's digital capitalism still follow an agenda which was developed in Britain in the heyday of imperialism and after the Great War as a reaction to a perceived crisis of progressive thinking and as a contribution to the establishment of technoscience in society. Notwithstanding its focus on individual choices, the ideological foundations of current transhumanism are thus collectivistic. Due to its largely quasi-religious character, transhumanism could and can be an element of politically quite different projects, such as British imperialism, scientistic communism and 'digital capitalism'; and current transhumanism, as an ideology for technoscience, still expresses the belief in a grand narrative about the future of humankind in which technoscience is portrayed as a means of salvation.

In light of the strange fact that the transhumanist grand narrative about the future has fascinated, and continues to fascinate representatives of a wide variety of political persuasions, it appears advisable to analyse the question of the desirability of transhumanism against the backdrop of different societal visions and political stances evident in the history of transhumanism. With a view to the above-mentioned current political discussions about the role transhumanism in our 'digital age', we may then first ask if transhumanism provides us with a progressive vision of the (far) future of our species, or if it should better be deemed liberal capitalism's last ideological resort, competing with nationalist and (openly) religious ideologies. On the basis of such an analysis, more specific questions concerning the desirability of transhumanism can be raised, for example with regard to the potential consequences of its rise for the goal to create a sustainable global society.

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183 Agogic Principles in Trans-human Settings

Published

Christian Stary

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This contribution proposes a learning approach to system design in a transhuman era. Understanding transhuman settings as systems of co-creation and co-evolution, development processes can be informed by learning principles. A development framework is proposed and scenarios of intervention are sketched. Illustrating the application of agogic principles sets the stage for further research in this highly diverse and dynamically evolving field.

184 Aspects of mind uploading

Published

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I will discuss various aspects of mind uploading, including practical (will it be possible?), ethical (is it morally permissible to develop uploading technology?), philosophical (if I upload, will the upload be conscious, and will it be me as opposed to merely a copy of me?) and sociological (what will a society dominated by uploads be like?).

185 Image of Men in Posthumanism of Information Society

Published

Felix Tretter

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Protecting human health and understanding the effects of information society on humans implicates a reference model of the essentials and "normal" functions of human beings. Such models are simply called "images of men" ("Menschenbilder"). In this paper, common concepts of men are mentioned and it is outlined that an image of men is a paradoxical construct. Especially Homo deficiens (Gehlen) and the natural artificiality (Plessner) are the roots of technophilia of humans that is one important driver of Information and Communication Technology (ICT). The other main driver is the efficiency-oriented modern society that provides such tools. One field is neuropsychiatry where monitoring of the mental and brain state for diagnosis and therapeutic modification by chemical and electrical tools is developing very fast. On the other hand, ICT already has some negative health implications in respect of internet addiction or digital dementia. These aspects of ICT society are discussed regarding the question of change of humans and of change of their image.

186 Imagined futures gone astray. An ontological analysis

Published

Wolfgang Hofkirchner

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This paper is on ontological assumptions on which ideologies such as trans- and post humanism are based. The method by which these ontological assumptions are criticised is the analysis of the way of thinking (reductionism/projectionism, disjunctionism, and integrationism).

187 Just Machine Test (JMT)

Published

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Within a few decades autonomous robotic devices, computing machines, autonomous cars, drones and alike will be among us in numbers, forms and roles unimaginable only 20 or 30 years ago. How can we be sure that those machines will not under any circumstances harm us ? We need a verification criterion: a test that would verify the autonomous machine's 'moral' aptitude, an aptitude to make 'good' rather than 'bad' choices. This paper discusses what such a test would consist of. We will call this test the ethical machine test or the Just Machine Test (JMT). The Just Machine Test is not intended to prove that machines have reached the level of moral standing people have, or reached the level of autonomy that endows them with 'moral personality' and makes them responsible for what they do.

188 Motives of transhumanism

Published

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Due to the concentration on necessity and underestimation of creativity and especially of the political realm men have lost understanding of their world. The accent on satisfying biological needs and improving man's environment through automated labour are expressions of that. Another example are the transhumanists' efforts to improve man's body. The efforts to perceive more, better, faster etc. without knowing why are just manifestations of endeavours deprived of sense.

189 The Utopia of Universal Control – Critical Thoughts on the Transhumanist and Technological-Posthumanist Concept of the Human, Transhuman, and Posthuman

Pending author revision

Janina Loh

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Trans- and posthumanism are two heterogeneous movements of the late 20th century, located in philosophical anthropology and philosophy of technology. They combine several disciplines such as philosophy, social and cultural studies, computer and AI-sciences. The transhumanist project is a development, enhancement, and perfection of man by transforming her. Posthumanism wants to overcome man and predicts her approaching end. The transhumanist goal is a "new human being", a human being x.0 so to speak, whereas the technological-posthumanists' goal is commonly an artificial superintelligence. Critical posthumanism questions humanist categories and traditional dualisms such as subject – object, man – woman, mind – body, the natural – the artificial, and so on. Via this procedure it aims at overcoming any anthropocentric and essentialist concept of "the human". In a nutshell, in trans- and posthumanism exist at least three strategies to overcome man: (1) Transhumanism tends to enhance man to a human x.0, (2) technological posthumanism creates an artificial alterity, and (3) critical posthumanism questions conventional categories to define man.
In my talk I will outline my critique of transhumanism and technological posthumanism as the agenda of a utopia of universal control. Transhumanist and technological-posthumanist thinking includes – *first of all* – the vision of a complete power of control over the human, via a trivial-anthropology and an implicit fundamentalism or technological determinism. *Second*, transhumanism and technological posthumanism also intend to control the hybrid beings on their way from the 'normal' human being 1.0 to the posthuman – i.e. transhuman beings – in fundamentally including methods of human enhancement and by this passivating the human being as an agent that is during the process of being enhanced no longer able to decide on her development herself. *Third*, transhumanist and technological-posthumanist thinkers wish to control the ultimate vision of the human evolution: the posthuman. In order to reach the goal of concretely describing, understanding, and constructing the posthuman transhumanism and technological posthumanism are even willing to commit a category error in trying to reach out to the transcendental realm of the indescribable. *Fourth*, especially technological posthumanism disapproves of the human body and intends to get rid of it as something that 'mother nature' ungratefully has saddled us with, in order to completely control this biological substratum of man. *Fifth*, again especially technological-posthumanist thinking reduces the human mind (and further cognitive competences) to "patterns" – a bundle of information that can be completely understood, calculated, controlled, and manipulated –, with the goal of uploading it on a computer interface.

190 Transhumanism and Nanotechnology – Will Old Myths Come True?

Published

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A major goal of transhumanism is the transformation of human beings into posthuman ones by exploiting present and future technologies (cf., e.g., Bostrom 2005). Nanotechnology is considered as a promising candidate in this respect. Its objects of interest are molecular structures with their surface properties and their specific design as sensors and actuators in various environments including the human blood circulation, lung, brain, etc.

In the mythologies all over the world one encounters the idea of super-natural strength, invulnerability, eternal youth, invisibility, invincibility, and immortality. Some proponents of transhumanism dream of a future in which all this will come true. And there are leading experts in nanotechnology who formulate quite similar aims and objectives of their area: the obligatory victory over Alzheimer disease and Parkinson disease, cleansing of wounds, blood, lung, brain enhancement, soldiers who fight without fear, managers who need no sleep to be able to work 24 hours a day 7 days a week for their company, magic hoods, and much more (cf, e.g., Roco and Bainbridge 2003).

In the presentation, I will discuss the relation between transhumanism and nanotechnology and compile some reasons why old myths will not come true.

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Mihail C. Roco and William Sims Bainbridge (Eds.): Converging Technologies for Improving Human Performance – Nanotechnology, Biotechnology, Information Technology and Cognitive Science, *NSF/DOC-sponsored report,* Kluwer Academic Publishers (currently Springer), Dordrecht, The Netherlands, 2003.

191 Transhumanism and/as Whiteness

Published

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1. Introduction

In a widely cited poststructuralist / anti-humanist critique of European humanism[1], Badmington [1] argues that "there is nothing more terrifying than a posthumanism that claims to be terminating 'Man' while actually extending 'his' term in office." (p.16) In this prescient statement, attention is drawn to the very real possibility of a posthumanist orientation that, while claiming to be 'critical', ends up re-inscribing precisely that very

humanism – focused on the figure of 'Man' as white, male, European and anthropocentric – that it sets out to challenge ('post-' *as* dialectical-engagement) and overcome ('post-' *as*temporal / historical transcendence to a new ontological condition). In this paper, I want to explore Badmington's statement in terms of a possible 'entangled' relationship between Transhumanism and posthumanism, with the latter considered in *both* its 'critical' *and* 'techno-scientific' or 'popular' manifestations, against the background of what is, ostensibly, a contemporary resurfacing – or *re*-iteration – of the historical phenomenon of 'White Crisis' with the aim of mounting a decolonial critique[2] of the Transhumanist / posthumanist project.

Badmington argues that "apocalyptic accounts of the end of 'Man,' it seems to me, ignore humanism's capacity for regeneration and, quite literally, recapitulation." (p.11) Against this, I want to suggest that it is the very 'apocalyptic'[3] nature of the phenomenon of 'White Crisis' – that is, perceived threat to white supremacy under mounting contestation from the non-white 'other' – that contributes to[4] engendering what I refer to as the 'algorithmic' transformation of humanism into posthumanism via Transhumanism as an 'iterative shift' within the historically-sedimented onto-logic of Eurocentric racialization. My point of departure turns on the 'between-ness' of the Transhuman[5] vis-à-vis the posthuman, such that the former is engaged against the background provided by the latter as *telos*, irrespective of how this is ultimately realized in techno-scientific form, viz. augmented biological form, uploaded mind or synthetic, artificial intelligence – that is, 'Mind Children'. Engaging Transhumanism as an 'iteration' within the 'algorithmic logic(s)' of race / racism / racialization[6] associated with colonial modernity, I explore how 'critical' posthumanism lends itself to co-option into techno-scientific posthumanism, and the implications of this in terms of its contributing to deferral of the 'decolonial moment' – that is, decolonization of the world system. Crucially, I maintain that the emergence of the techno-scientific posthuman points to a transformation in the nature of humanism that maintains structurally-asymmetric power relations between 'the (formerly) human' (as white, Western, male etc.) and the subaltern 'other' even as the latter contests the Eurocentric terrain of 'the human'[7].

1. Methodological Precedents

In the context of exploring race 'and/as' technology, Chun [16] maintains that race *as* technology "shifts the focus from the *what*of race to the *how* of race, from *knowing* race to *doing* race by emphasizing the similarities between race and technology"; further, that "*race as technology* is a simile that posits a comparative equality or substitutability – but not identity – between the two terms." (p.8) I am interested in exploring the implications of positing a similar 'comparative equality or substitutability' between two terms, however, one in which the ordering of terms is inverted somewhat in relation to that presented by Chun, viz. Transhumanism and/as whiteness[8], thereby engaging the issue of how Transhumanism might be thought about in relation to processes of racialization – specifically, those associated with the largely tacit 'background' phenomenon of a hegemonic whiteness[9]. Chun maintains that "by framing questions of race *and* technology, as well as by reframing race *as* technology, in relation to modes of media naturalization [we can] theoretically and historically better understand the force of race and technology and their relation to racism." (p.8) Similarly, I want to argue that

framing questions of Transhumanism *and* whiteness, as well as reframing Transhumanism *as* whiteness, in relation to historical processes of re-articulation of the latter (i.e. whiteness) enables us to theoretically and better understand how Transhumanism can – and arguably *does* – function as a techno-scientific articulation of whiteness during a period arguably marked by increasing contestation of other forms of this racial phenomenon[10].

Drawing inspiration from Chun's engagement with race and/as technology, and building on earlier work reflexively exploring other related 'as/and' configurations such as race and/as information [20] and Orientalism and/as information [21], informed by a critical race theory of information [22] and decolonial computing perspective [23][24] – that is, in terms of consideration of the 'entanglement' of race, religion, information, computing and related ICT phenomena with the body-politics and geo-politics (and theo-politics) of knowing and being – I critically interrogate Transhumanism as a techno-scientific response to the phenomenon of 'White Crisis' at least partly prompted by 'critical' posthumanist contestation of Eurocentrically-universal humanism.

1. Summary of Argument

I begin by briefly sketching the relationship of Transhumanism to Renaissance and Enlightenment humanism, and to 'critical' and techno-scientific posthumanism, drawing on arguments presented by Jotterand [25], Hughes [7], Ranisch [26] and Sombetzi [27] among others.

In framing my argument for Transhumanism and/as Whiteness, I draw upon the sociological exploration of the latter due to Garner [28][29] – in particular, (1) his 'processual' understanding of whiteness in dynamic relational-tension to other racialized identifies, (2) the function of whiteness as a tacit invisible 'background' standard, and (3) the socio-political structural manifestation of whiteness as continued, yet contested, globally-systemic white supremacy – a position he derives from Mills [30]. Concerns about the future of whiteness [31] are engaged against the backdrop of a purported shift to a 'post-racial' reality, the latter of which is subjected to decolonial critique by Sayyid [32][33]. Anxieties about the future (or otherwise) of whiteness can be shown to be related to the late 19th and early 20th century phenomenon of 'White Crisis' explored by Füredi [34] and Bonnett [35][36][37], the latter of whom refers to a 'decline' of overt discourses of whiteness and the concomitant 'rise' of a discourse about 'the West'[11]. It is suggested that the recent election of Donald Trump at President of the united States, the Brexit phenomenon in the UK, and the continued rise of Far / Alt-Right politics in the US and Europe can – and *should* – be seen as *one* response to the re-emergence of the phenomenon of 'White Crisis', almost fifty years on from the anti-racist struggles of the 1960s, and almost a century on from when 'White Crisis' was first being discussed in 'the West' (specifically, Britain and America); as Bonnett [37] states, "whiteness and the West ... are both projects with an in-built tendency to crisis. From the early years of the last century ... through the mid-century ... and into the present day ... we have been told that the West is doomed." (p.25)

In terms of thinking more specifically about *Transhumanism* and/as Whiteness, I want to argue that Transhumanism / posthumanism should be viewed as a somewhat *different* response to the phenomenon of 'White Crisis', one that is techno-

scientific and occurs in parallel with, albeit somewhat obscured by, the more overt phenomenon of conservative 'White Backlash' vis-à-vis socio-political phenomena associated with the response described earlier[12]. In particular I want to argue that the shift described by Füredi and Bonnett from 'white' to 'West' is usefully framed in terms of the re-inscription[13] – or rather, 'algorithmic' *re-iteration* – of whiteness under different signifiers including the techno-scientific signifier of Transhumanism associated with the convergence of GRIN/NBICS technologies; furthermore, that this shift in 'whiteness' needs to be situated within a longer historical frame than that going back to the late 19th century, arguably one that commences with the Columbian voyages in 1492 CE and results in the emergence of a racialized world system [38][14]; moreover, a history involving *other* 'paradigmatic' shifts including those from 'religious' to 'philosophical' to 'scientific' and latterly 'cultural' expressions of race / racism / racialization, such transformations constituting re-articulations – or rather, 're-iterations' – of the difference between the human (European) and the sub-human (non-European)[15]. Insofar as such iterations might be seen as different manifestations of the same phenomenon – thereby pointing to a certain continuity through change – I want to suggest that they are usefully understood in terms of what has been described elsewhere as 'algorithmic racism' [41][16]. However, I argue that the contemporary moment is marked by a shift from the distinction between sub-human (non-European, non-white) and human (European, white) to that between human (non-European, non-white) and Transhuman (European, white)[17], such shift being prompted, at least partly, by certain kinds of 'critical' posthumanist contestation of Eurocentric conceptions of the human against the much broader background or 'horizon' of a resurfacing of the phenomenon of 'White Crisis'.

Against more optimistic – and, I would aver, somewhat naïve – postmodern, post-structuralist, postcolonial and feminist readings of the cyborg as an emancipatory figure championing the destruction of borders, boundaries and binaries, and the embrace of hybridity, multiplicity and socio-political 'levelling' under a 'critical' posthumanism, I want to argue instead for viewing Cyborgism / Transhumanism as a techno-scientific response *by whiteness* to the perceived phenomenon of 'White Crisis' and mobilized *by whiteness* for purposes of maintaining Eurocentrism via refinement / adaptation and expansion under subaltern contestation. Drawing on recent mounting criticism[18] of the so-called 'ontological turn' towards a non-anthropocentric, post-dualistic 'materialism', yet conceding that such a turn was at least partly motivated by a concern to address legacy political and ecological injustices associated with modern/colonial projects by engaging with postcolonial and other forms of critique, I maintain that 'critical' posthumanism ultimately proves to be rather 'brittle' and 'unstable' vis-à-vis its commitment to emancipation of, and reparations towards, the 'other' and that this is due to a tendency to conflate different conceptions of the posthuman, including those that upon close inspection can be shown to be Eurocentrically rationalist. Going further, I argue that the hegemony of such Eurocentrically-rationalist conceptions of the posthuman, masked (or occluded) via their conflation with alternative variants of 'critical' posthumanism, enables the co-option and transformation of the latter into techno-scientific posthumanism, and that one means by which such transformation is facilitated is via their shared commitment to rather nebulous notions such as 'information' as ontologically basic[19]. On my more pessimistic reading, the 'entanglement' of the 'cybernetic' – latterly, 'computational', 'informational', 'algorithmic' – 'turn' with the 'ontological turn' to the posthuman acts to facilitate Transhumanism as a means by which to retrench Western

hegemony, especially under conditions of 'White Crisis' resulting from increasing subaltern contestation of Eurocentrism, and that 'critical' posthumanist endorsement of 'flat' ontologies functions discursively to occlude the continued existence of asymmetric hierarchies, and their algorithmic (re)production.

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[1] Badmington's argument is informed by various 'critical' currents within contemporary European thought including postcolonial theory and a commitment to the post-discursive, 'new materialist' embrace of boundary-disrupting ontological-affinity with the non-human (animal, machine etc.) associated with the 'ontological turn'. It is also motivated by a concern to address the political and ecological implications of the anthropocentrism and subject-object dualism associated with dominant strands of Enlightenment thought.

[2] By a 'decolonial' critique, I mean one that foregrounds considerations of the body-politics (who) and geo-politics (where) of knowing and being, and is preferentially disposed towards thinking through conceptual frameworks emerging from the margins / borders / periphery of the modern/colonial world system.

[3] There is a secular Enlightenment rationalist tendency to dismiss 'apocalyptic' narratives as an irrational hangover from the 'age of religion'; however, as Gray [2] convincingly argues, apocalyptic and utopian thinking derived from the Christian tradition informs secular frameworks, both those on the conservative 'right' and on the critical 'left'. In addition, there is the need to consider Noble's [3] and Davis' [4] exploration of the long durée

'entanglement' of apocalyptic religious and occultist thinking with scientific and technological development in the European / 'Western' tradition.

[4] By framing the issue in terms of 'contribution' rather than 'causation', I recognise that the Transhumanist / posthumanist project is over-determined in terms of its historical motivations and causes. Noble [3], Davis [4], Gray [2], Zimmerman [5, 6] and Hughes [7] trace some of these motivations to technological manifestations of Gnostic, millenarian / millenialist and apocalyptic currents within medieval Western Christianity, and drawing on recent scholarship at the intersection of critical race theory and critical theory of religion [8][9][10][11], I want to suggest that such 'techno-millenialist' currents feed into the emerging 'technology' of 'race' at the onset of colonial modernity which commenced with the Columbian voyages in 1492 CE. In short, insofar as ideas of leveraging technology to achieve utopian and/or apocalyptic purposes have a long history, I am *not*suggesting that the Transhumanist project is driven solely by a post-racial 'crisis of whiteness'; rather, I argue that under contemporary conditions of 'White Crisis', the Transhumanist project gains a sense of urgency as a techno-scientific resolution – or 'fix' –to such an anxiety-ridden state of affairs.

[5] According to Bostrom [12], "in its contemporary usage, 'transhuman' refers to an intermediary form between the human and the posthuman." (p.4) Transhumanism is generally framed in terms of the application of GRIN (Genetics, Robotics, Information Technology and Nanotechnology) in the service of self-directed evolution – that is, enhancement of the human – towards a technocratic future. A related acronym is NBICS which refers to the combined resources of nanotechnology, biotechnology, information technology, cognitive science and synthetic biology.

[6] Bostrom [13] maintains that "transhumanists [consider that] murder and enslavement, whether of humans by posthumans or the other way around, would be a moral atrocity and a crime", and points to their condemnation of "the racist and coercive state-sponsored eugenics programs of the 20th century" (pp.19-20). It is interesting to note, however, that a recent survey of the beliefs held by so-called 'technoprogressives' conducted by Hughes [14] revealed that only 35% self-identified as anti-racist. In addition to what this figure might indicate vis-à-vis relative lack of engagement with the issue of 'race' among Transhumanists, it is not at all clear how racism and anti-racism were understood in Hughes' survey, by questioners and respondents alike: for example, was racism framed in tacitly liberal terms – that is, as something personal, irrational, transient and exceptional – or was it understood along critical race theoretical terms as a systemic, rational, persistent and pervasive structural phenomenon [15]?

[7] As Badmington [1] states, "the seemingly posthumanist desire to download consciousness into a gleaming digital environment is itself downloaded from the distinctly humanist matrix of Cartesian dualism. Humanism survives the apparent apocalypse and, more worryingly, fools many into thinking that it has perished. Rumours of its death are greatly exaggerated" (p.11); in short, "the new *now* secretes the old *then*. Humanism remains." (p.14)

[8] In the context of the argument presented herein, 'whiteness' should be understood as referring to people of European descent. That said, it is important to appreciate that there

are 'shades of white' among Europeans, the 'intensity' of whiteness tending to increase as one moves closer to its 'core' located in 'the West' – that is, Northern Europe, the United States, Canada and Australia. For a useful discussion of how whiteness came to be exclusive to Europeans, see [17].

[9] In this connection, it is interesting to note that Bostrom [18] and other Transhumanists regularly invoke the notion of 'technology races', 20th century examples of which includes races to build the first fission or fusion bombs, achieve satellite and human launch capability, build an artificial intelligence etc. While Chun [16] invites us to consider race *as* technology, I am interested in exploring technology *as* race, in both the metonymic / ontic sense of technology as a *specific* means by which to instantiate race, as well the metaphorical / ontological sense of technology as a *general* means by which to think about the series of iterative shifts in how race is articulated at different periods within colonial modernity.

[10] Somewhat optimistically, Coleman [19] has argued that "technology's embedded function of self-extension may be exploited to liberate race from an inherited position of abjection toward a greater expression of agency" (p.177); on her view, by "extending the function of *techné* to race, I create a collision of value systems. In this formulation, race exists as if it were on par with a hammer or a mechanical instrument; *denaturing it from its historical roots, race can then be freely engaged as a productive tool*. For the moment, let us call 'race as technology' a disruptive technology that changes the terms of engagement with an all-too-familiar system of representation and power [emphasis added]." (p.178) I would suggest that such assertions, alleged resistant rhetorical potential aside, are problematic on account of an ostensibly tacit assumption that technology stands separate from, rather than 'entangled' with, race. What appears to be missing from Coleman's (and Chun's) formulation is reflexive consideration of technology and/as race – that is, recognition of the *racialized* ontology of technology under colonial modernity, and I suggest that this follows directly from the 'bracketing' of the historical that Coleman is committed to embracing in her 'technological turn'. Yet my critique of their position should not be understood as entailing support for the view that technology is *necessarily*, in the sense of *trans*-historically, racialized; on the contrary, a commitment to the *contingency* of technology's racialization is maintained, yet one that requires us to consider more seriously how the field of technology / 'technique' is racially-inflected, such racial inflection contributing to a *historical* essence that in colonial modernity has a racialized underside, and which thereby constraints / limits scope for resistant action vis-à-vis affording non-abject possibilities for racial agency.

[11] It is important to note that this 'crisis' literature appears at a time when proclamations of 'white racial supremacy' are made openly by various commentators belonging to the dominant Euro-American powers of the1920s and 1930s. Less than fifty years on, and whiteness under the signifier of 'the West' is plunged into further crisis as a result of the Civil Rights movement in the US and the increasing linkage of this struggle to global anti-colonial struggles. Formal independence from European colonial powers is achieved in the late 1960s, and the Civil Rights struggle achieves certain limited victories; however, structures of colonial domination persist in the 'operating logics' of the newly independent post-colonial

states, decolonization as a project arguably being aborted under the transition from a liberal to a neo-liberal world order in the 1980s onwards. As neo-liberalism morphs into neo-conservativism, the 'apocalyptic' project of a 'war on terror' surfaces [2] and the historically-sedimented figure of the Muslim 'other' as threat / enemy *re*-emerges [38]. Yet concurrent with and at least partly due to this centring of the specifically *Muslim* 'other' as enemy and the actualization of war against it, 'breathing room' is provided in South America, South Asia and latterly South Africa for the gestation and development of a *decolonial* project – that is, *re*-engagement with the unfinished project of decolonization (to be contrasted with Habermas' unfinished project of modernity). During the 2000s, the 'decolonial option' begins to be embraced by some members of 'minority' non-white groups located in the West, this tendency escalating in the 'post-racial' era under Obama, with increasing contestation of whiteness and Eurocentrism in the academy, activist mobilizations against anti-blackness and white supremacy in movements such as Black Lives Matter, and various contemporary 'anti-racist' responses to the rise of the Far / Alt-Right in the US and Europe against the backdrop of the continued rise of Islamophobia.

[12] Such phenomena include the resurgence of strident and protectionist 'strong-man' nation-statism, racialized articulation and foregrounding of 'concerns' about border controls, immigration, citizenship and notions of 'belonging', along with the rise of cruder and more overt forms of white supremacy in comparison with what was arguably the more subtle, more refined and more covert operation of the socio-political logics of 'racial liberalism' [30] in Western nation state formations.

[13] Bonnett [37] appears to concede the 'iterativity' of whiteness in referring to its 're-invention', "well into the twenty-first century", pointing out that "the history of whiteness is one of transitions and changes." (p.17)

[14] Hayles [39] argues that "we do not leave our history behind but rather, like snails, carry it around with us in the sedimented and enculturated instantiations of our pasts we call our bodies." (p.137) Apart from the need to decolonially interrogate *whose*history needs to be considered (body-politics of knowledge) and from where (geo-politics of knowledge), it is crucial to note that it is not *just* bodies that are sites for sedimentation and enculturation, but rather regimes of governmentality which include but transcend the body to include institutions, land, discursive practices etc. [40].

[15] What tends to be obscured, if engaged at all, in discussions of the relationship between the human and the Transhuman is the prior relationship between the human and the sub-human (which should not to be conflated with the broader category of the *non*-human), the latter providing the 'ontological ground' against which the former is constituted through a process of hierarchical negative dialectical opposition, viz. the human (superior) as the negation of the sub-human (inferior).

[16] According to Coleman [19], "race as we know it is an 'algorithm' inherited from the age of Enlightenment." (p.184) I want to suggest that not only is race an algorithm, *metaphorically-speaking*, but that following the 'cybernetic turn' of the 1950s, the continued rise of informational, computational and algorithmic logics (technical, social, cultural, economic,

political etc.) has resulted in a *metonymic* situation wherein the racial algorithm has engendered algorithmic formations of race.

[17] Notwithstanding the international nature of Transhumanist, Extropian and related techno-scientific movements, and granted the need to take seriously the 'hybrid' nature of these endeavours involving the contributions of various ethnicities, genders and nationalities, it is empirically demonstrable on demographic grounds, both quantitative and qualitative, that Transhumanism is hegemonically white, male and 'Western' (Euro-American); furthermore, it is a project whose trajectory is traceable, genealogically, to a specific historical and geographical experience, viz. the European Enlightenment – although arguments have been made that Transhumanism has much earlier antecedents within the European tradition going back to the twelfth, if not the ninth century CE [3][4]. On this basis, and in terms of its 'entanglement' with 'race', I want to suggest that Transhumanism is readily identified as a Eurocentric phenomenon.

[18] Criticism of the so-called 'ontological turn' associated with 'critical' posthumanism pointing to its tendency to re-inscribe Eurocentric rationalism despite the emancipatory rhetoric allegedly associated with 'flat' actor-network schemes, speculative realism, procedural metaphysics and object-oriented ontology etc., has been mounted from various perspectives including indigenous cosmology [42][43], black thought [44][45] and postcolonial critiques of Orientalism [46][47].

[19] I would suggest that such co-option occurs through a two-fold process of (1) 'epithet transfer' [48] – that is, simultaneous projection of subjective (mental) traits onto the objective (material) and vice versa, or a 'double movement' of anthropomorphization of the mechanistic and mechano-morphization of the anthropic – and (2) recourse to a de-materialized abstraction, viz. disembodied information, and its application to human and non-human (specifically, animal and artefactual) phenomena alike [49]. Ferrando [50] maintains that 'critical' posthumanism "does not turn technology into its main focus, which would reduce its own theoretical attempt to a form of essentialism and techno-reductionism" (p.28), however, I would suggest that framing 'critical' posthumanism against the background of what might be described, following Heidegger, as an *onto-theology* of 'information' (both totalizing and reductive), and the process of epithet transfer whereby objects-become-subjects (and subjects-become-objects), engenders precisely such a techno-reductionism; in short, 'critical' posthumanism, at least as framed against the Eurocentric backdrop of the 'ontological turn' towards objects, networks and informational flow, readily lends itself to such 'techno-reductionism'. In this connection, and in the context of exploring the implications of the 'ontological turn' to objects within anthropology, Fowles [47] points to the emergence of "a kind of quasi-posthumanist anthropology *in which objects freely assume the position of subjects* [emphasis added]" (p.20); crucially, he goes on to assert that in such a shift "there is some sort of transference at work. Critiques of the Western colonial project and of the human sciences' contribution to this project have been deflected onto the world of things. Eurocentrism has been discursively reconfigured as anthropocentrism" (p.23) such that "anthropological philosophers now find themselves empowered not just to make *claims about the basic entities of the world itself* (or, as some would insist, of 'the worlds themselves') but also to develop schemes for 'how things could

be' ... all by 'thinking through things' and without bothering much about the active political struggles of anthropology's traditional human subjects, subjects who now quietly retreat into the blurred backdrop [emphasis added]." (p.24)

192 Problems in the System of Scientific Knowledge

Published

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Problems play a crucial role in science. However, to correctly understand this role, it is necessary to have an adequate model of scientific knowledge. Here we use the most advanced and complete model called the modal stratified bond model of comprehensive knowledge systems. According to this model, problems are a specific kind of knowledge called erotetic knowledge generating the extensive erotetic system (modality) of scientific knowledge. Here we give a brief exposition of this system analyzing properties and aspects with the aim to determine the best form of problem description.

193 "Alternative Facts" and "Fake News": cultural studies' illegitimate brainchildren

Published

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Looking at the state of the Humanities today, a number of the demands by Cultural Studies theorists, from Birmingham to Chapel Hill have been met. In the western world, people – even outside academia - tend to accept that truth is not absolute, that culture is a construct and many have become aware that there is a continuous struggle for hegemony in discourse. Add to that that Stuart Hall's vision of a world in which the media finally is a free for all who want to make themselves heard has come true. The internet has made it much harder to exclude marginalized communities. This finding is not altogether wrong, as the internet was central to mobilizing protest in e.g. the Arab Spring revolt.
Yet discourse has not become more rational. What we also see is a triumphant return of right-wing movements, which - to reference Rainer Zimmermann – engage in "savage thought" on and through the net. And while I concur with him that their dominant discourse is irrational and abandons facticity, I am arguing that all this is directly related to the situation of the Humanities. The arguments of the latest wave of right-wing intellectuals show an embarrassing kinship with those of the left-wing Cultural Studies Project. White supremacy ideologue Richard Spencer (a former student under Marcuse disciple Paul Gottfried), e.g. reconciles, with ease, liberal ideas of identity politics with racism. But what may be more instructive will be a discussion of two phenomena that the right loves to exploit in their struggle for hegemony: "alternative facts" and "fake news". Although lies and canards are as old as journalism itself, it will become apparent that they have evolved into new

breeds in the digital age. They also are cultural studies' illegitimate brainchildren. The dynamics of the internet in combination with the belief in constructivism is proving to be toxic.
My presentation will look at the "alternative facts" and "fake news" of the alt-right in the USA and show how their creators make use of postulates and practices more commonly associated with cultural studies (and postmodernist thought).

194 A visual approach to mapping the intersection between scientific discourse, technological evolution, and social movements

Published

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The relationship between technology and sociopolitical change has been a major topic in academic discourse concerning political engagement and protest. Despite these two dynamics refer to different societal subsystems their relation has often been described through semi-causal relations as if new media could deterministically foster political engagement and spark protest [1] or, at the opposite if a specific socio-political context could deterministically produce technological innovation. This paper proposes to observe this problematic assumption through the lens on academic discourse about political engagement and protest from a longitudinal perspective covering the last 15 years of academic research. Aided by time-series visualisations [2], this talk draws a sociotechnical timeline of protest and media technologies scholarship to enhance our knowledge about academic research and, at the same time, to understand the perceived connection between media technologies and protest.

195 Biohacking: New Do-It-Yourself Practices as Technoscientific Work between Freedom and Necessity

Published

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If one contends that 'hacking' has become a crucial cultural practice in – and, to some extent, in opposition to – digital capitalism (Levy 1984/2010; Himanen 2001; Söderberg 2007; Coleman and Golub 2008), one may argue that 'biohacking', i.e. the extension of this practice to medical and biotechnologies and the life sciences, would constitute a key driver of the informatisation of the realm of life, as driven by processes of technoscientific convergence in the information paradigm (Castells 1996). Unlike older visions of a globalisation and of a unification of the human species enabled by technoscientific progress (Coenen 2014), this overall process of information displays a

Janus face (Hofkirchner and Fuchs 2003) insofar as the aspirations for global technological integration and universalist political hopes are tending to fall apart.
Due to the rise of biohacking, the overall process of an informatisation of life itself – which is, in turn, propelled by the informatisation of biological knowledge and technologies – is about to incorporate sections of the social world that extend beyond the traditional boundaries of academia and capitalist industry. As in hacking more generally (Coleman and Golub 2008), the moral visions in the biohacking movement(s) not only reveal broader contradictions, but at times offer critical perspectives and tangible alternatives to the ethico-political features of digital capitalism and to the overarching process of informatisation.
'Biohacking', however, is a notoriously ambiguous term: some biohacking practitioners and observers subsume to 'biohacking' all instances of use of modern biological and medical knowledge or technologies by groups and individuals who adhere to a hacker ethos as these take place outside the confines of academia and traditional capitalist industry. This, then, includes the do-it-yourself (DIY) application of knowledge in genetics and biotechnologies (Delfanti 2013) as well as experimental uses of a broad range of techniques for the modification of the human body (Duarte and Park 2014). However, these two sets of material practices have given rise to two distinct socio-cultural movements. While both are often called 'biohackers' (and in fact partly overlap with respect to practices and actor networks), their obvious differences have also given rise to distinct designations. While the former movement is widely known as 'DIY biology', the latter are designated variously as 'grinders', 'DIY transhumanists' and 'cyborgs'.
In view of the Janus-faced process of informatisation and the similarly Janus-faced role of 'hacking' in digital capitalism, the present paper provides an overview on differences and commonalities between the two movements ('DIY biology' and 'cyborgism') by focusing on selected political, socio-economic and philosophical aspects. It is argued that, notwithstanding significant differences between the two movements, both exhibit a distinct coupling of late-capitalist subjectivity with a re-evaluation of self-created physical spaces (Kostakis, Niaros and Giotitsas 2015) as loci of collective curiosity, with new visions of the commons in the digital era (as, for example, in the notion of 'biocommons'), and with emancipatory notions of technoscientific progress, thereby situating technoscientific work between the realms of freedom and necessity in novel ways.

196 From "Network Neutrality" to "Algorithm Neutrality": Idea Changes and Enlightenment

Published

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Since algorithmic recommendation has been widely adopted in information distribution, as a new concept of "network neutrality", "algorithmic neutrality" has come into the public view. Thus, from an initial requirement only to Internet Service Providers providing wire or wireless services, restricting their controlling of the application and content providers, "network neutrality" requirement has extended to contain content providers, service providers and terminal equipment manufacturers, until covers all the upstream and downstream industries' technologies around fixed or mobile networks. Nowadays, it has further become a requirement of platishers represented by social media to recommend information to users by algorithm.

197 Is digitalization dehumanization? - Dystopic Traits of Digitalization

Published

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Most phenomena in the world have both positive and negative aspects (pluses and minuses). This is also true of digitalization.
However, a lot more emphasis lately has been placed on the positive potentials of digitalization than on the negative potentials and already occurring negative effects.
Digitalization is supposed to bring increased efficiency leading to greater speed and lower costs. The question is greater speed and lower costs for whom?
In this paper, I will discuss the idea that perfectly well functioning social practices, like human face-to-face communication, shopping, banking, medical care, education, administration, policing etc should be "disrupted" (a recent buzz word) and exchanged for digital services, supposedly bringing greater efficiency through increased speed and lower costs.
We will study a number of such examples, coming, for example, from shopping, where customers are asked to register what they buy themselves and then pay with a plastic card, registering their purchase for the benefit of the shop owners, credit card company and bank, or from academic lecturing, where knowledgeable persons lecturing can be exchanged for a digital learning environment, where students learn on their own.
We will pose the question: "When is digitalization warranted and when not?" When is it better to trust established human practices than to disrupt and substitute them with digital replacements. When should we not fix what is not broken?
Some of the areas that will be examined are:

1. Administration
2. Banking
3. Shopping
4. Education
5. Health care
6. Security
7. Privacy
8. Human face-to-face communication

How can we digitalize with care, avoiding disruption of some of the best practices evolved by mankind?

Keywords
Digitalization, dehumanization, dystopia

198 On the Use and Abuse of Geopolitics

Published

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Originally, geopolitics was a theory that intended to conceptualize strategic insight into the world-wide political action of Great Powers governing their foreign policies. Hence, it was essentially a product of the late colonialism. In the tradition of Spengler and Toynbee, organicistic theories of the state dominated at the time, and authors like Kjellén and Mackinder followed this line in principle, not without influence onto the further development in Europe including the First World War as well as the Second. In more recent time, the US-American policy in the sense of Kissinger and especially Brzezinski continued this conception in one way or another. In the meantime, mainly during the eighties of the twentieth century, authors like Agnew and Toal have introduced what is called "critical geopolitics" trying to reconcile constructivist as well as realistic approaches to political theory and liberate them from organicistic ingredients by introducing post-colonial and cultural aspects, respectively. Some consequences are discussed here in detail, with a particular view to present-day populism.

199 Savage Thought and Totalitarianism

Published

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The concept of "savage thought" in the sense of Claude Lévi-Strauss is being discussed and applied to the magical context within which the discourse of the new right-wing movements is embedded gaining the quality of what we call "populism" for short. The role of digital media is discussed then in terms of a massive concentration of ideological information flow in the public domain. It is shown in particular that recent developments as to an enhancement of magical world-views can be re-traced to the explicit denial of the complexity that is necessarily encountered in the progressing motion of social evolution. The rational discourse of facticity is replaced then by the irrational discourse of mythology in order to find means of relief, discharge, and exculpation at the same time.

200 Social media materialities and political struggle: Power, images, and networks

Published

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This research investigates activists' social media tactics and how these tactics materialize at the intersection of social media materialities and protest. The argument is based on a case study of social media communication by activists involved in the Blockupy action against the opening of the new European Central Bank headquarters in March 2016 in Frankfurt am Main, Germany. We conclude by empirically and conceptually discussing the tension between activist agency and social media materialities.

201 The ladder of cyber-subsidiarity as a mediation between the autonomous citizens and the commons

Published

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The process of globalisation leveraged by digital technologies has dramatically increased the capacities of the capitalist milieu and its homogenisation momentum. This indeed endangers the preservation of cultural and community identities and their related capacities to act, including the capacity to sustainably adapt to their environments. Before this global issue, the author proposes the subsidiarity principle as a kind of fundamental ground for the Global Information Society, based on Stafford Beer's Viable system model.

202 Irrational discourse as a form of violation of the other with words

Published

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At re: publica 2010 Sascha Lobo gave a lecture entitled 'How to Survive a Shitstorm'. Thus he established the term. The term 'Shitstorm' describe a phenomenon often observed on the social web: One or two critical remarks trigger aggressive, insultung and even threatening verbal attacks which culminate in a 'wave of indignation' through active as well as seemingly passive actors.

203 Programming the State - Digital Technology and Institutional Design

Published

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During the last decades, the world has been going through major technological, economic and social changes. The evolutionary process has brought people together through flows of communication into global digital networks to an extent that scientists have started to talk of the rise of a new geological era called "Anthroposcene".
The paper "Programming the State – Digital Technology and Institutional Design" focuses on political aspects of the on-going technological transformation bringing us into a digital society. The aim is to discuss the relation between political and technological change by applying historical institutional theory to explain and understand how ideas and ideology are embedded into digital political institutions.
The discussion starts by explaining the basic concepts used in historical institutional theory such as path dependency and formative moments. I then turn to a theory of history formulated by R.G. Collingwood, as this help to understand how the formation of political institutions may be studied in terms of a design process. My argument is that in order to understand the design of political institutions we have to include the study of political ideology since ideologies serve as the design plan for specific institutional solutions. If we are to understand the logic of digitalisation we therefore have to be aware of which ideas that are embedded into digital technological solutions.
The paper ends with a discussion on the implications that may be drawn by this argument and whether or not it is possible to turn back from a path once chosen to step upon.

204 The Integration of Rural Community and Participatory Media Based on the Mobile Internet - A Practice of Mobile Internet in Western Rural China

Published

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Based on the mini-public theory, this paper examines the mobile Internet public platform in the countryside of western China, and sees it as the public sphere of digital community. The research considers that the public sphere of this kind of digital community transforms the "Half acquaintance society" into "acquaintances society" and constructs the rural endogenous order. Its essence is the new media empower the village elite outside the system to form a social-media-based alliance, and with the village idle staff, left-behind women and other people to form the media self-organizing, become a new village endogenous power. The elite alliance of outside institutions, through express in the public sphere, media mobilization, public action, and so on, connected the scattered in different space of "atomic" villagers, promote the development of rural society. With the change of the village power structure, the elite alliance of the outside system and the village of the state agent have formed a competitive relationship, temporarily formed a relatively balanced cooperative governance model. The public sphere of the digital community makes villages from the nominal villager autonomy to the autonomy mode of "self-management, self-education and self-service" through the public participation of the villagers.

205 The shaping of the public opinion: social media between populism and convivialism. A comparative study of Austria, Sweden, and the UK

Published

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Social, political and economic features of Austria as well as Sweden and the United Kingdom show similarities such that they can be examined in parallel and compared. Cultural differences in these countries are transmitted in a variety of situation, but they do not necessarily refer to the same social distinctions. Moreover, our observation of common features among these three countries will target the rise of right-wing political parties, invoked by the “crises” from Middle East. Furthermore this study aims to observe the reaction of the citizens of these three countries respectively, the sympathizers as well as those who disagree with such populistic proclamations. Such social and cultural issues arise attention and, at the same time call upon the empirical focus in anthropological

studies. We are suggesting this parallel examination with regard to the anthropological science and its methods that will help to carry out our research.
This research will contribute results with a critical discourse analysis in combination with empirical research methods and analysis.

206 Truth and visual discourse on Social Media

Published

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Discussions on fake news, alternative facts and the post-factual age demonstrate that we still expect a certain concept of truth on Social Media. At the same time, it is highly questionable if digital sharing-platforms with user-created content are the right place to provide reliable information. Furthermore, we have to consider the impact of visual evidence on irrational discourse, as information technology is offering images in ever-increasing quality and visual issues. I will concentrate on the role of images in Social Media and open a historical perspective: Social Media create an artificial reality, and it is a commonplace that in artificial realities truth and fiction cannot be distinguished. Can an image of reality that obstructs reality transport truth? Or should Social Media rather be seen as poetry?

207 World netizenship or barbarism

Published

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The talk will focus on the potential of social media to support commoning relations and the actuality of devastating impacts through post-truth, fake-news populism.

208 Artificial Dance

Published

Louise Crnkovic-Friis

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Art has always had the ambition to closely relate to human nature and culture –both by reflection and by pushing boundaries and challenging conventions. What happens when the human part is replaced by or complemented by an artificially human, machine intelligence? Artificial intelligence is on the way of fundamentally changing the world and will be permeating almost every part of our lives. It forces us to revisit many fundamental questions in not only philosophy and ethics but also art. Within art, dance is of special interest as it is intimately tied to the human body and expresses an embodied experience where both intellect and emotion have many degrees of freedom.
"Artificial dance" is the transdisciplinary exploration of AI and contemporary dance. Choreographer Louise Crnkovic-Friis presents an exhibition and performance that shows one form of collaboration between a human and AI choreographer. It is exploring two broad categories of research that relate to the artistic practice. The first one is the use of AI as a creativity catalyst – as a source of inspiration for the creative process. The second one is the exploration of hybrid choreography – creative collaboration between human and artificial intelligence. It also looks at the expectation vs perception of external viewers when they have been informed (or not) that an AI has been involved in creating the work. The performance and exhibition are a continuation of the work presented in the article "Generative Choreography using Deep Learning" at the ICCC 2016 conference. This project is supported by Konstnärsnämnden and Peltarion.