Senior Forum on The Philosophy of Information and the Development of Intelligent Society

on the occasion of the official opening of

The Western China Science And Technology Innovation Harbour,

Xi'an Jiaotong University, Shaanxi, China, September 12-13 2020

Computing Information for Intelligent Society.

Info-computational Approach to Decision-making

Gordana Dodig Crnkovic

Professor of Computer Science and Interaction Design, Chalmers University of Technology

Gothenburg, Sweden

http://gordana.se/

Introduction

How do we imagine humane (human-centered) intelligent information society?

"Intelligent information society is a hypothetical social organization. It is defined by data created, collected and accumulated through advanced information, communication technology infrastructure and artificial intelligence (AI). (…) Data, knowledge and information hold greater value compared to traditional production factors (labor and capital) in this type of society. As technology advances and automation increases, intelligent machines eventually replace human cognitive capabilities."

Wikipedia, https://en.wikipedia.org/wiki/Intelligent_information_society

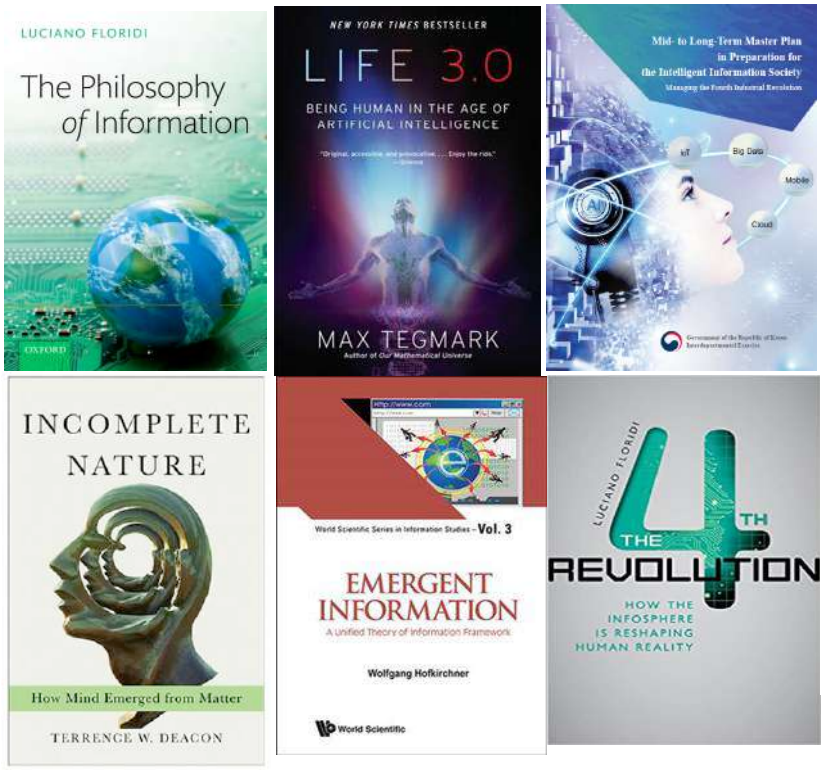
Do we want machines to replace human cognitive capabilities?

How does computing (information processing) affect envisaged "intelligent society"?

How do we imagine information, its structures and processes in such an "intelligent society"?

Human-centered intelligent information society

Information and data used for deducing/computing new information



philosophies

MDPI

Article

Philosophy of Information: Revolution in Philosophy. Towards an Informational Metaphilosophy of Science

Kun Wu [1] and Joseph Brenner [1,2,*]

[1] International Center for the Philosophy of Information, Xi'an Jiaotong University, Xi'an 710048, China; wukun@mail.xjtu.edu.cn
[2] International Center for Transdisciplinary Research, Paris c/o Chemin du Collège 1, Les Diablerets 1865, Switzerland
* Correspondence: joe.brenner@bluewin.ch; Tel.: +41-24-492-2118

Received: 10 August 2017; Accepted: 21 September 2017; Published: 2 October 2017

Abstract: In the most general if unconventional terms, science is the study of how man is part of the universe. Philosophy is the study of man's ideas of the universe and how man differs from the rest of the universe. It has of course been recognized that philosophy and science are not totally disjointed. Science is in any case not a monolithic entity but refers to knowledge as the results of reasoning and both invasive and non-invasive experiment. We argue that the philosophy of science, in studying the foundations, methods and implications of science and the link between philosophy and science, must now take into account the impact of the rapidly developing science and philosophy of information. We suggest that the philosophy of information is in fact a metaphilosophy, since informational processes operate in all the sciences and their philosophies. The simplest definition of (a) metaphilosophy is that of a set of statements about (a) philosophy, and any definition of a metaphilosophy thus requires one of philosophy and of the task of philosophy as well. According to Sellars, "the aim of philosophy is to understand how things in the broadest possible sense of the term hang together in the broadest possible sense of the term". In this paper, we focus on the recursive thought underlying those statements as real processes, occurring both in and between the fundamental and the meta-level. We propose a non-standard logic, Logic in Reality, as the logic of those processes. The metaphilosophy of information is thus a framework for talking about the scientific aspects of philosophy and the philosophical aspects of science. Both Logic in Reality and the metaphilosophy of information provide a basis for understanding the physical and epistemological dynamics of existence, that is, from where the properties of things come that enable both them and the concepts of them to contrast, conflict and ultimately "hang together". We conclude that the current convergence of science and philosophy under the influence of information science constitutes a revolution in philosophy, that is, in how science and philosophy are done. Many of the issues discussed in the metaphilosophy of information may thus be viewed as part of an emerging informational metaphilosophy of science.

Keywords: convergence; science; society; logic; metaphilosophy; philosophy; non-separability; information; revolution

1. Introduction

1.1. Philosophy, Science and Information

Human beings seem driven to gain knowledge (The concept (or belief) that knowledge is justified true belief and therefore that belief is primitive will not be discussed here.) about themselves and the world beyond that required for immediate survival. Science and philosophy are the two major modes of

Cybernetics and Human Knowing. Vol. 21, no. 4, pp. 83-97

Philosophy of Information in Chinese Style

Liqian Zhou[1] and Søren Brier[2]

Review of Wu Kun's *Philosophy of Information: Theory, System, Method*. Published by The Commercial Press, Beijing, 2005. 603 pp. ISBN 7100043824. CN ¥50.

No doubt, information is the keyword of our time since we even call our age the Information Age. Thus, it is natural that information becomes one of the hottest themes in present academics. The Information Age is not only an age for the West, but also for the East, as the study of information is a global one. Wu Kun, a professor of philosophy of information and philosophy of science and technology in Xi'an Jiaotong University, China, has established a complete unique theoretical system of philosophy of information through his persistent endeavor in the past 30 years. This is a review of Professor Wu Kun's representative original work, *Philosophy of Information: Theory, System, Method* (published in Chinese by The Commercial Press, China, 2005). Since it is a product of a Chinese style of philosophy of science and technology, known as dialectics of nature, I will not just describe the structure and content of the book, but also introduce its academic background. With the introduction of this special background, I think it will be easier for Western scholars to understand his unique system of philosophy of information. Then I will briefly describe the structure of the book and make some comments on it. Because of the importance of the definition of information in Wu's philosophy, my review will give priority to his definition of information.

Academic Background

Because of the historical reason that China was isolated from the West for a long time since 1949, Chinese scholars had few chances to be in touch with the main stream of philosophy in the West before the period of reform and opening up in China. However, this did not mean that there was no philosophy of science in China. As Marxism is the official philosophy, every discipline should be under its guidance, natural sciences included. Natural scientists in China and their directors should find philosophical rules to obey in classical Marxist works. What they found was Frederick Engels's unfinished work *Dialectics of Nature* (see Engels, 1968). In this outstanding work, Engels presented the most fully developed exposition of the dialectical materialist understanding of the theoretical problems in natural science in order to

1. Department of Philosophy & Religion, Nanjing University and Department of International Business Communication, Copenhagen Business School. Email: zl.bc@cbs.dk
2. Professor of the Semiotics of Information, Cognition and Communication Science, Department of International Business Communication, Copenhagen Business School. Email: sb.ibc@cbs.dk

"In the Fourth Industrial Revolution, the convergence of artificial intelligence, robot technology, big data and software disrupts fields such as labor, welfare, employment, education and defense. This has sparked revolutionary change across society."

Wikipedia, https://en.wikipedia.org/wiki/Intelligent_information_society

Ubiquitous information and computation

Information and computation are becoming ubiquitous and essential for human society, globally. As participants in a major technological and cultural change caused by ICT, *we want to be able to understand ongoing processes and anticipate future possibilities. When we introduce changes in the society, we want to know their possible consequences.*

Programs of social change often envisage certain goals, but it is not at all clear how those goals can be reached. Unfavorable development can result from the lack of understanding of possible outcomes of interventions, decisions and other changes in social systems.

Social decision making & social computing

At present, societal decisions are made based on intuitions of responsible leaders. As social agents we have intuitions on the individual level which are by necessity limited.

Info-computational techniques can augment personal intuitions and enlarge understanding on a social level. In the development towards increasingly intelligent society we will increasingly rely on intelligent technology. But technology is not enough, it is only the means to supporting human judgment.

As an illustration, in this talk I will discuss an example of computational modelling support to decision-making **in case of Covid pandemics.**

Two aspects of social computing

One important factor in human development of prosperous global society is understanding of the behavior of social systems. Computing as a method provides means for this understanding in a form of computational models, simulations and learning technologies that are being developed towards increasing intelligence.

There are two different types of **social computing** (Wang et al. 2007), centered on its two different aspects:

1. computing aspects - mechanisms and principles of social computing with computational modeling of groups of agents exchanging information in networks and
2. human aspects of social computing (critical theory), with social side of social web applications such as blogs, wikis, social bookmarking, instant messaging, and social networking sites and crowdsourcing.

This lecture will address both computational and human aspects of social computing and its relation to computational models.

Wang Fei-Yue e al., (2007) Social Computing: From Social Informatics to Social Intelligence. Article (PDF Available) in Intelligent Systems, IEEE 22(2):79 - 83 ·

Computer as a communication device

Computers were invented in order to **automatize calculations** [Hilbert program (1900); Turing Machine (1936)].

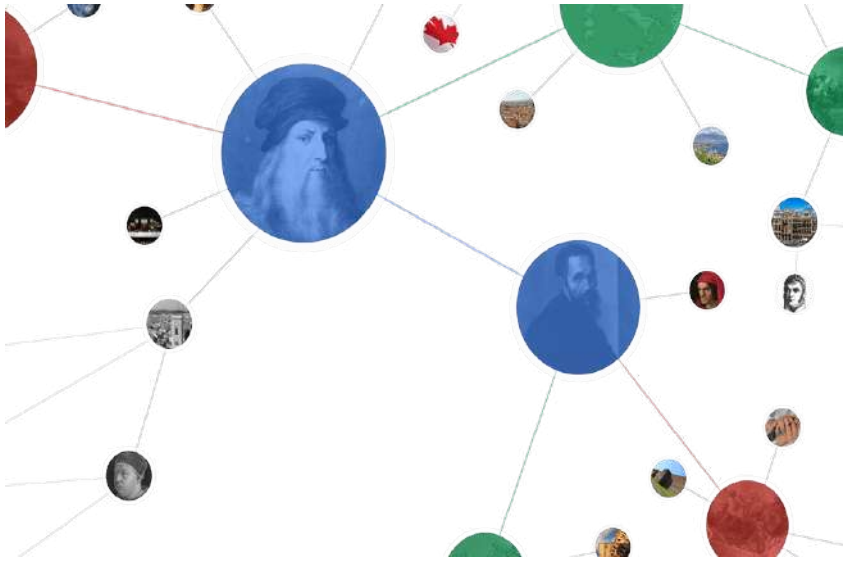
However, after a while, the importance of the computer as a **communication device was recognized**, with its consequent shared knowledge and community building, (Licklider and Taylor, 1968).

Hilbert, David (1900) "Mathematische Probleme", Nachrichten von der Königlichen Gesellschaft der Wissenschaften zu Göttingen, Math.-Phys. Klasse, 253-297. Lecture given at the International Congress of Mathematicians, Paris, 1900.

Turing AM. (1936) On Computable Numbers, with an Application to the EntscheidungsproblemÊ. Proceedings of the London Mathematical Society, series 2, 42:230-265.

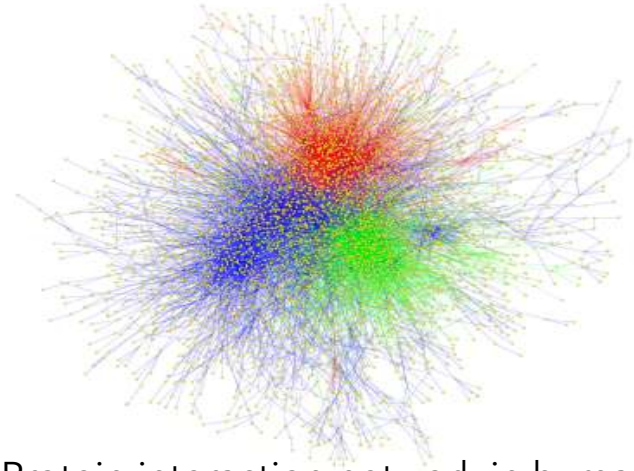
Licklider, J.C.R. and Taylor R. W. (1968) The computer as a communication device. Science and Technology (September), 20-41.

Human groups are information processing networks and knowledge generators

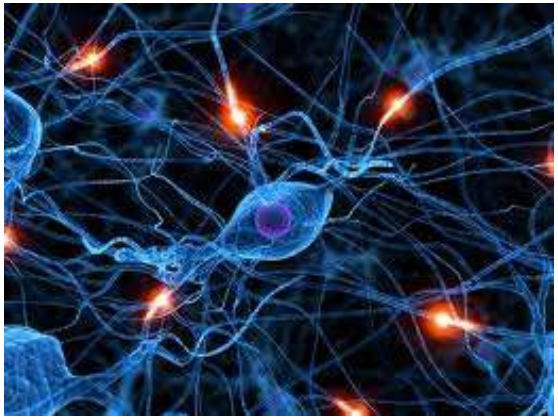


http://www.google.com/insidesearch/features/search/knowledge.html
Google Knowledge Graph
http://press.emerson.edu/imc/files/2011/12/social-network.jpg

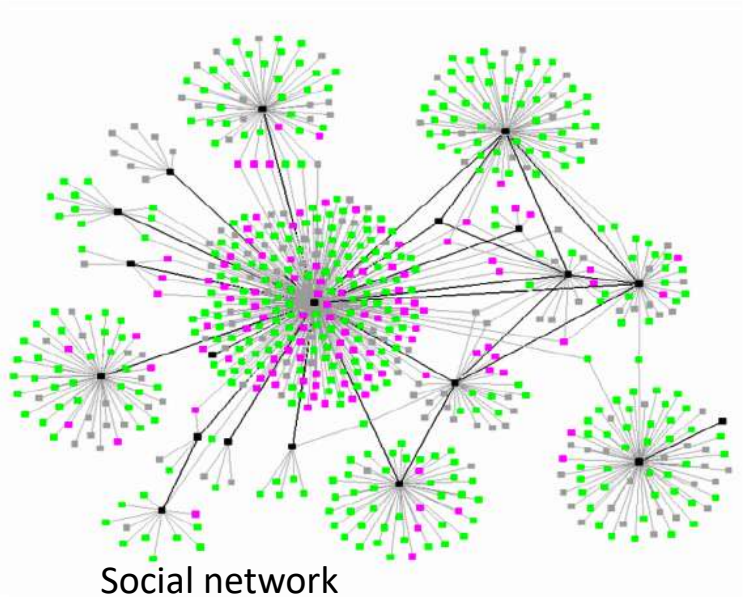
Conceptual basis: network models



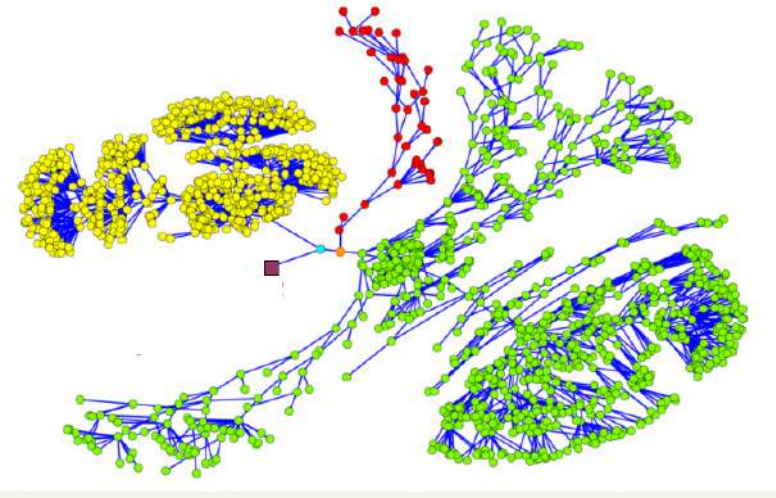
Protein interaction network in human cell



Human neural network



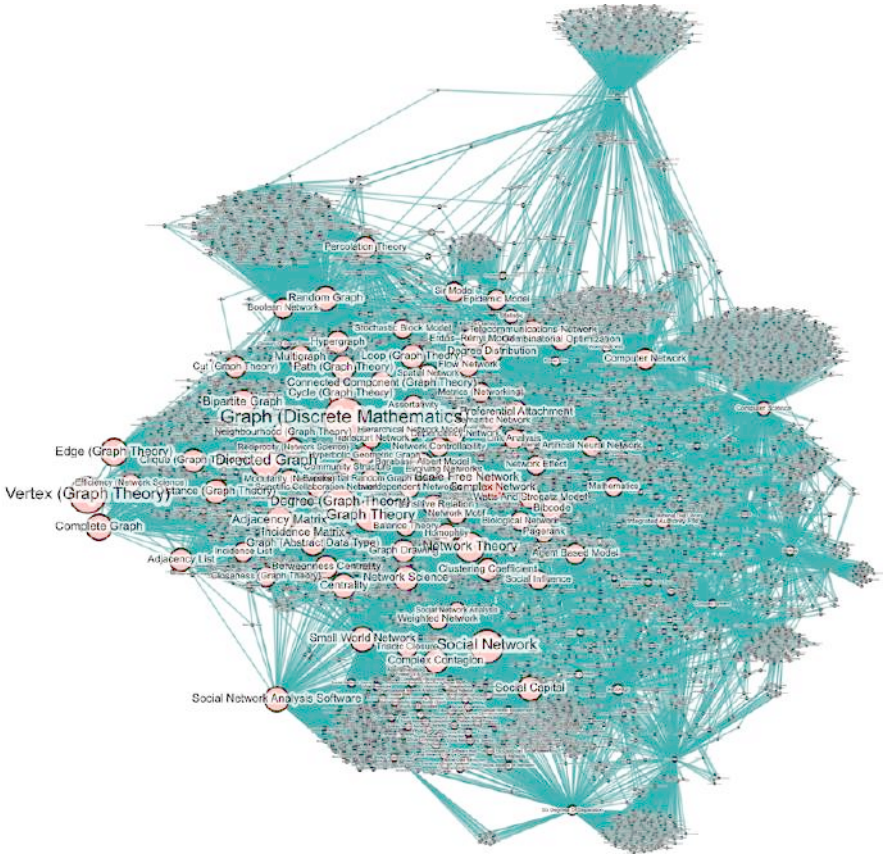
Social network



Evolutionary network

Networks of networks of information – complexity of behavior in societies of agents

In a complex system, what we see is dependent on where we are, and what sort of interaction we use to study the system.



Computational approaches to complex systems can be based on descriptive or generative models.

Generative models answer the question: How does the complexity (emergent properties) arise?

Evolution is the most well-known generative mechanism for generating increasingly complex networked systems (organisms).

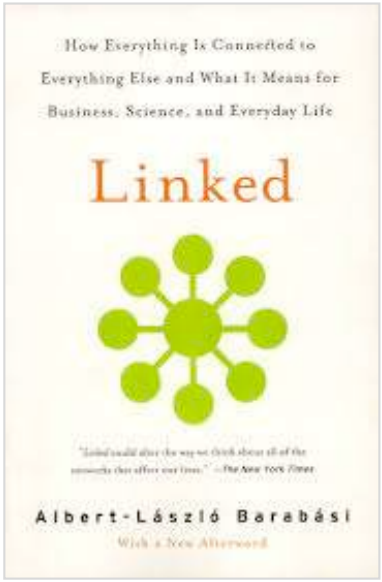
https://www.oreilly.com/library/view/complex-network-analysis/9781680505399/f_0040.xhtml

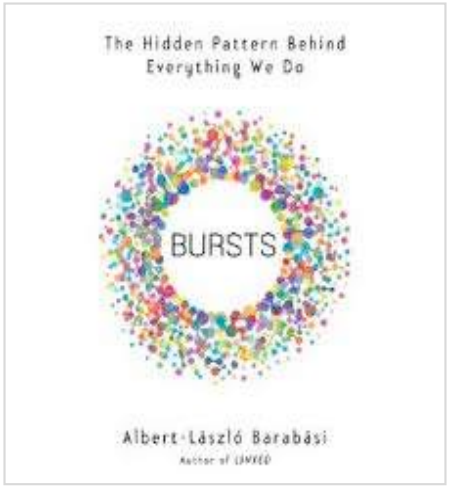
Complex systems
- networks of information processing nodes

" … systems that comprise many interacting parts with the ability to generate a new quality of collective behaviour through self-organization, e. g. the spontaneous formation of temporal, spatial or functional structures. They are therefore adaptive as they evolve and may contain self-driving feedback loops.

Thus, complex systems are much more than a sum of their parts. Complex systems are often characterized as having extreme sensitivity to initial conditions as well as emergent behaviours that are not readily predictable or even completely deterministic."

Robert Meyers, Encyclopaedia of Complexity and Systems Science (2009)





See the work of Albert-László Barabási who studies networks on different scales.
http://www.barabasilab.com/pubs-talks.php
http://www.youtube.com/watch?v=10oQMHadGos

Generative approaches.
Agent-based Models (ABM)

An **agent-based model (ABM)** is a computational model for simulating the actions and interactions of autonomous individuals in a network, with a view to assessing their effects on the system as a whole. They are used in study of **complexity** and **emergence**.

It combines elements of game theory, complex systems, emergence, computational sociology and evolutionary programming.

http://www.youtube.com/watch?v=2C2h-vfdYxQ&feature=related Composite Agents
http://en.wikipedia.org/wiki/Agent-based_model

Agent-based models of dynamic adaptive systems

ABMs in general are used to model complex, dynamical adaptive systems. The interesting aspect in ABMs is the link between micro- (individual agent) and macro- (society) level.

Multi-Agent Systems (MAS) models may be used for any number (in general heterogeneous) entities (agents), which can be modeled explicitly and spatially separated by the environment.

Interactions between agents are in general **asynchronous** which adds to the realism of simulation.

ABM simulation techniques are used to facilitate the study of society and to support decision-making policies, helping to analyze how changing policies affect social, political, and cultural behavior (Epstein, 2007).

Epstein, J. M. (2007). Generative Social Science: Studies in Agent-Based Computational Modeling. Princeton University.

Emergence of global social computing

With regard the human aspect, social computing is radically changing the character of human relationships worldwide (Riedl, 2011).

Instead of maximum 150 connections prior to ICT, (Dunbar, 1998), social computing easily leads to networks of several hundred of contacts.

It remains to understand what type of society will emerge from such massive "long-range" distributed interactions instead of traditional fewer and deeper short-range ones.

Riedl J. (2011) "The Promise and Peril of Social Computing", Computer, vol.44, no.1, pp. 93-95
Dunbar R. (1998) Grooming, Gossip, and the Evolution of Language, Harvard Univ. Press

Towards social intelligence

In this process, information load on individuals is steadily increasing, and social computing technologies are moving beyond simple social **information communication** toward **social intelligence**, (Zhang et al. 2011) (Lim et al. 2008) (Wang et al. 2007), which brings an additional level of complexity.

The question is what form of social intelligence can be beneficial for humans and humanity as a whole.

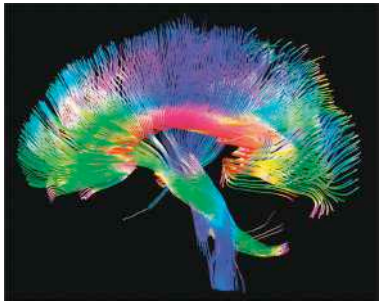
Zhang D., Guo B., Yu Z. (2011) Social and Community Intelligence, Computer, Vol. 99, No. PrePrints. doi:10.1109/MC.2011.65

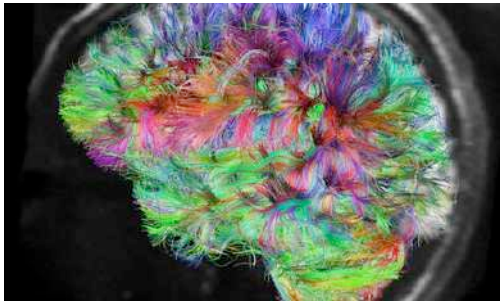
Lim H. C., Stocker R., Larkin H. (2008) Ethical Trust and Social Moral Norms Simulation: A Bio-inspired Agent-Based Modelling Approach. In: 2008 IEEE/WIC/ACM International Conference on Web Intelligence and Intelligent Agent Technology, December 2008. pp. 245-251.

Wang F-Y., Carley K. M., Zeng D., and Mao W. (2007) Social Computing: From Social Informatics to Social Intelligence. IEEE Intelligent Systems 22, 2 (March 2007), 79-83. DOI=10.1109/MIS.2007.41 http://dx.doi.org/10.1109/MIS.2007.41

From information to intelligence

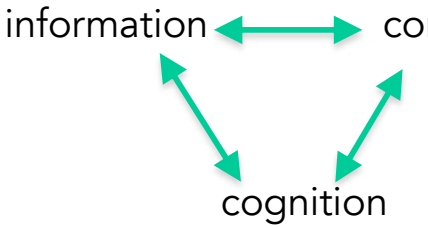
Information, computation, cognition Agency-based Hierarchies of Levels





Human connectome
http://outlook.wustl.edu/2013/jun/human-connectome-project

scientificamerican0612-50.pdf The Human Brain Project
http://www.nature.com/scientificamerican/journal/v306/n6/pdf/

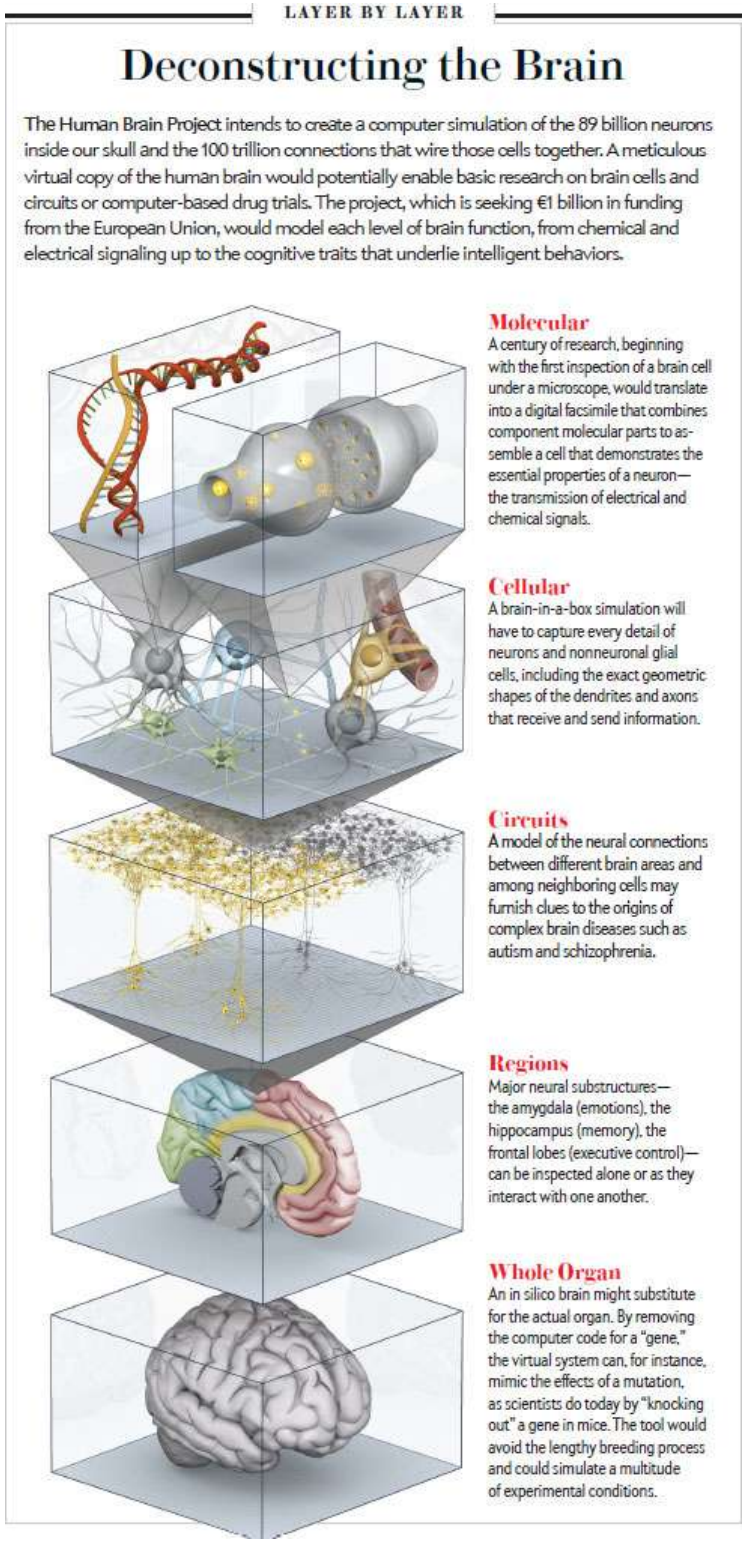


A framework based on an agent's perspective.

http://www.gordana.se/work/PT-AI-Oxford-2013.09.21-GDC.pdf
https://www.youtube.com/watch?v=1QSd-e8rrz4

Gordana Dodig-Crnkovic ShanghAI Lecture 2014: Information, Computation, Cognition Agency based Hierarchies of Levels

Henry Markram (2012) The Human Brain Project, *Scientific American* **306**, 50 – 55



Case study: Pandemics as a complex system and the strategies to control it

Given advanced information-communication technology of today, human society globally have got powerful tools to manage crisis such as current pandemics.

With new technologies social decision making is moving from a old centralized, top-down approach to a decentralized way where information flows both bottom-up, such as the data about the spread of infection, and the healthcare situation which is continuously updated. Also the overview picture of the global situation was constantly available, shared on the internet and frequently updated, thanks to the advanced ICT.

Decision-makers have got unprecedented possibility to make informed decisions. Corona pandemic is the first global experience of this kind for almost all countries in the world, and a lot can be learned for the future about intelligent management of the crisis.

Data-based decision-making and control. Lessons learned

In order to control a pandemic in an efficient and intelligent way, societies must base their policies on reliable information, which in turn is based on reliable and extensive (big) data.

Computational resources engaged in epidemic control:

- Data collection about individuals and their behavior in order to contain infections

- Data about available resources and their dynamical (real-time) allocation, maintenance and adaptation

- Intelligence involved in planning, optimization, prediction

Using computational models for social control

Computational models can be excellent tools for analysis of social phenomena as they give us an overview and possibility to study different possible scenarios in the development of social systems. However, they cannot replace good human judgment.

All simulations depend on the assumptions of the model, so in other words the old wisdom applies:
garbage in – garbage out!

Social computing can be expected to develop into everyday tools for decision-making concerning social phenomena – in economics, government, business, medicine, bioinformatics, epidemiology, politics, urban planning, etc. They should be used as tools to assist human judgment.

Simulating an epidemics

In the beginning of the epidemic, several computational models have been published, illustrating the influence of various factors on the spread of epidemic.

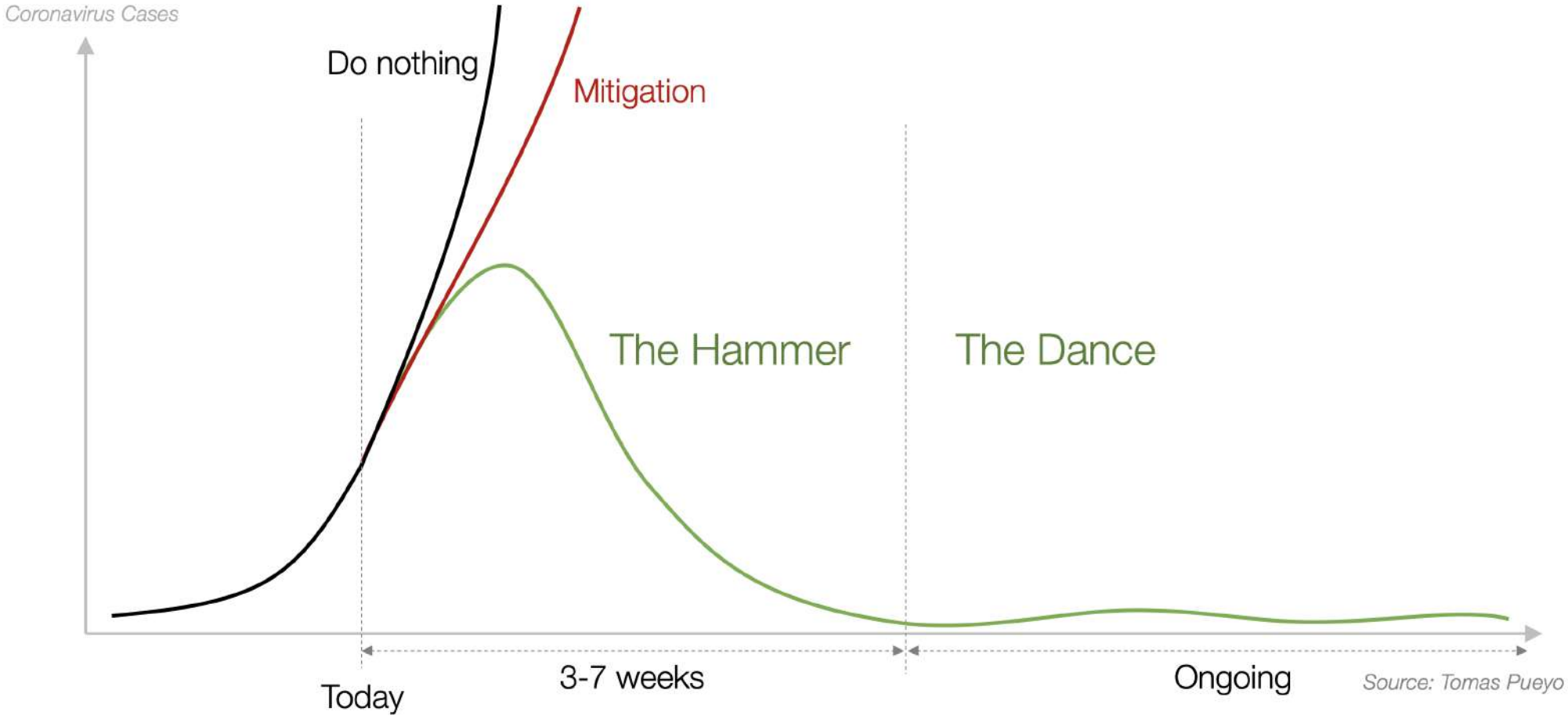
https://www.youtube.com/watch?v=gxAaO2rsdIs&feature=youtu.be Simulating an epidemic 3Blue1Brown (video)

https://medium.com/@tomaspueyo Tomás Pueyo, articles
https://www.youtube.com/watch?v=LE8uJcnvm5E (Part 1, video))
https://www.youtube.com/watch?v=5pJGQIV0CJg (Part 2, video)
https://www.youtube.com/watch?v=gyaevOeQHQA (Part 3, video)

However, not many were ready to use hose tools to inspire decision making.

“The hammer and the dance model”

Assessment of different interventions



https://medium.com/@tomaspueyo/coronavirus-the-hammer-and-the-dance-be9337092b56 Coronavirus: The Hammer and the Dance. What the Next 18 Months Can Look Like, if Leaders Buy Us Time
Published on Mar 19. 2020 in Medium

Humanistic approach to digital technologies Digital Humanism & COVID-19

https://www.youtube.com/results?search_query=Digital+Humanism+from+Covid-19

An example where computational simulation tools have been used:

https://www.youtube.com/watch?v=VTcAiiYnPPw&list=PLKsY-6BoMQ8Ild7x2yRWZ4nApmS2PuDAP&index=4&t=0s

Real Time Simulation Based Decision Support in Health Care Systems – COVID-19 Crisis

Using scenarios for the future development introduces two types of errors:
Model-driven & Data-driven

One of the examples where there is still a lot of controversy in many countries is corona contact tracing – the role of governments and tech giants is central in this case https://youtu.be/FKN2feOdGO8

The Digital Humanism movement
TU Vienna

The approach needs to be scientific, in the tradition of the enlightenment with transdisciplnary and interdisciplinary approach

It is a global international issue.

People are the central focus, as individuals and societies.

Technology is for people and not the other way round. *We need to put "humankind" at the center of our work.*

The challenge of building a just and democratic society with humans at the center of technological progress.

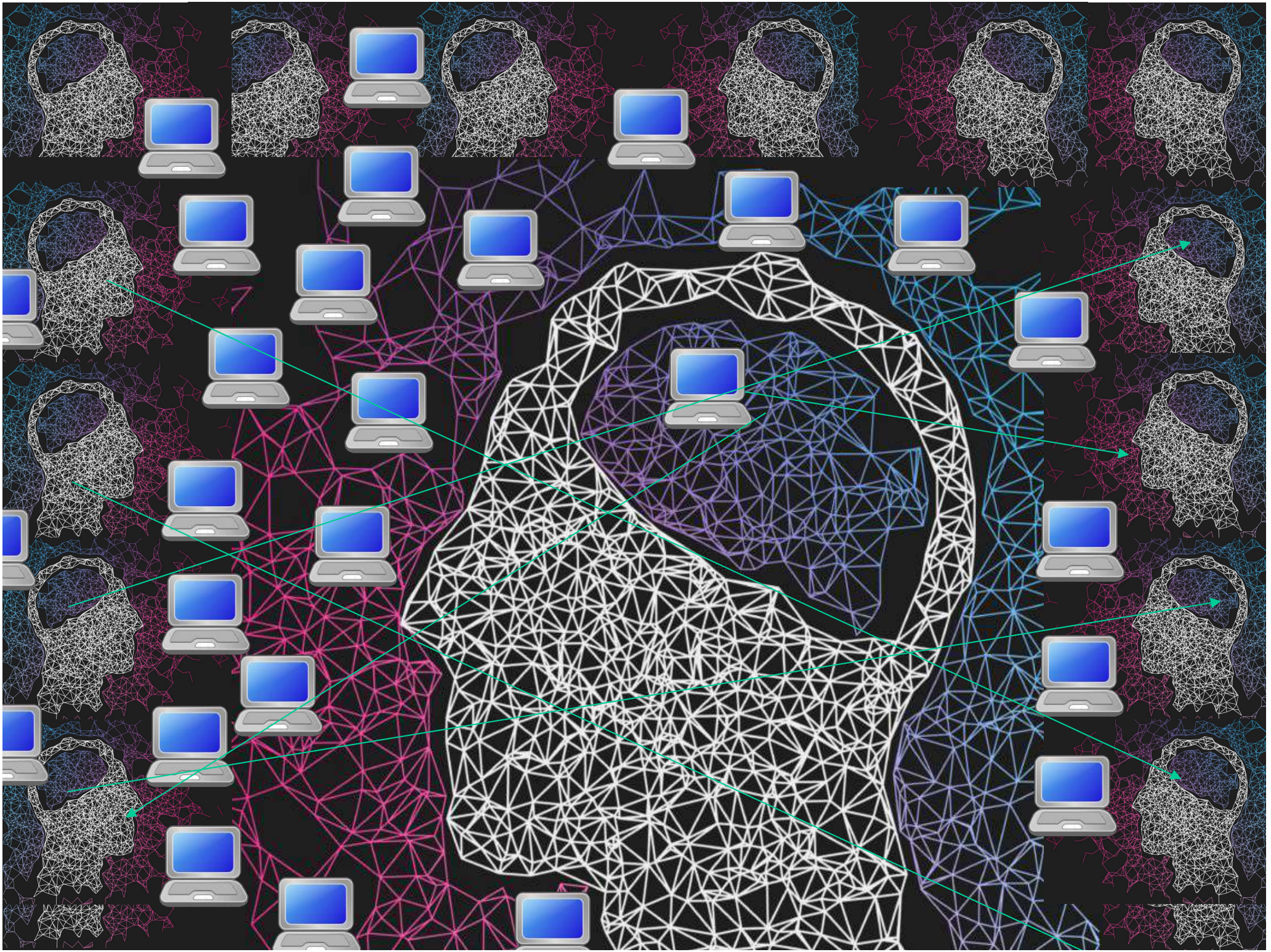
https://dighum.ec.tuwien.ac.at/ Digital Humanism movement web page at the Technical University in Vienna

Conclusion. Science, research, innovation and technology for humane intelligent society

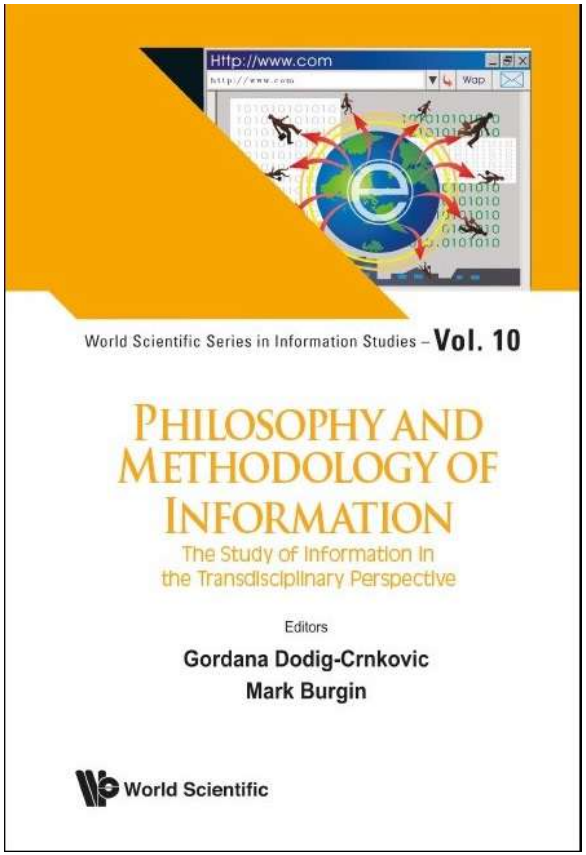
Our civilization relies heavily on technology and the prospect of knowledge society/intelligent society is connected to variety of data-/information- processing (computation) technologies. They require a lot of resources to develop, design, produce, adopt by the users, maintain and finally decommission/recycle.

It is easy to forget that technology is not its own purpose, but that its role is to support human life that is good, rich, meaningful and worthy.

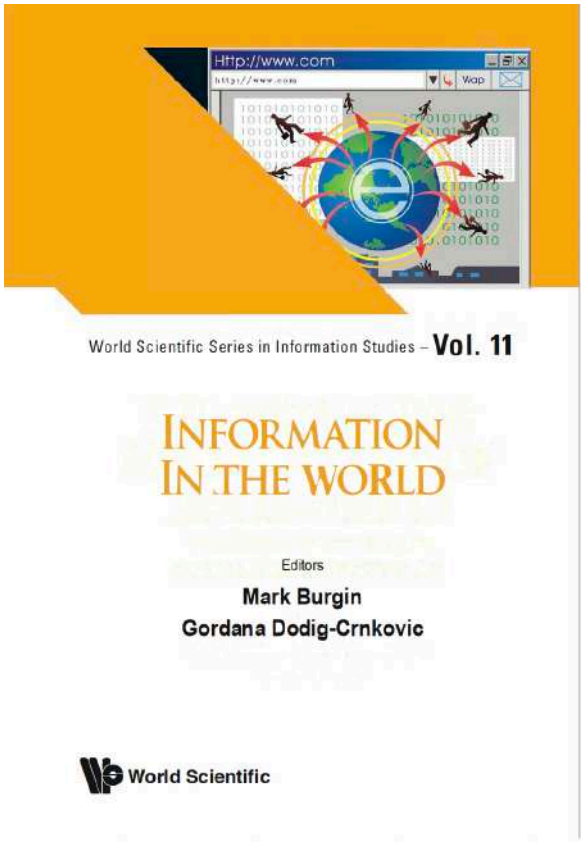
Thus, values of the human life must have highest priority in the development of the new ethical and good, humane intelligent society.



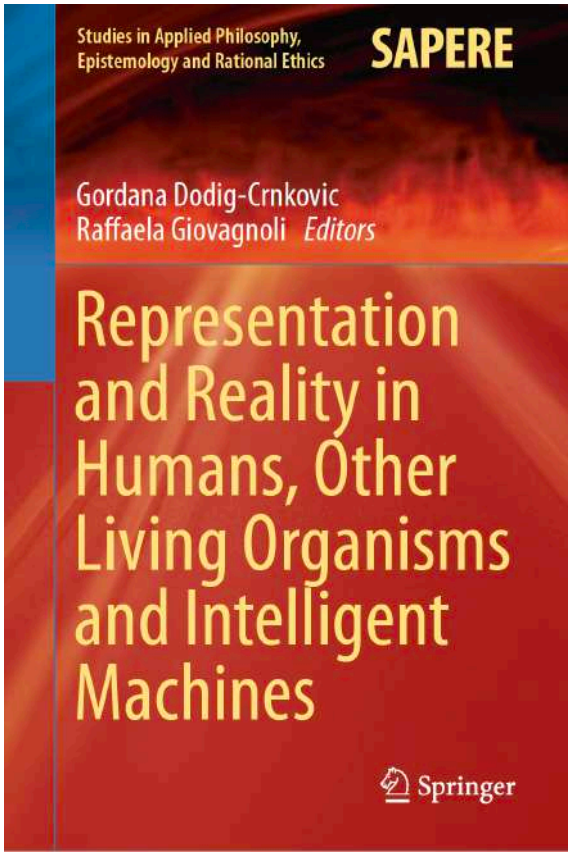
Related books



PHILOSOPHY AND METHODOLOGY OF INFORMATION
Dodig-Crnkovic G. and Burgin M. World Scientific Series in Information Studies, 2019

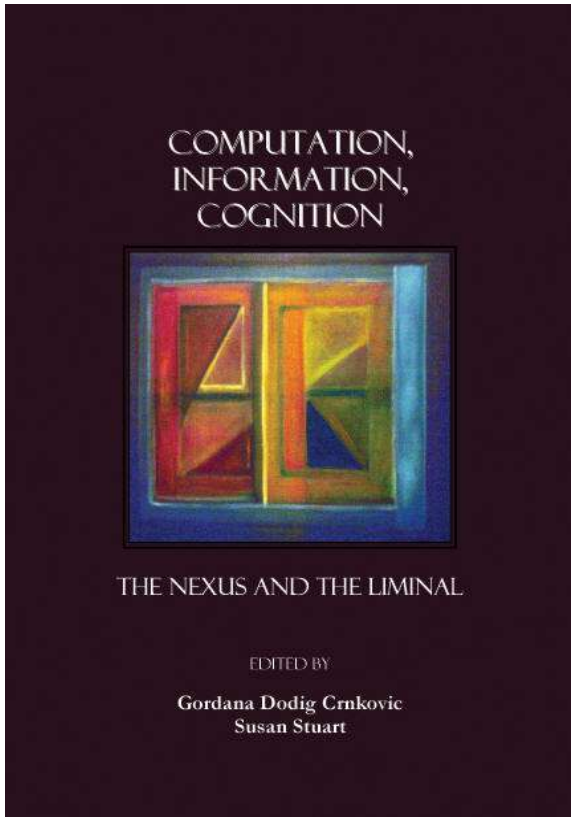


INFORMATION IN THE WORLD
Burgin M. and Dodig-Crnkovic M. World Scientific Series in Information Studies, 2020

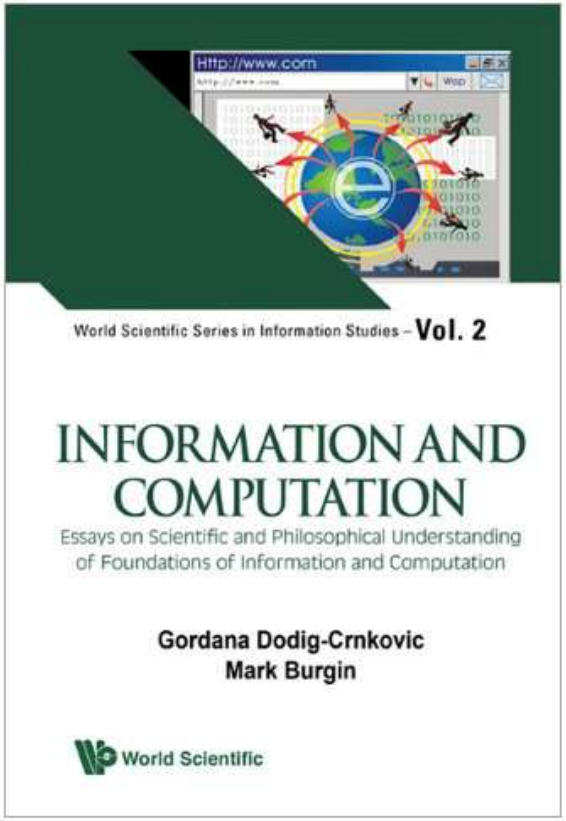


REPRESENTATION AND REALITY
Dodig Crnkovic G. and Giovagnoli R., Springer, 2017

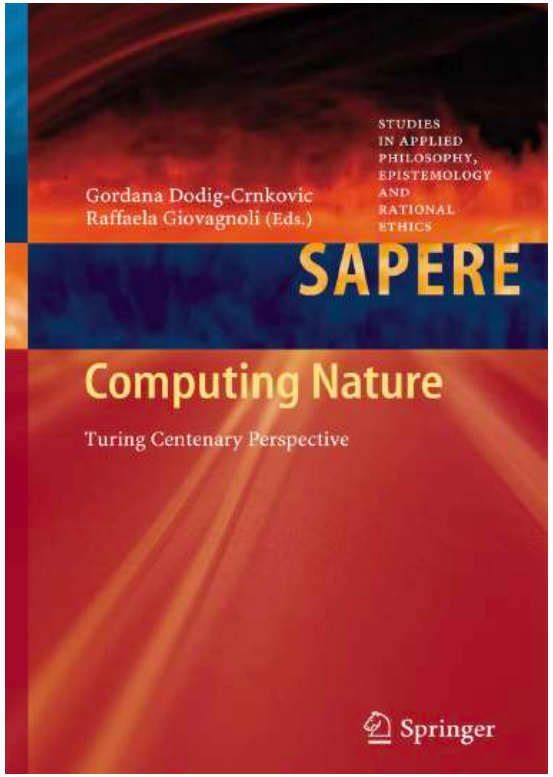
Related books



Computation, Information, Cognition
Gordana Dodig Crnkovic and
Susan Stuart, Edts.
Cambridge Scholars Publishing, 2007



Information and Computation
Gordana Dodig Crnkovic and
Mark Burgin, Edts.
World Scientific, 2011



Computing Nature
Gordana Dodig Crnkovic and
Raffaela Giovagnoli, Edts.
Springer, 2013

REFERENCES

Dodig-Crnkovic G., Dynamics of Information as Natural Computation, Information 2011, 2(3), 460-477; doi:10.3390/info2030460 Special issue: Selected Papers from FIS 2010 Beijing Conference, 2011.
http://www.mdpi.com/journal/information/special_issues/selectedpap_beijing
http://www.mdpi.com/2078-2489/2/3/460/ See also:
http://livingbooksaboutlife.org/books/Energy_Connections

Dodig-Crnkovic, G.; Rotolo, A.; Sartor, G.; Simon, J. and Smith C. (Editors)
Social Computing, Social Cognition. Social Network and Multiagent Systems. Social Turn - SNAMAS 2012
AISB/IACAP World Congress 2012. Birmingham, UK, 2-6 July 2012http://events.cs.bham.ac.uk/turing12/proceedings/11.pdf , 2012.

Dodig-Crnkovic G., Agent Based Modeling with Applications to Social Computing, Proceedings IACAP 2011. The Computational Turn: Past, Presents, Futures?, p 305, Mv-Wissenschaft, Münster, Århus University, Danmark, Editor(s): Charles Ess and Ruth Hagengruber, July 2011. http://www.idt.mdh.se/~gdc/work/IACAP11_Gordana-DC.pdf

Dodig-Crnkovic, G. Information, Computation, Cognition. Agency-based Hierarchies of Levels. In V. C. Müller (Ed.), Fundamental Issues of Artificial Intelligence (Synthese Library). Berlin: Springer. (forthcoming) http://www.idt.mdh.se/~gdc/work/Information-Computation-Agency-Cognition-20131218.pdf