Conference Report

2021 Summit of the International Society for the Study of Information (IS4SI) †

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†   Summary of 2021 Summit of the International Society for the Study of Information, online,
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Abstract: Continuing the tradition of S4SI Summits, the 2021 Summit had the form of ten federated conferences focusing on more specific aspects of the study of information. Its title, "Information Study for the Benefit of Humanity: Learning from the Past and Building the New Normal," referred to the present great challenge faced by the global community—the pandemic of a new coronavirus that itself can be considered a large scale informational phenomenon. However, the pandemic was not the only global challenge discussed at the conferences contributing to the summit. Another great global challenge discussed at the summit was related to the issues arising with the rapidly increasing role of information technology in all domains of human life and work, and the dangers of their abuse or uncontrolled drift in directions that threaten human wellbeing. These concerns pointed at the need for a better understanding of information as a central concept of science, technology, and culture, another main theme of the summit.

Keywords: information; computing; research forum; artificial and natural intelligence; theory; foundations; digital humanism

1. Introduction

The 2021 Summit of the International Society for the Study of Information (IS4SI) was the fourth biannual congregation of the members of the society together with other researchers, philosophers, and practitioners active in all domains of the study of information.

Continuing the tradition established at the earlier S4SI Summits in Vienna (2015), Gothenburg (2017), and Berkeley (2019), the 2021 Summit had the form of ten federated conferences focusing on more specific aspects of the study of information. Its title, "Information Study for the Benefit of Humanity: Learning from the Past and Building the New Normal," referred to the present great challenge faced by the global community—the pandemic of a new coronavirus that itself can be considered a large scale informational phenomenon involving biological, social, political manifestations of information and their dynamics. However, the pandemic was not the only global challenge discussed at the conferences contributing to the summit.

Another great global challenge discussed at the summit was related to the issues arising with the rapidly increasing role of information technology in all domains of human life and work. Although there are unquestionable, great benefits of Artificial Intelligence, digital means of communication, automation, and other technological developments in information processing, storage, and retrieval, there are equally great and formidable dangers of their intentional abuse or uncontrolled drift in directions that threaten human wellbeing. These concerns pointed at the need for a better understanding of information as a central concept of science, technology, and culture.

The search for an appropriate methodology for the study of information, providing us with the tools for such understanding, was the complementing theme of the summit. Not all contributions to the summit addressed directly the concept of information. The summit had, as one of its objectives, fostering mutual understanding between diverse fields of study, those in which information already has its central role and those where the presence of information is acknowledged but at present less recognized.

Due to the limited size, the summary of the summit is mainly about the plenary contributions consisting of plenary discussions and 76 plenary lectures, talks, and presentations suggested for all participants of the summit. The plenary sessions were scheduled without alternative tracks to allow for the attendance of all participants. The ten contributing conferences had their more extensive programs of presentations and discussions in parallel sessions with a more specialized focus, leaving the choice of attendance to the preferences of participants. The information about these parallel sessions can be found on the website of the Summit (IS4SI 2021) and/or on the individual websites of the contributing conferences.

2. President's Theme Statement for the 2021 IS4SI Summit (Marcin J. Schroeder)

The 2021 IS4SI Summit happened in the shadow of the global crisis of the new coronavirus pandemic. Dozens of millions of people have already been infected, some of them suffered but managed to recover but more than a million perished. Millions lost their sources of income, jobs, businesses. The word "crisis" comes from the Greek meaning discernment, judgment, which describes well our present experience. There are now many examples of authentic heroism manifested by people who risk their health or lives bringing medical care to those infected with the virus and there are many examples of the unscrupulous exploitation of human suffering for political or economic gains.

Recently, there is hope that new vaccines will soon bring the spread of the virus under control and that life will return to normal. In this desire to return to normal and to put the dramatic experience behind us there is a hidden danger of forgetting about what we can learn from it. Hegel, in the Introduction to his Philosophy of History, pessimistically claimed "What experience and history teach is this—that people and governments never learned anything from history, or acted on principles deduced from it." Now, almost two centuries later, this assessment of the short span of memory among politicians and in the general public is equally accurate, but this should not be an excuse for the academic community to forget and not to learn from our experience. Going back to the "old normal" would be a defeat of reason and betrayal of those who suffered and those who sacrificed themselves in the fight with the disease.

It is important not only not to forget and to learn, but what to learn. If the lesson we were given was only about the lack of responsibility of political and economic leaders, their lack of imagination, about the deficiency of their morals, or about the frequently irrational reactions of the general public, then the pain brought by the pandemic would have been in vain. We have multiple examples of those in the past centuries or even millennia. Only someone naïve can expect that next time will be different. Searching for someone to blame for errors cannot replace searching for sources of errors. We can see that a lot of damage and suffering was a result of ignorance fueled by antiscientific and anti-intellectual attitudes, frequent both among political and economic leaders and within broad masses of the human population. It would be counterproductive to be satisfied with this diagnosis, in particular in the latter case. Are we, members of the academic community, without blame? It is our responsibility to promote knowledge and understanding of the world through education. Can we be satisfied with what we offer our societies? Do we have a comprehensive, consistent, scientific, or more generally intellectual view of reality that we could all understand and share among ourselves, and which we can present to the global society?

This does not mean that we have to seek consensus regarding the answers to specific research questions. Progress in science and philosophy has always depended on competing ideas, but productive competition requires common foundations, common rules, and mu-

tual understanding. Therefore, we can disagree about answers, but we have to understand each other's questions. We should be able to present this common foundation to the general public, which does not have any reason to trust in our advice when confronted with the lack of agreement and mutual understanding among scientists and intellectuals, in stark contrast to the extreme self-confidence of those who unite in the fight for political and economic power.

There is a desperate need for building a common foundation for science, philosophy, and humanities, for the construction of a comprehensive view of reality integrating the results of diverse methods of inquiry, to restore the position of knowledge and reason as guides for the global society. IS4SI has a special role to play in this task. The concept of information, as probably no other concept in modern thought, is not only present and fundamental in virtually all academic and technological disciplines, but it is familiar (admittedly without a very deep understanding) to the majority of the human population. Its universality qualifies it as the best tool to build an authentic transdisciplinary vision of reality and, at the same time, its familiarity with the general public makes it a good tool for the propagation of this vision.

The 2021 Summit consisted of several component conferences grouping experts in specific forms of inquiry of information, at the same time including plenary activities bringing together all participants. These conferences provided an opportunity to present to fellow researchers the most recent developments within their foci of expertise and the plenary events of the summit had the role of a forum for the exchange of views coming from multiple perspectives for seeking mutual understanding and cooperation.

3. Organizing Committee of the Summit

The Organizing Committee was chaired by Marcin J. SCHROEDER (IS4SI President; Professor at Global Learning Center of IEHE, Tohoku University at Sendai, Japan) and it consisted of the chairs of the organizing committees of contributing conferences and the members with special responsibilities (e.g., information technology support):

- Syed Mustafa ALI (School of Computing and Communications, The Open University, Milton Keynes, UK),
- Charalambos ALIFIERIS (Independent Scholar, Greece),
- Peter BOLTUC (University of Illinois, Springfield, MO, USA & Warsaw School of Economics, Warsaw, Poland),
- Joseph BRENNER (Independent Scholar, Switzerland),
- Mark BURGIN (University of California, Los Angeles, CA, USA),
- Zhicheng CHEN (IS4SI Vice-President for Special Inteest Groups, China),
- Gordana DODIG-CRNKOVIC (Chalmers University of Technology and the University of Gothenburg, Gothenburg, Sweden),
- Raffaela GIOVAGNOLI (Faculty of Philosophy, Pontifical Lateran University, Vatican),
- Annette GRATHOFF (IS4SI Secretary General, Vienna, Austria),
- Masami HAGIYA (Department of Information Science, Graduate School of Information Science and Technology University of Tokyo, Tokyo, Japan),
- Wolfgang HOFKIRCHNER (The Institute for a Global Sustainable Information Society, Vienna, Austria),
- David J. KELLEY (AGI Laboratory, Seattle, WA, USA),
- Hans-Jörg KREOWSKI (University of Bremen, Bremen, Germany),
- Robert LOWE (Department of Applied IT, University of Gothenburg, Gothenburg, Sweden),
- Pedro MARIJUÁN (Independent Scholar, Zaragoza, Spain),
- Dénes NAGY (President, International Society for the Interdisciplinary Study of Symmetry, Budapest, Hungary),
- Yasuhiro SUZUKI (Graduate School of Informatics, Nagoya University at Nagoya, Nagoya, Japan)
- Vera VIANA (Faculty of Architecture, The University of Porto, Porto, Portugal),

- Kun WU (Department of Philosophy, School of Humanities and Social Sciences, Xi'an Jiaotong University, Xi'an, China),
- Yixin ZHONG (Beijing University of Posts and Telecommunications, Beijing, China).

Contributing conferences had their own organizing committees, with membership listed on the website of the Summit (IS4SI2021).

The summit did not have a program committee separate from program committees for contributing conferences, which, in some cases, were identical with organizing committees. Chair of the Summit Organizing Committee coordinated the work of program committees for contributing conferences regarding the choice and design of contributions to the plenary program. The schedule of plenary events was designed by the chair of the summit in cooperation with chairs and co-chairs of contributing conferences. This was a complex task for plenary events, which were intended for all participants of the summit as they were in almost all possible time zones of the world. There were last minute changes in the schedule due to unpredictable circumstances (e.g., health emergencies) that required fast decisions. For this reason, the flexible one person decision making on the schedule was preferable.

4. Contributing Conferences

The titles of contributing conferences (together with abbreviations used in the materials of the summit) were as follows:

- **Theoretical and Foundational Problems in Information Studies (TFP)**
- **Information in Biologically Inspired Computing Architectures (BICA)**
- **Digital Humanism (Dighum)**
- **Symmetry, Structure, and Information (SIS)**
- **Morphological Computing of Cognition and Intelligence (MORCOM)**
- **Habits & Rituals (H&R)**
- **13th International Workshop on Natural Computing (IWNC)**
- **Philosophy and Computing (APC)**
- **5th International Conference on Philosophy of Information (ICPI)**
- **Global Forum for Artificial Intelligence (GFAI)**

Some of these conferences belonged to the tradition of the IS4SI Summits, some others were new contributions from organizations with interests related to information.

A more detailed presentation of the topics and programs of contributing conferences and extended abstracts of papers presented at their sessions can be found on the website of the summit (IS4SI 2021) and the websites created by their organizers:

Dighum: IS4SI 2021 Digital Humanism workshop programmed—GSIS (accessed on 16 March 2022),

TFP: Theoretical and Foundational Problems (TFP) in Information Studies (tfpis.com) (accessed on 16 March 2022),

IWNC: https://www.natural-computing.com/#iwnc-13/ (accessed on 16 March 2022),

SIS web page: Schedule for the Conference "Symmetry, Structure and Information" in the IS4SI 2021 Summit—The International Society for the Interdisciplinary Study of Symmetry Schedule for the Conference "Symmetry, Structure and Information" in the IS4SI 2021 Summit—The International Society for the Interdisciplinary Study of Symmetry (symmetry-us.com) (Schedule for the Conference "Symmetry, Structure and Information" in the IS4SI 2021 Summit—The International Society for the Interdisciplinary Study of Symmetry (symmetry-us.com) (accessed on 16 March 2022).

All participants were invited to submit their papers to the Special Issue of Proceedings (MDPI). The choice of the venue for reviewing and publishing materials presented at the summit belongs to the organizing committees of contributing conferences and the present volume of proceedings includes only papers selected in this process. In essence, the review process had two stages—at first, the materials submitted for the presentation at the conference were reviewed and selected for presentation and then presented papers were reviewed and selected for publication.

Several videos with recordings of the presentations from the plenary sessions have been already edited and published on YouTube. Editing and publishing of other recordings is an ongoing project of IS4SI (IS4SI 2021 accessed on 16 March 2022).

5. Sessions of Plenary Program

The following list shows the titles of presentations at plenary sessions gathering all the participants of the summit and names of authors in the chronological order of their presentations. The titles of presentations at nonplenary, parallel sessions of contributing conferences are reported in the editorials in *Proceedings* for contributing conferences presenting submitted and accepted papers. The readers will find, in Proceedings, a large collection of papers derived from the work presented at the summit.

Presentations and discussions of the plenary program of the summit, listed below, addressed a very wide range of topics related to information studies from the aspects addressed by natural sciences (in particular biology and physics), computer science (including technological, philosophical and practical matters), logic, and mathematics, to humanities, social sciences, and philosophy. The intention of the program design was to saturate plenary sessions with topics providing a broad view on information and its role in our understanding of reality and, on the other hand, in creating a better future for humanity.

1. *Opening Panel Discussion "What is the SI in IS4SI?"* moderated by Marcin J. Schroeder (Tohoku University, Sendai, Japan)
2. *Autopoietic machines: Going beyond the half-brained AI and Church-Turing Thesis* presented by Rao Mikkilineni (Ageno School of Business, Golden Gate University, San Francisco, CA, USA)
3. *Research in the area of Neosentience, Biomimetics, and Insight Engine 2.0* by Bill Seaman (Computational Media, Arts and Cultures; Emergence Lab, Duke University, Durham, NC, USA)
4. *Mind, Nature, and Artificial Magic* by Rossella Lupacchini (University of Bologna, Bologna, Italy)
5. *Non-Diophantine arithmetics as a tool for formalizing information about nature and technology* by Michele Caprio, Andrea Aveni, and Sayan Mukherjee (Duke University, Durham, NC, USA)
6. *Ontological information—information as a physical phenomenon* by Roman Krzanowski (The Pontifical University of John Paul II, Krakow, Poland)
7. *Materialization and Idealization of Information* by Mark Burgin (University of California, Los Angeles, CA, USA)
8. *Paradigm Shift, an Urgent Issue for the Studies of Information Discipline* by Yixin Zhong (Beijing University of Posts and Telecommunications, Beijing, China)
9. *Structural Analysis of Information: Search for Methodology*, by Marcin J. Schroeder (Global Learning Center, IEHE, Tohoku University, Sendai, Japan)
10. *Quality of information* by Krassimir Markov (ITHEA, Sofia, Bulgaria)
11. *A QFT Approach to Data Streaming in Natural and Artificial Neural Networks* by Gianfranco Basti (Faculty of Philosophy, Pontifical Lateran University, Vatican City) and Giuseppe Vitiello (Department of Physics "E. R. Caianiello", University of Salerno, Fisciano (Salerno), Italy)
12. *Arithmetic loophole in Bell's theorem: Overlooked threat to entangled-state quantum cryptography* by Marek Czachor (Institute of Physics and Computer Science, Gdańsk University of Technology, Gdańsk, Poland)
13. *Advanced NLP procedures as premises for the reconstruction of the idea of knowledge* by Rafal Maciag (Institute of Information Studies, Jagiellonian University, Krakow, Poland)
14. *Toward a Unified Model of Cognitive Functions* by Pei Weng (Temple University, Philadelphia, PA, USA)
15. *A Nested Hierarchy of Analyses: From Understanding Computing as a Great Scientific Domain, through Mapping AI and Cognitive Modeling and Architectures, to Developing a*

    Common Model of Cognition by Paul Rosenbloom (USC Institute for Creative Technologies, University of Southern California, Playa Vista, CA, USA)

16. *The Development and Role of Symmetry in Ancient Scripts* by Peter Z. Revesz (Department of Computer Science and Engineering, University of Nebraska-Lincoln, Lincoln, NE, USA)

17. *Symmetry and Information: An odd couple (?)* by Dénes Nagy (President, International Society for the Interdisciplinary Study of Symmetry, Budapest, Hungary)

18. *Antinomies of Symmetry and Information* by Marcin J. Schroeder (Tohoku University, Sendai, Japan)

19. *SIS Conference Panel Discussion* moderated by Dénes Nagy & Marcin J. Schroeder

20. *Digital Humanism* by Julian Nida-Rümelin (Munich University, Munich, Germany)

21. *Humanism Revisited* by Rainer E. Zimmermann(Institute for Design Science Munich Germany/Clare Hall, Cambridge University, Cambridge, UK)

22. *The Indeterminacy of Computation: Slutz, Shagrir, and the mind* by B. Jack Copeland (University of Canterbury, Christchurch, New Zealand)

23. *Falling Up: The Paradox of Biological Complexity* by Terrence W. Deacon (University of California Berkeley, Berkeley, CA, USA)

24. *Almost disjoint union of Boolean algebras appeared in Punch Line* by Yukio Pegio Gunji (Department of Intermedia Art and Science, School of Fundamental Science and Technology, Waseda University, Tokyo, Japan)

25. *Why do not hatching alligator eggs ever produce chicks?* by Aaron Sloman (School of Computer Science, University of Birmingham, Birmingham, UK)

26. *Morphogenesis as a model for computation and basal cognition* by Michael Levin (Tufts Center for Regenerative and Developmental Biology, Tufts University, Medford, MA, USA)

27. *Cross-Embodied Cognitive Morphologies: Decentralizing Cognitive Computation Across Variable-Exchangeable, Distributed, or Updated Morphologies* by Jordi Vallverdú (Universitat Autònoma de Barcelona, Catalonia, Spain)

28. *Designing Physical Reservoir Computers* by Susan Stepney (University of York, York, UK)

29. *The Aims of AI: Artificial and Intelligent* by Vincent C. Müller (TU/e & University of Leeds, Turing Institute, Leeds, UK)

30. *Cognition through Organic Computerized Bodies. The Eco-Cognitive Perspective* by Lorenzo Magnani (University of Pavia, Pavia, Italy)

31. *Digital Consciousness and the Business of Sensing, Modeling, Analyzing, Predicting, and Taking Action* by Rao Mikkilineni (Ageno School of Business, Golden Gate University, San Francisco, CA, USA)

32. *On Leveraging Topological Features of Memristor Networks for Maximum Computing Capacity* by Ignacio Del Amo and Zoran Konkoli (Chalmers University of Technology, Gothenburg, Sweden)

33. *Habits and Rituals as Stabilized Affordances and Pregnances: A Semiophysical Perspective* by Lorenzo Magnani (University of Pavia, Pavia, Italy)

34. *A neurocomputational model of relative value processing: Habit modulation through differential outcome expectations* by Robert Lowe (Department of Applied IT, University of Gothenburg, Gothenburg, Sweden)

35. *Capability and habit* by Matthias Kramm (Wageningen University & Research, Wageningen, The Netherland)

36. *Collective Intentionality and the Transformation of Meaning During the Contemporary Rituals of Birth* by Anna M. Hennessey (Visiting Scholar, Berkeley Center for the Study of Religion, University of California, Berkeley, CA, USA)

37. *Habitual Behavior: from I-intentionality to We- intentionality* by Raffaela Giovagnoli (Faculty of Philosophy, Pontifical Lateran University, Vatican)

38. *Machines computing and learning?* by Genaro J. Mart'ınez (Artificial Life Robotics Laboratory, Escuela Superiorde C'omputo, InstitutoPolit´ecnico Nacional, M´exico & Unconventional Computing Lab, University of the West of England, Bristol, UK)

39. *Computing with slime mould, plants, liquid marbles, and fungi* by Andy Adamatzky (Unconventional Computing Lab, UWE, Bristol, UK)
40. *IWNC Panel Discussion* moderated by Marcin J. Schroeder
41. *Exploring open-ended intelligence using patternist philosophy* by Ben Goertzel (Singularty Net Foundation & OpenCog Foundation)
42. *The Artificial Sentience Behind Artificial Inventors* by Stephen Thaler (Imagination Engines Inc.)
43. *Potential Impacts of Various Inventorship Requirements* by Kate Gaudry (Kilpatrick Townsend & Stockton LLP)
44. *Panel Commentary* by Peter Boltuc (University of Illinois, Springfield, USA & Warsaw School of Economics, Warsaw, Poland)
45. *On Two Different Kinds of Computational Indeterminacy* by Oron Shagrir, Philippos Papayannopoulos, and Nir Fresco (Hebrew University of Jerusalem, Jerusalem, Israel)
46. *Cognitive neurorobotic self in the shared world* by Jun Tani (Cognitive Neurorobotics Research Unit, Okinawa Institute of Science and Technology (OIST), Okinawa, Japan)
47. *The Future of Anthroposociogenesis—Panhumanism, Anthroporelational Humanism and Digital Humanism* by Wolfgang Hofkirchner (The Institute for a Global Sustainable Information Society, Vienna, Austria)
48. *The Philosophy—Science Interaction in Innovative Studies* by Yixin Zhong (Beijing University of Posts and Telecommunications, Beijing, China)
49. *Information and the Ontic-Epistemic Cut* by Joseph Brenner (Independent Scholar, Switzerland)
50. *A Chase for God in the Human Exploration of Knowledge* by Kun Wu, Kaiyan Da, Tianqi Wu (Department of Philosophy, School of Humanities and Social Sciences, Xi'an Jiaotong University, Xi'an, China)
51. *The Second Quantum Revolution and its Philosophical Meaning* by Hongfang L. (School of Marxism University of Chinese Academy of Sciences)
52. *Information and Disinformation with their Boundaries and Interfaces* by Gordana Dodig-Crnkovic (Chalmers University of Technology and the University of Gothenburg, Gothenburg, Sweden)
53. *A Quantum Manifestation of Information* by Tian'en Wang (Shanghai University, Shanghai, China)
54. *Computation and Eco-Cognitive Openness-Locked Strategies, Unlocked Strategies, and the Dissipative Brain* by Lorenzo Magnani (University of Pavia, Pavia, Italy)
55. *In what sense should we talk about the perception of other minds?* by Duoyi Fei (China University of Political Science and Law, China)
56. *An a Priori Theory of Meaning* by Marcus Abundis (Bön Informatics, Aarau, Switzerland)
57. *Some Problems of Quantum Hermeneutics* by Guolin Wu (Institute for Advanced Study in Science, Technology and Philosophy, South China University of Science and Engineering, Guangzhou, China)
58. *The fast-changing paradigm of war calls for great wisdom of peace* by Lanbo Kang (Department of Political Science, Engineering University, Xi'an, China)
59. *Technologies, ICTs and Ambiguity* by Tomáš Sigmund (Prague University of Economics and Business, Czech Republic)
60. *The Data Turn of Scientific Cognition and the Research Program of Philosophy of Data* by Xinrong Huang (Research Center of Management Philosophy, Jiangxi University of Finance and Economics Nanchang, China)
61. *Testimony and Social Evidence in the Covid Era* by Raffaela Giovagnoli (Faculty of Philosophy, Pontifical Lateran University, Vatican)
62. *Developments of research on the Nature of Life from the Information Theory of Individuality* by Dongping Fan, Wangjun Zhang (South China Normal University, Institute for Science, Technology and Society, Center for Systems Science and Systems Management Research Guangzhou, Guangdong, China)
63. *On Information Interaction between the Hierarchy of the Material System* by Zhikang Wang (Sun Yat-sen University, China)

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