First Berlin-Cagliari-Helsinki Meeting

15 January 2021
Technische Universität Berlin
ZOOM MEETING xxxyyy

Programme

Friday 15.01.2021 – Morning

10.00 - 10.10 ENNO AUFDERHEIDE (AvH Secretary General)
Welcome Speech

10.15 - 11.00 KLAUS MAINZER (München/Tübingen)
Quantum Computing. From the Quantum World to Artificial Intelligence

11.00 - 11.45 PAAVO PYLKKÄNEN (Helsinki Univ.)
Quantum ontology and the mind-matter problem

11.45 - 12.30 STEFANIA CENTRONE (TU Berlin)
Reflections on Mind, Matter and the Implicate Order *by Paavo* Pylkkänen

Friday 15.01.2021 – Afternoon

14.00 - 14.45 ROBERTO GIUNTINI (Cagliari Univ.)
Quantum-Inspired Machine Learning

14.45 - 15.30 FABIO ROLI (Cagliari Univ.)
From known knowns to unknown unknowns in AI: Historical and Technical Issues

Participants: ENNO AUFDERHEIDE (AvH Secretary General), STEFANIA CENTRONE (TU Berlin), AXEL GELFERT (TU Berlin), ROBERTO GIUNTINI (Cagliari Univ.), REINHARD KAHLE (Tübingen Univ.), KLAUS MAINZER (TU München), KARL-GEORG NIEBERGALL (HU Berlin), PAAVO PYLKKÄNEN (Helsinki Univ.), FABIO ROLI (Cagliari Univ.)

Organizers: STEFANIA CENTRONE and AXEL GELFERT

Sponsored by:

Alexander von Humboldt Stiftung/Foundation
DFG Deutsche Forschungsgemeinschaft
SILFS società italiana di logica e filosofia delle scienze
Technische Universität Berlin
REGIONE AUTÒNOMA DE SARDIGNA
REGIONE AUTONOMA DELLA SARDEGNA

ABSTRACTS / PARTICIPANTS

Dr. Enno Aufderheide is the Secretary General of the Alexander von Humboldt Foundation. He previously held positions at the German Aerospace Centre, served as head of the Research Department at the German Council of Science and Humanities, as executive director for Science at the Helmholtz Association, and as head of the Research Policy and External Relations Department at the Max Planck Society. He also managed the Minerva Foundation for the promotion of German-Israeli academic cooperation. He has been a member of national and international committees for the promotion of science and authored numerous academic and science policy publications.

https://service.humboldt-foundation.de/web/secretary-general.html

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STEFANIA CENTRONE (TU Berlin)

Reflections on Mind, Matter and the Implicate Order *by Paavo* Pylkkänen

Stefania Centrone is currently *Privatdozentin* at the University of Hamburg and holds a *Heisenberg-Stelle* at the Technical University of Berlin. In 2012, she was awarded a DFG-Eigene Stelle for the project "Bolzanos und Husserls Weiterentwicklung von Leibnizens Ideen zur Mathesis Universalis" at the Carl von Ossietzky University of Oldenburg. In 2016, she was deputy professor of Theoretical Philosophy at the Georg-August-Universität Göttingen. She is author of the volumes *Logic and Philosophy of Mathematics in the Early Husserl* (Springer 2010) and *Studien zu Bolzano* (Academia Verlag 2015) and is editor of *Versuche über Husserl* (Mainer 2013), *Essays on Husserl's Logic and Philosophy of Mathematics* (Springer 2017), *Reflections on the Foundations of Mathematics: Univalent Foundation, Set Theory and General Things* (Springer 2019) (with Deborah Kant and Deniz Sarikaya), *Mathesis Universalis, Computability and Proofs* (Springer 2019) (with Sara Negri, Deniz Sarikaya and Peter Schuster). At the present she mainly works on *modal logic and Austro-Polnish philosophy*. Her most recent publications in this field are *Oskar Becker on Modalities* (with Pierluigi Minari) (2019) and *Oskar Becker, On the Logic of Modalities (1930). Translation, Commentary and Analysis* (with Pierluigi Minari) (2021).

Axel Gelfert (TU Berlin) has been Professor of Theoretical Philosophy at the Technical University of Berlin since 2017 ad is currently Head of the Institute of History and Philosophy of Science, Technology, and Literature at TU Berlin. Much of his work focuses on the intersection of philosophy of science and scientific practice. He is the author of *A Critical Introduction to Testimony* (Bloomsbury 2014) and *How to Do Science With Models* (Springer 2016).

https://www.philosophie.tu-berlin.de/menue/fachgebiete/theoretische_philosophie/prof_dr_axel_gelfert/

ROBERTO GIUNTINI (University of Cagliari)

Quantum-Inspired Machine Learning

The aim of this talk is to introduce a new quantum-like method for the binary classification applied to classical datasets. Inspired by the quantum Helstrom measurement, this approach enables us to define a new binary

classifier, called *Helstrom Quantum Classifier* (HQC). This classifier (based on the notion of quantum state discrimination-distinguishability) acts on quantum patterns (density operators) — that are the quantum encoding of the classical patterns of a dataset. We compare the performance of HQC with respect to several standard classifiers over different datasets and we show that HQC outperforms the other classifiers with respect to the Balanced Accuracy and other significant statistical measures. We also show that the performance of our classifier is positively correlated with the increasing of the number of copies of the density patterns (associated to the classical patterns) and the resulting tensor product thereof, a feature that has no classical counterpart.

Roberto Giuntini

KLAUS MAINZER (TU München / Universität Tübingen)

Quantum Computing. From the Quantum World to Artificial Intelligence

Quantum physics with superposition and entanglement of quantum states opens new avenues to quantum computing overcoming classical boundaries of computing. From a philosophical point of view, superposition and entanglement are deeply rooted in logical, ontological, and epistemic questions of the quantum world. From a technical point of view, superposition enables quantum parallelism overcoming classical supercomputers. Entanglement leads to quantum teleportation and a Quantum Internet. Even modern machine learning in AI can be improved by quantum algorithms.
Reference: K. Mainzer, Quantencomputer. Von der Quantenwelt zur Künstlichen Intelligenz, Springer: Berlin 2021

Klaus Mainzer is TUM Emeritus of Excellence and founding director of the Munich Center for Technology in Society (MCTS) at the Technical University of Munich (MCTS). At the Eberhard Karls University of Tübingen, he is senior professor and cofounder of the Carl Friedrich von Weizsäcker Center. Mainzer is member of the steering group (HLG) for standardization of artificial intelligence (AI) in Germany. He is President of the European Academy of Sciences and Arts in Salzburg and chairman of the board of trustees of the Forum Humanum Udo Keller Foundation. His recent books are *The Digital and the Real World. Computational Foundations of Mathematics, Science, Technology, and Philosophy* (World Scientific Singapore 2018), *Proof and Computation. Digitization in Mathematics, Computer Science, and Philosophy* (Ed. with Peter Schuster and Helmut Schwichtentenberg, World scientific Singapore 2018), *Artificial Intelligence. When do Machines take over?* (Springer 2019), *Quantencomputer. Von der Quantenwelt zur Künstlichen Intelligenz* (Springer 2021).
HTTPS://WWW.PROFESSOREN.TUM.DE/MAINZER-KLAUS

PAAVO PYLKKÄNEN (Theoretical philosophy, University of Helsinki)

Quantum ontology and the mind-matter problem

Quantum theory is very successful in predicting the results of experiments and enabling technical applications. Yet its physical meaning remains obscure. While some (e.g. Bohr) assumed that it is not possible to provide a coherent ontological interpretation of quantum theory, others (e.g. de Broglie, Bohm, Everett, Ghirardi et al., Penrose) have proposed candidates for quantum ontology. Some of these quantum

ontologies have implications for understanding the nature and relation of mental and physical properties. In this talk I will focus on Bohm and Hiley's quantum ontology, while also considering some of Penrose's ideas.

Paavo Pylkkänen is Senior Lecturer in Theoretical Philosophy and Director of the Bachelor's Program in Philosophy at the University of Helsinki, Finland. He is also Associate Professor in Theoretical Philosophy (currently on leave) at the University of Skövde, Sweden, where he initiated a Consciousness Studies Program. His main research areas are philosophy of mind, philosophy of physics and their intersection. A central problem is how to understand the place of mind – and especially conscious experience – in the physical world. Pylkkänen has explored this problem in the holistic and dynamic framework that is emerging from quantum theory and relativity (especially as developed by the physicists David Bohm and Basil Hiley). The overall aim of his research is to work toward a scientific metaphysics, a general world-view that reflects our best scientific theories. He is the author of *Mind, Matter and the Implicate Order* (Springer, 2007) and the editor of the *Bohm-Biederman Correspondence: Creativity and Science* (Routledge, 1999). In 2018-2020 he acted as the Vice Dean of Research at the Faculty of Arts, University of Helsinki.
https://philpeople.org/profiles/paavo-pylkkanen
https://researchportal.helsinki.fi/en/persons/paavo-pylkkänen

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FABIO ROLI (University of Cagliari)

From known knowns to unknown unknowns in AI: Historical and Technical Issues

"*There is great chaos under heaven: the situation is excellent*"
quote attributed to Mao Zedong

AI has been originally developed for *closed-world*, and *noise-free*, problems where the possible states of natures and actions that a rationale agent could implement were perfectly known. Using the words of a famous speech by Donald Rumsfeld, one could argue that, at that time, AI dealt with *known knowns*. Since the 1980s, when machine learning became an experimental science, AI researchers started to tackle pattern recognition problems with noisy data, using probability theory to model uncertainty and decision theory to minimize the risk of wrong actions. This was the era of *known unknowns*, characterized by the rise of benchmark data sets, larger and larger year after year, and the belief that real world problems can be solved collecting enough training data. However, recent results have shown that available data sets have often a limited utility when used to train pattern recognition algorithms that will be deployed in the real world. The reason is that modern machine learning has often to face with *unknown unknowns*. When learning systems are deployed in adversarial environments in the *open world*, they can misclassify (with high-confidence) never-before-seen inputs that are largely different from known training data. *Unknown unknowns* are the real threat in many security problems (e.g., zero-day attacks in computer security). In this talk, I give a historical and technical overview of the evolution of AI and machine learning for pattern recognition, and discuss how this evolution can be regarded as a transition from *known knowns* to *unknown unknowns*, and the key role that adversarial machine learning plays to make AI safer.

Fabio Roli is a Full Professor of Computer Science at the University of Cagliari, Italy, and Director of the Pattern Recognition and Applications laboratory (https://pralab.diee.unica.it/). He is partner and R&D manager of the company Pluribus One that he co-founded (https://www.pluribus-one.it). He has been doing research on the design of pattern recognition and machine learning systems for thirty years. His current h-index is 70 according to Google Scholar (Dec 2020). He has been appointed Fellow of the IEEE and Fellow of the International Association for Pattern Recognition. He was a member of NATO advisory panel for Information and Communications Security, NATO Science for Peace and Security (2008 – 2011).

http://pralab.diee.unica.it/en/FabioRoli
