Lecture Notes in Artificial Intelligence 12873

Subseries of Lecture Notes in Computer Science

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Stefan Edelkamp · Ralf Möller ·
Elmar Rueckert (Eds.)

KI 2021: Advances in Artificial Intelligence

44th German Conference on AI
Virtual Event, September 27 – October 1, 2021
Proceedings

Springer

Editors
Stefan Edelkamp
Czech Technical University in Prague
Prague, Czech Republic

Ralf Möller
University of Lübeck
Lübeck, Germany

Elmar Rueckert
University of Leoben
Leoben, Austria

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Artificial Intelligence
ISBN 978-3-030-87625-8 ISBN 978-3-030-87626-5 (eBook)
https://doi.org/10.1007/978-3-030-87626-5

LNCS Sublibrary: SL7 – Artificial Intelligence

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

KI 2021 was the 44th German Conference on Artificial Intelligence organized in cooperation with the Fachbereich Künstliche Intelligenz der Gesellschaft für Informatik (GI). The conference took place in an online fashion during September 27 to October 1, 2021. The German AI Conference basically started 45 years ago with the first GI-Fachgruppe KI meeting on October 7, 1975. KI is one of the major European AI conferences and traditionally brings together academic and industrial researchers from all areas of AI, providing an ideal place for exchanging news and research results on theory and applications. KI 2021 was organized in combination with INFORMATIK 2021, and we would like to thank Daniel Krupka and Alexander Scheibe from GI for their collaboration.

The technical program of KI 2021 comprised paper and poster presentations as well as tutorials and workshops. Overall KI 2021 received about 60 submissions of which 21 were selected as technical communications and papers, together with 6 poster presentations. We were honored that very prominent researchers kindly agreed to give very interesting keynote talks (alphabetical order, see also the abstracts below):

- Tristan Cazenave (Université Paris-Dauphine, France) Monte Carlo Search
- Giuseppe De Giacomo (Sapienza University of Rome, Italy) Autonomy in AI: Reactive Synthesis, Planning and Reinforcement Learning in Linear Temporal Logic on Finite Traces
- Birte Glimm (University of Ulm, Germany) Ontologies for Providing Map Knowledge to Autonomous Vehicles
- Kristian Kersting (TU Darmstadt, Germany) The Third Wave of AI [Joint Keynote with INFOMATIK2021]
- Katja Mombaur (University of Waterloo, Canada) Motion Intelligence for Human-Centred Robots
- Stuart Russell (University of California, Berkeley, USA) Human-Compatible Artificial Intelligence

An extensive range of special meetings, a tutorial, and several workshops rounded off the program:

Special Events

- CLAIRE National Meeting
- Early Career Research Consortium
- Meeting of the FBKI task force “AI in Education” (Arbeitskreis KiS)

Tutorial

– Christoph Stockhammer and Mihaela Jarema: Deep Learning Workflows for Biomedical Signal Data – A Practical Example

Workshops

– Christoph Beierle, Marco Ragni, Frieder Stolzenburg, and Matthias Thimm: 7th Workshop on Formal and Cognitive Reasoning FCR 2021
– Barbara Hammer, Malte Schilling, and Laurenz Wiskott: Trustworthy AI in the Wild
– Ulrich John, Petra Hostedt, and Mario Wenzel: 35th Workshop on (Constraint) Logic Programming (WLP 21)
– Sylvia Melzer, Stefan Thiemann, and Jost Gippert: Humanities-Centred AI (CHAI)
– Jürgen Sauer and Stefan Edelkamp: Planen und Konfigurieren (PuK)
– Andreas Hein, Mark Schweda, Silke Schicktanz, Stefan Teipel, and Thomas Kirste: Artificial Intelligence and Ethics

As Program Committee (PC) chairs, we would like to thank our speakers for their interesting and inspirational talks. Our thanks also go out to the organizers of INFORMATIK 2021 who provided support in terms of registration and setting up a virtual conference. We would like to thank the Program Committee members and additional reviewers for their efforts. Without their substantial voluntary work, this conference would not have been possible. We would also like to thank EasyChair for their support in handling submissions and Springer for their support in making these proceedings possible. Our institutions, the Czech Technical University in Prague (Czech Republic), the University of Lübeck (Germany), and the University of Leoben (Austria), also provided support for our participation, for which we are grateful. Many thanks go to Tanya Braun and Marcel Gehrke for helping with web pages and proceedings. We also thank the Fachbereich Künstliche Intelligenz der Gesellschaft für Informatik, in particular Matthias Klusch and Ingo Timm, for their ongoing support and dedication to KI 2021. Last but not least, we would like to thank our sponsors:

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August 2021

Stefan Edelkamp
Ralf Möller
Elmar Rueckert

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Abstracts of Invited Talks

Monte Carlo Search

Tristan Cazenave

Université Paris-Dauphine, France

Monte Carlo Search is a family of general search algorithms that have many applications in different domains. It is the state of the art in perfect and imperfect information games. Other applications include the RNA inverse folding problem, Logistics, Multiple Sequence Alignment, General Game Playing, Puzzles, 3D Packing with Object Orientation, Cooperative Pathfinding, Software testing and heuristic Model-Checking. In recent years, many researchers have explored different variants of the algorithms, their relations to Deep Reinforcement Learning and their different applications. The talk will give a broad overview of Monte Carlo Search and of its applications

Autonomy in AI: Reactive Synthesis, Planning and Reinforcement Learning in Linear Temporal Logic on Finite Traces

Giuseppe De Giacomo

Sapienza University of Rome, Italy

A central topic in AI is building autonomous agents that act intelligently. Reactive Synthesis, Planning in Nondeterministic Domains and Reinforcement Learning are all about automatically synthesizing an agent behavior/strategy/policy to accomplish a task in a partially controllable (nondeterministic) world. In this context, it is important to sharply distinguish between the world model (the domain) and the task specification (the goal), to take into account the fact that model of world seldom change, while the tasks that the agent has to accomplish in it change unceasingly as the agent operates. As a result, the agent will work for a task only for finite amount of time (before switching to the next), while the world continues to exist when the task is over. In this talk we discuss these issues, and consider various forms of synthesis, where the world and the agent tasks are expressed in Liner Temporal Logic, LTL, the formalism most commonly used in Formal Methods for specifying dynamic properties, as well as in its finite-trace variant, LTLf, which is particularly useful for specifying intelligent agent tasks.

Ontologies for Providing Map Knowledge to Autonomous Vehicles

Birte Glimm

University of Ulm, Germany

In order to understand its surroundings, an autonomous vehicle needs a detailed, high-definition map, which acts as a powerful virtual sensor. The current map ecosystem experiences, however, a range of challenges: First, despite ongoing standardization efforts, maps come in several proprietary formats. Second, current high-definition maps are so detailed that it is largely impossible to simply store a complete map within a navigation system. Instead, map data is sent dynamically to the vehicles based on the current position. Last but not the least, maps are highly dynamic and errors may easily be introduced. In order to address the challenges of scalability, velocity, and map data quality, we propose an ontology-based architecture with an embedded quality assurance mechanism. The dedicated low-level ontologies. The knowledge required for autonomous driving functions is then transferred into a more light-weight unified high-level ontology, which is queried by application functions, e.g., to determine whether a lane change is indicated. Our empirical evaluations provide evidence that this approach enables effective map data integration while providing efficient map updates with ensured map data quality.

The Third Wave of AI

Kristian Kersting

TU Darmstadt, Germany

Most of AI in use today falls under the categories of the first two waves of AI research. First wave AI systems follow clear rules, written by programmer, aiming to cover every eventuality. Second wave AI systems are the kind that use statistical learning to arrive at an answer for a certain type of problem. Think of image classification system. The third wave of AI envisions a future in which AI systems are more than just tools that execute human programmed rules or generalize from human-curated data sets. The systems will function as partners rather than as tools. They can acquire human-like communication and reasoning capabilities, with the ability to recognize new situations and to adapt to them. For example, a third wave AI system might note that a speed limit of 120 km/h does not make sense when entering a small village by car. In this talk I shall argue that it is time to usher in the third way of AI. We have deep models, even deep models that know when they do not know. We have the first models that combine learning and reasoning. We have machines that capture our moral compasses. We have machines that engage with us in order to be right for the right reasons.

Motion Intelligence for Human-Centred Robots

Katja Mombaur

University of Waterloo, Canada

Human-centred robots have the potential to support and facilitate people's lives, ranging from improved well-being and increased independence to reduced risk or harm, a removal of boring jobs. They can take the form of humanoid robots, wearable robots or other types of mobility assistance robots and have to enter in in close physical interactions with humans or support them physically. For this, human-centred robots require motion intelligence or embodied intelligence that makes the robot aware of how it moves in and interacts with its dynamic environment and with humans. In this talk, I will give an overview of our research on endowing human-centred robots with motion intelligence, covering examples from humanoid robotic co-workers to exoskeletons and external assistive devices in medical applications. An important ingredient of this research is to gain a fundamental understanding of the biomechanics of human movement and human-human and human-robot interaction and to translate this understanding into predictive mathematical models. Another core component of our research is the development of efficient algorithms for motion generation, control and learning, combining advanced model-based optimization with model-free approaches.

Human-Compatible Artificial Intelligence

Stuart Russell

University of California, Berkeley, USA

It is reasonable to expect that AI capabilities will eventually exceed those of humans across a range of real-world-decision making scenarios. Should we "expect the machines to take control," as Alan Turing and others have suggested? Or will AI complement and augment human intelligence in beneficial ways? It turns out that both views are correct, but they are talking about completely different forms of AI. To achieve the positive outcome, a fundamental reorientation of the field is required. Instead of building systems that optimize arbitrary objectives, we need to learn how to build systems that will, in fact, be beneficial for us. I will argue that this is possible as well as necessary. The new approach to AI opens up many avenues for research, including several that connect to core questions in philosophy and the social sciences.

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