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3 PREFACE

Knowledge Representation and Reasoning (KR) is a well-established and lively field of research within Artificial Intelligence. KR builds on the fundamental thesis that knowledge can be represented in an explicit declarative form, suitable for processing by dedicated symbolic reasoning engines. This enables the exploitation of knowledge that would otherwise be implicit through semantically grounded inference mechanisms. Consequently, KR has contributed to the theory and practice of various areas in AI, including agents, automated planning and natural language processing, and to fields beyond AI, including data management, semantic web, verification, software engineering, robotics, computational biology, and cyber security.

The KR conference series is the leading forum for timely in-depth presentation of progress in the theory and principles underlying the representation and computational management of knowledge and beliefs. Since 1989, it has been fostering not only communication and a cross-fertilization of ideas within the area but also collaboration across research boundaries. Its topics are diverse and cover a broad spectrum of research topics. To showcase the role of KR in key areas and in support of topic diversity, KR 2022 included for the third time the following tracks and special sessions in addition to the main conference track:

- *Applications and Systems Track:* This track invited submissions of papers on emerging and deployed applications of KR, describing all aspects of the development, deployment, and evaluation of KR systems to solve real-world problems, including interesting case studies and benchmarks, and discussing research experience and lessons learned.

- *Recent Published Research Track:* This track provided a forum to discuss important results related to KR that appeared recently in selective journals and conferences, but have not been previously presented at KR conferences.

- *Special Session on KR and Machine Learning:* This special session invited submissions of papers on synergistic integration of KR and machine learning methods. This topic has witnessed a growing interest over the past few years, partly due to increased activities in the field of explainable AI.

- *Special Session on KR and Robotics:* This special session invited submissions of papers on synergistic integration of KR and Robotics methods.

We received 218 submissions (180 full papers, 38 short papers) to the main technical program (including the Applications and Systems track, and the Special Sessions on KR and Machine Learning, and KR and Robotics), of which 58 (26.6%) were accepted (51 full papers and 7 short papers). In addition, we received 21 submissions to the Recently Published Research Track, of which 17 were accepted for presentation at the conference.

The following papers received the best paper awards of KR 2022:

- *Ray Reiter Best Paper Award:* "The Topology of Surprise" by Alexandru Baltag, Nick Bezhanishvili and David Fernández-Duque.

- *Ray Reiter Best Paper Award Runner-Up:* "Conservative Extensions for Existential Rules" by Jean Christoph Jung, Carsten Lutz, and Jerzy Marcinkowski.

- *Marco Cadoli Best Student Paper Award:* "Finite Entailment of UCRPQs over ALC Ontologies" by Victor Gutierrez-Basulto, Albert Gutowski, Yazmin Ibanez-Garcia, and Filip Murlak.

- *Marco Cadoli Best Student Paper Award Runner-Up:* "On Syntactic Forgetting with Strong Persistence" by Matti Berthold.

The award winners were selected from nominations made by area chairs and PC members by this year's award committee, consisting of Birte Glimm, Pierre Marquis, and Francesca Toni; we thank them all for contributing their time and expertise to this special task.

The program of KR 2022 included four invited talks by prominent researchers that focused on traditional KR fields, as well as established connections to applications and other research communities:

- Yejin Choi (University of Washington, USA): *Neuro-Symbolic Adventures on Commonsense Knowledge and Reasoning*

- Ulrike Hahn (Birkbeck University of London, UK): *Probabilities, Reasoning, and Argumentation*

- Anthony Hunter (University College London, UK): *From Non-monotonic Reasoning to Argumentation and Commonsense* (Great Moments in KR Talk)

- Leonid Libkin (University of Edinburgh, UK): *Graph Queries: Do We Study What Matters?*

Since KR 2022 took place as one of 12 conferences at FLoC 2022, the Federated Logic Conference, its attendants could also enjoy the topical diversity of invited talks from other FLoC 2022 conferences.

Continuing the good tradition of previous KR conferences, KR 2022 also hosted sessions that aimed at integrating young scientists into the KR family and connecting members of our research community in general:

- *Doctoral Consortium (DC):* The Doctorial Consortium students delivered lightning talks during a session of the main conference, followed by a poster session where they could discuss their work with other conference participants. They also enjoyed a joint lunch with the DC organizers and mentors.

- *Diversity & Inclusion (D&I):* For the second time, this year's conference included a session devoted to fostering diversity and inclusion in our research community, as well as further D&I-related activities.

Continuing the *Future of KR* session at KR 2021, we had a plenary session on *Current and Future Challenges in Knowledge Representation and Reasoning*, presenting results from a very recent Dagstuhl Perspectives Workshop.

In addition, KR 2020 initiated the tradition of *Test of Time* awards, which were continued at KR 2022. The Test of Time

award is for a paper published at least 15 years ago (counting from 2022) which has stood the test of time. This year the award went to "Combining Answer Set Programming with Description Logics for the Semantic Web", published in KR 2004 and Artificial intelligence 172 (12-13) (2008) by Thomas Eiter, Giovambattista Ianni, Thomas Lukasiewicz, Roman Schindlauer, and Hans Tompits.

For the very first time KR 2022 also awarded the *KR Early Career Award*. Researchers eligible for this award need to have completed their doctoral degree in 2020 or 2021. This year the award went to Markus Hecher from TU Vienna for his analysis of the paramaterized complexity of fundamental problems in artificial intelligence.

We are very grateful to our award committee—Meghyn Bienvenu, Frank Wolter, and Diego Calvanese—for contributing their time, expertise, and effort in selecting the winners.

As in recent years, KR 2022 solicited workshop and tutorial proposals via an open call. The following workshops and tutorials with a variety of interesting and timely topics could be offered to KR 2022 and FLoC 2022 attendants:

- WS: *Third Workshop on Explainable Logic-Based Knowledge Representation* (XLoKR 2022)

- WS: *Third Workshop on Parameterized Complexity of Computational Reasoning* (PCCR 2022)

- Tutorial: *Assumption-Based Nonmonotonic Reasoning*, Alexander Bochmann

- Tutorial: *Belief Change, Ontology Repair and Evolution*, Renata Wassermann

- Tutorial: *DatalogMTL: Theory and Practice of Temporal Reasoning*, Bernardo Cuenca, Przemysław Andrzej Wałega, Dingmin Wang, Michael Zakharyaschev, Guohui Xiao, Vladislav Ryzhikov

- Tutorial: *Hybrid Temporal Situation Calculus Planning with Continuous Processes: Semantics*, Mikhail Soutchanski

- Tutorial: *Referring Expressions in Artificial Intelligence and Knowledge Representation Systems*, David Toman, Grant Weddell

- Tutorial: *Logic meets Learning* + *Explainable Machine Learning*, Vaishak Belle

After two years of virtual KR conferences due to the Corona pandemic (KR 2020 and KR 2021), KR 2022 could be organized as a physical conference at the Technion in Haifa, Israel. This decision was confirmed on May 1, 2022, because the overall health situation was improving, and most countries returned to (almost) normal life over the summer of 2022. Nevertheless, for those authors who still could not travel for some reason, FLoC 2022 made it possible to present video talks. Two of our invited talks (those by Yejin Choi and Ulrike Hahn) were given as remote talks. In this way, we were happy to see large parts of the KR community meeting in person again after three years while also allowing for integrating the scientific contributions of those who could not come.

<div align="right">

Gabriele Kern-Isberner and Thomas Meyer
Program Chairs

Gerhard Lakemeyer
General Chair

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4   INVITED TALKS

Neuro-Symbolic Adventures on Commonsense Knowledge and Reasoning

Yejin Choi, University of Washington, USA

Neural language models, as they grow in scale, continue to surprise us with utterly nonsensical and counterintuitive errors despite their otherwise remarkable performances on numerous leaderboards. In this talk, I will argue that it is time to challenge the currently dominant paradigm of task-specific supervision built on top of large-scale self-supervised neural networks. First, I will highlight the importance of unsupervised, inference-time algorithms that can make significantly better lemonades out of off-the-shelf neural language models via flexible differentiable reasoning and discrete inference with predicate logic. Next, I will highlight the importance of melding explicit and declarative knowledge encoded in symbolic knowledge graphs with implicit and observed knowledge encoded in neural language models, with newest updates on ATOMIC 10x and distilled COMET, demonstrating a machine-authored KB that wins, for the first time, over a human-authored KB in all criteria: scale, accuracy, and diversity.

Yejin Choi is Brett Helsel Professor at the Paul G. Allen School of Computer Science & Engineering at the University of Washington and a senior research manager at AI2 overseeing the project Mosaic. Her research investigates a wide range of problems including commonsense knowledge and reasoning, neuro-symbolic integration, multimodal representation learning, and AI for social good. She is a co-recipient of the NAACL Best Paper Award in 2022, the ACL Test of Time award in 2021, the CVPR Longuet-Higgins Prize in 2021, a NeurIPS Outstanding Paper Award in 2021, the AAAI Outstanding Paper Award in 2020, the Borg Early Career Award in 2018, the inaugural Alexa Prize Challenge in 2017, IEEE AI's 10 to Watch in 2016, and the ICCV Marr Prize in 2013.

Probabilities, Reasoning, and Argumentation

Ulrike Hahn, Birkbeck University of London, UK

The talk will review different ways in which the study of human cognition has invoked probabilities, and examine the extent to which laypeople match up to probabilistic norms. This provides both evidence on the breadth of challenge faced by computational systems seeking to tackle real-world reasoning problem and indicates where computational systems could most usefully provide support.

Ulrike Hahn is a professor at the Department of Psychological Sciences at Birkbeck College, University of London, where she also serves as director of the Centre for Cognition, Computation and Modelling. Ulrike Hahn's research interests are, first and foremost, questions of human rationality. Her research examines human judgment, decision-making, and the rationality of everyday argument. She is presently particularly interested in the role of perceived source reliability for our beliefs, including our beliefs as parts of larger communicative social networks. Ulrike Hahn has served as a member of the Senior Editorial Board of Topics in Cognitive Science, as an Action Editor for Cognitive Psychology, as an Action Editor for Psychonomic Bulletin and a consulting editor for Psychological Review. She was awarded the Cognitive Section Prize by the British Psychological Society, the Kerstin Hesselgren Professorship by the Swedish Research Council, and the Anneliese Maier Research Award by the Alexander von Humboldt Foundation. She is a fellow of the German National Academy of Science (Leopoldina), a fellow of the Association for Psychological Science, a corresponding member of the Bayerische Akademie der Wissenschaften, and she holds an honorary doctorate from Lund University, Sweden.

From Non-monotonic Reasoning to Argumentation and Commonsense (Great Moments in KR Talk)

Anthony Hunter, University College London, UK

Interest in non-monotonic reasoning arose from the need to model how people in everyday life use defeasible knowledge (i.e., knowledge that is normally correct but can have exceptions). One path of research that has evolved from this is computational models of argument. This is concerned with modelling the human ability to handle incomplete and conflicting situations through the identification and analysis of arguments and counterarguments. A key problem in computational models of argument is the need to handle enthymemes. These are arguments that have some premises, and possibly the claim, being implicit. To understand enthymemes, for example exchanged during a dialogue, we often require commonsense reasoning. Whilst the need to formalise commonsense reasoning was a driver for research in non-monotonic reasoning, the questions of how to formalise commonsense reasoning, and how to acquire the knowledge necessary for commonsene reasoning, remain largely unanswered. In this talk, we will review the fields of non-monotonic reasoning, computational models of argument, and commonsense reasoning, and focus on the handling of enthymemes.

Anthony Hunter is Professor of Artificial Intelligence, and Head of the Intelligent Systems Group, in the UCL Department of Computer Science. He is a graduate of the University of Bristol and Imperial College London. He did his PhD in the Department of Computing at Imperial College on the topic of defeasible reasoning (supervised by Professor Dov Gabbay). After a couple of post-doctoral positions at Imperial (on the role of non-monotonic reasoning in machine learning, and on the analysis of inconsistency in specifications), he moved to University College London (UCL). He has published over 200 papers on knowledge representation and reasoning. His primary interest has been on computational models of argument (including deductive argumentation, probabilistic argumentation, persuasion, and enthymemes), and related topics including commonsense reasoning, paraconsistent reasoning, knowledge aggregation, and measures of inconsistency. His research has been funded by EPSRC, the Royal Society, the Leverhulme Trust, the Alan Turing Institute, and Innovate UK.

Graph Queries: Do We Study What Matters?

Leonid Libkin, University of Edinburgh, UK

Graph queries are studied extensively by many communities: data management, AI, Semantic Web. The development of the theoretical models of such queries happened in between the two eras of prominence of graphs: the early network data model (later overridden by relational) and more recent models of RDF and especially property graphs, gaining prominence in the last decade. Classical theory gives us the fundamental notion of Regular Path Queries (RPQ) and its many derivatives: CRPQs, UCRPQs, 2UCRPQs, ECRPQs, RDPQs, GXPath etc. This is still the model that dominates in research literature. Applications follow a different path however. A number of successful graph query languages including Cypher, PGQL, and GSQL led to the development of a new international standard called GQL (Graph Query Language). The core of GQL is inspired by RPQs in the same way the Hoover dam is inspired by a beaver blocking a local creek: the essence is similar, but the end result is not. However, GQL is still work in progress and even when finished it will come in the shape of hundreds of pages of specs, rather than a simple mathematical definition. The goal of this talk is to give such a definition to the community, and issue a call to change the main language of study to reflect graph languages that will dominate the practical landscape for decades to come.

Leonid Libkin is a professor of computer science at the University of Edinburgh and query language researcher at RelationalAI; he is also affiliated with École Normale Supérieure in Paris. He was previously scientific advisor to Neo4j, professor at the University of Toronto, and member of research staff at Bell Laboratories in Murray Hill. He received his PhD from the University of Pennsylvania in 1994. His main research interests are in the areas of data management and logic in computer science. He has written five books and over 250 technical papers. His awards include a Marie Curie Chair Award, a Royal Society Wolfson Research Merit Award, and six Best Paper Awards. He has chaired program committees of major database and logic conferences (PODS, LICS, ICDT), and served as chair of the 2010 Federated Logic Conference and general chair of PODS. He is an ACM fellow, a fellow of the Royal Society of Edinburgh, and a member of Academia Europaea.

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