What's hot in Statistical Relational Artificial Intelligence: Report from the 31st International Conference on Logic Programming 2021

Felix Weitkämper
LMU München

October 19, 2021

Due to the pandemic, this year's International Conference on Logic Programming (ICLP 2021) was once again held virtually rather than in the wonderful city of Porto, where it was originally to be located. Nevertheless, there was an exciting and taxing program, filling 8 days from the 20th to the 27th of September. Although traditionally the main focus of the ICLP lies in the areas of Prolog and Answer Set Programming, it has also been the premier venue for research on probabilistic logic programming ever since Sato introduced the distribution semantics at the 1995 edition of the conference.

This year, one session of the main conference was devoted to probabilistic logic programming, and additionally the 8th Workshop on Probabilistic Logic Programming (PLP 2021) was colocated with ICLP once again.

Furthermore, the considerable interest of the ICLP community in wider statistical relational AI was evidenced by the choice of invited talks, which included a presentation on the open-universe statistical relational language BLOG by Stuart Russell and a survey of neural knowledge representation featuring several statistical relational frameworks by William Cohen.

Four of the five original papers on probabilistic logic programming presented at the main track were dedicated to extensions of the distribution semantics.

Marco Gavanelli reported on joint work with Elena Bellodi, Riccardo Zese, Evelina Lamma and Fabrizio Riguzzi on adapting the distribution semantics to abductive reasoning with probabilistic integrity constraints. Abductive Logic Programming has been used with great success in applications such as fault diagnosis, where possible causes are hypothesised from an observed consequence. Since in practice the integrity constraints, the relationships known to hold in a situation, are often not absolutely certain, incorporating probabilistic integrity constraints is a natural extension. Furthermore, by incorporating classical techniques from abductive logic programming with the distribution semantics, their work allows abducing nonground literals with free variables too.

Mario A. Leiva reported briefly on joint work with Alejandro J. García, Paulo Shakarian and Gerardo I. Simari on Probabilistic Defeasible Logic Programming, in which a probabilistic model is combined with a defeasible model. The latter employs default reasoning based on argumentation to make inferences from presumptions and potentially contradictory information.

Damiano Azzolini presented joint work with Fabrizio Riguzzi on a syntax for hybrid probabilistic logic programs, which incorporate continuous distributions into probabilistic logic programming. This is of course vital to mny putative application domains, in which continuous distributions over some types of numerical data occur together with the binary or categorical distributions typically associated with probabilistic logic programming. While semantical aspects have been studied before, and the semantics is known to be well-defined, this contribution suggested a concrete syntax for hybrid probabilistic logic programs and discussed necessary syntactical restrictions. Damiano Azzolini also presented a recently published joint paper with Fabrizio Riguzzi and Evelina Lamma in which the authors extend the semantics of hybrid probabilistic logic programming even further to allow for function symbols to occur in the program.

Finally, Damiano Azzolini presented joint work with Fabrizio Riguzzi on Probabilistic Optimizable Logic Programs, in which in addition to probabilistic facts and rules there are also optimisable facts, constraints and an objective function. The system then finds among those probability assignments on the optimisable facts that satisfy the constraints the assignment that minimises the objective function. From a statistical relational AI standpoint this contributes to a line of work on relational optimisation while methodically it is closely linked to parameter learning in probabilistic logic programs. Aptly, this work bilds on the PITA engine which underlies the cplint probabilistic logic programming system, since the 10-year-test-of-time award was given to the very paper from ICLP 2011 which introduced the PITA system in the first place.

My own contribution was more analytically in nature and evaluated the asymptotic probabilities arising from probabilistic logic programs on large domain sizes. By leveraging techniques from classical finite model theory, I was able to show that asymptotically, probabilistic logic programs degenerate to so-called determinate probabilistic logic programs. These are essentially propositional in nature and are well-known to be particularly simple to work with. This gives rise to interesting non-expressibility results, since it implies that non-trivial projective families of distributions, which do not degenerate on large domain sizes cannot be expressed by probabilistic logic programs.

Before the conference Rafael Penaloza and I chaired the Probabilistic Logic Programming workshop, in which new technical developments, applications and work in progress around the topic could be presented. There was an interesting mix of contributions, ranging from an application of the ProbLog 2 engine in epidemic modelling, which I presented as joint work with Beatrice Sarbu and Kailin Sun to theoretical results on the decidability of independence queries in open-universe probabilistic logic programs, presented by Kilian Rückschloß (joint work with myself). In addition, Markus Hecher presented recently published joint work with Thomas Eiter and Rafael Kiesel on Algebraic Answer Set Counting, important to probabilistic logic programming through its applications to probabilistic inference.

Of particular interest were the invited talks by Stuart Russell and William Cohen, which highlighted frameworks that have been less-studied in the recent past. Stuart Russell presented BLOG, a statistical relational language based on Bayesian networks whose particular interest comes from its support for uncertainty not just about the rules and facts but about the domain itself. This is highly relevant in applications where the domain is not fixed or where the identity of putatively distinct domain elements is unclear (think for instance of different patient records that might in fact refer to the same person).

In a broad sweep of formalisms for neural and symbolic integration, William Cohen dwelled particularly on Stochastic Logic Programs and the closely related formalism TensorLog. They are of interest because they are among the few probabilistic logic programming approaches not to adopt the distribution semantics but instead to define probability distributions over the resolution proof trees, which is reminiscent of the program trace semantics used in other probabilistic programming languages.

For me one of the conclusions of this conference was the interest in languages and frameworks for probabilistic logic programming that lie outside the distribution semantics, but also the flexibility of the distribution semantics in admitting extensions to various other paradigms.

The list of papers accepted to the conference, with the titles of all the contributions mentioned here, can be found at
https://iclp2021.dcc.fc.up.pt/index-acceptedPapers.html.

As is by now traditional for ICLP, selected papers are published in two forthcoming special issues of Theory and Practice of Logic Programming. They can be accessed as soon as they are processed at
https://www.cambridge.org/core/journals/theory-and-practice-of-logic-programming/firstview.

In addition, there is an EPTCS volume of technical communications available at
http://eptcs.web.cse.unsw.edu.au/content.cgi?ICLP2021

which contains all those contributions that have not been selected for publication in TPLP.

The proceedings of the workshops, including PLP 2021, can be found in the dedicated CEUR-WS Volume 2970, available at
http://ceur-ws.org/Vol-2970/.