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Foreword

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This special issue on Inductive Logic Programming originated in the Thirteenth International Conference on Inductive Logic Programming (ILP 2003) held at the Novotel Hotel in Szeged, Hungary, September 29–October 1, 2003. The ILP conference series started in 1991 with a special focus on the induction of logic programs. In recent years, it broadened its scope to learning in logic, as well as multi-relational data mining and learning, statistical relational learning, learning from structured and semi-structured data and learning in other (non-propositional) logic-based knowledge representation frameworks. We selected five papers from the 17 submissions we received in response to the call for papers for this special issue. Each paper underwent the usual refereeing process of the Machine Learning Journal and was reviewed by at least three reviewers.

The paper *Relational IBL in Classical Music* by Asmir Tobudic and Gerhard Widmer is concerned with the problem of learning to play music expressively. That is, given a large number of complex performances by concert pianists, the goal is to learn predictive models of certain aspects of performance, in particular, tempo and loudness variations. The authors decompose performances into hierarchically nested phrases and show how to represent such a decomposition in first-order logic. The expressivity prediction problem is then solved by relational instance-based learning using a new similarity measure between relational structures. A performance obtained by this method won the second prize on the International Computer Piano Performance Rendering Contest in 2002.

Another new application field of ILP is presented in the paper *Mathematical Applications of Inductive Logic Programming* by Simon Colton and Stephen Muggleton. This paper deals with the application of ILP to discovery tasks in mathematics. The authors describe in detail the HR system which forms a theory using the Automated Theory Formation algorithm.

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One application is concerned with number theory; more than 20 sequences in the Encyclopedia of Integer Sequences were invented by HR. As another example, HR invented the notion of refactorable numbers which have lead to a publication in a number theory journal. Further interesting applications are presented from the fields graph theory, finite algebras, and automated theorem proving.

Computational drug design, in particular, the problem of proposing promising ligands for development and testing has always been a challenging application field for ILP. While previous related ILP papers have been restricted to binary classification problems (i.e., active/inactive), the paper *Quantitative Pharmacophore Models with Inductive Logic Programming* by Ashwin Srinivasan, David Page, Rui Camacho, and Ross D. King is concerned with quantitative pharmacophoric models. The authors address the quantitative SAR problems of predicting the probability of a molecule's activity, as well as its affinity. They propose an ILP approach for the solution of these problems and evaluate it empirically on the Thermolysin inhibition problem.

Relational reinforcement learning is concerned with the situation when the state-action space has no natural representation with tuples of constants. In the paper *Gaussian Processes for Relational Reinforcement Learning* by Kurt Driessens, Jan Ramon, and Thomas Gärtner, the authors present a new development in the field of relational reinforcement learning. To approximate the mapping from state-action pairs to Q-values in the RRL system, a relational reinforcement Q-learning algorithm, so far first-order distance-based algorithms and first-order regression trees have been applied. The authors show how to apply Gaussian processes to this problem and evaluate their approach empirically on the block world problem and on the Tetris computer game.

While the number of propositions and the size of the target formula are natural complexity parameters for learning in propositional logic, these parameters usually cannot be adapted to learning in first-order logic. This problem is addressed in the paper *Complexity Parameters for First Order Classes* by Marta Arias and Roni Khardon.The authors consider different complexity parameters of first-order Horn expressions, investigate how these parameters relate to each other, identify three crucial parameters (number of clauses, maximum number of literals in a single clause, maximum number of terms and subterms in a single clause), and give a new notion of size. The characterization of the VC dimension shows that the new size and parameters are indeed crucial for learnability.

We would like to thank all authors for submitting their papers and the more than 50 referees for their thorough work. Moreover, we are particularly thankful to Foster Provost for providing the opportunity to prepare this special issue.

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