Sabancı Üniversitesi

Faculty of Engineering and Natural Sciences

AI Day
on
Knowledge Representation and Automated Reasoning

Wednesday, 21 May 2008

13:40–15:30, FENS G035
15:40–17:00, FENS G029

Knowledge Representation and Automated Reasoning (KR&AR) is a vibrant and exciting field of Artificial Intelligence (AI), that has led to significant advances in practical applications in a wide range of areas in computer sciences and other sciences, such as natural language understanding, machine learning, intelligent user interfaces, robotics, multi-agent systems, semantic web, web servcies, game playing, software engineering, distributed computing, security, databases, computational biology, historical linguistics, operations research, game theory, economics. KR&AR is the study of representing knowledge explicitly in such a way that a computer can reason about it (infer appropriate knowledge from it) to behave intelligently. Explicit representations of knowledge manipulated by reasoning engines are an integral and crucial component of intelligent systems.

The AI Day at Sabancı University includes talks about recent progress on the theoretical principles underlying the representation and computational management of knowledge, and applications of KR&AR to some challenging problems in computational biology and biomedical informatics.

Distinguished Speaker

Vladimir Lifschitz, University of Texas at Austin

Vladimir Lifschitz is Gottesman Family Centennial Professor in Computer Sciences at the University of Texas at Austin. His research interests are in the areas of knowledge representation and computational logic. He is a Fellow of the Association for the Advancement of Artificial Intelligence, a co-editor of the Handbook of Knowledge Representation, the Editor-in-Chief of the ACM Transactions on Computational Logic, and an Editorial Advisor of the journal Theory and Practice of Logic Programming. He has received the Publisher's Prize at International Joint Conference on Artificial Intelligence twice, and the Most Influential Paper in 20 Years Award from the Association for Logic Programming.

AI Day Program

14:00 – 15:00	Vladimir Lifschitz, University of Texas at Austin "A New Perspective on the Semantics of Answer Set Programming"
15:00 – 15:30	Orkunt Sabuncu, Middle East Technical University "Computing Answer Sets using Model Generation Theorem Provers"
15:40 – 16:00	Esra Erdem, Sabancı University "An Overview of KR&AR Research at Sabancı University"
16:00 – 16:30	Ferhan Türe, Sabancı University "Efficient Haplotype Inference with Answer Set Programming"
16:30 – 17:00	Esra Erdem, Sabancı University "A New Approach to Integrating Biomedical Ontologies and Answering Complex Queries related to Drug Discovery"

A New Perspective on the Semantics of Answer Set Programming

Vladimir Lifschitz

University of Texas at Austin

The definition of a stable model has provided a declarative semantics for Prolog programs with negation as failure and has led to the development of answer set programming. We propose a new definition of that concept, which is based on a syntactic transformation that turns a logic program into a formula of second-order logic. This idea leads to a new approach to defining the semantics of answer set programming languages.

This is work in progress, joint with Paolo Ferraris (Google), Joohyung Lee (Arizona State University), and Ravi Palla (Arizona State University).

Short Bio:

Vladimir Lifschitz is Gottesman Family Centennial Professor in Computer Sciences at the University of Texas at Austin. His research interests are in the areas of knowledge representation and computational logic. He is a Fellow of the Association for the Advancement of Artificial Intelligence, a co-editor of the Handbook of Knowledge Representation, the Editor-in-Chief of the ACM Transactions on Computational Logic, and an Editorial Advisor of the journal Theory and Practice of Logic Programming. He has received the Publisher's Prize at International Joint Conference on Artificial Intelligence twice, and the Most Influential Paper in 20 Years Award from the Association for Logic Programming.

Computing Answer Sets using Model Generation Theorem Provers

Orkunt Sabuncu

Middle East Technical University

The grounding step of Answer Set Programming (ASP) generates a propositional instance of a logic program with variables. It may generate a huge propositional instance and make the search process of answer set solvers more difficult. On the other hand, model generation theorem provers have the capability of producing a model when the first-order input theory is satisfiable. We propose the use of model generation theorem provers as computational engines for ASP. It can be seen as lifting SAT-based ASP to the first-order level for tight programs to eliminate the grounding step of ASP or to perform it more intelligently using the model generation system. In this talk, the use of model generation theorem provers (Darwin, Paradox and FM-Darwin) for computing answer sets will be presented.

Joint work with Ferda Nur Alpaslan (Middle East Technical University).

Short Bio:

Orkunt Sabuncu received his B.Sc. and M.Sc. degrees both in Computer Engineering from Middle East Technical University. He is a doctoral student at Middle East Technical University. His research interests include answer set programming, logic programming and knowledge representation. He is a researcher at Intelligent Systems Lab at Middle East Technical University currently.

Efficient Haplotype Inference with Answer Set Programming

Ferhan Türe

Sabancı University

Identifying maternal and paternal inheritance is essential to be able to find the set of genes responsible for a particular disease. However, due to technological limitations, we have access to genotype data (genetic makeup of an individual), and determining haplotypes (genetic makeup of the parents) experimentally is a costly and time consuming procedure. With these biological motivations, we study a computational problem, called Haplotype Inference by Pure Parsimony (HIPP), that asks for the minimal number of haplotypes that form a given set of genotypes. HIPP has been studied using integer linear programming, branch and bound algorithms, SAT-based algorithms, or pseudo-boolean optimization methods. We introduce a new approach to solving HIPP, using Answer Set Programming (ASP). According to our experiments with a large number of problem instances (some automatically generated and some real), our ASP-based approach solves the most number of problems compared with other approaches. Due to the expressivity of the knowledge representation language of ASP, our approach allows us to solve variations of HIPP, e.g., with additional domain specific information, such as patterns/parts of haplotypes observed for some gene family, or with some missing genotype information. In this sense, the ASP-based approach is more general than the existing approaches to haplotype inference.

This is work in progress, joint with Esra Erdem.

Short Bio:

Ferhan Türe received his BSc degree in Computer Engineering and Mathematics from Koç University in 2006, and he is currently continuing his MSc studies in Computer Science and Engineering at Sabancı University. His research interests include natural language processing, knowledge representation, and automated reasoning.

A New Approach to Integrating Biomedical Ontologies and Answering Complex Queries related to Drug Discovery

Esra Erdem

Sabancı University

We introduce a new method for integrating relevant parts of knowledge extracted from biomedical ontologies and answering complex queries related to drug safety and discovery, using Semantic Web technologies and Answer Set Programming (ASP). We illustrate the applicability of our ASP-based method with six complex queries about drug safety and discovery, on some toy ontologies whose content has been extracted from some existing biomedical ontologies, such as DrugBank or PharmGKB. We have observed that some of the complex queries about drug safety and discovery cannot be represented using the existing Semantic Web query languages (e.g., SPARQL) and rule languages (e.g., SWRL), and thus cannot be answered using the existing relevant reasoners (e.g., ARQ, BOSSAM); in that sense the ASP-based approach extends/complements the existing approaches. We have also illustrated the effectiveness of our method by computing an answer to a real-world biomedical query that requires the integration of NCBI Entrez Gene and the Gene Ontology.

This is work in progress, joint with Olivier Bodenreider (NIH), Zeynep Çoban (Harvard School of Public Health), Mahir C. Doğanay (Sabancı University), and Hilal Koşucu (University of Toronto).

Short Bio:

Esra Erdem received her Ph.D. in Computer Sciences at the University of Texas at Austin in 2002. She was a post-doctoral fellow in the Cognitive Robotics Group at the University of Toronto (2002–2003), and a research scientist in the Knowledge-Based Systems Group at Vienna University of Technology (2003–2006). Since September 2006, she has been an assistant professor at Sabancı University.