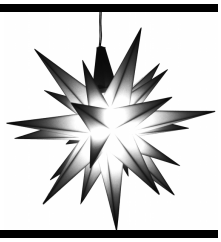
European PhD Program in Computational Logic

EPCL Basic Training Camp 2012
10-21 December 2012, TU Dresden



Last update: 18 December 2012 9:10

Changes

- *Dec 11: Unfortunately the lectures and talk by Pascal Hitzler on 12-13 Dec. had to be canceled*

The annual EPCL Basic Training Camp provides a set of research talks and courses in specialized topics within Computational Logic, addressed to young researchers.

In 2012, the EPCL Basic Training camp takes place at TU Dresden. The lecturers will be

- José Júlio Alferes, Universidade Nova de Lisboa, Portugal
- Andreas Bauer, NICTA, Australia
- Anton Belov, University College Dublin, Ireland
- Diego Calvanese, Free University of Bozen-Bolzano, Italy
- Thomas Eiter, Technische Universität Wien, Austria
- Pascal Hitzler, Wright State University, Ohio, USA
- Sergei O. Kuznetsov, National Research University Higher School of Economics, Moscow, Russia
- Sergei Obiedkov, National Research University Higher School of Economics, Moscow, Russia
- Reinhard Pichler, Technische Universität Wien, Austria
- André Platzer, Carnegie Mellon University, Pennsylvania, USA
- Horst Reichel, TU Dresden, Germany
- Evgueni N. Smirnov, Maastricht University, Netherlands

Up-to-date information about EPCL is provided at `http://www.epcl-study.eu/`.

Location

The Basic Training Camp takes place in

Room 2026

of the building of the *Fakultät Informatik* of TU Dresden, Nöthnitzer Straße 46, 01187 Dresden.

The site is close to the tramway stop *Münchner Platz* (Tramway 3) and bus stop *Helmholtzstraße* (Bus 85). Its Google Maps link is: `http://goo.gl/maps/YBnzT`

Research Talks

Representing and Reasoning about Normative Systems in Deontic Logic

José Júlio Alferes
Universidade Nova de Lisboa, Portugal
http://centria.fct.unl.pt/~jja/

Abstract: Normative systems have been advocated as an effective tool to regulate interaction in multi-agent systems. The use of deontic operators and the ability to represent defeasible information are known to be two fundamental ingredients to represent and reason about normative systems. In this talk I'll propose a framework that combines a deontic logic and non-monotonic logic programming, deontic logic programs, to represent and reason about normative systems.

Decentralised LTL Monitoring

Andreas Bauer
NICTA, Australia
http://baueran.multics.org/

Extensions and Generalizations of Minimal Unsatisfiability

Anton Belov
University College Dublin, Ireland
http://anton.belov-mcdowell.com/

Abstract: Motivated by practical applications, the concepts related to minimal unsatisfiability and minimal unsatisfiable subformulas (MUSes) have recently been extended beyond propositional formulas in CNF, and, also, generalized to the case of satisfiable formulas. In this talk I will discuss the algorithms and the optimization techniques for the computation of MUSes in some of these extended and generalized domains.

Verification of Data-Centric Dynamic Systems

Diego Calvanese
Free University of Bozen-Bolzano, Italy
http://www.inf.unibz.it/~calvanese/

Uniform Evaluation of Nonmonotonic Description Logic Programs

Thomas Eiter
Technische Universität Wien, Austria
http://www.kr.tuwien.ac.at/staff/eiter/

Abstract: Nonmonotonic description logic programs are a major formalism for a loose coupling of rules and ontologies, formalized in logic programming and description logics, respectively. While this approach is attractive for combining systems, the impedance mismatch between different reasoning engines and the API style interfacing are an obstacle to efficient evaluation of dl-programs in general. Uniform evaluation circumvents this by transforming programs into a single formalism, which can be evaluated on a single reasoning engine. In this talk, we consider recent and ongoing work on this approach which uses relational first-order logic (and thus relational database engines) and datalog as target formalisms. Experimental data show that significant performance gains are possible compared to and suggest the potential of this approach.

Semantic Web in the Big Data Age

Pascal Hitzler
Wright State University, Ohio, USA
http://www.pascal-hitzler.de/

Abstract: One of the most important challenges currently facing computer science, is to make sense and use of the overwhelming amounts of data which are constantly produced all over the world. In this presentation, we discuss opportunities and challenges related to the application of Semantic Web technologies to Big Data, with a focus on methods from computational logic.

Knowledge Discovery with Pattern Structures for Big Data

Sergei O. Kuznetsov
National Research University Higher School of Economics, Moscow, Russian Federation
http://www.hse.ru/en/org/persons/139837

Learning Ceteris Paribus Preferences

Sergei Obiedkov
National Research University Higher School of Economics, Moscow, Russian Federation
http://www.hse.ru/en/org/persons/228403

Abstract: We present an approach to learning ceteris paribus preferences (i.e., preferences that hold "other things being equal") over attribute subsets from preferences over individual objects. We provide semantics for such preferences based on formal concept analysis and show that ceteris paribus preferences valid in a dataset correspond to implications valid in a certain formal context built from this dataset. The size of the context is quadratic in the size of the original dataset; thus, algorithms for computing implications valid in a formal context can be adapted to compute a semantically complete set of preferences for a given dataset in a relatively efficient way. Preferences computed from a training dataset can then be used to extend the preference relation to new objects based on the attributes they have. Unfortunately, computing preferences as implications is essentially equivalent to enumerating Horn prime implicates (with a fixed positive literal) of a Boolean formula specified by the set of its satisfying assignments, and no output-polynomial algorithm is known for this. However, to compute preferences over new objects induced by the preference theory behind the training dataset, it is not necessary to compute this theory explicitly: a well-known abduction algorithm for Horn formulae represented by their characteristic models can be modified to obtain an algorithm for inducing preferences between a pair of new objects that runs in time polynomial in the size of the training dataset.

Optimization of Semantic Web Queries

Reinhard Pichler
Technische Universität Wien, Austria
http://www.dbai.tuwien.ac.at/staff/pichler/

Abstract: The Semantic Web is the initiative of the World Wide Web Consortium (W3C) to make information on the Web readable not only by humans but also by machines. Two fundamental standards released by the W3C are the Resource Description Framework (RDF) as the standard data model for the Semantic Web and SPARQL as the standard query language for RDF data. A systematic investigation into the optimization of SPARQL queries has been missing so far. In this talk we report on some foundational research in this direction. Three crucial ingredients of query optimization are presented:

- an appropriate data structure (which we refer to as pattern trees) which allows for a simplified representation of an important class of SPARQL queries. Since pattern trees have a natural operational semantics, we may consider them as Query Execution Plans (QEPs).
- transformation rules which allow us to transform the pattern trees. We can thus aim at the transformation of patterns trees to obtain better QEPs. Moreover, we may use these transformation rules to define normal forms of pattern trees.
- the study of basic computational problems such as containment and equivalence, which are at the heart of query optimization of any query language.

This talk is based on joint work with Andrés Letelier, Jorge Pérez and Sebastian Skritek which appeared at PODS 2012.

The Complete Proof Theory of Hybrid Systems

André Platzer
Carnegie Mellon University, Pennsylvania, USA
http://symbolaris.com/

Hybrid systems are a fusion of continuous dynamical systems and discrete dynamical systems. They freely combine dynamical features from both worlds. For that reason, it has often been claimed that hybrid systems are more challenging than continuous dynamical systems and than discrete systems. We now show that, proof-theoretically, this is not the case. We present a complete proof-theoretical alignment that interreduces the discrete dynamics and the continuous dynamics of hybrid systems. We give a sound and complete axiomatization of hybrid systems relative to continuous dynamical systems and a sound and complete axiomatization of hybrid systems relative to discrete dynamical systems. Thanks to our axiomatization, proving properties of hybrid systems is exactly the same as proving properties of continuous dynamical systems and again, exactly the same as proving properties of discrete dynamical systems. This fundamental cornerstone sheds light on the nature of hybridness and enables flexible and provably perfect combinations of discrete reasoning with continuous reasoning that lift to all aspects of hybrid systems and their fragments.

Coinduction and Declarative Programming

Horst Reichel
TU Dresden, Germany
http://wwwtcs.inf.tu-dresden.de/users/reichel/

Combining of Version Spaces and Support Vector Machines for Reliable Classification

Evgueni N. Smirnov
Maastricht University, Netherlands
http://www.personeel.unimaas.nl/smirnov/

The talk starts with a definition of the problem of reliable classification. Then we show that version spaces are a natural solution to that problem. In this context we focus on the implementation of version-space classification. We show that contrary to the general opinion to classify with version spaces we do not need an explicit representation. Instead we need to solve the consistency problem. The problem is to test the hypothesis space for a hypothesis (classifier) that is consistent with the training data. We propose to employ support vector machines for the consistency test. The resulting implementation we call version space support vector machines (VSSVMs). We show experimental results of VSSVMs for reliable-classification problems and provide conclusions.

Lectures

Integration of Default Rules and Ontologies

José Júlio Alferes
Universidade Nova de Lisboa, Portugal
http://centria.fct.unl.pt/ jja/

Rule languages have, for a long time, been a major approach to knowledge representation and reasoning. In particular, nonmonotonic rules, that allow for the representation of defaults and exceptions, are of particular importance. State-of-the art ontology languages, significantly used for knowledge representation in the Semantic Web, don't usually admit defaults or the representation of exception to the defaults. In this lecture, after covering foundations of semantics of (nonmonotonic) rules for knowledge representation, we survey approaches for the combination of such rules with ontology languages.

Temporal Logic Model Checking

Andreas Bauer
NICTA, Australia
http://baueran.multics.org/

Runtime Verification

Andreas Bauer
NICTA, Australia
http://baueran.multics.org/

Minimal Unsatisfiability: Theory, Algorithms and Applications

Anton Belov
University College Dublin, Ireland
http://anton.belov-mcdowell.com/

Minimal unsatisfiability and minimally unsatisfiable subformulas (MUSes) find a wide range of practical applications, including hardware and software design and verification, product configuration and knowledge-based validation. This course provides an introduction to the topic of minimal unsatisfiability in classical propositional logic and some of its extensions. The course covers the basic theory of minimal unsatisfiability and related concepts, algorithms and optimization techniques for computing and approximating MUSes, and some of the concrete applications of minimal unsatisfiability. The course assumes familiarity with classical propositional logic, propositional satisfiability (SAT) and the basics of SAT solving.

Description Logics for Conceptual Modeling

Diego Calvanese
Free University of Bozen-Bolzano, Italy
http://www.inf.unibz.it/~calvanese/

Description Logics for Data Access

Diego Calvanese
Free University of Bozen-Bolzano, Italy
http://www.inf.unibz.it/~calvanese/

Foundations of Data and Knowledge Systems

Thomas Eiter and Reinhard Pichler
Technische Universität Wien, Austria
http://www.kr.tuwien.ac.at/staff/eiter/
http://www.dbai.tuwien.ac.at/staff/pichler/

Syllabus: Query and Rule Languages (Datalog, Conjunctive Queries, etc) Declarative Semantics (model theoretic, algebraic) Operational Semantics (semi-naive, SLD, Rete, Magic Templates etc) Complexity and Expressiveness.

Parts of the course follow François Bry, Norbert Eisinger, Thomas Eiter, Tim Furche, Georg Gottlob, Clemens Ley, Benedikt Linse, Reinhard Pichler and Fang Wei: *Foundations of Rule-Based Query Answering*. Reasoning Web 2007: 1-153

Integrating Ontology Language Paradigms

Pascal Hitzler
Wright State University, Ohio, USA
http://www.pascal-hitzler.de/

Ontology languages constitute today's most central knowledge representation and reasoning paradigm. However, ontology languages can differ significantly in theoretical and practical characteristics, and this provides an obstacle for semantic information integration and interoperability. In this lecture, we present recent advances in the integration of ontology language paradigms, including description logics, rules, and commonsense reasoning approaches.

Mining Implicational Dependencies: An Algorithmic Perspective

Sergei O. Kuznetsov
National Research University Higher School of Economics, Moscow, Russian Federation
http://www.hse.ru/en/org/persons/139837

Logics of Dynamical Systems

André Platzer
Carnegie Mellon University, Pennsylvania, USA
http://symbolaris.com/

We study the logic of dynamical systems, that is, logics and proof principles for properties of dynamical systems. Dynamical systems are mathematical models describing how the state of a system evolves over time. They are important in modeling and understanding many applications, including embedded systems and cyber-physical systems. In discrete dynamical systems, the state evolves in discrete steps, one step at a time, as described by a difference equation or discrete state transition relation. In continuous dynamical systems, the state evolves continuously along a function, typically described by a differential equation. Hybrid dynamical systems or hybrid systems combine both discrete and continuous dynamics.

This lecture is a brief survey of differential dynamic logic for specifying and verifying properties of hybrid systems. We explain hybrid system models, differential dynamic logic, its semantics, and its axiomatization for proving logical formulas about hybrid systems. We study differential invariants, i.e., induction principles for differential equations. We briefly survey theoretical results, including soundness and completeness and deductive power. Differential dynamic logic has been implemented in automatic and interactive theorem provers and has been used successfully to verify safety-critical applications in automotive, aviation, railway, robotics, and analogue electrical circuits.

Classification with Version Spaces

Evgueni N. Smirnov
Maastricht University, Netherlands
http://www.personeel.unimaas.nl/smirnov/

The lecture starts with a definition of classification problem. Then we introduce version spaces as an approach to that problem. We define the main representation of version spaces and present an incremental algorithm to learn that representation from training data. We study the question when version spaces converge to the correct hypothesis (classifier). In addition to that we analyze the problem when version spaces can classify beyond the training data. In this context we introduce the notion of inductive bias. We analytically derive the bias of version spaces.

Classification with Decision Trees

Evgueni N. Smirnov
Maastricht University, Netherlands
http://www.personeel.unimaas.nl/smirnov/

The lecture starts with a definition of decision trees and types of classification problems for which they are applicable. We introduce the basic learning algorithm and focus on attribute selection criteria (e.g.,information gain, gini, etc.). We analyze the performance of decision trees on real data and in this context introduce the notion of overfitting. We show the main approaches that deal with this phenomenon: pruning, bagging, and random forest. The lecture concludes with some practical extensions of decision trees for classification problems characterized by inadequate attributes, missing-value attributes, and large-size data.

Social Events

Wednesday 12 December, 15:55: Albertinum

We will visit the *Albertinum* with its collection of paintings *Galerie Neue Meister* and sculptures *Skulpturensammlung*, from romanticism to the present.

- `http://www.skd.museum/en/museums-institutions/albertinum/index.html`
- `http://www.googleartproject.com/collection/galerie-neue-meister-new-masters-gallery/`
- Special rooms are dedicated to Gerhard Richter (`http://www.gerhard-richter.com/art/search/?museum=dresden`) and Sigmar Polke.

We meet at 15:55 in the big entrance hall of the Albertinum. The Albertinum is in 5 min walking distance from the Tramway stop *Synagoge* (`http://goo.gl/maps/xdoWS`). Tramway 3, direction *Wilder Mann*, directly goes to *Synagoge* in about 12 min from *Münchner Platz* or from *Plauen Nöthnitzer Straße*.

After leaving the Albertinum, we will walk to the nearby Christmas Market at the Frauenkirche, with its offerings of Stollen, Bratwurst, Glühwein etc.

This map show the main sights in the center of Dresden : `http://www.dresdener-stadtplan.com/adresse/karte/dresden/pos/13623,61460.html`

Monday, 10 December

13.15 – 13.30	WELCOME
13.30 – 15.00	LECTURE: Andreas Bauer *Temporal Logic Model Checking*
15.00 – 15.30	COFFEE BREAK
15.30 – 17.00	LECTURE: Anton Belov *Minimal Unsatisfiability: Theory, Algorithms and Applications – Part I*

Tuesday, 11 December

9.00 – 10.30	LECTURE: Anton Belov *Minimal Unsatisfiability: Theory, Algorithms and Applications – Part II*
10.30 – 11.00	COFFEE BREAK
11.00 – 12.30	LECTURE: Andreas Bauer *Runtime Verification*
12.30 – 14.00	LUNCH BREAK
14.00 – 15.00	RESEARCH TALK: Sergei Obiedkov *Learning Ceteris Paribus Preferences*
15.00 – 15.30	AFTERNOON COFFEE

Wednesday, 12 December

9:30 – 10.30	RESEARCH TALK: Anton Belov *Extensions and Generalizations of Minimal Unsatisfiability*
10.30 – 11.00	COFFEE BREAK
11.00 – 12.00	RESEARCH TALK: Andreas Bauer *Decentralised LTL Monitoring*
12.00 – 13.30	LUNCH BREAK
13.30 – 15.00	LECTURE: Pascal Hitzler CANCELED *Integrating Ontology Language Paradigms – Part I*
15:55	SOCIAL EVENT: Visit to *Albertinum* and Christmas market at Frauenkirche

Thursday, 13 December

9.00 – 10.00	RESEARCH TALK: Pascal Hitzler CANCELED *Semantic Web in the Big Data Age*
10.00 – 10.30	COFFEE BREAK
10.30 – 12.00	LECTURE: Pascal Hitzler CANCELED *Integrating Ontology Language Paradigms – Part II*
12.00 – 13.30	LUNCH BREAK
13.30 – 15.00	LECTURE: José Júlio Alferes *Integration of Default Rules and Ontologies – Part I*
15.00 – 15.30	COFFEE BREAK
15.30 – 16.30	RESEARCH TALK: Horst Reichel *Coinduction and Declarative Programming*
16.30	AFTERNOON COFFEE

Friday, 14 December

9.00 – 10.00	RESEARCH TALK: José Júlio Alferes *Representing and Reasoning about Normative Systems in Deontic Logic*
10.00 – 10.30	COFFEE BREAK
10.30 – 12.00	LECTURE: José Júlio Alferes *Integration of Default Rules and Ontologies – Part II*
12.00 – 13.30	LUNCH BREAK
13.30 – 14.30	RESEARCH TALK: Sergei O. Kuznetsov *Knowledge Discovery with Pattern Structures for Big Data*
14.30 – 15.00	COFFEE BREAK
15.00 – 16.30	LECTURE: Sergei O. Kuznetsov *Mining Implicational Dependencies: An Algorithmic Perspective*

Monday, 17 December

9.00 – 10.30	LECTURE: Diego Calvanese *Description Logics for Conceptual Modeling*
10.30 – 11.00	COFFEE BREAK
11.00 – 12.00	LECTURE: Evgueni N. Smirnov *Classification with Version Spaces*
12.00 – 12.15	SHORT BREAK
12.15 – 12.45	RESEARCH TALK: Evgueni N. Smirnov *Combining of Version Spaces and Support Vector Machines for Reliable Classification*
12.45 – 14.15	LUNCH BREAK
14.15 – 15.45	LECTURE: Evgueni N. Smirnov *Classification with Decision Trees*
15.45 – 16.15	COFFEE BREAK
16.15 – 17.45	LECTURE: André Platzer *Logics of Dynamical Systems – Part I*

Tuesday, 18 December

9.00 – 10.00	RESEARCH TALK: Diego Calvanese *Verification of Data-Centric Dynamic Systems*
10.00 – 10.30	COFFEE BREAK
10.30 – 12.00	LECTURE: Diego Calvanese *Description Logics for Data Access*
12.00 – 13.30	LUNCH BREAK
13.30 – 15.00	RESEARCH TALK: André Platzer *The Complete Proof Theory of Hybrid Systems*
15:00 – 15:30	COFFEE BREAK
15.30 – 17.00	LECTURE: André Platzer *Logics of Dynamical Systems – Part II*

Wednesday, 19 December

9.00 – 10.30	LECTURE: Reinhard Pichler *Foundations of Data and Knowledge Systems – Part I*
10.30 – 11.00	COFFEE BREAK
11.00 – 12.00	LECTURE: Reinhard Pichler *Foundations of Data and Knowledge Systems – Part II*
12.00 – 13.30	LUNCH BREAK
13.30 – 15.00	LECTURE: Reinhard Pichler *Foundations of Data and Knowledge Systems – Part III*
15.00 – 15.30	COFFEE BREAK
15.30 – 17.00	LECTURE: Reinhard Pichler *Foundations of Data and Knowledge Systems – Part IV*
18:00	SOCIAL EVENT

Thursday, 20 December

9.00 – 10.30	RESEARCH TALK: Reinhard Pichler *Optimization of Semantic Web Queries*
10.30 – 11.00	COFFEE BREAK
11.00 – 12.30	LECTURE: Thomas Eiter *Foundations of Data and Knowledge Systems – Part V*
12.30 – 14.30	LUNCH BREAK
14.30 – 16.30	LECTURE: Thomas Eiter *Foundations of Data and Knowledge Systems – Part VI*

Friday, 21 December

9.00 – 11.00	LECTURE: Thomas Eiter *Foundations of Data and Knowledge Systems – Part VII*
11.00 – 11.30	COFFEE BREAK
11.30 – 12.30	RESEARCH TALK: Thomas Eiter *Uniform Evaluation of Nonmonotonic Description Logic Programs*
12.30	FAREWELL COFFEE