TECHNISCHE UNIVERSITÄT DRESDEN

Artificial Intelligence, Computational Logic

PROJECT GROUP COMPUTATIONAL LOGIC

Sebastian Rudolph, Sarah Gaggl and Michaël Thomazo

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DRESDEN concept Exzellenz aus Wissenschaft und Kultur

Organization

- The students will work on a small scientific project.
- Depending on the specific topic the students will review the related literature, identify the appropriate methodology and solve the given tasks.
- The respective steps will be discussed in regular meetings with the supervisor.
- At the end of the semester the students will present their results in a talk and submit a project report.

Topics - 1. Description Logics

1.1 Inconsistency Handling in Description Logics

- Supervisor: Sebastian Rudolph
- Dealing with inconsistencies is a very important challenge in practical scenarios of ontology use.
- The aim of this project is to understand, present, and formally compare different approaches to inconsistency in DLs (such as paraconsistent reasoning and reasoning with maximal consistent subontologies).

Topics - 1. Description Logics ctd.

1.2 Reducing Grounded Circumscription to Standard Reasoning

- Supervisor: Sebastian Rudolph
- Mainstream Description Logics do not support nonmonotony. In some modelling tasks, however, this feature is required.
- One approach to add "mild" nonmonotonic modelling to DLs is called "grounded circumscription".
- In this project, efficient ways of reasoning with grounded-circumscription in DLs, based on existing reasoning machinery for standard DLs, shall be explored.

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Topics - 1. Description Logics ctd.

1.3 Creating a DL-Ontology

- Supervisor: Sebastian Rudolph
- Over the past years, Description Logic research has investigated a large variety of logics ranging from very lightweight DLs like EL to the very expressive DLs that underly today's most advanced ontology modelling language OWL.
- The goal of this project is to create an ontology describing these diverse logics and their properties (such as expressiveness, reasoning complexity, etc.) in a way that the reasoning capabilities of OWL can be used to infer information about these properties from given facts.

Topics - 2. Formal Concept Analysis

2.1 Meta-Modelling in FCA

- Supervisor: Sebastian Rudolph
- FCA starts from a very basic data structure comprising objects and their attributes.
- Sometimes, however, it is benefitial to also define attributes of attributes (so-called meta attributes).
- The general goal of this project is to develop a framework for this kind of Meta-Modelling in FCA, including formal definitions and appropriate visualizations.

Topics - 2. Formal Concept Analysis ctd.

2.2 Executing Logical Operations on Formal Contexts via OBDDs

- Supervisor: Sebastian Rudolph
- Formal contexts, the basic data structures in FCA can be described as Boolean functions.
- On the other hand, Boolean functions can be expressed (often very efficiently) via ordered binary decision diagrams (OBDDs).
- This project aims at expressing standard operations on formal contexts by means of OBDDs and comparing the efficiency to the standard algorithms.

Topics - 2. Formal Concept Analysis ctd.

2.3 Finding the Least Common Subsumer of Closure Operators

- Supervisor: Sebastian Rudolph
- There are several ways to encode closure operators.
- Two such encodings are formal contexts and implication sets.
- Finding the lcs of two closure operators expressed as implication sets is easy, one just computes the union of the two sets.
- Finding the lcs in the contextual encoding seems less straightforward. This project is dedicated to this task.

Topics - 3. Abstract Argumentation

3.1 Implementing labeling-based Algorithms

- Supervisor: Sarah Gaggl
- Labeling-based algorithms are used as direct implementation method to compute solutions for abstract Argumentation Frameworks (AFs).
- Such labelings distinguish different statuses of arguments, e.g. whether they are accepted, attacked or undecided. The label of one argument has immediate implications for its neighbors.
- The idea of labeling-based algorithms is to use these implications to prune the search space.
- The task of this topic is to implement an existing algorithm for a specific semantics and evaluate the performance compared to the system ASPARTIX.

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Topics - 3. Abstract Argumentation ctd.

3.2 Approximating Skeptical Preferred Reasoning

- Supervisor: Sarah Gaggl
- Most of the argumentation semantics are intractable, in particular skeptical reasoning for preferred semantics is Π_2^P-complete.
- On attempt to improve the performance is to approximate the acceptance of an argument from easier decision problems from other semantics.
- The task is to analyse and implement algorithms for top-down and bottom-up approximations and compare the approaches to existing implementations.

Topics - 4. Existential Rules

4.1 Query-dependent algorithm

- Supervisor: Michaël Thomazo
- Most of the proposed approaches for Ontology-Based Data Access do not take into account properties of the query
- Some approaches propose a modification of the ruleset with respect to the query
- Goal of the project: understand, implement and/or extend these approaches

Topics - 4. Existential Rules

4.2 Adaptation of current algorithms to data updates

- Supervisor: Michaël Thomazo
- Current algorithms for OBDA would recompute everything from scratch if the data changes
- Data updates is a classical topic in database theory
- Goal of the project: understand how updates are dealt with in databases and lift the approaches to some existential rules algorithms.