Cape-KR 2025 Invited talks

Monday 10 February 2025 | 11:00-12:00

Answer Set Programming in a Nutshell

by Torsten Schaub

Answer Set Programming (ASP) has become a popular approach to declarative problem solving. More precisely, ASP is a rule-based formalism for modeling and solving knowledge-intense combinatorial (optimization) problems. What makes ASP attractive is its combination of a declarative modeling language with highly effective solving engines. This allows us to concentrate on specifying - rather than programming the algorithm for solving - a problem at hand. Historically, ASP has its roots in deductive databases, logic programming, and non-monotonic reasoning; its solving engines draw on the same technology as solvers for satisfiability testing. Given this origin, ASP is tailored to support closed as well as open world reasoning, which makes it predestined for knowledge representation and reasoning tasks. Interesting applications of ASP can be found in decision support systems, industrial team-building, music composition, natural language processing, product and software configuration, phylogeneticics, robotics, systems biology, timetabling, and many more.

The talk will give a gentle introduction to ASP, its logical foundations, modeling capabilities, and solving engines, and conclude with an outlook on the ASP's potential impact as a knowledge-driven AI tool.

Cape-KR 2025

Invited talks

Tuesday 11 February 2025 | 09:00-10:00

Lemur: Integrating Large Language Models in Automated Program Verification

by Nina Narodytska

The demonstrated code-understanding capability of LLMs raises the question of whether they can be used for automated program verification, a task that demands high-level abstract reasoning about program properties that is challenging for verification tools. We propose a general methodology to combine the power of LLMs and automated reasoners for automated program verification. We formally describe this methodology as a set of transition rules and prove its soundness. We instantiate the calculus as a sound automated verification procedure and demonstrate practical improvements on a set of synthetic and competition benchmarks..

Cape-KR 2025

Invited talks

Wednesday 12 February 2025 | 09:00-10:00

DLs and SHACL Validation: negation, core models, and open-worlds

by Magdalena Ortiz

The Description Logics (DL) community has traditionally favoured classical open-world semantics, and has mostly studied reasoning tasks based on satisfiability and entailment. But alternative choices lead to other scenarios where DLs can also be powerful tools. In particular, we will look at SHACL, a language for describing constraints on RDF graphs, which is syntactically no different from a DL but it makes different semantic choices, and the central reasoning task is validation. We will present our work on SHACL validation in the presence of DL ontologies, a problem that combines both open and closed-world reasoning. We will discuss some semantic challenges and describe techniques for building core universal models and validation via rewriting.

(Based on joint work with Anouk Oudshoorn, Shqiponja Ahmetaj and Mantas Šimkus).

Cape-KR 2025

Invited talks

Thursday 13 February 2025 | 09:00-10:00

Dynamics of True Belief: Learning by Revision and Merge

by Nina Gierasimczuk

Successful learning can be understood as convergence to true beliefs. Can a particular belief revision method generate a universal learning function? In other words, can it learn all that is learnable by any learner? The same can be asked about multi-agent belief revision, where a group of agents revise their collective conjectures by a combination of belief revision and belief merge. In my talk I will address those questions with the tools of formal learning theory, modal logic, and general topology.

Cape-KR 2025 Invited talks

♡ Friday 14 February 2025 ♡ | 09:00-10:00

Towards controlled flexibility for reasoning in description logics

by Anni-Yasmin Turhan

Formal ontology languages have classical semantics that is clear cut. The reasoning problems for these languages are usually defined by building on these semantics. In case of description logics, classical first-order semantics is typically used to define reasoning problems such as, for example, deciding subsumption or answering different forms of queries over data. These settings have been intensively studied in terms of complexity and the development of reasoning algorithms that come with guarantees. In applications the terminology is often built before the exact structure of the data is known. In case the application data is incomplete, evolving over time or if some data sources are simply unreliable, this can lead to missing expected query results. Here, flexibility when answering queries is highly desirable.

The goal of this talk is to discuss approaches that admit flexibility in queries or ontologies so that "near misses" of classical results can be retrieved as well, while at the same time admitting the same or at least similar guarantees that classical reasoning does. In particular, we will discuss reasoning in description logics that use rough sets or notions of similarity to achieve this.

Cape-KR 2025 Tutorials

Monday 10 February 2025 | 14:00-15:00; 15:30-16:30

Neurosymbolic Visual Commonsense: On Integrated Reasoning and Learning about Space and Motion in Embodied Multimodal Interaction

by **Mehul Bhatt**

We present recent and emerging advances in computational cognitive vision addressing artificial visual and spatial intelligence at the interface of (spatial) language, (spatial) logic and (spatial) cognition research. With a primary focus on explainable sensemaking of dynamic visuospatial imagery, we highlight the (systematic and modular) integration of methods from knowledge representation and reasoning, computer vision, spatial informatics, and computational cognitive modelling. A key emphasis here is on generalised (declarative) neurosymbolic reasoning & learning about space, motion, actions, and events relevant to embodied multimodal interaction under ecologically valid naturalistic settings in everyday life. Practically, this translates to general-purpose mechanisms for computational visual commonsense encompassing capabilities such as (neurosymbolic) semantic question-answering, relational spatio-temporal learning, (non-monotonic) visual abduction etc.

The presented work is motivated by and demonstrated in the applied backdrop of areas as diverse as autonomous driving, cognitive robotics, design of digital visuoauditory media, and behavioural visual perception research in cognitive psychology and neuroscience. More broadly, our emerging work is driven by an interdisciplinary research mindset addressing human-centred responsible AI through a methodological confluence of AI, Vision, Psychology, and (human-factors centred) Interaction Design.

Cape-KR 2025 Tutorials

Tuesday 11 February 2025 | 16:00-17:00

Overview on Conditional Reasoning in Knowledge Representation

by Giovanni Casini

In this tutorial we present an overview of the role conditional reasoning has played, and continues to play, in the field of Knowledge Representation and Reasoning. We begin by introducing some approaches to achieving nonmonotonicity, with a particular focus on ranked semantics and the definition of structural properties, which help us analyse the characteristics of the inference relations we establish. Next, we explore various types of reasoning that have been studied using nonmonotonic conditionals, including presumptive, deontic, causal, probabilistic, and counterfactual reasoning. Presumptive reasoning will be emphasised as a particularly illustrative example of conditional reasoning within Knowledge Representation and Reasoning, highlighting its close connections to deontic and counterfactual reasoning. Finally, we will examine key differences between the conditional approach and other widely used methods, such as those based on the Closed-World Assumption and Negation-As-Failure.

Cape-KR 2025 Tutorials

Thursday 13 February 2025 | 16:00-17:00

Designing Virtual Knowledge Graphs

by Diego Calvanese

Complex data processing tasks, including data analytics and machine/deep learning pipelines, in order to be effective, require to access large datasets in a coherent way. Knowledge graphs (KGs) provide a uniform data format that guarantees the required flexibility in processing and moreover is able to take into account domain knowledge. However, actual data is often available only in legacy data sources, and one needs to overcome their inherent heterogeneity. The recently proposed Virtual Knowledge Graph (VKG) approach is well suited for this purpose: the KG is kept virtual, and the relevant content of data sources is exposed by declaratively mapping it to classes and properties of a domain ontology, which users in turn can query. In this talk we introduce the VKG paradigm for data access, present the challenges encountered when designing complex VKG scenarios, and discuss possible solutions, in particular the use of mapping patterns to deal with the complexity of the mapping layer and its relationship to domain ontologies.

Overview:
1. Motivation and VKG Solution
2. KG Components
3. Formal Semantics and Query Answering
4. Designing a VKG System
5. Conclusions