Knowledge Representation and Reasoning

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Where it is taught

6 ECTS credits course, with 2 hours lectures and 2 hours labs per week, taught at:

- **Mestrado em Engenharia Informática**
  Basic course of the specialisation area of "Decision Support and Artificial Intelligence"

- **European Master in Computational Logic**
  Integrated in the elective 12 ECTS credits module of "Knowledge Representation and Agents"

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Knowledge Representation and Reasoning ⇒AI

Data Structure and Algorithms ⇒ CS

What it is good for

- Fundamental topic in Artificial Intelligence
  - Planning
  - Legal Reasoning
  - Model-Based Diagnosis
- Logic based agents technology
- Expert and rule-based systems
- Semantic Web
- Ontologies and data-modelling

Goals

- Provide a current perspective about logical languages for representing knowledge an its applications;
- Supply a coherent and rigourous approach to different functionality of reasoning in AI, with support in Computational Logic;
- Cover aspects of common sense reasoning, with non-monotonic languages and of representation of ontologies, with description languages;
- Use up-to-date languages and tools for modeling concrete problems

What it covers

- Logical approaches to knowledge representation
- Issues in representing knowledge
  - Semantics; expressivity; complexity
- Representation formalisms
- Forms of reasoning
- Methodologies
- Applications

What is studied (1)

- Logic rule-based languages for representing knowledge
  - Start by pointing out the need of non-monotonicity to reason about incomplete knowledge
  - Seminal non-motonic languages
    - Default logic
    - Auto-epistemic logic
  - Logic Programming as a non-monotonic language for representing knowledge

What is studied (2)

- Logic Programming for Knowledge Representation
  - Thorough study of semantics of normal and extended (paraconsistent) programs
  - Proof procedures allowing for reasoning
  - Programming under these semantics
    - Answer-Set Programming
    - Programming with tabling
  - Example methodologies in application areas

What is studied (3)

- Forms of reasoning
  - Deductive reasoning
  - Abductive reasoning
  - Reasoning under inconsistent knowledge
- Knowledge evolution
  - Belief Revision
  - Knowledge Updates

What is studied (4)

- Methods and languages for knowledge updates
  - Methodologies for reasoning about changes
    - Situation calculus
    - Event calculus
  - Languages for describing evolving knowledge
    - Action languages
    - Logic programming update languages

What is studied (5)

- Ontologies for defining objects, concepts, roles and their structure
  - Basic notions of ontologies
  - Ontology design
- Languages for defining ontologies
  - Basic notions of Description Logic
- Representing knowledge with rules and ontologies

What types of issues

A mixture of:

- Theoretical study of classical issues, well established for years
  - E.g. default and auto-epistemic logic, situation and event calculus, ...
- Theoretical study of state-of-the-art languages and corresponding systems
  - E.g. answer-sets, well-founded semantics, action languages, logic programming updates, ...
- Practical usage of state-of-th-art systems
  - E.g. programming with ASP-solvers and with XSB-Prolog, use of Protégé, ...
- Current research issues with still open topics
  - E.g. combining rules and ontologies

What else is in the report

- Detailed goals, rationale and syllabus of the course
- Insertion in the programmes at the department
  - Pre-requisites and how they are met
  - Follow-up studies
- Teaching and evaluation methods
- Support material, slides, exercises, exams
- Comparison to courses in other universities