ÖREBRO UNIVERSITET

**Course syllabus**
Third-cycle courses and study programmes

# Knowledge Representation, 3.5 credits

## *Kunskapsrepresentation, 3,5 hp*

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| **Course Code/Codes** | 50DT042 |
| **Subject Area** | Computer Science (Datavetenskap) |
| **School/equivalent** | School of Science and Technology (Institutionen för naturvetenskap och teknik) |
| **Valid from** | 2016-12-15 |
| **Approved** | 2016-12-15 |
| **Revised** | |
| **Approved by** | Head of School Peter Johansson |
| **Translation to English, date and signature** | N/A |

# 1 Course content

Knowledge Representation (KR) is the study of how knowledge can be encoded in a machine, in such a way that the machine can use this knowledge to understand the world, solve problems, perform tasks or achieve goals. KR is one of the main areas in the field of Artificial Intelligence (AI), but it has deep roots in fields like philosophy, psychology, linguistics and mathematical logic. This course introduces the student to the main principles and methods of KR, with a special emphasis on its applicability to the area of robotics. The course comprises a mixture of top-down teaching on the basic principles, and bottom-up self-study on individual advanced issues.

The course will cover the following topics:

- The influence from cognitive sciences
- The influence from formal systems
- Ontologies and ontology management tools
- Dealing with specialized types of knowledge: spatial, temporal, causal, normative, etc.
- Dealing with uncertainty: quantitative and qualitative tools, semantics of uncertainty.

Additionally, some specific topics will be discussed on a year-by-year basis, depending on the interests of the students and on the current advances of the field.

# 2 Outcomes

## 2.1 The course in relation to the doctoral programme

The course shall primarily refer to the following intended learning outcomes for third-cycle courses and study programmes as described in the Higher Education Ordinance, i.e. the doctoral student shall demonstrate:

*Knowledge and understanding*

- broad knowledge and systematic understanding of the research field (part of outcome 1)
- familiarity with the methods of the specific field of research in particular (part of outcome 2)

*Competence and skills*

- the capacity for scholarly analysis and synthesis (part of outcome 3)
- the capacity to review and assess new and complex phenomena, issues and situations autonomously and critically (part of outcome 3)
- the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively (part of outcome 4)
- the ability to identify the need for further knowledge (outcome 7)

The intended learning outcomes are listed in the same order as in the general syllabus for the programme.

### 2.2 Intended course learning outcomes

To obtain a passing grade, the doctoral student shall demonstrate:

- A clear understanding of the basic principles of Knowledge Representation, and on how these have evolved over the history of the field of Artificial Intelligence. (Relates to outcome 1.)

- An understanding of what it means to represent knowledge in a formal system, including the fundamental relation between syntax and semantics and an appreciation of the computational challenges involved. (Relates to outcome 1.)

- The ability to tell if and how a given fragment of knowledge can be formally represented, and to judge the adequacy of different formalisms to represent that knowledge. (Relates to outcomes 2 and 3.)

- The ability to tell if and how uncertainties present in a given fragment of knowledge can be represented, and to judge the adequacy of different tools to represent those uncertainties. (Relates to outcomes 2 and 3.)

- The ability to critically read, understand and evaluate scholarly work on specific issues related to Knowledge Representation, and to convey this understanding to other persons. (Relates to outcomes 4 and 7.)

## 3 Reading list and other teaching material

The following course readings and teaching material will be used on the course:

Stuart Russel and Peter Norvig (latest edition).
Artificial intelligence: a modern approach.
Pearson, 2013.

Ronald J. Brachman and Hector J. Levesque (latest edition).
Knowledge Representation and Reasoning.
Morgan Kaufmann.

Wiebe van der Hoek (latest edition).
Uncertainty, Rationality, and Agency.
Springer, 2006.

Lecture notes prepared by the teacher.

Selected research papers about specific self-study topics. These will be decided year-by-year depending on the interests of the students and on the current advances of the field.

## 4 Teaching formats

Teaching on the course takes the following format:

- Lectures delivered by the teacher;
- guided self-studies on specific, individual topics;
- seminars delivered by the students on these specific topics;
- practical group exercises.

## 5 Examination

The course is assessed through an examination consisting of the components listed below. The individual components are not graded separately but together they provide the basis for assessment and grading.

- A written examination on the general contents of the course, as delivered during the lectures;

- A guided self-study about a specific topic agreed with the teacher, leading to the student giving a seminar on that topic; the student must show understanding of the topic, of its relation to the main issues of Knowledge Representation, and of its strong and weak points; the student must also show the ability to critically discuss the topic with the other students in a question-answering session.

- Attendance at lectures and seminars.

## 6 Grades

Examinations on third-cycle courses and study programmes are to be assessed according to a two-grade scale with either of the grades ‘fail’ or ‘pass’ (local regulations).

The grade shall be determined by a teacher specifically nominated by the higher education institution (the examiner) (Higher Education Ordinance).

To obtain a passing grade on examinations included in the course, the doctoral student is required to demonstrate that he/she attains the intended course learning outcomes as described in section 2.2. Alternatively, if the course consists of multiple examinations generating credit, the doctoral student is required to demonstrate that he/she attains the outcomes that the examination in question refers to in accordance with section 5.

A student who has failed an examination is entitled to a retake.

If an examination consists of several examination components, and a student fails an examination component, the examiner may, as an alternative to a retake, set a make-up assignment with regard to the examination component in question.

A doctoral student who has failed an examination twice for a specific course or course element is entitled, upon his/her request, to have another examiner appointed to determine the grade.

## 7 Admission to the course

### 7.1 Admission requirements

To gain access to the course and complete the examinations included in the course, the applicant must be admitted to a doctoral programme at Örebro University.

### 7.2 Selection

Selection between applicants who have been admitted to doctoral programmes at Örebro University and who otherwise meet the admission requirements as listed above is made according to the following order of precedence:

If no other selection criteria are specified in this section, priority shall be given to applicants with a lower number of course credits left before the award of their degree over applicants with a higher number of remaining course credits. Should two or more students have equal number of credits, selection will be done through the drawing of lots. This also applies within any selection groups listed unless otherwise stated.

### 7.3 Other applicants than doctoral students admitted at Örebro University

Other applicants than doctoral students admitted at Örebro University may be given access to the course on the grounds of provisions for and/or agreements regarding contracted courses, joint degrees, national graduate schools or cooperation in other respects with other universities.

Any decisions on what such other applicants may be given access to the course are made separately and on the basis of the provisions and/or agreements that occasion the student to apply for the course.

For participation in the course in other respects, the same provisions shall apply as for doctoral students admitted to Örebro University.

## 8 Transfer of credits for courses, study programmes and other experience

Provisions on the transfer of credits can be found in the Higher Education Ordinance and on the university's webpage.

## 9 Other information

The course is taught in English.

## Transitional provisions

N/A.