**T-79.5102**

Special Course in Computational Logic (4 cr)

**Autumn 2008**

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### Agenda for Autumn 2008

- Contents according to the TKK Study Programme 2008–2009:
  
  *Knowledge representation, reasoning, and decision-making. Automated reasoning.*

- In Autumn 2008, the course concentrates on **agent-based computing** in which **software agents** are used as natural building blocks of complex software systems.

- From the methodological point of view, the course provides an introduction to using **Bayesian networks** for the representation of probability distributions and as the basis of uncertain reasoning.

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### Practical Arrangements

**Lectures:** Tuesdays, 14–16, room TB353

**Lecturer:** Docent, D.Sc.(Tech.) Tomi Janhunen, office TB335, tel. 09 451 3255, email @tkk.fi

**Tutorials:** Wednesdays, 15–16, room TB353

**Course assistant:** M.Sc.(Tech.) Antti Hyvärinen, office TB358, tel. 09 451 4774, email @tkk.fi

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### Course Contents

➤ **Lectures**

1. Design of intelligent agents: structure, functionality, properties of environments
2. Conditional probabilities and the Bayes' rule
3. Decision-making on the basis of uncertain information
4. Decision and utility theory
5. Optimization of behavior
6. Learning agents and inductive learning

➤ **Project Work**

The simulation league of RoboCup (http://www.robocup.org/)
Project Work

The goal is to implement a soccer playing agent, or a team of agents, for the simulation league of RoboCup.

Compatibility with the RoboCup-server/monitor is required.

Server:
- State of the field
- Simulation of the movements of the players and the ball
- Player interface (a protocol)

Monitor:

\[
\begin{align*}
A_1 & \quad \ldots \quad A_n \\
\uparrow & \quad \uparrow & \quad \uparrow
\end{align*}
\]

Project Work (Cont’d)

The protocol between the server and players defines:
1. Actions available to players and action parameters
2. Pieces of information that can be obtained from percepts

Given a sequence of percepts, a player is supposed to build/update its own view of the world and decide about the next action to take.

You are not supposed to implement the protocol, i.e., use one of existing libraries in your preferred programming language.

An existing implementation can also be used as a starting point.

The project is done in groups of 1–3 students and the project plan must be first approved by the course assistant.

Course Material

The course book
Stuart Russell and Peter Norvig:
Artificial Intelligence: A Modern Approach
Chapters 2, 13–19, to the extent presented at lectures.

Lecture notes

Problems from tutorials and their solutions

RoboCup documentation

Tentative Schedule

Period 1 (Lectures 1–7)
- Sep 9: Intelligent agents
- Sep 10: (Continued)
- Sep 23: Uncertainty
- Sep 30: Probabilistic reasoning
- Oct 7: (Continued)
- Oct 14: Probabilistic reasoning over time
- Oct 21: Making simple decisions
**Tentative Schedule**

**Period II (Lectures 8–12)**
- **Nov 4**: Making simple decisions (continued)
- **Nov 11**: Making complex decisions
- **Nov 18**: (Continued)
- **Nov 25**: Learning from observations
- **Dec 2**: Logical and Bayesian learning
- **Dec 9**: (In reserve)

**General Objectives**

- In-depth understanding of the agent model
- Basics of probability theory and Bayesian networks
- Practical modelling skills
- Familiarity with some applications of agent technology
- Hands-on experience on implementing software agents

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**Formal Course Requirements**

Course credits (4 cr) are granted on the following basis:

1. An examination is passed with a grade 1–5.
   - The first exam is arranged on the 18th of December, 2008, 13–16, in hall T1.
   - Additionally, two other exams are arranged **on demand** in 2009.

2. The project work is passed (with distinction).
   - Implementing a soccer playing agent in a simulated environment.
   - Participation in a cup among the teams implemented by groups.
   - Grading on the scale **failed**, **passed**, and **passed with distinction**.

The grade for the exam determines the course grade expect that grades 1–4 are raised by one if the project is passed with distinction.

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**Roots of Agent-Based Systems**

- Object-oriented programming
- Artificial intelligence
- Distributed computing
- Game theory
- Economics

S. Russell & P. Norvig:

An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators.
### Themes Related to Agents

- Communication and interaction between agents
- Coordination and negotiation
- Intelligence and rational behaviour
- Knowledge representation and reasoning
- Distributed heterogeneous databases, ontologies
- Cooperation, delegation, distributed services
- Trading mechanisms
- Mutual trust and information security

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### Applications

- Desktop
  - Operating systems, application programs
- Internet
  - Information retrieval, filtering, digital services, mobile applications, digital libraries, electronic trade, auctions
- Intranet
  - Workflow management, automation, resource management, network management, distributed databases, personal digital assistants

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