DEGREE CURRICULUM

AUTOMATIC LEARNING AND REASONING

Coordination: BEJAR TORRES, RAMON

Academic year 2023-24

AUTOMATIC LEARNING AND REASONING 2023-24

Subject's general information

<table>
<tr><td>Subject name</td><td>AUTOMATIC LEARNING AND REASONING</td></tr>
<tr><td>Code</td><td>102040</td></tr>
<tr><td>Semester</td><td>2nd Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Bachelor's Degree in Computer Engineering</td><td>3</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
<tr><td>Bachelor's Degree in Computer Engineering</td><td>3</td><td>OPTIONAL</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>6</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
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<tr><th>Activity type</th><td>PRALAB</td><td>TEORIA</td></tr>
<tr><th>Number of credits</th><td>3</td><td>3</td></tr>
<tr><th>Number of groups</th><td>1</td><td>1</td></tr>
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<tr><td>Coordination</td><td>BEJAR TORRES, RAMON</td></tr>
<tr><td>Department</td><td>COMPUTER ENGINEERING AND DIGITAL DESIGN</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>6 ECTS = 25x6 = 150
- 60 hours of on-class activities
- 90 hours of autonomous activities</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>Lectures at the classrom in Spanish, but learning material is provided always in English. Lectures can also be given in English if requested by students.</td></tr>
<tr><td>Distribution of credits</td><td>Ramon Bejar Torres 6</td></tr>
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AUTOMATIC LEARNING AND REASONING 2023-24

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
BEJAR TORRES, RAMON	ramon.bejar@udl.cat	6	

Subject's extra information

To successfully address the subject, it is advisable to have taken before, or attend during the same course, subjects about:

- Computational Logic (compulsory at this level Computer).
- Artificial intelligence (compulsory at this level Computer).

But the most important requirement is the computacional logic subject, although minimal knowledge about heuristic search in AI is also highly recommended.

Learning objectives

Expected learning outcomes linked to UdL strategic and cross-disciplinary competences :

- Knows how to prepare technical documents with different presentation tools for digital documents (CT3).
- Knows how to work with technical and scientific documents written in English (CT2).
- Understands the main problems encountered in the design of intelligent systems capable of reasoning and learning and knows how to analize the requirements in the design of these systems (EPS6).

Expected learning outcomes linked to specific competences :

- Knows the basics of using formal logic for knowledge representation in intelligent agents (GII-C5).
- Knows how to design a basic intelligent agent that is capable of acting in response to their environment and their internal knowledge (GII-C4).
- Understands the basics of representation, inference and learning under knowledge models based on Bayesian networks (GII C4-C5 and GII GII-C7).

Competences

Strategic:

CT2. Mastering a foreign language, especially English.

CT3. Training Experience in the use of the new technologies and the information and communication technologies.

Cross-disciplinary:

EPS6. Capacity of analysis and synthesis.

Specific:

GII-C4. Capacity to understand the basics, paradigms and techniques of the intelligent systems and analyse, design and build systems, services and computer applications that use these techniques in any field of application.

GII-C5. Capacity to acquire, obtain, formalise and represent the human knowledge in a computable form to solve problems by means of a computer system in any field of application, particularly in the ones related with computation, perception and performance in environments or intelligent surroundings.

GII-C7. Capacity to know and develop techniques of computational learning and design and implement applications and systems that use them, including the ones devoted to automatic extraction of information and knowledge from big volumes of data.

Subject contents

In this course, starting from basic knowledge of IA presented in the first semester, we will present different ways of representing knowledge and reasoning processes carried out on this knowledge as well as machine learning.

Knowledge representation, and obtaining answers to questions through automated reasoning, allows us to create systems for solving various problems such as resolving conflicts in resource allocations in business environments or intelligent systems for searching on web systems, where a question as "give me websites where they talk about mammals," can get back as response pages where they talk about whales, even if these pages do not mention explicitly the relationship between mammals and whales.

Finally, we reinforce the basic knowledge on learning initiated also on the first semester, covering a learning system widely used in real applications of artificial intelligence: Bayesian networks learning. They are used in systems such as automatic recommenders for online shopping sites such as Amazon that can be used to Recomending buying a book based on a profile that is learned for each user, or spam filters for email tools like Thunderbird mail, where the decision to classify emails as spam depends on a model that is refined according to the experience of previously obtained spam messages.

The syllabus of the course will be the next one:

1. Knowledge Representation and Reasoning with CP0 and CP1
2. Integration of knowledge representation formalisms and efficient reasoning for Agents
3. Representation of Ontologies with Description Logics
4. Probabilistic models for knowledge representation and inference under incomplete information
5. Model learning from incomplete information: Bayesian networks.

Methodology

There will be three types of activities:

1) On-line master classes with videos on the virtual campus.

2) Laboratory classes

3) Independent work outside the classroom to finish exercises and to do the mandatory assignments for this subject.

Development plan

Weeks 1-3: Introduction and basics of CP0 for automatic reasoning

Weeks 4-6: Reasoning in agents with CP0

Weeks 7: Working with the practice of agents

Week 8: Reasoning with ontologies

Week 9: Partial examination on the first part

Week 10: Introduction to reasoning with probabilistic models

Weeks 11-13: Inference with probabilistic models

Week 14-15: Learning with probabilistic models

Week 16: Use of Weka to learn probabilistic models

Week 17: Work with practice on learning probabilistic models

Week 18: Partial examination on the second part

Evaluation

Evaluation activities

Acr.	Evaluation activity	Weight	Minimum grade	In group	Mandatory	
P1	*Programming assignment (1)*	24%	NO	YES	NO	
P2	*Machine learning project*	20%	NO	YES	NO	
PR	*Exercises in the classroom*	5%	NO	NO	NO	
E1	*Written exam (2)*	28%	NO	NO	NO	
E2	*Written exam (2)*	28%	NO	NO	NO	

FinalGrade = 0,24*P1 + 0,20*P2 + 0.28*E1+ 0.28*E2+ 0,05*PR
(1): The presented program **will not be evaluated** if it does not meet minimum requirements regarding organization and good programming practices. These rules will be presented at the beginning of the course.
(2): There is a second chance to pass each exam at the end of the semester.

Bibliography

All learning material will be provided during the course in the form of slides, lectures notes and manuals of the different programs to be used. However, some part of the contents can be complemented with some chapters from the book:

- Artificial Intelligence, a modern approach (3rd edition). Stuart Russel and Peter Norvig. Publisher: Pearson.