

Course guide

270023 - IA - Artificial Intelligence

Last modified: 30/01/2024

Unit in charge: Barcelona School of Informatics
Teaching unit: 723 - CS - Department of Computer Science.

Degree: BACHELOR'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: JAVIER VAZQUEZ SALCEDA

Others:

Primer quadrimestre:
SERGIO ÁLVAREZ NAPAGAO - 21, 22
JAVIER BÉJAR ALONSO - 11
VÍCTOR GIMÉNEZ ÁBALOS - 11, 12, 13
IGNASI GÓMEZ SEBASTIÀ - 12, 13
JAVIER VAZQUEZ SALCEDA - 21, 22

Segon quadrimestre:
CARLES FENOLLOSA BIELSA - 11, 12
VÍCTOR GIMÉNEZ ÁBALOS - 11, 12, 13
RAMON SANGÜESA SOLE - 13
JAVIER VAZQUEZ SALCEDA - 11, 12

PRIOR SKILLS

Prior skills on Logics acquired in the course Mathematica Foundations (FM):

- Knowledge of the basic concepts: logical propositions and predicates
- Ability to formulate a problem in logical terms.
- Knowledge of logical inference and decision. Understanding resolution strategies.

Prior skills on Algorithmics acquired in the course on Data Structures and Algorithmics (EDA):

- Knowledge on tree and graph structures,
- Knowledge on tree and graph search algorithms.
- Basic notions in algorithmic complexity.

REQUIREMENTS

- Prerequisite EDA
- Corequisite PROP

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CCO2.1. To demonstrate knowledge about the fundamentals, paradigms and the own techniques of intelligent systems, and analyse, design and build computer systems, services and applications which use these techniques in any applicable field.

CCO2.2. Capacity to acquire, obtain, formalize and represent human knowledge in a computable way to solve problems through a computer system in any applicable field, in particular in the fields related to computation, perception and operation in intelligent environments.

CCO2.4. To demonstrate knowledge and develop techniques about computational learning; to design and implement applications and system that use them, including these ones dedicated to the automatic extraction of information and knowledge from large data volumes.

Generical:

G1. ENTREPRENEURSHIP AND INNOVATION: to know and understand the organization of a company and the sciences which govern its activity; capacity to understand the labour rules and the relation between planning, industrial and business strategies, quality and benefit. To develop creativity, entrepreneur spirit and innovation tendency.

G5. TEAMWORK: to be capable to work as a team member, being just one more member or performing management tasks, with the finality of contributing to develop projects in a pragmatic way and with responsibility sense; to assume compromises taking into account the available resources.

TEACHING METHODOLOGY

The classroom sessions are divided into theory, problems and laboratory sessions.

Theory sessions introduce the knowledge of the course concepts, switching between the exhibition of new material with examples and discussion with students on concepts and examples.

Problem sessions deepen the knowledge on techniques and algorithms explained in the Theory sessions. They stimulate the participation of students to discuss possible alternatives.

Laboratory sessions develop small practical assignments by using AI tools and languages in order to practice and enhance the students' knowledge on concepts, techniques and algorithms.

LEARNING OBJECTIVES OF THE SUBJECT

1. Know the origins and foundations of artificial intelligence.
2. Understand the basic concepts: artificial intelligence and rationality.
3. Learn different problem-solving techniques based on search.
4. Understanding knowledge representation concepts and techniques.
5. Analyze a problem and determine which problem-solving techniques are best suited.
6. Analyze the knowledge needed to solve a problem.
7. Extracting and representing the knowledge needed to build an application in the field of knowledge-based systems.
8. To analyze a problem and determine which representation and reasoning techniques are best suited.
9. Understand the basic planning concepts and techniques.
10. Extract and represent the actions needed to solve a problem by means of a planner.
11. Understand the machine learning concept and know some of its types.
12. Understanding the relationship between adaptation and learning.
13. Applying machine learning techniques to simple problems.
15. Knowing some artificial intelligence application areas.

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	20.00
Self study	84,0	56.00
Guided activities	6,0	4.00

Type	Hours	Percentage
Hours medium group	15,0	10.00
Hours small group	15,0	10.00

Total learning time: 150 h

CONTENTS

Introduction to Artificial Intelligence

Description:

What is Artificial Intelligence? Origins and foundations of artificial intelligence. Application areas.

Problem-Solving by means of Search

Description:

Introduction to automatic problem-solving methods: state space representation, informed and local search algorithms, genetic algorithms, games, and constraint satisfaction problems.

Knowledge representation and reasoning

Description:

Introduction to knowledge representation techniques. Motivation. Procedural representations and production systems. Structured representations (Ontologies). Representing uncertainty in knowledge.

Planning

Description:

Introduction to problem-solving through planning. Linear and hierarchical planning. Planning in deterministic and stochastic environments.

Machine Learning

Description:

Machine Learning and its role in systems which adapt to the user or the environment. Types of learning. Learning Decision Trees. Artificial Neural Networks.

Other Artificial Intelligence techniques, areas and applications

Description:

Data Mining, Case Based Reasoning, Qualitative Reasoning, Multiagent Systems, Automatic Text and Speech Processing, Perception and Vision, Recommender Systems, Intelligent Tutor Systems, Artificial Intelligence in Web Services' environments, Grid Computing and Cloud Computing.

ACTIVITIES

Introduction to Artificial Intelligence

Description:

Students will learn the origins and foundations of Artificial Intelligence and some of the application areas. To reinforce learning, the student must read chapter 1 of the book of Russell & Norvig, which is available online.

Specific objectives:

1, 2, 15

Related competencies :

G5. TEAMWORK: to be capable to work as a team member, being just one more member or performing management tasks, with the finality of contributing to develop projects in a pragmatic way and with responsibility sense; to assume compromises taking into account the available resources.

G1. ENTREPRENEURSHIP AND INNOVATION: to know and understand the organization of a company and the sciences which govern its activity; capacity to understand the labour rules and the relation between planning, industrial and business strategies, quality and benefit. To develop creativity, entrepreneur spirit and innovation tendency.

Full-or-part-time: 4h

Theory classes: 2h

Self study: 2h

Problem-Solving through Search

Description:

Students not only should attend the teacher lectures, but also do exercises on the use of search algorithms, and participate in discussions with the teacher and other students on when is best to use each of the algorithms. In the laboratory students will apply what they learned in a moderate problem.

Specific objectives:

3, 5, 6

Related competencies :

G5. TEAMWORK: to be capable to work as a team member, being just one more member or performing management tasks, with the finality of contributing to develop projects in a pragmatic way and with responsibility sense; to assume compromises taking into account the available resources.

G1. ENTREPRENEURSHIP AND INNOVATION: to know and understand the organization of a company and the sciences which govern its activity; capacity to understand the labour rules and the relation between planning, industrial and business strategies, quality and benefit. To develop creativity, entrepreneur spirit and innovation tendency.

Full-or-part-time: 52h

Theory classes: 16h

Laboratory classes: 5h

Self study: 31h

Delivering the Search practical assignment.

Description:

Delivery of the report on the search algorithms practical assignment that students have done in the lab sessions.

Specific objectives:

3, 5

Related competencies :

G5. TEAMWORK: to be capable to work as a team member, being just one more member or performing management tasks, with the finality of contributing to develop projects in a pragmatic way and with responsibility sense; to assume compromises taking into account the available resources.

G1. ENTREPRENEURSHIP AND INNOVATION: to know and understand the organization of a company and the sciences which govern its activity; capacity to understand the labour rules and the relation between planning, industrial and business strategies, quality and benefit. To develop creativity, entrepreneur spirit and innovation tendency.

Partial AI exam

Description:

Partial exam on problem solving

Specific objectives:

3, 5, 6

Related competencies :

G5. TEAMWORK: to be capable to work as a team member, being just one more member or performing management tasks, with the finality of contributing to develop projects in a pragmatic way and with responsibility sense; to assume compromises taking into account the available resources.

G1. ENTREPRENEURSHIP AND INNOVATION: to know and understand the organization of a company and the sciences which govern its activity; capacity to understand the labour rules and the relation between planning, industrial and business strategies, quality and benefit. To develop creativity, entrepreneur spirit and innovation tendency.

Full-or-part-time: 2h

Guided activities: 2h

Knowledge Representation and Reasoning

Description:

Students not only should attend the teacher lectures, but also do exercises on the use of Knowledge Representation techniques and discuss with the teacher and other students on when is best to use each technique. In the laboratory students will apply what they learned in a moderate problem.

Specific objectives:

4, 6, 7

Related competencies :

G5. TEAMWORK: to be capable to work as a team member, being just one more member or performing management tasks, with the finality of contributing to develop projects in a pragmatic way and with responsibility sense; to assume compromises taking into account the available resources.

Full-or-part-time: 47h 30m

Theory classes: 15h

Laboratory classes: 7h

Self study: 25h 30m

Problem-solving through Planning

Description:

Students not only need to attend the presentations the teacher, but also do exercises on the use of planning algorithms, and participate in discussions with the teacher and other students on when is best to use each of the algorithms. In the laboratory students will apply what they learned in an easy problem.

Specific objectives:

6, 9, 10

Related competencies :

G5. TEAMWORK: to be capable to work as a team member, being just one more member or performing management tasks, with the finality of contributing to develop projects in a pragmatic way and with responsibility sense; to assume compromises taking into account the available resources.

Full-or-part-time: 18h

Theory classes: 6h

Laboratory classes: 3h

Self study: 9h

Delivering the Knowledge Representation practical assignment.

Description:

Delivery of the report of the practical assignment on knowledge representation that students have developed in the laboratory.

Specific objectives:

4, 6, 7, 8

Related competencies :

G5. TEAMWORK: to be capable to work as a team member, being just one more member or performing management tasks, with the finality of contributing to develop projects in a pragmatic way and with responsibility sense; to assume compromises taking into account the available resources.

G1. ENTREPRENEURSHIP AND INNOVATION: to know and understand the organization of a company and the sciences which govern its activity; capacity to understand the labour rules and the relation between planning, industrial and business strategies, quality and benefit. To develop creativity, entrepreneur spirit and innovation tendency.

Machine Learning

Description:

Students not only should attend the teacher lectures, but also do exercises on the use of basic Machine Learning algorithms and participate in discussions with the teacher and other students on when is best to use these algorithms.

Specific objectives:

11, 12, 13

Full-or-part-time: 11h

Theory classes: 2h

Self study: 9h

Delivering the Innovation assignment.

Description:

Delivery of the report on examples of business innovation related to the use of Artificial Intelligence techniques.

Specific objectives:

2, 15

Related competencies :

G5. TEAMWORK: to be capable to work as a team member, being just one more member or performing management tasks, with the finality of contributing to develop projects in a pragmatic way and with responsibility sense; to assume compromises taking into account the available resources.

G1. ENTREPRENEURSHIP AND INNOVATION: to know and understand the organization of a company and the sciences which govern its activity; capacity to understand the labour rules and the relation between planning, industrial and business strategies, quality and benefit. To develop creativity, entrepreneur spirit and innovation tendency.

Other Artificial Intelligence techniques, areas and applications

Description:

Students not only should attend to the other student's presentations, but also participate in discussions with the professor and the other students on the potential impact Artificial Intelligence techniques have had on the companies analyzed in the Innovation assignment that students have made during the course.

Specific objectives:

15

Related competencies :

G5. TEAMWORK: to be capable to work as a team member, being just one more member or performing management tasks, with the finality of contributing to develop projects in a pragmatic way and with responsibility sense; to assume compromises taking into account the available resources.

G1. ENTREPRENEURSHIP AND INNOVATION: to know and understand the organization of a company and the sciences which govern its activity; capacity to understand the labour rules and the relation between planning, industrial and business strategies, quality and benefit. To develop creativity, entrepreneur spirit and innovation tendency.

Full-or-part-time: 13h 30m

Guided activities: 6h

Self study: 7h 30m

Final AI exam

Description:

Final exam for the course contents.

Specific objectives:

5, 6, 7, 8, 10, 13

Related competencies :

G5. TEAMWORK: to be capable to work as a team member, being just one more member or performing management tasks, with the finality of contributing to develop projects in a pragmatic way and with responsibility sense; to assume compromises taking into account the available resources.

G1. ENTREPRENEURSHIP AND INNOVATION: to know and understand the organization of a company and the sciences which govern its activity; capacity to understand the labour rules and the relation between planning, industrial and business strategies, quality and benefit. To develop creativity, entrepreneur spirit and innovation tendency.

Full-or-part-time: 2h

Guided activities: 2h

GRADING SYSTEM

The student assessment will consist of a partial exam mark, a final exam mark, a mark for the Innovation assignment and a laboratory mark.

The partial exam will be done during standard class hours. Passing the partial exam does not mean that those course contents won't appear again in the final exam. People who do not pass the partial will be evaluated their theoretical knowledge only on the final exam mark.

The mark of the Innovation assignment will come from a group work where examples on business innovation related to the use of Artificial Intelligence techniques should be found and analyzed. the work will be presented and discussed in the classroom.

The laboratory mark will come from the practical assignments' reports.

The calculation of the final mark will be as follows:

PM = partial exam mark

FM = final exam mark

LM = laboratory mark

IM = Innovation assignment mark

$$\text{MARK} = \max((\text{PM} \cdot 0.2 + \text{FM} \cdot 0.3), \text{FM} \cdot 0.5) + \text{LM} \cdot 0.4 + \text{IM} \cdot 0.1$$

Competences' Assessment

The assessment of the competence on entrepreneurship and innovation is based on work done during the laboratory assignments and the Innovation assignment. The ABCD grade is calculated from a detailed rubric given to students at the beginning of the course.

The assessment of the competence on teamwork is also based on work done during the laboratory assignments and the Innovation assignment. The ABCD grade is calculated from a detailed rubric given to students at the beginning of the course.

BIBLIOGRAPHY

Basic:

- Russell, S.J.; Norvig, P. Artificial intelligence: a modern approach. 4th ed., global ed. Harlow: Pearson Education Limited, 2022. ISBN 9781292401133.
- Luger, G.F. Artificial intelligence: structures and strategies for complex problem solving. 6th ed. Pearson Education : Addison Wesley, 2009. ISBN 9780321545893.
- Brachman, R.J.; Levesque, H.J. Knowledge representation and reasoning. Amsterdam: Elsevier, 2004. ISBN 9781558609327.
- Koller, D.; Friedman, N. Probabilistic graphical models: principles and techniques. MIT Press, 2009. ISBN 9780262013192.

Complementary:

- Nilsson, N.J. Artificial intelligence: a new synthesis. Morgan Kaufmann Publishers, 1998. ISBN 1558604677.
- Escolano, F.; Cazorla, M.; Alfonso, M.; Colomina, O.; Lozano, M. Inteligencia artificial: modelos, técnicas y áreas de aplicación. Thomson, 2003. ISBN 8497321839.
- González, A.J.; Dankel, D.D. The engineering of knowledge-based systems: theory and practice. Prentice Hall, 1993. ISBN 0132769409.
- Dechter, R. Constraint processing. Morgan Kaufmann Publishers, 2003. ISBN 1558608907.
- Mitchell, T.M. Machine learning. The McGraw-Hill Companies, 1997. ISBN 0070428077.
- Hecht-Nielsen, R. Neurocomputing. Addison-Wesley, 1990. ISBN 0201093553.

RESOURCES

Hyperlink:

- <http://plato.stanford.edu/entries/chinese-room/>- http://en.wikipedia.org/wiki/Turing_test-
<http://www.cs.berkeley.edu/%7Erussell/aima1e/chapter01.pdf>-
http://protege.stanford.edu/publications/ontology_development/ontology101.pdf