

## Course guide

### 270033 - SID - Distributed Intelligent Systems

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:** Spanish

#### LECTURER

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**Coordinating lecturer:** SERGIO ÁLVAREZ NAPAGAO

**Others:** Segon quadrimestre:  
SERGIO ÁLVAREZ NAPAGAO - 11, 12  
JAVIER VAZQUEZ SALCEDA - 11, 12

#### PRIOR SKILLS

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Students must have taken the Artificial Intelligence course (or some similar course)

#### REQUIREMENTS

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- Prerequisite IA

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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##### 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.

##### Generical:

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.

G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

#### TEACHING METHODOLOGY

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The teaching methodology consists exposure theory classes in theory and application of concepts in classes and laboratory problems. The examination will the same for all groups.

## LEARNING OBJECTIVES OF THE SUBJECT

- 1.To master the basic concept of Artificial Intelligence
- 2.To master the concept of intelligent agent and its role in the development of Multi Agent Systems
- 3.To Master the specific logics for Artificial Intelligence and Multiagent systems
- 4.To manage the basic of concepts of Ontologies and their application to real-world problems
- 5.To manage and apply development methodologies of Multiagent systems
- 6.To manage interaction protocols for agents' communication
- 7.Be able to analyze communication needs for a Multiagent system and be able to implement a pertinent communication protocol
- 8.To understand the foundations of game theory and decision theory and their relation with Multiagent systems
- 9.To understand negotiation mechanisms for Multiagent Systems
- 10.Be able to understand applications of MAS to robotics

## STUDY LOAD

Type	Hours	Percentage
Hours medium group	15,0	10.00
Guided activities	6,0	4.00
Hours large group	30,0	20.00
Hours small group	15,0	10.00
Self study	84,0	56.00

**Total learning time:** 150 h

## CONTENTS

### Artificial Intelligence perspectives

**Description:**

Introduction to those real fields in which AI is or can be successfully applied.

### An introduction to intelligent agents

**Description:**

What is an agent?  
Agents as basic building blocks.  
Agent types.  
Agent-building architectures and methodologies.

### Ontologies

**Description:**

What is an Ontology?  
Methods for constructing Ontologies.  
Description logics.  
Ontological languages.

### Logic systems for Artificial Intelligence

**Description:**

Reasoning for AI applications.

Modal logics.

Temporal logics.

Reasoning under uncertainty.

### Communication

**Description:**

The need for communication between agents.

Speech Act Theory.

Languages for establishing communication between agents.

### Coordination

**Description:**

Need for co-ordination in multi-agent systems.

Cooperation

Negotiation between intelligent agents.

### Introduction to Physical Agents

**Description:**

Agents for the real world: robotics, domotics, machine vision, control

## ACTIVITIES

### Artificial Intelligence Perspectives

**Description:**

The student will learn about the origins and foundations of Artificial Intelligence as well as some of the areas of application. To enhance student's learning he should read and understand the material assigned by the teacher.

**Specific objectives:**

1

**Related competencies :**

G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

**Full-or-part-time:** 10h

Theory classes: 2h

Laboratory classes: 2h

Self study: 6h

## An introduction to intelligent agents

### Specific objectives:

2, 5

### Related competencies :

G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

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.

G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

### Full-or-part-time: 22h

Theory classes: 4h

Laboratory classes: 4h

Self study: 14h

## Ontologies

### Description:

Students not only should attend the lectures, but also do exercises on the use of Ontologies 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

### Related competencies :

G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

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.

G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

### Full-or-part-time: 26h

Theory classes: 4h

Laboratory classes: 4h

Self study: 18h

### Logic systems for Artificial Intelligence

**Specific objectives:**

3

**Related competencies :**

G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

**Full-or-part-time:** 23h

Theory classes: 2h

Laboratory classes: 6h

Self study: 15h

### Partial Exam

**Description:**

The partial exam will be done during standard class hours. People who do not pass the partial will be evaluated again on the final exam.

**Specific objectives:**

1, 2, 3, 4, 5

**Related competencies :**

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**Full-or-part-time:** 2h

Guided activities: 2h

### Communication

**Description:**

Students not only attend lectures, but also do exercises on the use of mechanisms for communication between autonomous agents and discuss with the teacher and other students when it is best to use each technique. In the laboratory the students apply what they learned in a problem.

**Specific objectives:**

6, 7

**Related competencies :**

G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

**Full-or-part-time:** 23h

Theory classes: 4h

Laboratory classes: 4h

Self study: 15h

### Coordination

**Specific objectives:**

8, 9

**Related competencies :**

G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

**Full-or-part-time:** 27h

Theory classes: 5h

Laboratory classes: 7h

Self study: 15h

### Introduction to Physical Agents

**Description:**

Students not only should attend the lessons, but also read the proposed papers

**Specific objectives:**

10

**Related competencies :**

G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

**Full-or-part-time:** 14h

Theory classes: 4h

Laboratory classes: 3h

Self study: 7h

### Evaluation of practical exercises

**Description:**

Delivery of the report on the practical works (3 or 4 four) made along the laboratory sessions.

**Specific objectives:**

5, 6, 7

**Related competencies :**

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### Final Exam

**Description:**

Final exam for all the course contents.

**Specific objectives:**

1, 2, 3, 4, 5, 6, 7, 8, 9, 10

**Related competencies :**

G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

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.

G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

**Full-or-part-time: 3h**

Guided activities: 3h



## GRADING SYSTEM

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Evaluation is based on a final exam and a part exam, grading of course assignments, and a grade for lab work. The final and part exams will test the theoretical knowledge and the methodology acquired by students during the course. The grade for course assignments will be based on submissions of small problems set during the course. Lab grades will be based on students' reports and lab practical work carried out throughout the course.

At about half of the 4-month term there will be an exemptive exam, testing the first half of the course (exemptive only if the grade is 5 or more). The final exam will test both the first and the second part of the course. The first half is compulsory for those students who did not pass the part exam, and optional for the rest. The maximum of both grades (or only the one for the midterm exam) will stand as the grade for the first part.

The final grade will be calculated as follows:

GPar = part exam grade

GEx1 = 1st half of the final exam grade

GEx2 = 2nd half of the final exam grade

Total Exams grade =  $[\max(\text{Gpar}, \text{GEx1}) + \text{GEx2}]/2$

Final grade = Total Exams grade \* 0.5 + Exercises grade \* 0.2 + lab grade \* 0.3 (code + inform)

Competences' Assessment

The assessment of the competence on teamwork is based on work done during the laboratory assignments.

## BIBLIOGRAPHY

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### Basic:

- Russell, S.J.; Norvig, P. Artificial intelligence: a modern approach. 4th ed. Harlow: Pearson, 2022. ISBN 9781292401133.
- Minsky, M.L. The emotion machine: commonsense thinking, artificial intelligence, and the future of the human mind. Simon and Schuster, 2006. ISBN 9780743276641.
- Wooldridge, M.J. Reasoning about rational agents. MIT Press, 2000. ISBN 0262232138.
- D'Inverno, M.; Luck, M. Understanding agent systems. 2nd ed. Springer, 2004. ISBN 3540407006.
- Wooldridge, M. An introduction to multiagent systems. 2nd ed. John Wiley & Sons, 2009. ISBN 9780470519462.

### Complementary:

- Murphy, R.R. Introduction to AI robotics. 2nd ed. Cambridge, Massachusetts: MIT Press, 2019. ISBN 9780262348157.

## RESOURCES

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### Hyperlink:

- <http://aima.cs.berkeley.edu/>