Universidad de Alcalá

TEACHING GUIDE

Planning and Scheduling

Degree in
Computer Science Engineering

Universidad de Alcalá

Academic Year 2021/2022

3rd Year - 2nd Semester

Approved by the School Board on July 6, 2021

TEACHING GUIDE

Course Name:	**Planning and Scheduling**
Code:	**781003**
Degree in:	**Computer Science Engineering**
Department and area:	**Automática** **Computer Architecture and Technology**
Type:	**Compulsory**
ECTS Credits:	**6.0**
Year and semester:	**3rd Year, 2nd Semester**
Teachers:	Por definir
Tutoring schedule:	Consultar al comienzo de la asignatura
Language:	English

1. COURSE SUMMARY

This course offers a vision of the different model languages and techniques that are used in the area of Artificial Intelligence (AI) called Planning and Scheduling.

Planning and Scheduling are used to determine the set of steps or actions that need to be applied, given an initial state, to solve a given problem (goal state). Classical planning models will be studied, including the current heuristic planning techniques, as well as the techniques used in scheduling. Students will work with current planners to solve real problems. Besides, a practical approach to planning will be offered through the modeling of robotic control problems, workflows, cybersecurity, etc.

2. SKILLS

Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following basic, generic and cross curricular skills:

en_CG8 - Knowledge of the basic subjects and technologies, which enable them to learn and develop new methods and technologies, as well as those that provide them with great versatility to adapt to new situations.

en_CG9 - Ability to solve problems with initiative, decision making, autonomy and creativity. Ability to know how to communicate and transmit the knowledge, skills and abilities of the profession of Computer Engineering Engineer.

en_CB1 - That students have demonstrated to possess and understand knowledge in an area of study that is based on general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that involve knowledge from the forefront of their field of study.

en_CB2 - That the students know how to apply their knowledge to their work or vocation in a professional manner and possess the competencies that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study.

en_CB3 - That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

en_CB4 - That students can transmit information, ideas, problems and solutions to both a specialized and non-specialized public.

en_CB5 - That the students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

en_TRU1 - Capacity of analysis and synthesis.

en_TRU2 - Oral and written competencies.

en_TRU3 - Ability to manage information.

en_TRU4 - Autonomous learning skills.

en_TRU5 - Team work.

Specific Skills

This course contributes to acquire the following specific skills:

en_CC4 - Ability to know the fundamentals, paradigms and techniques of intelligent systems and analyze, design and build systems, services and computer applications that use these techniques in any field of application.

en_CC5 - Ability to acquire, obtain, formalize and represent human knowledge in a computable way to solve problems through a computer system in any field of application, particularly those related to aspects of computing, perception and performance in intelligent environments or environments.

en_CC7 - Ability to know and develop computational learning techniques and design and implement applications and systems that use them, including those dedicated to automatic extraction of information and knowledge from large volumes of data.

Learning Outcomes

After succeeding in this subject the students will be able to:

RA1. Define the concept of AI Planning.

RA2. Explain how classic search techniques differ in planning systems.

RA3. Explain the differences between planning as search, operator-based planning and propositional planning, providing examples of domains where they are applicable.

RA4. Define and provide examples of each of the following techniques: Case- based, learning and probabilistic planning.

RA5. Compare and contrast static planning with those that need dynamic execution.

RA6. Explain the impact of dynamic planning in Robotics.

3. CONTENTS

Contents Blocks	Total number of hours
PART 1: Introduction. Introduction to Planning; Search algorithms review; CSP review	8 hours
PART 2: Planning. Planning Domain Languages; Planning Techniques; Conditional Planning; Replanning	22 hours
PART 3: Scheduling. Scheduling Techniques; Learning	14 hours
PART 4: Application Domains. Robotic control techniques; Path planning techniques; Other domains	16 hours

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	58 hours (56 hours on-site +2 exams hours)
Number of hours of student work:	92
Total hours	150

4.2. Methodological strategies, teaching materials and resources

Lectures & Assessments	• **Theoretical lectures**: these lectures will be given in large groups, where the lecturer will develop the most relevant concepts to the course. • **Case studies resolution**: these will be given in small groups. In these sessions, the lecturer will pose diverse problems that can be solved using the techniques explored during the theoretical lectures. They will then be solved with the guidance of the lecturer. • **Reports and assignment presentations**: students will present reports and assignments, done individually or in small groups, in class. These presentations will use proper multimedia resources. • **Partial assessments**: throughout the course, the lecturer will pose several partial assessments to test the knowledge and practical application of students.
Autonomous work	• **Readings** • **Activities**: exercises, conceptual maps, exemplifications, information searches, etc • **Forum and activities participation**: usually through the e-learning platform used in the course.
Mentoring	• Mentoring will be done in groups as well as individually. The lecturer can assess the acquisition of skills and review the reports given by students.
Materials and resources	• The materials for the preparation of the face-to-face sessions, as well as the activities that the student must carry out individually, can be found on the Blackboard platform of the University of Alcalá. The functioning of this teaching tool will be detailed in the presentation class, as well as the dates of deliverables and partial exams, and the mechanism of communication with the students. • For each activity, the teacher will provide a series of bibliographical references that can be consulted in the library of the Superior Polytechnic School. For those activities that require it, the teacher will indicate the way to plan that activity, as well as the deliverables that should result from the realization of it.

5. ASSESSMENT: procedures, evaluation and grading criteria

Preferably, students will be offered a continuous assessment model that has characteristics of formative assessment in a way that serves as feedback in the teaching-learning process.

5.1. PROCEDURES

The evaluation must be inspired by the criteria of continuous evaluation (Learning Assesment Guidelines, LAG, art 3). However, in compliance with the regulations of the University of Alcalá, an alternative process of final evaluation is made available to the student in accordance with the Learning Assesment Guidelines as indicated in Article 10, students will have a period of fifteen days from the start of the course to request in writing to the Director of the Polytechnic School their intention to take the non-continuous evaluation model adducing the reasons that they deem convenient. The evaluation of the learning process of all students who do not apply for it or are denied it will be done, by default, according to the continuous assessment model. The student has two calls to pass the subject, one ordinary and one extraordinary.

Ordinary Call

Continous Assessment:

1. Ongoing evaluation: successful completion of the practical assignments, partial exam(s) and/or coursework, and a final exam. The overcoming of the practical assignments will be carried out throughout the semester.
2. Final evaluation: written exam on the theoretical and practical contents of the course

Assessment through final exam:

There are two possibilities:

1. The student has successfully completed the practical assignments and s/he will be assigned the grade obtained in the Continuous assessment if s/he decides it. The rest of the evaluation will be based on a final exam.
   The student has not completed the practical assignments or decides not to submit it for assessment. The evaluation will consist of a written exam.

Extraordinary Call

The procedure will be the same as that described for the assessment by means of a final exam in the ordinary call.

5.2. EVALUATION

EVALUATION CRITERIA

The assessment criteria measure the level in which the competences have been acquired by the student. For that purpose, the following are defined::

CE1. The student is able to argue and contrast the general aspects of the planning systems.

CE2. The student is able to formally represent knowledge in planning systems.

CE3. The student has acquired knowledge about the different techniques in the planning systems.

CE4. The student demonstrates that s/he can apply planning systems to real problems in robotics

and other domains.

According to the RD 1125/2003 regulating the Diploma, the marks must adopt the scale of notes with a decimal number and a qualitative rating:

- 9,0 - 10 MATRÍCULA DE HONOR. Not exceeding 5%
- 9,0 - 10 SOBRESALIENTE
- 7,0 - 8,9 NOTABLE
- 5,0 - 6,9 APROBADO
- 0,0 - 4,9 SUSPENSO

GRADING TOOLS

The work of the student is graded in terms of the assessment criteria above, through the following tools:

- Testing Laboratory (PL): to enable the student to model, implement and execute planning systems.
- Partial exam tests (PEP): Consisting in solving practical problems of planning systems and demonstrating knowledge of the existing techniques.
- Coursework (TA): The teacher may propose coursework and/or the participation in various activities carried out inside and outside the classroom.
- Final exam tests (PEF): Consisting in solving practical problems of planning systems and demonstrating knowledge of the existing techniques.

GRADING CRITERIA

In the ordinary call-continuous assessment the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CG8, CG9, CC4, CC5	RA1, RA2, RA3, RA4, RA5, RA6	CE2, CE3, CE4	PL1	105%
CG8, CG9, CC4, CC5	RA1, RA2, RA3, RA4, RA5, RA6	CE2, CE3, CE4	PL2	105%
CC7	RA1, RA2, RA3, RA4, RA5, RA6	CE2, CE3, CE4	PL3	105%
CG8, CG9, CC4, CC5	RA1-RA3	CE1-CE3	PEP/TA	30%
CG8, CG9, CC4, CC5, CC7	RA1-RA6	CE1-CE4	PEF	40%

In the ordinary call-final evaluation, the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CG8, CG9, CC4, CC5, CC7	RA1-RA6	CE1-CE4	PEF	100%

Extraordinary call

In the case of the extraordinary call, the same percentages that have been established in the case of the evaluation by means of a final exam will be maintained.

6. BIBLIOGRAPHY

6.1. Basic Bibliography

- Malik Ghallab, Dana Nau and Paolo Traverso (2016). Automated Planning and Acting. Cambridge University Press, online ISBN: 9781139583923.
- Stuart Russell y Peter Norvig (2009). Artificial Intelligence: A Modern Approach. (Third Edition). Ed. Pearsons.
- McDermott, Drew; Ghallab, Malik; Howe, Adele; Knoblock, Craig; Ram, Ashwin; Veloso, Manuela; Weld, Daniel; Wilkins, David (1998). PDDL---The Planning Domain Definition Language. Technical Report CVC TR98003/DCS TR1165. New Haven, CT: Yale Center for Computational Vision and Control. CiteSeerX 10.1.1.51.9941

6.2. Additional Bibliography

- Malik Ghallab, Dana Nau & PaoloTraverso (2004). Automated Planning: Theory and Practice. The Morgan Kaufmann Series in Artificial Intelligence.
- James Allen y James Hendler (1990). Readings in Planning. Ed. Morgan Kaufmann Series in Representation and Reasoning.
- Fikes and Nilsson (1971). STRIPS: A New Approach to the Application of Theorem Proving to Problem Solving, Artificial intelligence, 2 (3-4): 189-208.
- A. Blum and M. Furst (1997). Fast Planning Through Planning Graph Analysis. Artificial Intelligence, 90:281-300 (1997).
- Jörg Hoffmann (2001). FF: The Fast-Forward Planning System. AI Magazine, 22 (3):57-62.

Disclosure Note

The University of Alcalá guarantees to its students that, if due to health requirements the competent authorities do not allow the total or partial attendance of the teaching activities, the teaching plans will achieve their objectives through a teaching-learning and evaluation methodology in online format, which will return to the face-to-face mode as soon as these impediments cease.