UAB
Universitat Autònoma de Barcelona

Intelligent Robots

Code: 106589
ECTS Credits: 6

2024/2025

Degree	Type	Year
2504392 Artificial Intelligence	OB	3

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

For a full understanding of the contents of the subject, it is necessary to have a basic skill in programming and a good mathematical foundation. For this, you must have passed Fundamentals of Programming II and Fundamentals of Mathematics I and II. You must also understand how computational systems are organized to carry out their functions and, for this, you must have taken Fundamentals of Computing.

Objectives and Contextualisation

Robotics is the part of Engineering that applies to the development of robots, that is, machines with the ability to interact with their environment. The complexity of this interaction depends not only on the number of elements they include to act in their environment (actuators) but also on the information they can extract from the elements they use to perceive it (sensors).

Robots are more or less intelligent depending on their ability to take advantage of information from their environment and their own experience to decide their future actions.

Depending on the actuators, a distinction can be made between manipulator robots (arms) and mobile robots (vehicles) whose development is different because they have equally different functionalities.

With this subject, students are expected to achieve the following objectives:

- Learn about the use of service robots in industry and logistics.
- Have notions of the development process of robot manipulators and robotic vehicles.
- Acquire a practical skill in the development of basic manipulator and mobile robots.
- Knowing how to integrate robots into larger applications.

Competences

- Act within the field of knowledge by evaluating the social, economic and environmental impact beforehand.
- Analyse and solve problems effectively, generating innovative and creative proposals to achieve objectives.
- Conceive, design, analyse and implement autonomous cyber-physical agents and systems capable of interacting with other agents and/or people in open environments, taking into account collective demands and needs.
- Conceptualize and model alternatives of complex solutions to problems of application of artificial intelligence in different fields and create prototypes that demonstrate the validity of the proposed system.
- Identify, analyse and evaluate the ethical and social impact, the human and cultural context, and the legal implications of the development of artificial intelligence and data manipulation applications in different fields.
- Students can apply the knowledge to their own work or vocation in a professional manner and have the powers generally demonstrated by preparing and defending arguments and solving problems within their area of study.
- Work cooperatively to achieve common objectives, assuming own responsibility and respecting the role of the different members of the team.

Learning Outcomes

1. Analyse and solve problems effectively, generating innovative and creative proposals to achieve objectives.
2. Design, prototype and evaluate task-specific and environment-specific intelligent robotics systems.
3. Identify the best solutions for designing intelligent robots specialised in tasks in specific environments.
4. Identify the ethical and social impact and legal implications intelligent robotics systems have in their field of application.
5. Identify the social, economic and environmental implications of academic and professional activities for the field of knowledge.
6. Students can apply the knowledge to their own work or vocation in a professional manner and have the powers generally demonstrated by preparing and defending arguments and solving problems within their area of study.
7. Work cooperatively to achieve common objectives, assuming own responsibility and respecting the role of the different members of the team.

Content

- Introduction to robotics.
- Kinematic models of robots.
- Robot control software design.
- Robot programming.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes

Type: Directed			
Class: Active participation in the discussions arising from the presentation of content or the proposed solutions to problems	38	1.52	1, 3, 4, 5
Practices: Development of projects in the laboratory	12	0.48	1, 2, 6, 7
Type: Supervised			
Practices: Monitoring the execution of laboratory projects	6	0.24	1, 2, 6, 7
Tutoring: Follow-up of issues arising in class	2	0.08	1, 3, 4, 5
Type: Autonomous			
Practices: Development of projects and preparation of reports	30	1.2	1, 2, 6, 7
Problems: Solving problems	24	0.96	1, 2, 6
Theory: Study	22	0.88	3, 4, 5

Teaching is structured around the following activities:

- Classroom classes: Presentation of knowledge and discussion of solutions to problems both those proposed in the same classes and those that arose during the practice.
- Laboratory practices: Teamwork sessions, all following a script and supervised by a teacher. Each session will cover a specific aspect of robot design and programming.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Continuous assessment tests (3)	25%	6	0.24	1, 2, 3
Final exam	50%	2	0.08	1, 2, 3
Laboratory (6)	25%	6	0.24	4, 5, 6, 7
Make-up exam	50%	2	0.08	1, 2, 3

a) Procedure and assessment activities' plan

The assessment is continuous with specific activities (exams and assignments) throughout the course. These assessment activities generate a series of grades that determine the final grade.

The calculation of the final grade, n, follows the expression:

$$n = \max(x \cdot 50\% + c \cdot 25\%, x \cdot 75\%) + p \cdot 25\%$$

where x, c, and p are the grades of the exam, continuous assessment, and laboratory practices, respectively.

If the continuous assessment grade is smaller than the exam grade, $c < x$, the final grade does not take it into account. Therefore, the final grade is the maximum between the final grade with and without continuous assessment.

If $x < 5$ or $p < 5$, the final grade (n) is at most 4.5. In other words, the exam and practicals must be passed separately.

The grade for the practical part (p) is obtained from the weighted average of the grades corresponding to each practice session. Five are expected to be evaluated. In case of non-attendance, the absent person will have a 0 as a grade for the corresponding session.

The exam grade (x) is the final exam grade, which can be recovered in a second exam.

The continuous assessment grade (c) is obtained from a weighted average of the continuous assessment tests taken throughout the course. Three are planned.

Grades on continuous assessment tests can be increased with benefits gained from active participation in problem seminars. Information regarding the mechanisms for obtaining these bonuses will be made public with due advance notice during the course.

If the continuous assessment grade is equal to or higher than 5 and the three continuous assessment tests have been taken, there is no need to take the final exam and $x = c$.

b) Assessment activities schedule

The dates of the continuous assessment theory and problem-solving tests, assignment submission deadlines will be published on the Campus Virtual (CV) and may change to adapt to eventual incidents: it will always be reported previously through the CV since it is understood that it is the usual communication platform between lecturers and students outside the classroom.

c) Re-assessment procedures

Late submissions, subject to prior notice, will be accepted and penalized with a lower grade. Late submissions without prior notice or justification of force majeure will not be accepted. A second submission period may be opened for reports that receive a negative evaluation. Unaccepted or unsubmitted assignment reports will be scored 0 and will not have the option of a second assessment.

In accordance with the coordination of the Degree and the deanship of the School of Engineering, the following activities cannot be re-assessed:

- Project, 25% of the final grade

The continuous assessment can be made up by the final examination.

There is a make-up exam for the final examination, too.

d) Assessment review procedure

Assessment activities can be reviewed any time after corresponding grades are published and before the deadline for the revision of the final exam.

Should the change of a grade be agreed upon, that grade may not be modified in a later review.

No reviews will be done after the closure of the reviews of the final exam, but for the make-up exam.

e) Grading

A "non-assessable" grade is assigned to students that have not participated in any assessment activity. In any other case, notparticipating inan assessment activity scores 0 in the weighted average computation.

Honours will be awarded to those who obtain grades greater than or equal to 9.0 in each part, up to 5% of those enrolled in descending order of final grade. They may also be granted in other cases, provided that they do not exceed 5% and the final grade is equal to or greater than 9.0.

f) Irregularities, copies and plagiarism

Copies are evidences that the work or the examination has been done in part or in full without the author's intellectual contribution. This definition also includes attempts of copying in exams and reports, and violations of the norms that ensure intellectual authorship. Plagiarisms refer to the works and texts of other authors that are passed on as their own. They are a crime against intellectual property. To avoid plagiarism, quote the sources you use when writing the corresponding work reports or examinations.

In accordance with the UAB regulations, copies or plagiarisms or any attempt to alter the assessment result, for oneself of for others, like e.g. letting other copy, imply a final grade for the corresponding part (exam, continuous assessment or project) of 0 in the computation of the final score and failing the course. This does not limit the right to take action against perpetrators, both in the academic field and in the criminal.

g) Assessment of repeaters

There is no differentiated treatment for repeaters, but they can take advantage of their own material from the previous year provided it is informed in the corresponding reports.

h) Single assessment

This course does not have a single assessment procedure.

Bibliography

- J.J. Graig (2005) *Introduction to Robotics: Mechanics and Control*. Pearson Education International.
- R. Siegwart, I.R. Nourbaksh (2004) *Introduction to Autonomous Mobile Robots*. The MIT Press.

Software

- CoppeliaSim, EDU Version, Coppelia Robotics [https://www.coppeliarobotics.com/]
- ZeroBrane Studio, ZeroBrane [https://studio.zerobrane.com/]
- Draw.io, diagrams.net [https://app.diagrams.net/]

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	English	first semester	afternoon
(PLAB) Practical laboratories	1	English	first semester	afternoon
(PLAB) Practical laboratories	2	English	first semester	afternoon
(TE) Theory	1	English	first semester	afternoon