ROBOTICS & AUTOMATION LAB

Otras actividades/Other activities OACT SEP-2024 RAL-4BCSAI.OACT.M.A

Area Computer Science and AI

Number of sessions: 15

Academic year: 24-25

Degree course: FIRST

Number of credits: 1.0

Semester: 2º

Category: null

Language: English

Professor: **EDUARDO CASTELLÓ FERRER**

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Prof. Eduardo Castelló Ferrer received his B.Sc. (Hons.) degree in intelligent systems from the University of Portsmouth (U.K.) in 2007, and his M.Eng. and Ph.D. degrees in robotics engineering from Osaka University (Japan) in 2011 and 2016, respectively. Prof. Castelló's experience and interests comprise robotics, cryptography, and complex systems. He was a Marie Curie Fellow at the MIT Media Lab, where he innovated the combination of distributed robotic systems and blockchain technology. In addition to his position as an assistant professor at IE, Prof. Castelló is a research fellow at the MIT Connection Science group where he focuses on implementing new security, behavior, and business models for robotics using novel cryptographic methods.

Office Hours

Office hours will be on request. Please contact at:

ecastello@faculty.ie.edu

SUBJECT DESCRIPTION

The Czech playwright Karel Capek is credited with coining the word "robot" in his 1920 play, R.U.R. (Rossum's Universal Robots), but the concept of robots as machines with a certain degree of autonomy has been around for centuries. Science fiction aside, a robot is computer that has the physical ability to interact with the world around it. In other words, a goal-oriented machine that can sense, plan, and act. A robot senses its environment using different sensors and uses that information together with a goal to plan an action. In this course, we will cover all the necessary concepts to make real hardware-based robots, sense, plan, and act in realistic environments. The experimental sessions in this lab course are complemented by a theory-based course (Robotics & Automation - RA-CSAI.4.M.A), where all the theoretical concepts to control the robots are taught.

LEARNING OBJECTIVES

By the end of this course, students should be able to:

- Understand the basic concepts behind a modern robotics system: sensing, planning, and actuation.
- Program and interact with real-world robotic arms, humanoids, rovers, and drones.
- Foster teamwork in order to compete in a robotics competition.

TEACHING METHODOLOGY

IE University teaching method is defined by its collaborative, active, and applied nature. Students actively participate in the whole process to build their knowledge and sharpen their skills. Professor's main role is to lead and guide students to achieve the learning objectives of the course. This is done by engaging in a diverse range of teaching techniques and different types of learning activities such as the following:

Learning Activity	**Weighting**	**Estimated time a student should dedicate to prepare for and participate in**
Lectures	4.0 %	1.0 hours
Discussions	4.0 %	1.0 hours
Exercises in class, Asynchronous sessions, Field Work	28.0 %	7.0 hours
Group work	60.0 %	15.0 hours
Individual studying	4.0 %	1.0 hours
TOTAL	100.0 %	25.0 hours

AI POLICY

Generative artificial intelligence (GenAI) tools may be used in this course for assignment and code writing with appropriate acknowledgement. GenAI may not be used for presentations, group submissions, and exams. If a student is found to have used AI-generated content inappropriately, it will be considered academic misconduct, and the student might fail the respective assignment or the course.

PROGRAM

SESSION 1 (LIVE IN-PERSON)

Basic robot programming. In this session, we will review the concepts already covered in the theory-based class (Robotics & Automation - RA-CSAI.4.M.A).

SESSION 2 (LIVE IN-PERSON)

Motor control and arm kinematics.

SESSION 3 (LIVE IN-PERSON)

Robot Manipulation. In this session, we will review the concepts already covered in the theory-based class (Robotics & Automation - RA-CSAI.4.M.A).

SESSION 4 (LIVE IN-PERSON)

Human-Robot Interaction. In this session, we will review the concepts already covered in the theory-based class (Robotics & Automation - RA-CSAI.4.M.A).

SESSION 5 (LIVE IN-PERSON)

Vehicle location estimation. In this session, we will review the concepts already covered in the theory-based class (Robotics & Automation - RA-CSAI.4.M.A).

SESSION 6 (LIVE IN-PERSON)

Mobile robot path planning. In this session, we will review the concepts already covered in the theory-based class (Robotics & Automation - RA-CSAI.4.M.A).

SESSION 7 (LIVE IN-PERSON)

Computer vision and visual navigation. In this session, we will review the concepts already covered in the theory-based class (Robotics & Automation - RA-CSAI.4.M.A).

SESSION 8 (LIVE IN-PERSON)

Group project starts

SESSION 9 (LIVE IN-PERSON)

Group project

SESSION 10 (LIVE IN-PERSON)

Group project Milestone A

SESSION 11 (LIVE IN-PERSON)

Group project

SESSION 12 (LIVE IN-PERSON)

Group project

SESSION 13 (LIVE IN-PERSON)

Group project - Milestone B

SESSIONS 14 - 15 (LIVE IN-PERSON)

Group project competition

EVALUATION CRITERIA

CLASS PARTICIPATION

The rating of the class participation is based on two aspects, the presence and contributions to class discussions. Contributions on class discussions will focus on quality, not quantity of the contribution, so that students who participate often do not necessarily receive a better grade than those who participate less frequently. Therefore, students are encouraged to start contributing to the discussions since the beginning of the course.

INDIVIDUAL AND WORKGROUP ASSIGNMENTS

You are expected to complete several labs exercises individually and present their results in multimedia form. In addition, you will be evaluated based on your contribution to your group's solution to the "challenge", which will take place at the end of course. These practices will give you the opportunity to reflect on what you have learnt in class and apply it to some practical problems. More details of the lab exercises will be provided by the start of the course.

criteria	percentage	Learning Objectives	Comments
Individual work	20 %		
Group Presentation	60 %		
Class Participation	20 %		

RE-SIT / RE-TAKE POLICY

BIBLIOGRAPHY

Recommended

- Bruno Siciliano, Oussama Khatib. (2016). *Springer Handbook of Robotics.* Springer. ISBN 9783319325 (Digital)
- Roland Siegwart, Illah R. Nourbakhsh, Davide Scaramuzza. (2011). *Introduction to Autonomous Mobile Robots.* MIT Press. ISBN 978026201535 (Digital)
- Kevin M. Lynch, Frank C. Park. (2017). *Modern Robotics: Mechanics, Planning, and Control.* Cambridge University Press. ISBN 978110715630 (Digital)
- Morgan Quigley, Brian Gerkey, William Smart. (2016). *Programming Robots with ROS: A Practical Introduction to the Robot Operating System.* O'Reilly Media. ISBN 978144932389 (Digital)

BEHAVIOR RULES

Please, check the University's Code of Conduct here. The Program Director may provide further indications.

ATTENDANCE POLICY

Please, check the University's Attendance Policy here. The Program Director may provide further indications.

ETHICAL POLICY

Please, check the University's Ethics Code here. The Program Director may provide further indications.