POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

pl. M. Skłodowskiej-Curie 5, 60-965 Poznań

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Multiagent systems
Course

Field of study	Year/Semester
Automation and Robotics	1/2
Area of study (specialization)	Profile of study
Automation and robotics systems	general academic
Level of study	Course offered in
Second-cycle studies	polish
Form of study	Requirements
part-time	elective

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
12	12	-
Tutorials	Projects/seminars	
-	-	

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

Dr. Eng. Wojciech Kowalczyk

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Faculty of Control, Robotics and Electrical Engineering

Piotrowo 3, 60-965 Poznan

Responsible for the course/lecturer:

Prerequisites

Knowledge: The student starting this course should have basic knowledge of automation, robotics and computer science.

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Skills: He/she should have the ability to program in a high-level language and understand the source code created by another programmer, as well as the ability to obtain information from the indicated sources. He/she should know the methods of modeling mobile robots and issues related to controlling such a robot. He should have basic knowledge in the field of sensors. He/she should also understand the need to expand their competences / be ready to cooperate within the team.

Social Competence: In addition, in terms of social competences, the student must have such qualities as honesty, responsibility, perseverance, cognitive curiosity, creativity and personal culture.

Course objective

1. Provide students with basic knowledge in the field of multi-agent systems used in automation and robotics. Overview of wired and wireless communication protocols useful from the point of view of multi-agent systems. Obtaining information about the task environment of the mobile robot, and the impact on this environment. Interaction of a multi-agent system with a human.

2. Developing students' skills in problem analysis as well as designing and implementing a multi-agent system.

3. Shaping in students the ability to work in a team at various stages of the project from analysis of assumptions to implementation and testing.

Course-related learning outcomes

Knowledge

1. He/she has specialist knowledge in the field of remote and distributed systems, real-time systems and network techniques, - [K2_W3]

2. He/she understands the methodology of designing specialized analog and digital electronic systems, - [K2_W4]

3. He/she has extended knowledge of the modeling of linear and nonlinear systems, - [K2_W5]

4. He/she has detailed knowledge of the construction and use of advanced sensory systems, - [K2_W6]

5. He/she has an ordered, theoretically founded, detailed knowledge of methods of analysis and design of control systems - [K2_W7]

Skills

1. He/she can make critical use of literature information, databases and other sources in Polish and a foreign language, - [K2_U1]

2. He/she is able to prepare and present an oral presentation in Polish and in a foreign language on specific issues in the field of automation and robotics, - [K_U5]

3. He/she is able to simulate and analyze the operation of complex automation systems as well as plan and carry out experimental verification, - [K2_U9]

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4. He/she can designate models of simple systems and processes, and use them for the purposes of analysis and design of automation and robotics systems, - [K2_U10]

5. He/she can integrate and program specialized robotic systems, - [K2_U12]

6. He/she can select and integrate the elements of a specialized measurement and control system, including: a control unit, an executive system, a measuring system and peripheral and communication modules - [K2_U13]

Social competences

1. He/she understands the need and knows the possibilities of continuous training improving professional, personal and social competences, is able to inspire and organize the learning process of other people, - [K2_K1]

2. He/she is aware of the need for a professional approach to technical issues, scrupulous reading of the documentation and the environmental conditions in which the devices and their components may function, - [K2_K4]

3. He/she is aware of the social role of a technical university graduate and understands the need to formulate and transmit to the society (in particular through the mass media) information and opinions on the achievements of automation and robotics in the field of research and application works and other aspects of engineering activities; makes efforts to provide such information and opinions in a commonly understandable manner with justification of different points of view - [K2_K6]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:

In the field of lectures:

- on the basis of answers to questions about the material discussed in previous lectures,

In the field of laboratories:

- on the basis of an assessment of the current progress of work,

Summative assessment:

a) in the field of lectures, verification of the assumed learning outcomes is carried out by:

1. assessment of the knowledge and skills shown in the written exam, during which the student answers 5 questions selected from 30 previously provided to students and one question requiring problem analysis. The maximum number of points in the exam is 30, in order to obtain a satisfactory grade, the student must obtain at least 15 points

2.discussion of the exam results,

b) in the field of laboratories, verification of the assumed learning outcomes is carried out by:

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3.assessment of the performance of works and skills related to their implementation,

4.assessment of teamwork skills,

5. evaluation and? Defense? reports on implementation by the student (the report describes the work carried out in the field of analysis, design and implementation as well as tests),

Obtaining additional points for activity during classes, especially for:

1. discuss additional aspects of the issue,

2.effectiveness of applying the acquired knowledge while solving a given problem,

3.the ability to cooperate within a team that practically carries out detailed tasks,

4. identifying students' perceptual difficulties enabling ongoing improvement of the teaching process.

Programme content

  The lecture program covers the following topics:

Basic definitions: agent, multi-agent techniques, multi-agent systems and their features; cooperative and selfish types of interactions in multi-agent systems; advantages of solutions using multi-agent techniques; links with other fields of science and technology; modularity, scalability, redundancy, specialization, distributed task execution, resource / information sharing; challenges related to the use of multi-agent systems; examples of applications using multi-agent techniques. Issues related to the interaction of a multi-agent system with a human, ergonomics.

A mobile robot as an enbodied agent: wired and wireless communication, network protocols, their advantages and disadvantages from the point of view of applications in multi-agent systems; architectures of communication systems; connection-based and connectionless communication, broadcasting; properties of various communication methods in terms of mobility, energy efficiency, range, required bandwidth.

Control techniques used in multi-robot systems: behavioral methods, virtual structure method, methods of tracking the leader(s), hybrid solutions. Applications of individual techniques, their advantages and disadvantages. Nonlinearities; nonholonomic limitations of mobile robots. Robot formations' classification according to the working environment and the types of robots used. Formation function and its use in steering. Complex formations using leader tracking techniques (leaders, virtual leader); the issue of propagation and amplification of errors in robot chains.

The interaction of the agent with the environment, properties of the environment from the point of view of the agent perceiving through sensors and interacting through effectors. Features of an intelligent agent, a target-oriented agent and a reactive agent. Implementation of the robot-agent movement: using local artificial potential functions to avoid collisions between robots and with obstacles, local minima and unstable equilibrium points.

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Laboratory classes are conducted in the form of nine 2-hour meetings, held in the laboratory. During the first four meetings, students implement the 'agent' program in teams of 2. Then, in larger teams that integrate previously implemented programs, creating a multi-agent system. As part of the laboratories, students learn such issues as: the use of communication protocols to exchange data between agents, designing a data frame. Implementation of communication in unicast and multicast modes. Task decomposition into functionalities performed by various agents. Implementation of the designed components of a multi-agent system. Team launch of a multi-agent system (individual agents are implemented by subgroups).

Teaching methods

1. lecture: multimedia presentation, presentation illustrated with examples given on the blackboard.

2. project activities: team work, workshops, discussion, performing experiments.

Bibliography

Basic

1. M. Wooldridge, An Introduction to Multiagent Systems, Wiley and Sons 2002

Additional

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	31	1,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	44	1,5

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1 delete or add other activities as appropriate