COURSE DESCRIPTION

Learning Robots

Academic year 2026

1. Programme-related data

1.1. Higher Education Institution	Babeş Bolyai University
1.2. Faculty	Faculty of Mathematics and Computer Science
1.3. Department	Department of Computer Science
1.4. Field	Computer Science
1.5. Level of study	Master
1.6. Degree programme / Qualification	Artificial Intelligence for Connected Industries
1.7. Form of education	Full time

2. Course-related data

2.1. Course title	**Learning Robots**			Course code	**MME8220**
2.2. Course coordinator	Lect. PhD. Horea-Bogdan Mureșan				
2.3. Seminar coordinator	Lect. PhD. Horea-Bogdan Mureșan				
2.4. Year of study	2	2.5. Semester	1	2.6. Type of assessment	Exam
2.7. Course status	Compulsory			2.8. Course type	Specialty subject

3. Total estimated time (hours per semester of teaching activities)

3.1. Number of hours per week	**4**	of which: 3.2. course	**2**	3.3. seminar/ laboratory/ project	**1/0/1**
3.4. Total of hours in the curriculum	56	of which: 3.5. course	28	3.6. seminar/ laboratory	**28**

Time allocation for individual study (IS) and self-taught activities (ST)	**hours**
Learning from textbooks, course materials, bibliography, and notes (IS)	32
Additional research in the library, on subject-specific electronic platforms, and on-site	32
Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays	36
Tutoring (professional guidance)	5
Examinations	14
Other activities	-

3.7. Total hours of individual study (IS) and self-taught activities (ST)	**119**
3.8. Total hours per semester	**175**
3.9. Number of credits	**7**

4. Prerequisites (where applicable)

4.1. curriculum-related	Programming in Python or C++ Basics of ROS and simulated robots
4.2 skills-related	Understanding of machine learning concepts

5. Specific conditions (where applicable)

5.1. course-related	Projector, IoT Laboratory, Robots
5.2. seminar/laboratory-related	Computers, simulation environments, Python/C++ programming environment

6.1. Competencies resulting from the completion of the degree programme *(as referred to in the curriculum)*[1]

Professional competencies	
Competency code	**Competency**
PC4	Align software with system architectures
PC7	Develop software
PC10	Develop software prototype
PC15	Debug software
PC21	Use software libraries
Transversal competencies	
Competency code	**Competency**
TC2	Apply knowledge of science, technology, and engineering
TC3	Work in teams
TC4	Solve problems

6.2. Learning outcomes relevant to the degree programme (as referred to in the curriculum)[2]

Learning outcomes targeted by the subject		
Competency code	**Knowledge and comprehension**	**Specific academic skills**
PC4	The graduate possesses fundamental knowledge in modelling which allows the analysis of problems from industry, transforming them into concrete requirements and developing relevant software models.	The graduate is able to carry on activities for education and training on different topics related to software systems, artificial intelligence, automatics, robotics and networks
PC7	The graduate possesses the fundamental knowledge in automatics and robotics, advanced networks architectures and IoT systems, being able to use and apply this knowledge to produce new relevant solutions.	The graduate knows and respects the ethical and legal principles and rules in scientific research.
PC10	The graduate has the necessary knowledge to devise, model and design of complex software applications in the field of artificial intelligence for connected industries.	The graduate has the ability to perform educational activities in the domain of algorithmics and programming for schools and high schools.
PC15	The graduate has the ability of interdisciplinary vision between computer science subdomains in order to combine them in a software system in the field of artificial intelligence for connected industries.	The graduate has the skills to perform research in the domain of educational sciences, particularly in domains that rely on algorithmic thinking and critical thinking.

[1] The professional and/or transversal skills targeted by the subject for which the course description is prepared will be copied from the curriculum of the degree programme. For each competency, the complete entry, including the competency code, will be copied with the exact wording that appears in the curriculum, without any changes. If no competency is copied from either of the two categories, the row corresponding to that category is deleted from the table.

[2] The learning outcomes relevant for the degree programme and targeted by the subject for which the course description is prepared will be listed. The entries, copied without any changes from the Curriculum by subject type (Core Subject/Specialisation Subject/Complementary Subject), are listed under the corresponding competency.

PC21	The graduate possesses the fundamental knowledge in automatics and robotics, advanced networks architectures and IoT systems, being able to use and apply this knowledge to produce new relevant solutions.	The graduate knows and respects the ethical and legal principles and rules in scientific research.
TC2 **TC3** **TC4**	The graduate proves advance programming skills which will allow learning, accumulating solid knowledge and rapid understanding of modern technologies.	

7. Subject-specific learning outcomes

Knowledge and comprehension
The graduate has the ability to conduct project-oriented, scientific work in the area of robotics.
The graduate has the knowledge required to design software for robots, model problems and solutions for robotic platforms.
The graduate can implement robot-specific programming knowledge in dedicated applications.
Specific academic skills
The graduate has the ability to define an innovative project topic, acquire skills and technologies required for the project, find related works, and base their own work on them where appropriate.
The graduate can work independently in a team and apply state-of-the-art methods to develop concepts and solutions for the project topic
The graduate uses efficient methods and techniques for learning, information, research, and development of abilities for knowledge exploitation, for adapting to the needs of a dynamic society and for communication in a widely used foreign language.

8. Contents

8.1. Course	**Teaching and learning methods**	**Remarks**[3]
1. Introduction to Learning Robots	Interactive exposure Presentation Explanation Practical examples Case-study discussions	
2. Robot categories		
3. Simulated environments		
4. Basics of electronics		
5. DC motors		
6. - 7. Robot locomotion		
8. - 9. Sensors		
10. Audio/Video Processing		
11. 12. Integrating AI		
13. -14. Student presentations		
Bibliography		

[3] For example, organisational aspects, recommendations for students, specific aspects relating to the course/seminar, such as inviting experts in the field, etc.

1. Sebastian Thrun, Wolfram Burgard, Dieter Fox, *Probabilistic Robotics*
2. Christopher Bishop, *Pattern recognition and machine learning*
3. Stuart Russell, Peter Norvig, *Artificial intelligence. A modern approach*
4. Patrick Goebel, *ROS by Example INDIGO – Volume 1*
5. Choreographe
6. https://www.ros.org/
7. Puppy Pi
8. Arm Pi
9. NAO V6
10. https://www.universal-robots.com/products/collaborative-robots-cobots-benefits
11. Bodur, Mehmet (2006), Computational Principles of Robotics, Course Notes, Department of Computer Engineering, Eastern Mediterranean University, pp. 2
12. W. He, Z. Li and C. L. P. Chen, "A survey of human-centered intelligent robots: issues and challenges," in *IEEE/CAA Journal of Automatica Sinica*, vol. 4, no. 4, pp. 602-609, 2017, https://doi.org/10.1109/JAS.2017.751060/
13. D. Nitzan, "Development of intelligent robots: Achievements and issues," in *IEEE Journal on Robotics and Automation*, vol. 1, no. 1, pp. 3-13, March 1985, https://doi.org/10.1109/JRA.1985.1086994
14. Lai. R., Lin, W., Wu, Y. (2018). Review of Research on the Key Technologies, Application Fields and Development Trends of Intelligent Robots. In: Chen, Z., Mendes, A., Yan, Y., Chen, S. (eds) Intelligent Robotics and Applications. ICIRA 2018. Lecture Notes in Computer Science(), vol 10985. Springer, Cham. https://doi.org/10.1007/978-3-319-97589-4_38
15. Matthias Wahde, Introduction to Autonomous Robots, 2016, https://www.me.chalmers.se/~mwahde/courses/aa/2016/FFR125_LectureNotes.pdf
16. Michel Albonico, Milica Đorđević, Engel Hamer, Ivano Malavolta, *Software engineering research on the Robot Operating System: A systematic mapping study*, Journal of Systems and Software, Volume 197, 2023, https://doi.org/10.1016/j.jss.2022.111574

8.2. Seminar/ laboratory	**Teaching and learning methods**	**Remarks**
The goal is to define a project and implement the experimental design in a simulated robot. Each student will work within a team to implement a project focusing on developing a Learning Robot. To achieve these goals, seminar/laboratory work (2 hours every 2 weeks) will have the following structure:	Interactive exposure Explanation Practical examples Case-study discussions	
Introduction Definition of a concrete project idea		
Project plan - Define the steps of the project - Perform a systematic literature review		
Technology review - Evaluate available technologies and select the most suitable ones for the chosen project - Architecture design		
Implementation and integration - Implement and integrate the experimental design.		
Test - Use a simulated robot to test the implementation		

Deployment - Deploy the implementation on a robot - Prepare project presentation		

Bibliography

1. Sebastian Thrun, Wolfram Burgard, Dieter Fox, *Probabilistic Robotics*
2. Christopher Bishop, *Pattern recognition and machine learning*
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4. Patrick Goebel, *ROS by Example INDIGO – Volume 1*
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11. Bodur, Mehmet (2006), Computational Principles of Robotics, Course Notes, Department of Computer Engineering, Eastern Mediterranean University, pp. 2
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13. D. Nitzan, "Development of intelligent robots: Achievements and issues," in *IEEE Journal on Robotics and Automation*, vol. 1, no. 1, pp. 3-13, March 1985, https://doi.org/10.1109/JRA.1985.1086994
14. Lai. R., Lin, W., Wu, Y. (2018). Review of Research on the Key Technologies, Application Fields and Development Trends of Intelligent Robots. In: Chen, Z., Mendes, A., Yan, Y., Chen, S. (eds) Intelligent Robotics and Applications. ICIRA 2018. Lecture Notes in Computer Science(), vol 10985. Springer, Cham. https://doi.org/10.1007/978-3-319-97589-4_38
15. Matthias Wahde, Introduction to Autonomous Robots, 2016, https://www.me.chalmers.se/~mwahde/courses/aa/2016/FFR125_LectureNotes.pdf
16. Michel Albonico, Milica Đorđević, Engel Hamer, Ivano Malavolta, *Software engineering research on the Robot Operating System: A systematic mapping study*, Journal of Systems and Software, Volume 197, 2023, https://doi.org/10.1016/j.jss.2022.111574

9. Evaluation

Type of activity	9.1 Evaluation criteria[4]	9.2 Evaluation methods[5]	9.3 Percentage in the final grade
9.4. Course	Knowledge of designing software for learning robots	Written examination	10%
9.5. Seminar/ laboratory	Specify, design, implement, and test a learning robot	Project implementation and presentation	90%
9.6 Minimum standard for passing			
Each student should obtain a minimum of 5 for the written exam and research paper.			

[4] The evaluation criteria must directly reflect the learning outcomes targeted at the level of the degree programme respectively at the level of the subject. More specifically, the learning outcomes set out in the expected learning outcomes are assessed.

[5] Both final evaluation methods and ongoing evaluation strategies should be established.

10. SDG labels (Sustainable Development Goals)[6]

	○	Sustainable Development Generic Label

								
○	○	○	○	○	○	○	○	X
								No label applies
○	○	○	○	○	○	○	○	○

Date of entry:
07.05.2026

Signature of course coordinator

Lect. PhD. Horea-Bogdan Mureșan

Signature of seminar coordinator

Lect. PhD. Horea-Bogdan Mureșan

Date of approval in the department:
...

Signature of the head of department

Assoc. Prof. PhD. Adrian Sterca

[6] Select a single label which, according to the *Implementation of SDG labels in the academic process*, best matches the subject. If the subject addresses sustainable development in a generic manner (i.e. by presenting/introducing the general framework of sustainable development, etc.), then the Sustainable Development generic label may be applied. If none of the labels describe the subject, select the last option: *"No label applies."*