

SYLLABUS

Artificial Intelligence

University year 2025-2026

1. Information regarding the programme

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 of study	Computer Science
1.5. Study cycle	Bachelor
1.6. Study programme/Qualification	Computer Science
1.7. Form of education	Full time

2. Information regarding the discipline

2.1. Name of the discipline		Artificial Intelligence				Discipline code		MLE5029
2.2. Course coordinator					Mihoc Tudor Dan			
2.3. Seminar coordinator					Mihoc Tudor Dan			
2.4. Year of study	2	2.5. Semester	6	2.6. Type of evaluation	E	2.7. Discipline regime		Obligatory

3. Total estimated time (hours/semester of didactic activities)

3.1. Hours per week	4	of which: 3.2 course	2	3.3 seminar/laboratory/project	0/2/0
3.4. Total hours in the curriculum	56	of which: 3.5 course	28	3.6 seminar/laboratory/project	0/28/0
Time allotment for individual study (ID) and self-study activities (SA)					hours
Learning using manual, course support, bibliography, course notes (SA)					28
Additional documentation (in libraries, on electronic platforms, field documentation)					10
Preparation for seminars/labs, homework, papers, portfolios and essays					20
Tutorship					8
Evaluations					20
Other activities: comunicare bidirecțională cu titularul de disciplină					8
3.7. Total individual study hours	94				
3.8. Total hours per semester	150				
3.9. Number of ECTS credits	6				

4. Prerequisites (if necessary)

4.1. curriculum	Data Structures, and Algorithms Theory
4.2. competencies	Average programming skills in a high-level programming language

5. Conditions (if necessary)

5.1. for the course	projector
5.2. for the seminar/lab activities	laboratory with computers; high-level programming language environment;

6.1. Specific competencies acquired ¹

Professional / essential competencies	• use of software tools in an interdisciplinary context; • use of theoretical foundations of computer science as well as of formal models; • use of artificial intelligence concepts and techniques to solve real-world problems.
Transversal competencies	• application of organized and efficient work rules and of responsible attitudes towards the didactic-scientific field, to bring creative value to one's own potential, with respect for professional ethics principles and norms; • use of efficient methods and techniques to learn, inform, research, and develop the abilities to bring value to knowledge, to adapt to the requirements of a dynamic society, and to communicate efficiently in the Romanian language and in an international language.

6.2. Learning outcomes

Knowledge	The student knows: • to use the knowledge related to programming, mathematics, engineering and technology and has the skills to use them to create complex information technology systems; • to use integrated development environments for creating large complex applications; • to present and explain methods, algorithms, paradigms and techniques used in various branches of computer science.
Skills	The student is able to: • identify complex problems and examine related issues to develop solving options and implement solutions; • combine diverse information to formulate solutions and generate ideas for developing new products and applications; • present and explain methods, algorithms, paradigms and techniques used in various branches of computer science.
Responsibility and autonomy:	The student has the ability to work independently to obtain: • solutions and generate ideas for developing new products and applications; • GUI applications using architectural templates suitable for specific user interaction applications.

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	• Ability to understand and use the basic AI algorithms and principles; • Ability to model real-life problems as AI problems and find optimal solutions to them.
7.2 Specific objective of the discipline	• Acquire knowledge about the main classes of AI algorithms, machine learning, the basic notions of game theory, and knowledge base reasoning.

8. Content

8.1 Course	Teaching methods	Remarks
1. Introduction to AI: History, Method, and Ethical Issues; Mathematical Prerequisites; Data Preprocessing.	• Exposure, • description, • explanation, • examples,	
2. Machine learning and decision trees.		
3. Neural networks I: Perceptron model, feed-forward neural networks.		

¹ One can choose either competences or learning outcomes, or both. If only one option is chosen, the row related to the other option will be deleted, and the kept one will be numbered 6.

4. Neural networks II: Multi-layer neural networks, backpropagation algorithm.	• case studies, • discussion.		
5. Types of ANNs I: CNNs, RNNs, LSTMs, GRUs, Transformers, and BERT.			
6. Problem solving as search: problem spaces, uninformed search, BFS, DFS, limited DFS, iterative deepening search, and UCS.			
7. Problem solving as search: informed search, heuristic search, best-first search, Greedy, A* algorithm, and A* variants.			
8. Local search: simulated annealing, hill climbing, and evolutionary computation.			
9. Evolutionary strategies, evolutionary programming, and genetic programming.			
10. Swarm intelligence: particle swarm optimization, ant colony optimization.			
11. Adversarial Searching: Game playing, Minimax search, Alpha-beta pruning.			
12. Intelligent Systems: Support Vector Machines, K-means.			
13. Knowledge representation and reasoning in rule-based systems.			
14. Uncertainty management in rule-based systems.			
Bibliography			
➤ Goldberg, D.E., <i>Genetic Algorithms</i>, Addison-Wesley, Reading, 1989. ➤ Russell, S. J., and Norvig, P., <i>Artificial Intelligence: A Modern Approach</i>, N. J., Prentice Hall/Pearson Education, 2003. ➤ Zaki, Mohammed J., and Wagner Meira Jr., <i>Data mining and machine learning: fundamental concepts and algorithms</i>, Cambridge University Press, 2020. ➤ Géron, Aurélien, <i>Hands-on machine learning with Scikit-Learn, Keras, and Tensor Flow</i>, O'Reilly Media, Inc., 2022.			
8.2 Seminar / laboratory			Teaching methods
1. Get familiar with SciPy, Matplotlib, and other packages. Perform data preprocessing.	• Examples, • Case Studies, • Dialogue, • Exercises, • Small student projects.	Evaluation: • Quiz • Presentation	
2. Monte Carlo Methods: simulation, sampling, and biases.			
3. Build a DT for a specific problem. Validate the results.			
4. Get familiar with PyTorch. Build a perceptron for several problems.			
5. Build and train a simple feedforward artificial network for a specific problem. Select, modify, and visualize specific network parameters.			
6. Solve a classification problem using ANNs.			
7. Build a CNN for image recognition.			
8. Perform transfer learning on a neural network.			
9. Modeling problems for the DFS approach.			
10. Implement an evolutionary algorithm and apply it to a specific problem.			
11. Implement a PSO for a mathematical problem.			
12. Implement an RBS in an uncertain environment.			
13. Hyperheuristics.			
Bibliography			
➤ Goldberg, D.E., <i>Genetic Algorithms</i>, Addison-Wesley, Reading, 1989. ➤ Russell, S. J., and Norvig, P., <i>Artificial Intelligence: A Modern Approach</i>, N. J., Prentice Hall/Pearson Education, 2003.			

- Zaki, Mohammed J., and Wagner Meira Jr., *Data mining and machine learning: fundamental concepts and algorithms*, Cambridge University Press, 2020.
- Géron, Aurélien, *Hands-on machine learning with Scikit-Learn, Keras, and Tensor Flow*, O'Reilly Media, Inc., 2022.

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

- The course follows the scheme and structure used by the most important universities in the USA and Europe.
- The course exists in the study programs of all major universities in Romania and abroad.
- The contents of the discipline cover the major subjects of Artificial Intelligence in the context of modern software development and trends in society.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Course	How well do students know the basic principles of the AI domain?	Written Examination	65%
	How well can they apply the course concepts to solve real problems?		
10.5 Seminar/laboratory	How well are students able to implement the presented methods and algorithms in laboratories?	Evaluation of laboratory assignments and projects	45%
10.6 Minimum standard of performance			
• All laboratory classes are mandatory. The minimum attendance requirement for passing is 90% in laboratories. • To pass, students need a minimum final mark of 5 (on a scale of 1 to 10).			

11. Labels ODD (Sustainable Development Goals)²

Not applicable.

Date:
11 April 2025

Signature of course coordinator

Lector Univ. PhD. Tudor Mihoc

Signature of seminar coordinator

Lector Univ. PhD. Tudor Mihoc.

Date of approval:
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Signature of the head of department

Assoc. Prof. PhD. Adrian STERCA

² Keep only the labels that, according to the [Procedure for applying ODD labels in the academic process](#), suit the discipline and delete the others, including the general one for *Sustainable Development* – if not applicable. If no label describes the discipline, delete them all and write „*Not applicable.*”.