syllabus

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**

2. Information regarding the discipline

2.1 Name of the discipline (en) (ro)			**Artificial Intelligence** **Inteligență Artificială**					
2.2 Course coordinator			**Lecturer, PhD Mihoc Tudor Dan**					
2.3 Seminar coordinator			**Lecturer, PhD Mihoc Tudor Dan**					
2.4. Year of study	**2**	2.5 Semester	**4**	2.6. Type of evaluation	**E**	2.7 Type of discipline	**O**	
2.8 Code of the discipline			**MLE5029**					

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

3.1 Hours per week	**4**	Of which: 3.2 courses	**2**	3.3 seminar/laboratory	**2 lab**
3.4 Total hours in the curriculum	**56**	Of which: 3.5 courses	**28**	3.6 seminar/laboratory	**28**
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					28
Additional documentation (in libraries, on electronic platforms, field documentation)					14
Preparation for seminars/labs, homework, papers, portfolios and essays					28
Tutorship					7
Evaluations					20
Other activities:					
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	Graph Theory, Data Structures and Algorithms
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 or lab activities	Laboratory with computers; high-level programming language environment

6. Specific competencies acquired

Professional competencies	**CE1.1**	**To describe the concepts and the research directions in Artificial intelligence,**
	CE1.2	**To assess the quality and stability of the obtained solutions and to compare them with solutions obtained by traditional methods.**
	CE1.3	**To use methods, techniques, and algorithms from AI in order to model several classes of problems.**
	CE1.4	**To identify and explain specific AI techniques and algorithms and use them to solve specific problems.**
	CE1.5	**To integrate models and specific AI solutions in dedicated applications.**
Transversal competencies	**CT1**	**To apply the rules for organized and efficient work.**
	CT2	**To promote a responsible attitude towards the educational - scientific domain in order to use the creative potential.**
	CT3	**To respect the principles and norms of professional etiquette.**
	CT4	**To use efficient learning methods and techniques for learning, documenting, and searching.**
	CT5	**To develop the capacity to use knowledge, adapt at the requests of a dynamic society, and properly communicate.**

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 objectives of the discipline	Acquire knowledge about the main classes of soft computing algorithms, 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, • case studies, • discussion	
2. **Machine learning and decision trees**		
3. **Neural networks I:** Perceptron model, feed-forward neural networks		
4. **Neural networks II:** Multi-Layer layer neural networks, Backpropagation Algorithm		
5. **Types of ANNs I:** CNNs, RNNs, LSTM, GRU, Transformers, and BERT		
6. **Types of ANNs II:** GPT Series, Siamese Networks, CapsNets, Autoencoders, GANs, Attention-Based Models, GNNs, Neural Style Transfer Networks, and Neuroevolution		
7. **Intelligent Systems**: Support Vector Machines, K mean		
8. **Knowledge representation and reasoning in rule-based systems:** Uncertainty management in rule-based systems		
9. **Problem solving as search:** Problem spaces, Uninformed search, BFS, DFS, Limited DFS, Iterative deepening search, UCS		
10. **Problem solving as search:** Informed search, Heuristic search, Best-first search, Greedy, A* algorithm, A* variants		
11. **Local search:** Simulated annealing, Hill climbing **Evolutionary computation:** Evolutionary algorithms		
12. **Evolutionary Computation:** Evolutionary strategies, Evolutionary programming, and Genetic programming		
13. **Swarm intelligence**: Particle swarm optimization, Ant colony optimization		
14. **Adversarial Searching:** Game playing, Minimax search, Alpha-beta pruning		

Bibliography:

- Goldberg, D. E., *Genetic Algorithms,* Addison-Wesley, Reading, 1989.
- Russell, S., J., and Norvig, P., *Artificial Intelligence: A Modern Approach*, 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 TensorFlow*, O'Reilly Media,Inc., 2022.

8.2 **Laboratory/Seminars**	Teaching methods	Remarks
1. Get familiar with Scipy, Matplotlib, and other packages. Perform data preprocessing.	• Examples • Case Studies • Dialogue • Exercises • Small student projects	Evaluation: • Quiz • Presen-tation
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 simple ANN for a specific problem. Select, modify, and visualize specific network parameters.		
5. Build a CNN for image recognition.		
6. Build a prediction system based on a time series		
7. Implement a clustering algorithm and apply it to a specific problem		
8. Perform transfer learning on a large language model		
9. Model a problem for a DFS approach		
10. Implement an evolutionary algorithm and apply it on a specific problem		
11. Implement a PSO for a mathematical problem		
12. Memetic Algorithms		

Bibliography:

- Goldberg, D. E., *Genetic Algorithms,* Addison-Wesley, Reading, 1989.
- Russell, S., J., and Norvig, P., *Artificial Intelligence: A Modern Approach*, N.J., Prentice Hall/Pearson Education, 2003.
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9. Correlating 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.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	How well do students know the basic principles of the AI domain? How well can they apply the course concepts to solve real problems?	Written exam	60%
10.5 Seminar/lab activities	How well are students able to implement the presented methods and algorithms in labora-tories?	Laboratory / seminar assignments	40%
10.6 Minimum performance standards			
All seminar and laboratory classes are mandatory. Minimum attendance requirements in order to pass are 75% in seminars and 90% in laboratories. At least **grade 5** (from a scale of 1 to 10) at the final mark is required in order to pass.			

Date

Signature of course coordinator
Lecturer Phd. Tudor Dan Mihoc

Signature of seminar coordinator
Lecturer, Phd. Tudor Dan Mihoc

Date of approval

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Signature of the head of department

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