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	Artificial Intelligence

2. Information regarding the discipline

2.1 Name of the discipline (en) (ro)			Fundamentals of Machine Learning				
2.2 Course coordinator			Prof. PhD. Dioșan Laura				
2.3 Seminar coordinator			Prof. PhD. Dioșan Laura				
2.4. Year of study	**2**	2.5 Semester	**4**	2.6. Type of evaluation	**E**	2.7 Type of discipline	**Compulsory**
2.8 Code of the discipline		MLE5228					

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

3.1 Hours per week	5	Of which: 3.2 course	2	3.3 seminar/laboratory	2lab
3.4 Total hours in the curriculum	70	Of which: 3.5 course	28	3.6 seminar/laboratory	28
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					25
Additional documentation (in libraries, on electronic platforms, field documentation)					29
Preparation for seminars/labs, homework, papers, portfolios and essays					30
Tutorship					7
Evaluations					3
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	• Algorithms, data structures, statistics
4.2. competencies	• Average programming skills

5. Conditions (if necessary)

5.1. for the course	• Projector
5.2. for the seminar /lab activities	• Computers, specific development environment

6. Specific competencies acquired

Professional competencies	CE1.1 Description of artificial intelligence concepts and research directions CE1.2 Evaluation of the quality and stability of the obtained solutions and their comparison with the solutions obtained by traditional methods CE1.3 Using artificial intelligence methods, techniques and algorithms to model solutions to classes of problems
Transversal competencies	**CT1.** Application of efficient work rules and responsible attitudes towards the scientific domain, for the creative exploitation of one's own potential according to the principles and rules of professional ethics **CT3.** Use of 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.

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

7.1 General objective of the discipline	Emphasis the proper machine learning methods and techniques for solving real-world problems
7.2 Specific objective of the discipline	This course is aimed to advance both theoretical and practical aspects of Machine Learning. The course aims to provide an overview of the discipline and its main areas. At the end of the course, students will understand the basic principles of machine learning and associated algorithmic approaches and have knowledge of machine learning applications.

8. Content

8.1 Course	Teaching methods	Remarks
1. Introduction to Machine Learning	• Interactive	

2. Intelligent systems – Machine Learning (computational intelligence) a. Problem formalisation ▪ Regression problems ▪ Supervised classification problems ▪ Unsupervised classification problems b. Supervised learning ▪ Performance measures ▪ Algorithms a. Least Mean Square Root b. Descent Gradient c. Logistic regression d. Artificial neural networks e. Convolutional Neural Networks f. K-nearest neighbour g. Decision trees h. Support Vector Machines i. Bayesian models j. Evolutionary algorithms c. Unsupervised learning ▪ Performance measures ▪ Algorithms d. Reinforcement learning ▪ Performance measures ▪ Algorithms a. Q-learning b. Neural Networks 3. Hybrid systems 4. Real-world intelligent systems 5. information processing that were collected in different domains (medical, biological, financial, psychology, etc) and represented in different modalities: a. Texts b. Images c. Sounds d. Networks / graphs	exposure • Presentation • Explanation • Practical examples • Case-study discussions	

Bibliography

1. S. Russell, P. Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, 1995
2. C. Groşan, A. Abraham, Intelligent Systems: A Modern Approach, Springer, 2011
3. M. Mitchell, An Introduction to Genetic Algorithms, MIT Press, 1998
4. A. Hopgood, Intelligent Systems for Engineers and Scientists, CRC Press, 2001
5. T. M. Mitchell, Machine Learning,McGraw-Hill Science, 1997
6. James Kennedy, Russel Eberhart, Particle Swarm Optimisation, Proceedings of IEEE International Conference on Neural Networks. IV. pp. 1942–1948, 1995
7. Marco Dorigo, Christian Blum, Ant colony optimization theory: A survey, Theoretical Computer Science 344 (2005) 243 – 27
8. H.F. Pop, G. Şerban, Inteligenţă artificială, Cluj Napoca, 2004
9. D. J. C. MacKey, Information Theory, Inference and Learning Algorithms, Cambridge University Press, 2003
10. C. Bishop, Pattern Recognition and Machine Learning, Springer, 2006
11. I. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016

https://www.deeplearningbook.org/		
8.2 Seminar / laboratory	Teaching methods	Remarks
1. Eficient solutions for algorithmic problems 2. Introduction to Machine Learning – performance measures 3. Regression problems – Least Mean Square Root 4. Data normalisation 5. Regression problems – descent gradient 6. Classsification problems – logistic regression 7. Regression problems – Artificial Neural Networks 8. Classification problems – Artificial Neural Networks 9. Regression problems – Evolutionary Algorithms 10. Classification problems – Evolutionary Algorithms 11. Clustering 12. Real-world problems – ML-based solutions 13. Development of applications that include intelligent components	• Interactive exposure • Explanation • Conversation • Didactical demonstration	

Bibliography

1. S. Russell, P. Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, 1995
2. C. Groşan, A. Abraham, Intelligent Systems: A Modern Approach, Springer, 2011
3. A. Hopgood, Intelligent Systems for Engineers and Scientists, CRC Press, 2001
   A. Geron, Hands-On Machine Learning with Scikit-Learn and TensorFlow, https://github.com/ageron/handson-ml

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 exists in the curriculum of many universities in the world.
- The results of course are considered by software companies particularly useful and topical, developing needed abilities in modelling and visualization of data.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Knowledge of the basic concepts of the field Applying the intelligent principles from the course content to solve complex and difficult problems	Written exam	50%
10.5 Seminar/lab activities	· Specification, design, implementation and testing of intelligent methods · Effective problem	Systematic observation of the student while solving the task Practical projects	50%

	solving with the help of previously implemented methods		

10.6	Minimum performance standards
- Each student has to demonstrate that he has reached an acceptable level of knowledge and understanding of the field, that he is able to express the knowledge in a coherent form, that he has the ability to establish certain connections and to use the knowledge in solving some problems. - To pass the exam you must: - at least 60% of the laboratory assignments are completed - an evaluation average (written exam, seminar, laboratory) to be above 5	

Date	Signature of course coordinator	Signature of seminar coordinator
……	Prof. PhD. Dioșan Laura	Prof. PhD. Dioșan Laura

Date of approval	Signature of the head of department
.....	Prof. PhD. Dioșan Laura