**SYLLABUS**

**1. Information regarding the programme**

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| 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**

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|---|---|---|---|---|---|---|---|
| 2.1 Name of the discipline (en) (ro) | | | Fundamentals of Machine Learning | | | | |
| 2.2 Course coordinator | | | | | | | |
| 2.3 Seminar coordinator | | | | | | | |
| 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)

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|---|---|---|---|---|---|
| 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: ..... | | | | | - |

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| 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)

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| 4.1. curriculum | • Algorithms, data structures, statistics |
| 4.2. competencies | • Average programming skills |

**5. Conditions** (if necessary)

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

**6. Specific competencies acquired**

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| **Professional competencies** | CE1.1 Description of artificial intelligence concepts and research directions<br><br>CE1.2 Evaluation of the quality and stability of the obtained solutions and their comparison with the solutions obtained by traditional methods<br><br>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<br><br>**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)

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| 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 | |

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

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| https://www.deeplearningbook.org/ | | |
| **8.2 Seminar / laboratory** | Teaching methods | Remarks |
| 1. Eficient solutions for algorithmic problems<br>2. Introduction to Machine Learning – performance measures<br>3. Regression problems – Least Mean Square Root<br>4. Data normalisation<br>5. Regression problems – descent gradient<br>6. Classsification problems – logistic regression<br>7. Regression problems – Artificial Neural Networks<br>8. Classification problems – Artificial Neural Networks<br>9. Regression problems – Evolutionary Algorithms<br>10. Classification problems – Evolutionary Algorithms<br>11. Clustering<br>12. Real-world problems – ML-based solutions<br>13. Development of applications that include intelligent components | • Interactive exposure<br>• Explanation<br>• Conversation<br>• 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<br>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<br>· Effective problem | Systematic observation of the student while solving the task<br>Practical projects | 50% |

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| | 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

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Date of approval Signature of the head of department

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