# SYLLABUS

## 1. Information on the study programme

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| 1.1. Higher education institution | West University of Timisoara |
| 1.2. Faculty | Mathematics and Computer Science |
| 1.3. Department | Computer Science |
| 1.4. Study program field | Computer Science |
| 1.5. Study cycle | Master |
| 1.6. Study programme / Qualification | ARTIFICIAL INTELLIGENCE AND DISTRIBUTED COMPUTING |

## 2. Information on the course

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| 2.1. Course title | | | Machine Learning | | | | |
| 2.2. Lecture instructor | | | Darian M. Onchis | | | | |
| 2.3. Seminar / laboratory instructor | | | Darian M. Onchis | | | | |
| 2.4. Study year | II | 2.5. Semester | I | 2.6. Examination type | E | 2.7. Course type | Obl. |

## 3. Estimated study time (number of hours per semester)

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| 3.1. Attendance hours per week | 3 | out of which: 3.2 lecture | 2 | 3.3. seminar / laboratory | 1 |
| 3.4. Attendance hours per semester | 42 | out of which: 3.5 lecture | 28 | 3.6. seminar / laboratory | 14 |

| **Distribution of the allocated amount of time*** | **Hours** |
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| Study of literature, course handbook and personal notes | 23 |
| Supplementary documentation at library or using electronic repositories | 23 |
| Preparing for laboratories, homework, reports etc. | 50 |
| Exams | 6 |
| Tutoring | 6 |
| Other activities… | |

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| 3.7. Total number of hours of individual study | 108 |
| 3.8. Total number of hours per semester | 150 |
| 3.9. Number of credits (ECTS) | 5 |

## 4. Prerequisites (if it is the case)

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| 4.1. curriculum | Algorithmics, Probability and Statistics, Programming |
| 4.2. competences | Undergraduate knowledge of Algorithmics and Statistics |

## 5. Requirements (if it is the case)

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| 5.1. for the lecture | Lecture room. For the online activity we will use Google Classroom for course management, Moodle platform, elearning.e-uvt for exams and tests and Google Meet for video conferencing. |

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| 5.2. for the seminar / laboratory | Computer room |

**6. Specific acquired competences**

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| Professional competences | • Machine learning algorithms design, Applications in signal processing |
| Transversal competences | • Project work, team work |

**7. Course objectives**

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| 7.1. General objective | Introduction in Machine Learning |
| 7.2. Specific objectives | Presentation of selected topics of Machine Learning and specific applications |

**8. Content**

| **8.1. Lecture** | **Teaching methods** | **Remarks, details** |
|---|---|---|
| Introduction to Machine Learning. Association Rules | Lecture, exemplification, demonstration | 2h |
| Machine learning types and application domains. Supervised and unsupervised learning examples | Lecture, exemplification, demonstration | 2h |
| Kernel based learning | Lecture, exemplification, demonstration | 2h |
| Support Vector Machines | Lecture, exemplification, demonstration | 2h |
| Reinforcement learning I, II | Lecture, exemplification, demonstration | 4h |
| Neural networks and deep learning I, II, III. Convolutional neural networks. Recurrent neural networks. Autoencoders. Generative adversarial networks | Lecture, exemplification, demonstration | 6h |
| Sparse dictionary learning. Knowledge distillation and curriculum learning. | Lecture, exemplification, demonstration | 4h |
| Machine learning for signal and image processing I, II. Other selected applications. | Lecture, exemplification, demonstration | 4h |

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| Final recap. Projects grading. Exam preparation | Lecture, exemplification, demonstration | 2h |

**Recommended literature**

„Machine Learning”, Tom Mitchell; McGraw-Hill, 1997
„Support Vector Machines and other kernel-based methods”, Nello Cristianini, John Shawe-Taylor, Cambridge University Press, 2000
„Foundations of Statistical Natural Language Processing”, Christopher Manning, Hinrich Schuetze; MIT Press, 2009
„Financial Signal Processing and Machine Learning”, Ali N. Akansu (Editor), Sanjeev R. Kulkarni (Editor), Dmitry M. Malioutov (Editor), Wiley-IEEE Press, May 2016
http://ai.stanford.edu/~nilsson/mlbook.html
http://web.cs.iastate.edu/~honavar/Courses/cs673/machine-learning-courses.html
https://www.coursera.org/learn/machine-learning
https://developers.google.com/machine-learning/crash-course/
„A deep learning approach to condition monitoring of cantilever beams”, D Onchis, Computers in Industry, 2018
“Refined Deep Learning for Digital Objects Recognition via Betti Invariants”. Darian M. Onchis, Codruta Istin, Pedro Real: CAIP (1) 2019: 613-621

| **8.2. Seminar / laboratory** | **Teaching methods** | **Remarks, details** |
|---|---|---|
| Introduction to Machine Learning. Implementation of the Apriori algorithm | Dialog, Problem posing, Implementation | 2h |
| Kernel based learning. SVM examples. | Dialog, Problem posing, Implementation | 2h |
| Reinforcement learning. Implementation of Q-learning and SARSA algorithms. | Dialog, Problem posing, Implementation | 2h |
| Neural networks and deep learning. Implementation and testing of the selected networks. | Dialog, Problem posing, Implementation | 4h |
| Sparse dictionary learning. Applications. | Dialog, Problem posing, Implementation | 2h |
| Machine learning for signal and image processing | Dialog, Problem posing, Implementation | 2h |

**Recommended literature**

„Machine Learning”, Tom Mitchell; McGraw-Hill, 1997
„Support Vector Machines and other kernel-based methods”, Nello Cristianini, John Shawe-Taylor, Cambridge University Press, 2000
“Deep Learning with Python”, François Chollet, November 2017, ISBN 9781617294433
Lab materials: https://darianonchis.wordpress.com/

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| http://scikit-learn.org/stable/<br>https://www.tensorflow.org/<br>https://colab.research.google.com |

**9. Correlations between the content of the course and the requirements of the professional field and relevant employers.**

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| The course contents are not overlapping with the Data Mining course. The course is intended to follow the needs of the IT companies active in the field. |

**10. Evaluation**

| Activity | 10.1. Assessment criteria | 10.2. Assessment methods | 10.3. Weight in the final mark |
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| 10.4. Lecture | Knowledge of machine learning algorithms | Project defense: theoretical part and related questions | 30% |
| | Applications of selected algorithms | Project defense: application part | 30% |
| 10.5. Seminar / laboratory | Usage of specific Machine Learning software | Laboratory assignments | 40% |
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| 10.6. Minimum needed performance for passing | | | |
| Knowledge of basic machine learning algorithms. Realization of a project.<br><br>Kernel based learning and SVMs, specific neural networks<br><br>Correct usage of Machine Learning software packages. | | | |

Date of completion 14.09.2021 | Signature (lecture instructor) | Signature (seminar instructor)

Date of approval | Signature (director of the department)