Universitatea Ștefan cel Mare Suceava

Appendix 1. Course syllabus R40 – F01

COURSE SYLLABUS

1. Program information

Faculty	Faculty of Electrical Engineering and Computer Science
Department	Computer Science
Field of study	Computers and Information Technology
Cycle of studies	Master's Degree
Study Program	Artificial Intelligence & Social Robotics Applied to Global Health

2. Course information

Course name	**ADVANCED MACHINE LEARNING**				
Year of study	1	Semester	1	Evaluation type	Exam
Course regime	Course category by educational content: DF – Fundamental, DS – Specialization, DC – Complementary				DF
	Course category by optionality: DOB – Compulsory, DOP – Optional, DFA – Elective				DOB

3. Total estimated time (hours allocated to teaching activities)

I a) Number of hours per week	3	Lecture	2	Seminar	-	Laboratory / practical work	1	Project	-
I b) Total number of hours per semester according to curriculum	42	Lecture	28	Seminar	-	Laboratory / practical work	14	Project	-

Distribution of time allocation per semester (hours)	No. hours
II. Individual study	105
III. Examinations	3
IV. Other activities (specify):	-

Total individual study hours (II+III)	108
Total hours per semester (I.b+II+III+IV)	150
Number of credits	6

4. Specific competencies acquired

Transversal competencies	CT1 - work in teams
Professional / general competencies	CP2 – develop product design CP4 – develop data processing applications CP5 – apply statistical analysis techniques CP6 – analyze big data

5. Learning outcoms

Knowledge	**Skills**	**Responsibility and autonomy**
The student/graduate identifies, critically evaluates, and applies specialized concepts and methods from the field of artificial intelligence and advanced data analytics as a foundation for original thinking and/or research.	The student/graduate applies advanced supervised and unsupervised machine learning methods, efficient feature selection techniques, and pattern extraction from relational, non-relational, and multimodal data to solve complex problems.	The student/graduate autonomously manages design and development activities by applying artificial intelligence techniques and assumes responsibility for the validity of the mathematical, statistical, and scientific foundations.

6. **Course objectives** (derived from the grid of specific competencies acquired)

General objective of the course	Mastery of advanced machine learning techniques and methods and their application for the development of research, analysis, design, and modeling skills in machine learning-based systems.

7. **Teaching and learning content**

Lectures	**No. of hours**	**Teaching methods**	**Remarks / Notes**
1. Introduction: Core Concepts and Machine Learning Paradigms	2	Lecture, discussion, exemplification, demonstration	
2. Library Overviews: NumPy (Numerical Python), SciPy (Scientific Python), Matplotlib (Python Plotting Library), and Pandas (Python Data Analysis Library)	2		
3. Machine Learning Methods and Models	2		
4. Dimensionality Reduction	2		
5. Supervised Learning (metric-based algorithms)	2		
6. Bayesian Methods	2		
7. Decision Trees	2		
8. Ensemble Methods: The AdaBoost Algorithm	2		
9. Linear and Logistic Regression	2		
10. Classifier Performance Evaluation	2		
11. Unsupervised Learning Methods	4		
12. Deep Learning and Reinforcement Learning	4		

Recommended minimum bibliography

1. Bishop, Christopher. M., Hugh Bishop. (2024). *Deep Learning - Foundations and Concepts*. https://www.bishopbook.com/
2. Osvaldo Simeone. (2022). *Machine Learning for Engineers.* Cambridge University Press.
3. Aurelien Geron. (2019). *Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow*. O'Reilly Media.
4. Yutaka Matsuo, Yann Le Cun et al. (2022). Deep learning, reinforcement learning, and world models. *Neural Networks* 152, 267-275. https://doi.org/10.1016/j.neunet.2022.03.037
5. Ian Goodfellow, Yoshua Bengio, Aaron Courville. (2016). Deep Learning. MIT Press. https://www.deeplearningbook.org/
6. Andreas C. Müller, Muller Andreas C, Sarah Guido. (2016). *Introduction to Machine Learning with Python: A Guide for Data Scientists.* O'Reilly Media.
7. Şt. Gh. Pentiuc. (1997). Aplicaţii ale recunoaşterii formelor în diagnosticul automat. Editura Tehnică, Bucureşti.
8. Norman Fenton, Martin Neil, Probability Theory and Bayesian Belief Bayesian Networks, http://www.eecs.qmul.ac.uk/~norman/BBNs/BBNs.htm

Applications (Seminar / Laboratory / Practical work / Project)	**No. of hours**	**Teaching methods**	**Remarks / Notes**
1. Familiarization with Python, scikit-learn, Kaggle datasets, and data visualization. Working within a team and defining responsibilities.	2	Practical work, experiment, discussion, case study	
2. Study of the k-Nearest Neighbors	2		
3. Supervised Bayesian Learning	2		
4. Unsupervised Learning	2		
5. Hierarchical Clustering	2		
6. Text Document Classification	2		
7. Presentation and defense of homework assignments	2	Demonstration, discussion	

Attendance at compulsory activities is regulated by USV's "Framework Regulation on Student Assessment". Make-up for mandatory practical activities scheduled during the semester is carried out in accordance with the provisions of this regulation. Practical activities scheduled throughout the semester may be replaced by the completion and presentation of high-complexity projects from the course syllabus, with the approval of the course instructor.

Recommended minimum bibliography

1. scikit-learn: Machine Mearning in Python, http://scikit-learn.org/stable/
2. Kaggle Learn, https://www.kaggle.com/learn
3. Google Machine Learning Crash Course, https://developers.google.com/machine-learning/crash-course
4. Osvaldo Simeone. (2022). M*achine Learning for Engineers.* Cambridge University Press.

5. Chollet, F. (2021). *Deep Learning with Python*. Manning Publications, 2nd Ed.Chollet, F.. Deep Learning with Python. Manning Publications, 2nd Edition, 2021

8. **Evaluation**

Type of activity	Evaluation criteria	Evaluation methods	Weight in final grade
Final evaluation	In-depth study, critical analysis, and application of specialized concepts and methods in Machine Learning as a foundation for original research. The capacity to model and solve problems using advanced machine learning techniques and methodologies.	Assessment through a written test.	50%
Evaluation of ongoing practical activities	The ability to utilize efficient feature selection and data pattern extraction techniques, alongside supervised and unsupervised learning algorithms, to solve complex problems.	Continuous assessment through practical examination.	30%
	Execution of comprehensive research assignments, encompassing literature review, theoretical grounding, research planning, and software implementation on empirical datasets, concluded by the synthesis of a technical report.	Summative evaluation through a research assignment (notebook and oral defense).	20%

Physical accessibility: activities are conducted in classrooms and laboratories accessible to wheelchair users via ramps/lifts (USV buildings C/D); **Accessibility of teaching materials:** documents are available in digital PDF format with selectable text and slides with large fonts; **Evaluation accessibility:** ongoing evaluation through projects; possibility of extended time for the written tests and oral verification.

Date	Academic title, Name, Surname, Signature of Course Instructor	Academic title, Name, Surname, Signature of Practical Work Instructor
23.09.2026	Prof. dr. ing. Stefan-Gheorghe PENTIUC	Prof. dr. ing. Stefan-Gheorghe PENTIUC

Date of approval	Academic title, Name, Surname, Signature of Program Coordinator
24.09.2026	Prof. univ. dr. ing. Radu-Daniel VATAVU

Date of departmental approval	Academic title, Name, Surname, Signature of Head of Department
24.09.2026	Prof. univ. dr. ing. Ovidiu-Andrei SCHIPOR

Date of Faculty Council Approval	Academic title, Name, Surname, Signature of Dean
25.09.2026	Prof. univ. dr. ing. Laurentiu-Dan MILICI