SYLLABUS
MACHINE LEARNING

1. **Information on academic programme**

1.1. University	**„1 Decembrie 1918" din Alba Iulia**
1.2. Faculty	**Faculty of Informatics and Engineering**
1.3. Department	**Informatics, Mathematics and Electronics Department**
1.4. Field of Study	**Computer Science**
1.5. Cycle of Study	**Undergraduate**
1.6. Academic programme / Qualification	**Computer Science**

2. **Information of Course Matter**

2.1. **Course**	*Machine Learning*			2.2. **Code**		CSE 311	
2.3. **Course Leader**		Lect.univ.dr. Muntean Maria-Viorela					
2.4. **Seminar Tutor**		Asist.univ.drd. Cristea Daniela					
2.5. Academic Year	**III**	2.6. Semester	**II**	2.7. Type of Evaluation (E – final exam/ CE - colloquy examination / CA -continuous assessment)	**E**	2.8. Type of course (**C**– Compulsory, **Op** – optional, **F** - Facultative)	**Op**

3. Course Structure (Weekly number of hours)

3.1. Weekly number of hours	*5*	3.2. course	***2***	3.3. seminar, laboratory	***3***
3.4. Total number of hours in the curriculum	**60**	3.5. course	***24***	3.6. seminar, laboratory	***36***
Allocation of time:					Hours
Individual study of readers					***40***
Documentation (library)					***20***
Home assignments, Essays, Portfolios					***18***
Tutorials					**-**
Assessment (examinations)					***12***
Other activities…….					**-**

3.7 Total number of hours for individual study	**90**
3.9 Total number of hours per semester	**150**
3.10Number of ECTS	**6**

4. Prerequisites (*where applicable*)

4.1. curriculum-based	***1. Artificial intelligence***
4.2. competence-based	*C2.1 The identification of appropriate methodologies for software systems development.* *C2.2 The identification and explanation of appropriate mechanisms for software systems specification.* *C2.3 The use of methodologies, specification mechanisms and development environments for the development of computer applications.* *C2.4. The use of appropriate criteria and methods for the evaluation of computer applications.*

	C2.5. The development of dedicated computer projects. *C3.1. The description of concepts, theories and models used in the application field.* *C3.2 The identification and explanation of base computer models that is suitable for the application domain.* *C3.3. The use of computer and mathematical models and tools to solve specific problems in the application field.* *C3.4. Data and model analysis.* *C3.5. The development of software components of interdisciplinary projects.* *C4.1 The definition of base concepts and principles of computer science and mathematics as well as of the mathematical theories and models.* *C4.2 The interpretation of mathematical and computer science (formal) models.* *C4.3 The identification of appropriate models and methods for solving real-life problems.* *C4.4 The use of simulation in the study of the behavior of developed models and evaluation of results.* *C4.5 The embedding of formal models in specific applications in various domains.*

5. Requisites (*where applicable*)

5.1. course-related	Room equipped with video projector and board
5.2. seminar/laboratory-based	*Laboratory – computers, Software: Matlab minimum 6.5, Python minimum 2.7, Internet access.*

6. Specific competences to be acquired (chosen by the course leader from the programme general competences grid)

Professional competences	***C1. Programming in high-level languages*** *C1.1 The appropriate description of programming paradigms and of specific language mechanisms, as well as the identification of differences between semantic and syntactic aspects.* *C1.2 The explaining of existing software applications using different abstraction layers (architecture, packages, classes, methods), correctly using base knowledge.* *C1.3 The development of correct source codes and the testing of various components in a known programming language, given a set of design specifications.* *C1.4 The testing of various applications given specific testing plans* *C1.5 Developing program units and their documentation.* ***C2. Development and maintenance of computer applications*** *C2.1 The identification of appropriate methodologies for software systems development.* *C2.2 The identification and explanation of appropriate mechanisms for software systems specification.* *C2.3 The use of methodologies, specification mechanisms and development environments for the development of computer applications.* *C2.4. The use of appropriate criteria and methods for the evaluation of computer applications.* *C2.5. The development of dedicated computer projects.* ***C3. The use of computer tools in an interdisciplinary context*** *C3.1. The description of concepts, theories and models used in the application field.* *C3.2 The identification and explanation of base computer models that are suitable for the application domain.* *C3.3. The use of computer and mathematical models and tools to solve specific problems in the application field.* *C3.4. Data and model analysis.* *C3.5. The development of software components of interdisciplinary projects.*
Transversal competences	-

7. Course objectives (as per the programme specific competences grid)

7.1 General objectives of the course	*The course provides an introduction to the theory and practice of Machine Learning as part of Artificial Intelligence.* *The course presents the main learning concepts: decision trees, neural networks, instance-based learning, analytical learning, Bayesian learning, Support Vector Machines. It also introduces the main approaches and developments in pattern recognition (statistical approach, neural approach, syntactic approach).*
7.2 Specific objectives of the course	

8. Course contents

8.1 Course (learning units)	**Teaching methods**	**Remarks**
1. Introduction to Machine Learning. Concept learning.	***Lecture, conversation, exemplification***	2h
2. Decision Trees	***Lecture, conversation, exemplification***	2h
3. Artificial Neural Networks	***Lecture, conversation, exemplification***	2h
4. Assumptions evaluation and Bayesian learning.	***Lecture, conversation, exemplification***	2h
5. Instance-based learning. Analytical learning	***Lecture, conversation, exemplification***	2h
6. Machine Learning and Data Mining	***Lecture, conversation, exemplification***	2h
7. Support Vector Machines	***Lecture, conversation, exemplification***	2h
8. Approaches to pattern recognition. Classification methods.	***Lecture, conversation, exemplification***	2h
9. Statistical approaches to pattern recognition. Feature selection.	***Lecture, conversation, exemplification***	2h
10. Syntactic elements in pattern recognitions	***Lecture, conversation, exemplification***	2h
11. Clustering methods. K-means algorithm.	***Lecture, conversation, exemplification***	2h
12. Image Analysis Techniques.	***Lecture, conversation, exemplification***	2h
Seminars-laboratories	**Teaching methods**	
1. Supervised and unsupervised learning. Applications in Matlab and R language.	***Laboratory activities***	3h
2. Bayesian learning. Matlab implementations	***Project-work, computer-based activities, laboratory activities***	3h
3. Instance-based learning. Analytical learning. Matlab and R language implementations	***Project-work, computer-based activities, laboratory activities***	3h
4. Decision trees. Implementation and examples.	***Project-work, computer-based activities, laboratory activities***	3h
5. Classification techniques using the k-nearest neighbor. Implementation in one programming language of choice (Matlab, R, C++, Python)	***Project-work, computer-based activities, laboratory activities***	3h

6. Support Vector Machines. Matlab implementation.	***Project-work, computer-based activities, laboratory activities***	3h
7. Neural networks. Applications and examples.	***Project-work, computer-based activities, laboratory activities***	3h
8. Unsupervised K-means algorithm. Applications and examples.	***Project-work, computer-based activities, laboratory activities***	3h
9. Approaches to pattern recognition. Feature selection. Syntactic elements in pattern recognitions. Matlab implementations.	***Project-work, computer-based activities, laboratory activities***	3h
10. Image Analysis Techniques. Examples.	***Project-work, computer-based activities, laboratory activities***	6h
11. Practical evaluation.	***Project-work, computer-based activities, laboratory activities***	3h

References

1. Bishop, Christopher M., *Pattern Recognition and Machine Learning*, 1st ed. 2006 Springer-Verlag New York, Inc. Secaucus, NJ, USA, ISBN 978-0-387-31073-2.
2. Stephen Marsland, *Machine Learning: An Algorithmic Perspective*, Chapman & Hall/CRC Machine Learning & Pattern Recognition, 2009, ISBN-10: 1420067184, ISBN-13: 978-1420067187.
3. Mitchell, T., *Machine Learning*, The McGraw-Hill Companies, Inc., 1997, pp. 52-78.
4. Morariu, D. I., *Text Mining Methods based on Support Vector Machines*, ed. MATRIX ROM, Bucureşti, 2008.
5. Kaelbling, L. P., *Learning in Embedded Systems*, MIT Press, 1993.
6. Cristianini, N., and Shawe-Taylor, J., *An Introduction to Support Vector Machines and Other Kernel-based Learning Methods*, Cambridge University Press, 2000, ISBN: 0521780195.
7. Haykin, S., *Neural Networks: A Comprehensive Foundation*, Prentice Hall, 1999.
8. Abe, S., *Support Vector Machines for Pattern Classification*, Second Edition, Springer New York Dordrecht Heidelberg London, 2010, ISBN: 978-1-84996-097-7, DOI: 10.1007/ 978-1-84996-098-4.
9. Lampert, C., *Kernel Methods in Computer Vision*, Foundations and Trends in Computer Graphics and Vision: Vol. 4: No 3, 2009.
10. Han, J., Kamber, M., *Data Mining: Concepts and Techniques*, Second Edition, Morgan Kaufmann Press, Elsevier Inc, San Francisco, ISBN 13: 978-1-55860-901-3, ISBN 10: 1-55860-901-6, 2006.
11. Bramer, M., *Principles of Data Mining*, Springer-Verlag, London, ISBN-10: 1-84628-765-0, ISBN-13: 978-1-84628-765-7, 2007.
12. Witten, I., H., Frank, E., *Data Mining. Practical Machine Learning Tools and Techniques*, Second Edition, Kaufmann Press, Elsevier Inc, San Francisco, ISBN: 0-12-088407-0, 2005.
13. Kargupta, H., Han, J., Yu, P., S., Motwani, R., Kumar, V., *Next Generation of Data Mining*, Chapman & Hall / CRC, Taylor and Francis Group, 2010, ISBN: 978-1-4200-8586-0.
14. RUSSELL, Stuart J., NORVIG, Peter, *Artificial Intelligence: a modern approach*, 3rd ed., Upper Saddle River, NJ: Pearson Education, 2010, ISBN 978-0-13-207148-2.
15. PYTHON MACHINE LEARNING: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2, Sebastian RASCHKA; Vahid MIRJALILI (2019), Autori: RASCHKA, Sebastian; MIRJALILI, Vahid, Ediție: Editia a treia, Third Edition - Includes TensorFlow 2, GANs, and Reinforcement Learning, ISBN: 9781789955750
16. HANDS-ON MACHINE LEARNING WITH SCIKIT-LEARN, KERAS / Aurelien GERON (2019), Autori: GERON, Aurelien, Ediție: Editia a doua, ISBN: 9781492032649
17. http://www.cs.uiuc.edu/class/fa06/cs446/
18. *IEEE Transactions on Machine Learning and Pattern Recognition*

9. Corroboration of course contents with the expectations of the epistemic community's significant representatives, professional associations and employers in the field of the academic programme

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10. Assessment

Activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Course	*Final evaluation*	*Tests, control papers*	50%
10.5 Seminar/laboratory	*Continuous assessment*	*Laboratory activities/projects portfolio*	50%
10.6 Minimum performance standard: grade 5 on all criteria			

Submission date _____

Course leader signature _____

Seminar tutor signature _____

Date of approval by Department members _____

Department director signature _____