General information		
Course leader	**Leo Mršić, PhD, Assistant Professor**	
Course title	**Machine learning concepts and techniques**	
Study programme		
Course status	Mandatory	
Year	Year 1, semester 1	
Number of credits and mode of teaching delivery	ECTS student workload coefficient	4
	Number of hours (L+E+S)	45 (30 P + 15 V + 0 S)

COURSE DESCRIPTION
14. *Course objectives*
Machine learning is the name for a group of algorithms for automatic data processing. Machine learning forms the foundation of today's data science. Data processing by machine learning methods results in a predictive model, but applications are far wider than the prediction itself, so machine learning is used for any input and output mapping that is too hard to manually input or for which there are no clearly defined rules to be entered, or these rules change too often. Machine Learning is divided into supervised, uncontrolled and awarded. This course will deal primarily with supervised machine learning, although the part will be dedicated to uncontrolled. Deep learning is today the most important machine learning method used in the world's most important production systems for various tasks. Through this course, we will present and implement basic deep learning techniques on examples from natural language processing such as machine translation, sentiment analysis, and recognition of named entities. Also, the course will handle awarded learning. The course objective is to familiarize students with basic machine learning algorithms and basic techniques of their optimization, as well as the methods of reduction of features, to enable students to deepen their understanding of mathematics and algorithms of deep neural architecture and deep learning, as well as acquire practical knowledge to implement deep learning. Students will acquire the skills of designing deep architecture in TensorFlow, as well as hand-made deep neural networks that can be implemented later in any programming language.
15. *Conditions for enrolment in the course*
No formal conditions.
16. *Expected learning outcomes of the course*
• **LO1: Judge which algorithm is best for a particular problem** • **LO2: Critically evaluate the components of selected algorithms for machine learning and find out which type of problem the algorithm is most appropriate for** • **LO3: Evaluate the impact of various feature reductions**

- **LO4: Directly apply the selected machine learning method to the selected problem and completely solve it and critically evaluate changes in information during passage through artificial neuron**
- **LO5: Evaluate the influence of different components of deep neural architecture**
- **LO6: Directly apply the selected depth architecture to the problems of natural language processing and computer vision**
- **LO7: Design concepts of deep architecture in TensorFlow**
- **LO8: Design concepts of hand-made deep neural networks**
- **LO9: Design concepts of natural language processing services**

17. *Course content*

Introduction to Machine Learning. Decision trees. Normalization and Data Cleansing. Linear regression, regression tree. Efficiency measures. Random woods. Support vector machines. PCA / ICA. XGBOOST, LIGHTGBM. Uncontrolled study. Logistic regression.
Introduction to deep learning. Perceptron. Logistic Regression. Artificial neural networks. Stochastic gradient descent. Regularization. Convolutional neural networks. Autoencoders. Recurrent neural networks. Neural language models. Trends and future.

18. *Teaching delivery modes:*	lectures seminars and workshops exercises remote learning field work	independent work multimedia and network laboratory mentoring other _____
19. *Comments*		

20. *Student obligations*

STUDENT ATTENDANCE

Class attendance is mandatory in the percentage prescribed by the Studies and examination regulations.

PASSING THE EXAM
The course has defined learning outcomes. In order for a student to pass the course, he/she must achieve a minimum of 50% of the points available for each learning outcome and collect a minimum of 50.01 points out of a possible 100 points per course.

21. *Monitoring[5] student work*

Class attendance		Activity during class	10%	Seminar paper		Experimental work	
Written exam	90%	Oral exam		Essay		Research	
Project		Continuous assessment of knowledge		Student report		Practical work	
Portfolio							

22. *Assessment and evaluation of student work during classes and the final exam*

A grading system based is on a credit accumulation model combined with a defined sub-model, providing a model of the grading method and checking the satisfaction of learning outcomes used in this course.

CONCRETE REVIEW OF EVALUATION METHODS

The maximum number of points that a student can earn in a course is 100. Grades are calculated according to the following criteria table within which the distribution of passing grades in terms of the number of points is applied.

Points	Grade
0,00 - 50,00	(1) unsatisfactory
50,01 - 58,00	(2) sufficient
58,01 - 75,00	(3) good
75,01 - 92,00	(4) very good
92,01 - 100,00	(5) excellent

The method of accumulating points is determined in this course in accordance with the elements of scoring as follows:

Criterion	Maximum points
Written exam	90
Activity during class	10
TOTAL	100

The way of taking the colloquiums, the learning outcomes it covers, as well as the implementation of exams and remedial exams are defined by the "Instructions for attending and taking the course".

23. *Required reading (at the moment of submitting the joint study programme report)*

Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, 2017 edition, Introduction to Statistical Learning
Aurélien Géron, Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems
S.Skansi 2018. Introduction to Deep Learning. Springer
Goodfellow, I., Bengio, Y., Courville, A. 2016. Deep Learning (Adaptive Computation and Machine Learning series). Cambridge: MIT Press https://arxiv.org/abs/1609.08144

24. *Additional reading (at the moment of submitting the joint study programme report)*

25. *Number of copies of required reading in relation to the number of students who currently attend a course*

Title	*Number of copies*	*Number of students*

26. *Methods of quality monitoring that ensure the acquisition of knowledge, skills and competencies.*
Monitoring the fulfilment of the desired learning outcomes is an important element of assessment because learning outcomes are the "guarantees" that the school gives to students, but also to employers and the wider community. Learning outcomes represent the minimum threshold that each student must achieve in order to pass the course. For a passing grade, the student must satisfy all the learning outcomes with the demonstrated knowledge, which corresponds to 50% of the points achieved for each learning outcome. The method of scoring based on learning outcomes is presented in the document "Instructions for attending and taking the course".