Specification for the book of courses

Study program		Electrical Engineering and Computer Science	
Module		Communications and Information Technologies - Communications and Information Processing	
Type and level of studies		Undergraduate Academic Studies	
The name of the course		Machine Learning in Communications	
Lecturer (for lectures)		Perić H. Zoran, Ćirić G. Dejan, Nikolić R. Jelena	
Lecturer/associate (for exercises)		Nikolić R. Jelena, Ćirić G. Dejan	
Lecturer/associate (for OFE)		Nikolić R. Jelena, Ćirić G. Dejan	
Number of ECTS	6	**Course status (obligatory/elective)**	Elective
Prerequisites			
Course objectives	Providing fundamental knowledge about machine learning methods and algorithms (types of learning, regression, training and testing, regularization, neural networks). Training students to analyze and understand the essence of engineering problems in modern communications that are processed and solved by applying the machine learning methods.		
Course outcomes	Acquired knowledge about machine learning algorithms and potentials for their applications as well as gained practical experience in working with software tools for machine learning.		
Course outline			
Theoretical teaching	Introduction to machine learning. Supervised learning. Algorithm of the nearest neighbor. Linear regression. Logistic regression. Target function. Data models. Hypotheses, hypothesis space. Learning algorithms. Training set, test set. Models based on instances. Minimization of the error function. Training techniques. Central challenges in machine learning: underfitting and overfitting. Regularization for prevention of overfitting. Learning curve. Artificial neural networks. Neural network training (backward propagation). Extremely Fast Learning Method (ELM). Support Vector Machines (SVM). Unsupervised learning. Maximum Likelihood Estimation for unsupervised learning, regression and classification. Reinforced learning. Dimensionality reduction (the problem of analyzing the principal component). Anomaly detection. Comparison of the machine learning methods. Machine learning for large data sets. Applications of machine learning.		
Practical teaching (exercises, OFE, study and research	Practical exercises: theoretical and practical knowledge is acquired by solving tasks and some practical problems in machine learning and students have the opportunity to understand the importance of applying machine learning algorithms. Laboratory exercises: students gain practical experience in working with software tools for implementation of machine learning algorithms.		
Textbooks/references			
1	T. Hastie, R. Tibshirani, J. Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd Edition, Springer, 2009.		
2	I. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016.		
3	C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2007.		
4	G. James, D. Witten, T. Hastie, R. Tibshirani, An Introduction to Statistical Learningwith Applications in R, Springer, 2017.		
5	I. H. Witten, E. Frank, M. Hall, Data Mining:Practical Machine Learning Tools and Techniques, 4th ed., Morgan Kaufmann, Elsevier, Cambridge, USA, 2017		

Number of classes of active education per week during semester/trimester/year

Lectures	Exercises	OFE	Study and research work	Other classes
3	1	1	0	0

Teaching methods	Lectures, Power Point presentations, practical exercises, practical training on computers, homework assignments, consultations.

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points
Activity during lectures	5	**Written exam**	25
Exercises	20	**Oral exam**	25
Colloquia	25		
Projects			