Faculty of Electrical Engineering / /

Course:				
Course ID	**Course status**	**Semester**	**ECTS credits**	**Lessons** (Lessons+Exercises+Laboratory)
13296	Mandatory	3	6	3+0+1
Programs				
Prerequisites	Fundamentals of Machine Learning and Artificial Intelligence			
Aims	Through this course, students become familiar with modern computer vision methods based on deep learning, popular programming libraries for working with neural networks. Additionally, students are introduced to the three basic tasks of computer vision - image classification, image segmentation, and object detection in images.			
Learning outcomes	After passing this exam, the student will be able to correctly use the Keras and TensorFlow programming libraries, create a model of a fully connected neural network according to the given specification, create a model of a convolutional neural network according to the given specification, perform image classification through deep learning in a predefined image database, and perform image segmentation through deep learning.			
Lecturer / Teaching assistant	Prof. dr Nikola Žarić			
Methodology	Lectures and exercises in a computer classroom / laboratory. Learning and independent completion of practical tasks. Consultations.			
Plan and program of work				
Preparing week	Preparation and registration of the semester			
I week lectures	Introduction to computer vision. Review of linear algebra material.			
I week exercises	Review of linear algebra material.			
II week lectures	Python – review. Working with the Keras and TensorFlow libraries.			
II week exercises	Python, Numpy, TensorFlow, Keras			
III week lectures	Mathematical model of neural networks. Representation of data for neural networks. Working with tensors.			
III week exercises	Mathematical model of neural networks. Representation of data for neural networks. Working with tensors.			
IV week lectures	Gradient optimization method. Backpropagation.			
IV week exercises	Training the first neural network			
V week lectures	Deep learning. Convolutional neural networks. Building blocks of convolutional neural networks.			
V week exercises	Training the first convolutional neural network			
VI week lectures	Convolutional neural networks – well-known architectures.			
VI week exercises	--			
VII week lectures	Midterm exam			
VII week exercises	Midterm exam			
VIII week lectures	Image classification.			
VIII week exercises	Training a convolutional neural network for image classification			
IX week lectures	Image classification – continuation.			
IX week exercises	Image classification.			
X week lectures	Image segmentation.			
X week exercises	Image segmentation.			
XI week lectures	Object detection in images. Popular models.			
XI week exercises	Object detection in images. Popular models.			
XII week lectures	Techniques for enhancing deep network training (data augmentation). Using pre-trained models - fine-tuning the network.			
XII week exercises	Techniques for enhancing deep network training (data augmentation). Using pre-trained models - fine-			

	tuning the network.
XIII week lectures	Make-up exam for the midterm
XIII week exercises	Make-up exam for the midterm
XIV week lectures	Presentations of student projects
XIV week exercises	Presentations of student projects
XV week lectures	Presentations of student projects
XV week exercises	Presentations of student projects
Student workload	6 credits x 40/30 = 8 hours

Per week	**Per semester**
6 credits x 40/30=8 hours and 0 minuts 3 sat(a) theoretical classes 1 sat(a) practical classes 0 excercises **4 hour(s) i 0 minuts** of independent work, including consultations	Classes and final exam: **8 hour(s) i 0 minuts x 16 =128 hour(s) i 0 minuts** Necessary preparation before the beginning of the semester (administration, registration, certification): **8 hour(s) i 0 minuts x 2 =16 hour(s) i 0 minuts** Total workload for the subject: **6 x 30=180 hour(s)** Additional work for exam preparation in the preparing exam period, including taking the remedial exam from 0 to 30 hours (remaining time from the first two items to the total load for the item) **36 hour(s) i 0 minuts** Workload structure: **128 hour(s) i 0 minuts (cources), 16 hour(s) i 0 minuts (preparation), 36 hour(s) i 0 minuts (additional work)**
Student obligations	Regular attendance at lectures, appropriate behavior, participation in assessments (midterms and final project).
Consultations	By agreement
Literature	François Chollet, Deep Learning with Python, Second Edition, Manning Publications Co, 2021.
Examination methods	Midterm exam: total of 50 points Project: total of 50 points Note: To be eligible to work on the project, the student must score at least 50% on the midterm exam.
Special remarks	
Comment	To be eligible to work on the project, the student must score at least 50% on the midterm exam.

Grade:	F	E	D	C	B	A
Number of points	less than 50 points	greater than or equal to 50 points and less than 60 points	greater than or equal to 60 points and less than 70 points	greater than or equal to 70 points and less than 80 points	greater than or equal to 80 points and less than 90 points	greater than or equal to 90 points