M124	**Advanced concepts in machine learning**	L	P	S	ECTS
		3	2	1	8

Course objectives. Introduce students with modern neural networks and their applications in computer vision and natural language understanding. The course starts with a recap of linear models and discussion of stochastic optimization methods that are crucial for training deep neural networks. Students will study all popular building blocks of neural networks including fully connected layers, convolutional and recurrent layers. Students will use these building blocks to define complex modern architectures in PyTorch or TensorFlow frameworks.

Prerequisites. Machine learning

Course content.

1. Introduction. Different network architectures.
2. Algorithms for computation (approximation) of gradient in deep networks.
3. Regularization for deep learning. Optimization for training deep models.
4. Convolutional networks.
5. Sequence modelling. Recurrent and recursive nets.
6. Practical methodology: performance metrics, baseline models, selecting hyperparameters, debugging strategies.

LEARNING OUTCOMES

No.	LEARNING OUTCOMES
1.	Understanding neural network and different network architectures.
2.	Applying different methods for computing gradient in deep networks.
3.	Applying regularization techniques.
4.	Understanding convolutional architectures and understand the set of problems they apply to.
5.	Understanding recurrent architectures and understand the set of problems they apply to.
6.	Using at least one programming library for practical usage of neural networks on real problems, such as PyTorch, or TensorFlow.
7.	Being able to explain advantages and disadvantages of deep learning.

RELATING THE LEARNING OUTCOMES, ORGANIZATION OF THE EDUCATIONAL PROCESS AND ASSESSMENT OF THE LEARNING OUTCOMES

TEACHING ACTIVITY	ECTS	LEARNING OUTCOME **	STUDENT ACTIVITY*	EVALUATION METHOD	POINTS	
					min	max
Attending lectures and exercises	1	1-7	Lecture attendance, discussion, teams work, independent work on given tasks and short written exams	Attendance lists, tracking activities, closed form exercises	0	4
Homework assignments	1	1-7	Independent work on given problems	Evaluation	0	4
Written exam (Mid-terms)	3	1-8	Preparing for written exam	Evaluation	25	46

Final exam	3	1-8	Revision	Oral exam	25	46
TOTAL	8				50	100

Teaching methods and student assessment. Lectures and exercises are obligatory. The exam consists of a written and an oral part. Upon completion of the course, students can take the exam. Successful midterm exam scores replace the written exam. Exercises are both auditory and laboratory. Laboratory exercises include the usage of computers. Students can improve their grades by writing homework assignments and seminars.

Can the course be taught in English: Yes

Basic literature:

1. I. Goodfellow, Y. Bengio, A. Courville, Deep Learning, The MIT Press, Cambridge, 2016.

Recommended literature:

1. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.