COURSE UNIT DESCRIPTION

Course unit title	Course unit code
Deep Learning	

Lecturer(s)	Department where the course unit is delivered
Coordinator: Linas Petkevičius **Other lecturers:**	Department of Software Engineering Institute of Computer Science Faculty of Mathematics and Informatics Vilnius University

Cycle	Type of the course unit
Second	Optional

Mode of delivery	Semester or period when the course unit is delivered	Language of instruction
Face-to-face	Spring semester	Lithuanian

Prerequisites
Prerequisites:

Number of credits allocated	Student's workload	Contact hours	Individual work
5	**125**	**42**	**83**

Purpose of the course unit: programme competences to be developed

Purpose of the course unit – to acquire knowledge of regression/classification usage for complex structure data, generative models, reinforcement and deep learning. Principles of use deep learning methods for detection and segmentation tasks. Complex data analysis, practical knowledge of machine/deep frameworks. Developing teamwork skills, developing critical and analytical thinking.

Generic competences:

- To solve non-standard theoretical and empirical tasks creatively (GC1).
- Critically analyze and properly use the scientific literature (GC2).
- Use interdisciplinary knowledge (GC2)

Specific competences:

- Know and understand the basic principles and problems of data science at a higher level (SC5).
- Evaluate the adequacy of statistical models and correct them (SC8);
- Analyze large data (SC9);
- Prepare initial data for research and professional use of data analysis packages (SC10);

Learning outcomes of the course unit: students will be able to	Teaching and learning methods	Assessment methods
Develop applications using machine/deep learning paradigm, by applying open-source deep learning frameworks.	Lectures, problem-oriented teaching, case studies, information retrieval, literary reading, individual work, tutorials, laboratory work.	Written exam Laboratory works Defending team project
Design, implementand develop applied data analysis programs on complex data.		
Develop the knowledge how to prepare technical reports, present results. Develop practical skills of statistical learning procedures (training, validation, testing), be able to use generative models.		

Course content: breakdown of the topics
Course introduction, frameworks.
Definitions form linear algebra, convolutions, kernels.
Definitions from probability and information theory.
Numerical computations, data flow paradigm, automatic differentiation.
Parameters estimation, numerical optimization, regularization.
Data compression, autoencoders
Convolutional neural network, classification
Convolutional neural network, detection
Convolutional neural network, segmentation
Recurrent neural networks
Recurrent neural networks, text analysis
External memory models
Generative models, GAN
Reinforcement learning
Reinforcement learning, policies, applications.
Project presentations.
Preparation for exam. Exam.

Assessment strategy	Weight %	Deadline	Assessment criteria
Laboratory assignment No. 1 & 2	40%	8th and 15th week of the semester	Students have to implement software and be defended of given task applying the method presented during lectures and previous laboratory work tasks. The penalty for exceeding the deadline is 0.1 points for each week exceeding the deadline.
Defending project	30%	16th week of the semester	Practical project: the team of 2-3 students do the project; In the begin of the semester the team select publication from the given list. In hole semester team analyze the publication and applying to given task. Technical report up to 8 pages must be prepared. In the report defense the methodology from paper, results on new task and conclusions must be presented.
Written exam	30%		Exam can be taken only when laboratory assignments defended or team project defended. Maximum 3 points can be collected, which attribute to the 30% of the final score. The exam consists of 20 open, semi-open and close-ended questions and tasks each of them is assessed between 0.1 and 0.5 points (accordingly to the difficulties). Questions and tasks are formulated from topics set out in lectures.

Author	Publishing year	Title	Number or volume	Publisher or URL
Required reading				

Goodfellow, Ian, Yoshua Bengio, Aaron Courville	2016	Deep learning		MIT press, 2016, ISBN: 9780262035613
Kevin P. Murphy	2012	Machine Learning: A Probabilistic Perspective		MIT press, 2012, ISBN: 978-0-262-01802-9
Sutton, Richard S., Andrew G. Barto	1998	Reinforcement learning: An introduction	Vol. 1. No. 1.	Cambridge: MIT press, 1998, ISBN: 9780262193986
Recommended reading				
T. Hastie, R. Tibshirani, J. Friedman	2008	The Elements of Statistical Learning		Springer
David J. C. MacKay	2003	Information Theory, Inference, and Learning Algorithms		Cambridge university press, ISBN: 9780521642989