Subject code	ECTS credits
INF5007	6

Course title in Lithuanian

NEURONINIAI TINKLAI

Course title in English

NEURAL NETWORKS

Short course annotation in Lithuanian (up to 500 characters)

Kurse nagrinėjami dirbtinių ir biologinių neuronų tinklų sudarymo, analizės ir taikymo principai: dirbtinių neuroninių tinklų taikymas klasifikavimo ir prognozavimo uždaviniams spręsti, asociatyvinės ir autoasociatyvinės atmintys; prognozavimo ir klasifikavimo tikslumo rodikliai ir jų įvertinimas, duomenų paruošimas; neuroinformatika ir biologinių neuronų bei jų formuojamų tinklų modeliavimo principai; neuroninių sistemų pritaikymas robotikoje.

Short course annotation in English (up to 500 characters)

The goal of this course is to introduce the students with theory and application of artificial and biological neural networks: artificial neural networks for classification and prediction, associative and autoassociative memories, accuracy estimation in classification and prediction, feature selection and extraction; neuroinformatics and biologically realistic neural networks; application of neural systems in robotics.

Prerequisites for entering the course

Probability Theory, Mathematical Statistics, Algebra

Course aim

Course aim is to provide knowledge of artificial neural network theory and theoretical neuroscience, develop students' skills in applying artificial neural networks in real-world tasks.

Links between study programme outcomes, course outcomes, criteria of learning achievement evaluation, study methods and methods of learning achievement assessment

Course outcomes	Criteria of learning achievement evaluation	Study methods	Methods of learning achievement assessment
1. Knowledge and understanding of neural networks in prediction, pattern recognition, robot control tasks	Student demonstrates the knowledge and understanding of neural networks by solving the tasks and providing a theoretical background	Lectures, practical works, individual work	Mid-term exam
2. Ability to use neural networks in prediction, pattern recognition, robot control tasks and to interpret the results; ability to select an appropriate neural network; ability to estimate the performance of the neural system.	Student demonstrates the ability to apply neural networks in prediction, pattern recognition, robot control tasks for the teacher supplied problem using MATLAB or other programming language	Lectures, practical works, individual work	Mid-term exam
3. Ability to extract meaningful parameters for neural network applications and solve real-world tasks.	Student shows ability to select appropriated feature selections and extraction algorithms for classification and prediction given real-world problems.	Lectures, practical works, individual work	Exam
4. Identify developed model problems and solve them	Student demonstrates the ability to identify problems of neural methods and find problems solution methods	Lectures, practical works, individual work	Exam

5. Understand principles of modelling biologically realistic neural systems and links between artificial and biologically realistic neural networks.	Student demonstrates ability to define the main principles of modelling biologically realistic neural networks and compare the advantages and limitations of artificial and biologically realistic neural networks	Lectures, practical works, individual work	Essay presentations
6. Present report of performed study	Student formulates a task, presents solution, formulates conclusions	Individual work, self-study of literature, discussions, consulting	Essay presentations

Links between study programme outcomes and course outcomes

Study programme outcomes	Running number of course outcome					
	1	**2**	**3**	**4**	**5**	**6**
4. Identify, select and understand the state-of-the-art literature of mathematics and apply the gained knowledge to specific scientific and practical tasks	+	+		+		
5. Develop mathematical models integrating the knowledge from various fields and different mathematical modelling techniques, and analyse the modelling results assessing the model adequacy and accuracy	+	+	+	+	+	
11. Convey mathematical information to specialists of different fields orally and/or in written form, critically evaluate it					+	+
13. Take moral responsibility for the results of work						+

Content

No.	Content (topics)
1.	Neuroinformatics.
2.	Neural networks in biological systems.
3.	Unsupervised learning. Hebb's learning rule. Associative and autoassociative memory.
4.	Supervised learning. Single-layer perceptron.
5.	Multi-layer perceptron. Back-propagation learning.
6.	Overtraining. Performance accuracy evaluation.
7.	Feature extraction and selection.
8.	Radial Basis Neural networks.
9.	Learning Vector Quantization.
10.	Support vector machines.
11.	Reinforcement learning. Policy gradient learning. Neuronal robot control
12.	Presentation of project results.

Distribution of workload for students (contact and independent work hours)

Lectures	**30 hours**
Seminars and laboratory work	**30 hours**
Individual students work	**100 hours**
Total:	**160 hours**

Structure of cumulative score and value of its constituent parts

Final written exam (50%), mid-term written exam (17%), and assessments of homework work (33%).

Recommended reference materials

No.	Publication year	Authors of publication and title	Publishing house	Number of copies in		
				University library	*Self-study rooms*	*Other libraries*
Basic materials						
1.	1994	S. Haykin. Neural Networks: A	IEEE Press/Macmillan	1		

		Comprehensive Foundation.	College Publishing Company, New York,			
2.	2001	Š. Raudys. Statistical and Neural Classifiers: An integrated approach to design	Springer, London	1		
3.	2014	M.T.Hagan, H.W.Demuth. Neural Network Design. http://hagan.okstate.edu/NNDesign.pdf		eBook	eBook	eBook
Supplementary materials						
1.	1999	Koch, C. Biophysics of Computation: Information Processing in Single Neurons	Oxford University Press: New York, New York,	1		

Course programme designed by

Prof. Dr. Minija Tamošiūnaitė, Assoc. Prof. Dr. Aušra Saudargienė