SYLLABUS OF A MODULE

Polish name of a module	**SZTUCZNE SIECI NEURONOWE**
English name of a module	**ARTIFICIAL NEURAL NETWORKS**
ISCED classification - Code	0613
ISCED classification - Field of study	Software and applications development and analysis
Languages of instruction	English
Level of qualification: ***1 – BSc (EQF 6)*** ***2 – MSc (EQF 7)*** ***3 – PhD (EQF 8)***	*2*
Number of ECTS credit points	*5*
Examination: ***EO – exam oral*** ***EW – exam written*** ***A - assignment***	*EW*
Available in semester: ***S – Spring only*** ***A – autumn only*** ***Y - booth***	*S*

Number of hours per semester:

Lecture	Exercises	Laboratory	Seminar	E-learning	Project
15E		45			

MODULE DESCRIPTION

MODULE OBJECTIVES

O1. Familiarizing students with the principles of operation of basic artificial neural network models

O2. Learning the algorithms for training artificial neural networks

O3. Becoming familiar with available external tools for building artificial neural networks

PRELIMINARY REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic programming skills
2. Knowledge of basic mathematical analysis and probability
3. Knowledge of the English language

LEARNING OUTCOMES

LO 1 – The student has knowledge of modern methods for creating artificial neural networks and deep learning.

LO 2 – Can create models of artificial neural networks, including deep and convolutional networks.

LO 3 – Can think and act creatively and entrepreneurially.

MODULE CONTENT

Type of classes – lecture	**Number of hours**
Lec 1 - Introduction	**1**
Lec 2 - Various neuron models	**1**
Lec 3 - Mulilayer neural networks	**1**
Lec 4 - Backpropagation	**1**
Lec 5 - Loss functions and optimizers	**1**
Lec 6 - Filters in image processing	**1**
Lec 7 - Convolutional neural networks.	**1**
Lec 8 - Transfer learning.	**1**
Lec 9 - Popular model of convolutional neural networks	**1**
Lec 10 - Basics of recurrent neural networks (Elman, Jordan)	**1**
Lec 11 - LSTM, GRU	**1**
Lec 12 - Echo-State Network	**1**
Lec 13 - Convolutional LSTM	**1**
Lec 14 - Hopfield neural networks, BAM	**1**
Lec 15 - WTA, WTM	**1**
Sum	**15**
Type of classes– laboratory.	**Number of hours**
Lab 1 - Introduction to the programing environment	**3**
Lab 2 - Data generators	**3**
Lab 3 - Perceptron and sigmoidal neuron	**3**
Lab 4 - Backpropagation algorithm	**3**
Lab 5 - The external package to neural network training	**3**
Lab 6 - Various aspects of multilayer neural networks training	**3**
Lab 7 - Introduction to convolutional neural networks	**3**
Lab 8 - Various aspects of convolutional neural networks training.	**3**
Lab 9 - Application of pre-trained models	**3**
Lab 10 - Introduction to recurent neural networks	**3**
Lab 11 - Various aspects of recurent neural networks training	**3**
Lab 12 - Combination of convolutional and recurrent networks	**3**
Lab 13 - Convolutional LSTM in practice	**3**
Lab 14 - Creating Hopfield neural networks	**3**
Lab 15 - Hopfield neural networks for image reconstruction	**3**
Sum	**45**

TEACHING TOOLS

1. Lecture using multimedia presentations
2. Preparation of reports on the implementation of the exercises
3. Instructions for performing laboratory exercises
4. Laboratory equipped with PC-class computers

WAYS OF ASSESSMENT (F – FORMATIVE, S – SUMMATIVE

F1. - assessment of preparation for laboratory exercises
F2. - assessment of the ability to apply the acquired knowledge while doing the exercises
F3. - evaluation of reports on the implementation of exercises covered by the curriculum
F4. - assessment of activity during classes
S1. - assessment of the ability to solve posed problems and the way of presenting obtained results – Test / Oral examination / Laboratory report *
S2. - assessment of mastering the lecture material – lecture credit (exam)

*) the condition for obtaining credit is to receive positive grades from all laboratory exercises and to carry out the verification task.

STUDENT'S WORKLOAD

L.p.	Forms of activity	Average number of hours required for realization of activity
1.	**Contact hours with teacher**	
1.1	Lectures	15
1.2	Tutorials	
1.3	Laboratory	45
1.4	Seminar	
1.5	Project	
1.6	Examination	2
	Total number of contact hours with teacher:	62
2.	**Student's individual work**	
2.1	Preparation for tutorials and tests	10
2.2	Preparation for laboratory exercises, writing reports on laboratories	25
2.3	Preparation of project	
2.4	Preparation for final lecture assessment	
2.5	Preparation for examination	13
2.6	Individual study of literature	15
	Total number of hours of student's individual work:	63
	Overall student's workload:	125
Overall number of ECTS credits for the module		5
Number of ECTS points that student receives in classes requiring teacher's supervision:		2.48
Number of **ECTS** credits acquired during practical classes including laboratory exercises and projects:		1.8

BASIC AND SUPPLEMENTARY RESOURCE MATERIALS

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, http://www.deeplearningbook.org, 2016
2. Charu C. Aggarwal, Neural Networks and Deep Learning. A Textbook, Springer, 2018,

3. James P. Coughlih, Robert H. Baran: Neural Computation in Hopfield Networks and Boltzmann Machines, Univ of Delaware Pr 1995
4. David Foster, Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, O'reilly, 2019

MODULE COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

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