SYLLABUS OF A MODULE

Polish name of a module	**Sieci neuronowe i uczenie maszynowe**
English name of a module	Neural networks & machine learning
ISCED classification - Code	0619
ISCED classification - Field of study	*Information and Communication Technologies (ICTs), not elsewhere classified*
Languages of instruction	*English*
Level of qualification:	*2*
Number of ECTS credit points	*5*
Examination:	*A*
Available in semester:	*A*

Number of hours per semester:

Lecture	Tutorial	Laboratory	Seminar	Project	Others
30	15	0	0	30	0

MODULE DESCRIPTION

Module objectives

O1. Introducing the students to the basic methods of neural networks and machine learning.

O2. Obtaining by the students the practical skills in solving various problems by making use of neural networks and machine learning.

PRELIMINARY REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The knowledge in the field of the mathematics.
2. The basic knowledge in the field of the mathematical statistics.
3. The basic knowledge in the field of probability theory.
4. The basic knowledge and skills in computer programming.
5. The skills to use different sources of information and technical documentation.

6. The skills of working alone and in the group.
7. The skills of correct interpretation and presentation of his/her own activity.

LEARNING OUTCOMES

LO 1 - Students possess the basic theoretical knowledge in the field of modeling, simulation and classification by making use of machine learning and neural networks.

LO 2 - Students are able to solve various problems of pattern recognition, approximation and prediction.

LO 3 - Students are able to use the modem methods for modeling different types of systems.

LO 4 - Students are familiar with principles of computational intelligence.

MODULE CONTENT

Type of classes – Lectures	**Number of hours**
Neuron and its models, structure and functioning of a single neuron, perceptron	**2**
Adaline model, Sigmoidal neuron model, Hebb neuron model	**2**
Backpropagation algorithm, Backpropagation algorithm with momentum term	**2**
Variable-metric algorithm , Levenberg-Marquardt algorithm, Recursive least squares method	**2**
Hopfield neural network , Hamming neural network	**2**
BAM network , Self-organizing neural networks with competitive learning, WTA neural networks, WTM neural networks, ART neural networks	**2**
Radial-basis function networks. Probabilistic neural networks 2	**2**
Data clustering methods- HCM algorithm, FCM algorithm. PCM algorithm	**2**
Gustafson-Kessel algorithm, FMLE algorithm. Clusteringvalidity measures	**2**
Support vector machines for classification 2	**2**

Support vector machines for regression 2	**2**
Decision trees- ID3	**2**
Decision trees- C4.5	**2**
Fuzzy decision trees	**2**
Principal Component Analysis	**2**
Type of classes– Tutorial	**Number of hours**
Neuron and its models, structure and functioning of a single neuron, perceptron	**1**
Adaline model, Sigmoidal neuron model, Hebb neuron model	**1**
Backpropagation algorithm, Backpropagation algorithm with momentum term	**1**
Variable-metric algorithm, Levenberg-Marquardt algorithm, Recursive least squares method	**1**
Hopfield neural network , Hamming neural network	**1**
BAM network , Self-organizing neural networks with competitive learning, WTA neural networks, WTM neural networks, ART neural networks	**1**
Radial-basis function networks, Probabilistic neural networks	**1**
Data clustering methods- HCM algorithm, FCM algorithm. PCM algorithm	**1**
Gustafson-Kessel algorithm, FMLE algorithm. Clustering validity measures	**1**
Support vector machines for classification	**1**
Support vector machines for regression	**1**
Decision trees- ID3	**1**
Decision trees- C4.5	**1**
Fuzzy decision trees	**1**
Principal Component Analysis	**1**
Type of classes– Laboratories	**Number of hours**
Designing multilayer neural network	**2**
Designing Hopfield neural network	**2**

Designing Hamming neural network	**2**
Designing WTA neural network	**2**
Designing radial- basis neural network	**2**
Designing probabilistic neural network	**2**
Designing decision trees ID3	**2**
Designing decision trees C4.5	**2**
Designing fuzzy decision trees	**2**
Designing system for classification using support vector machines	**2**
Designing system for regression using support vector machines	**2**
Solving the problem of clustering using FCM algorithm	**2**
Solving the problem of clustering using PCM algorithm	**2**
Solving the problem of clustering using Gustafson-Kessel algorithm	**2**
Solving the problem of dimension reduction	**2**

TEACHING TOOLS

1. – lectures using multimedia presentations
2. – exercises in the form of solving by students a problems posed in the time of the lectures
3. – project classes – presentation by students the progress in the tasks

WAYS OF ASSESSMENT (F – FORMATIVE, S – SUMMATIVE

F1. – assessment of preparation for laboratory exercises
F2. – assessment of the ability to apply acquired knowledge during laboratory exercises and projects
F3. – assessment of reports
F4. – assessment of activity during classes
S1. – assessment of the ability to solve the posed problems and the method of presentation of the obtained results - credit for the grade
S2. – assessment of mastery of the lecture material - passing the lecture (or exam)

*) warunkiem uzyskania zaliczenia jest otrzymanie pozytywnych ocen ze wszystkich ćwiczeń laboratoryjnych oraz realizacji zadania sprawdzającego

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	30
1.2	Tutorials	15
1.3	Laboratory	0
1.4	Seminar	0
1.5	Project	30
	Total number of contact hours with teacher:	75
2.	**Student's individual work**	
2.1	Preparation for tutorials and tests	11
2.2	Prreparation for laboratory exercises, writing reports on laboratories	0
2.3	Preparation of project	15
2.4	Preparation for final lecture assessment	10
2.5	Preparation for examination	0
2.6	Individual study of literature	14
	Total numer of hours of student's individual work:	50
	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:		3
Number of **ECTS** credits acquired during practical classes including laboratory exercises and projects :		1,8

BASIC AND SUPPLEMENTARY RESOURCE MATERIALS

Leszek Rutkowski, Computational Intelligence, Springer, 2008
Shai Shalev-Shwartz , Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014
Ethem Alpaydin, Introduction to Machine Learning, M i T Press, 2014

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

Prof. dr hab. inż. Rafał Scherer, rafal.scherer@pcz.pl