STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Computational Intelligence Methods**		Code
Field of study **Mathematics in Technology**	Profile of study (general academic, practical) **general academic**	Year /Semester **4 / 7**
Elective path/specialty **Modelling in technics**	Subject offered in: **Polish**	Course (compulsory, elective) **obligatory**
Cycle of study: **First-cycle studies** **(Polish Qualifications Framework level six)**	Form of study (full-time,part-time) **full-time**	
No. of hours Lecture: **30** Classes: **-** Laboratory: **30** Project/seminars: **-**		No. of credits **4**
Status of the course in the study program (Basic, major, other) **other**	(university-wide, from another field) **university-wide**	
Education areas and fields of science and art **Technical sciences** **Technical sciences**		ECTS distribution (number and %) **4 100%** **4 100%**

Responsible for subject / lecturer:

dr inż. Dominik Belter
email: dominik.belter@put.poznan.pl
tel. 61 665 2809
Faculty of Electrical Engineering
ul. Piotrowo 3A, 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Knowledge in mathematics, mathematical modelling, computer science and numerical methods. [K_W01 (P6S_WG), K_W02 (P6S_WG), K_W06 (P6S_WG)], K_W011 (P6S_WG)]
2	**Skills**	The use of mathematical apparatus in the analysis of simple continuous signals, the use of tools and numerical methods, the ability of effective self-education in a field related to the selected study. [K_U01 (P6S_UW), K_U03 (P6S_UW), K_U09 (P6S_UU)]
3	**Social competencies**	Awareness of the need to extend their competences in the field of electrical engineer work, readiness to cooperate within a team. [K_K01 (P6S_KK), K_K03 (P6S_KO)]

Assumptions and objectives of the course:

Knowledge of theoretical and practical issues related to basic methods of computational intelligence. Presentation of general characteristics of machine learning methods and computational intelligence. Introduction to the issue of optimization with evolutionary and population methods, regression, clustering and strengthening learning. Acquisition of practical skills in deep neural networks.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. knows and understands engineering technologies and is familiar with the latest trends in the development of computational intelligence methods. - [K_W011 (P6S_WG)]

Skills:

1. can define concepts related to optimization, regression and classification, can select a tool for the analyzed problem, can properly analyze and use the obtained results, can use Python language documentation and TensorFlow, NumPy, scikit libraries. - [K_U01 (P6S_UW), K_U02 (P6S_UW), K_U05 (P6S_UW), K_U09 (P6S_UW)]

2. can assess the possibilities of applying specific optimisation techniques in the issues carried out by the engineer - [K_U02 (P6S_UW), K_U03 (P6S_UW)]

Social competencies:

1. Is aware of the knowledge concerning methods of computational intelligence, as well as the necessity of its constant expansion and transmission to the society - [K_K01 (P6S_KK), K_K02 (P6S_KK), K_K05 (P6S_KR)]

Assessment methods of study outcomes

Lecture:

- evaluation of the knowledge and skills shown in a written credit of a combined test and problematic nature (checking the ability to solve problems of optimization, regression, classification and learning of agents).

Laboratory exercises:

- verification of preparation (knowledge) for laboratory classes,
- rewarding practical knowledge gained during previous laboratory exercises,
- evaluation of knowledge and skills related to the performance of tasks during classes.

Obtaining additional points for activity during classes, especially for:

- ability to cooperate as part of a team that practically performs a specific task in a laboratory,
- use of elements and techniques going beyond the material from the scope of the conducted lecture and laboratory exercises

Course description

Introduction to solving black-box problems and programming in Python. Analysis of problems and applications of computational intelligence methods, optimization with evolutionary and computational intelligence methods. Regression methods - Gaussian mixtures, Kernel Density Estimation. Introduction to artificial neural networks: the backward propagation of errors, convolutional neural networks, architectures of convolutional neural networks, applications in image processing systems: classification, objects detection, image segmentation. Generative properties of neural networks. Reinforcement learning for control. Use of computational intelligence methods in robotics.

Applied methods of education:

Lectures - lecture with multimedia presentation (including: drawings, photos, animations, films) supplemented with examples given on the board, taking into account various aspects of the presented issues, including: economic and social, presentation of a new topic preceded by a reminder of related content, known to students from other subjects,

laboratory - programming work related to problem solving, demonstrations, team work.

Update: 10.2018

Basic bibliography:

1. M Bishop, Pattern Recognition and Machine Learning, Springer
2. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 2015
3. Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016

Additional bibliography:

1. Michael Nielsen, *Neural Networks and Deep Learning, 2016*
2. Francois Chollet, Deep Learning with Python, 2017
3. Csaba Szepesvari, Ronald Brachman, Thomas Dietterich, Algorithms for Reinforcement Learning (Synthesis Lectures on Artificial Intelligence and Machine Learning), 2015

Result of average student's workload

Activity	Time (working hours)
1. participation in lectures	30
2. participation in laboratory classes	30
3. taking part in consultations on the lecture	5
4. participating in consultations concerning the laboratory	5
5. preparation for laboratory exercises	5
6. prepare to pass laboratory exercises	5
7. prepare for the examination	20
8. participation in the examination	**3**

Student's workload

Source of workload	hours	ECTS
Total workload	108	4
Contact hours	73	3
Practical activities	50	2