STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Knowledge Engineering		**1010332531010330400**
Field of study **Information Engineering**	Profile of study (general academic, practical) **(brak)**	Year /Semester **2 / 3**
Elective path/specialty **Information Technologies**	Subject offered in: **Polish**	Course (compulsory, elective) **obligatory**
Cycle of study: **Second-cycle studies**	Form of study (full-time,part-time) **full-time**	
No. of hours Lecture: **15** Classes: **-** Laboratory: **15** Project/seminars: **-**		No. of credits **5**
Status of the course in the study program (Basic, major, other) **(brak)**	(university-wide, from another field) **(brak)**	
Education areas and fields of science and art **technical sciences** **Technical sciences**		ECTS distribution (number and %) **5 100%** **5 100%**

Responsible for subject / lecturer:

dr inż. Beata Jankowska
email: beata.jankowska@put.poznan.pl
tel. +48 61 665 37 24
Wydział Elektryczny
ul. Piotrowo 3A 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Student has a knowledge of advanced programming techniques and methods.
2	**Skills**	Student can model and analyse computing systems; when formulating and solving computer problems, he/she can integrate the knowledge from different domains and fields of science.
3	**Social competencies**	Student can think and work creatively and enterprisingly.

Assumptions and objectives of the course:

providing students with: the knowledge of different formal methods of knowledge representation (both certain and uncertain) and different techniques of knowledge acquisition, including - machine learning; the ability to design and implement small expert systems.

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

Knowledge:

1. Student has an organized and theoretically grounded knowledge of data integration and exploration. - [K_W07]
2. Student knows problems of knowledge engineering and the methods of their solving. - [K_W09]

Skills:

1. In a team, a student can design and implement particular modules of non-standard or complex information systems. - [K_U09]
2. Student can propose and justify improvements of the existing information solutions. - [K_U12]

Social competencies:

1. Student realises the necessity to inform general public about achievements of computer science and other aspects of computer engineers - [K_K02]

Assessment methods of study outcomes

Lecture: written exam consisting of theoretical questions and simple problems to solve.

Labs: rating a student's solution of a group project task (oral report, implementation in an appropriate programming language/environment, written specification); rating a student's activity in class discussions and solving lab problems.

More than 50% points are necessary for passing the exam and labs.

Course description

Lectures. The notions of data, information and knowledge. Multimodal data. Main rules of knowledge engineering. Sources of knowledge and classical techniques of knowledge acquisition. Principles of machine learning. Rule-knowledge representation. Certain and uncertain knowledge. Algorithms of machine induction of classical rules (i.a. the Michalski's AQ, the Clark's and Niblett's CN2, the Quinlan's C4.5 algorithms) and algorithms of machine induction of rules with first order and second order uncertainty (i.a. the Agrawal's and Srikant's Apriori, the Bayes network construction NBC algorithms). Reasoning in classical rule-based systems and rule-based systems with uncertainty. Modeling uncertainty using rough sets. Fuzzy sets and fuzzy relations. Fuzzy reasoning. Fuzzy controller design. Extraction of features from images and sequences of images. Deep machine learning. Convolutional neural networks. Expert systems and their usage in diagnostics, classification, construction, prediction and simulation. Medical expert systems.

Labs. Programming environments for developing expert systems (CLIPS, FuzzyCLIPS, JESS, NEURONIX, NETICA). Designing and implementing small expert systems with certainty/uncertainty. Inductive learning of rule-based knowledge from images and sequences of images.

Applied methods of teaching: Lectures - interactive lectures, with questions addressed to the whole group of students or to individual students; lectures supplemented by materials for self-studying in the Moodle e-learning platform;

Labs - university classes supplemented by materials prepared for self-performing of work in the Moodle e-learning platform; team work.

2017 update: Modeling uncertainty using rough sets. Extraction of features from images and sequences of images. Deep machine learning. Convolutional neural networks.

Basic bibliography:

1. Traczyk W., Inżynieria wiedzy, Akademicka Oficyna Wydawnicza EXIT, Warszawa 2010.

2. Russell S.J., Norviq P., Artificial Intelligence: A Modern Approach. Third Edition, Pearson Education India, 2015.

Additional bibliography:

1. Cichosz P., Systemy uczące się (wydanie 2), PWN, 2007.

2. Giarratano J.C., Riley G.D., Expert Systems: Principles and Programming. (Fourth Edition), PWS Publishing Company, 2004.

3. Nielsen M., Neural Networks and Deep Learning, free online book, August 2017, http://neuralnetworksanddeeplearning.com/index.html.

4. Senthil Kumar A.V., Fuzzy Expert Systems for Disease Diagnosis, 1st edition, IGI Global, 2014.

Result of average student's workload

Activity	Time (working hours)
1. Lectures	15
2. Labs	15
3. Final exam and consultations	20
4. Preparing for labs	10
5. Expert system architecture - literature study and design	20
6. Expert system implementation	25
7. Preparing for the final exam	20

Student's workload

Source of workload	hours	ECTS
Total workload	125	5
Contact hours	50	2
Practical activities	50	2