FACULTY OF PURE AND APPLIED MATHEMATICS
SUBJECT CARD

Name in Polish: Maszynowe uczenie
Name in English: Machine learning
Main field of study (if applicable): Applied Mathematics
Specialization (if applicable): Data Engineering
Level and form of studies: 2nd* level, full-time / ~~part-time~~*
Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~*
Subject code
Group of courses YES / ~~NO~~*

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	crediting with grade				
For group of courses mark (X) final course	X				
Number of ECTS points	3		2		
including number of ECTS points for practical classes (P)	2		2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,5		1,5		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Programming skills
2. Know the basics of logic

\

SUBJECT OBJECTIVES

C1 Familiarize students with different approaches and tasks of inductive learning
C2 Familiarize students with supervised and unsupervised learning
C3 Ability to choose the method for a given task
C4 Understanding the role of data quality in machine learning

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEK_W01 Student knows the methods of supervised learning
PEK_W02 Student knows unsupervised learning methods
PEK_W03 Student knows the role of data and how to prepare them for a given task of inductive learning
relating to skills:
PEK_U01 Student knows how to select a method for a given task
PEK_U02 Student is able to prepare data for inductive learning task
PEK_U03 Student is able to properly analyze the results of inductive learning

relating to social competencies: PEK_K01 Student is able to analyze the results of induction learning together with others

PROGRAMME CONTENT		
Form of classes – lecture		**Number of hours**
Lec 1	Introduction to the course. Basic concepts, types of machine learning, examples	2
Lec 2	Learning, Generalization, VC dimension	2
Lec 3	Supervised learning - Classification, Regression. Classification measures Learning using the Version Space	2
Lec 4	Classification - induction of a set of rules (ILA, AQ, and / or other algorithms)	2
Lec 5	Decision tree generation methods, inference in decision trees	2
Lec 6	Dimensional reduction methods	2
Lec 7	Neural networks	2
Lec 8	Overfitting, Regularization, Validation	2
Lec 9	SVM and kernel	2
Lec 10	Ensemble of Classifiers, Bagging and boosting	2
Lec 11	Multi-class classification and multi-label classification, example: image annotation	2
Lec 12	Unsupervised Learning - Clustering. Clustering Ensembles	2
Lec 13	Data mining process - an idea, tasks. Frequent Patterns. Exemplary methods, e.g.: A-Priori algorithm	2
Lec 14	Evolutionary computation in data mining tasks	2
Lec 15	Test	2
	Total hours	**30**

Form of classes - laboratory		**Number of hours**
Lab 1	Introductory classes, description of tasks, conditions of credit.	2
Lab 2	Get acquainted with selected environments: Weka, R, Python	2
Lab 3	Exercise 1: A comparison of selected classifiers	2

Lab 4	Continuation of Exercise 1	2
Lab 5	Presentation of Exercise 1 for evaluation	2
Lab 6	Exercise 2: Impact of attributes selection on classification quality - filter and wrapper approaches	2
Lab 7	Continuation of Exercise 2	2
Lab 8	Presentation of Exercise 2 for evaluation	2
Lab 9	Exercise 3: Ensemble of Classifiers - Selected Decision Making Techniques	2
Lab10	Continuation of Exercise 3	2
Lab11	Presentation of Exercise 3 for evaluation	2
Lab 12	Exercise 4: Generation of association rules, analysis of the method properties	2
Lab 13	Continuation of Exercise 4	2
Lab 14	Presentation of Exercise 4 for evaluation	2
Lab 15	Summarization of lectures	2
	Total hours	**30**

TEACHING TOOLS USED
1. Knowledge presentations using the projector. 2. Audiovisual media in the demos versions presentation. 3. Searching and study of scientific literature in the WRUT Library.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEK_W01, PEK_W03,	test
F2	PEK_U01 – PEK_U03, PEK_K02	Rating for lab exercises
F3	PEK_W02, PEK_W03	test
F4	PEK_U04, PEK_K01	participation in the discussion of the exercises results
P1	PEK_W01-W03	test grade
P2	PEK_U01 – PEK_U03, PEK_K02	Final score of laboratory based on the sum of points scored for each exercise

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] "Introduction to Machine Learning". Second Edition. Ethem Alpaydın. The MIT Press Cambridge, Massachusetts London, England, 2010.
[2] „Systemy uczące się". Cichosz Paweł. WNT, 2009.
[3] „Mining of Massive Datasets". Jure Leskovec, Stanford Univ.; Anand Rajaraman, Milliway Labs; Jeffrey D. Ullman, Stanford Univ. Copyright c 2010, 2011, 2012, 2013, 2014 Anand Rajaraman, Jure Leskovec, and Jeffrey D. Ullman

SECONDARY LITERATURE:

[1] "Automating the Design of Data Mining Algorithms. An Evolutionary Computation Approach", Natural Computing Series. Gisele L. Pappa and Alex A. Freitas. Springer-Verlag Berlin Heidelberg 2010.
[2] "Machine Learning", Tom Mitchell, McGraw Hill, 1997.
[3] "A Course in Machine Learning", Hal Daumé III, Copyright © 2012 Hal Daumé III

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Halina Kwaśnicka (halina.kwasnicka@pwr.edu.pl)