STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Recommender systems		**1010331571010337135**

Field of study	Profile of study (general academic, practical)	Year /Semester
Information Engineering	**(brak)**	**4 / 7**
Elective path/specialty	**Subject offered in:**	**Course (compulsory, elective)**
Information Technologies	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours					No. of credits
Lecture: **15**	Classes: **-**	Laboratory: **-**	Project/seminars: **15**		**3**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
(brak)	**(brak)**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**3 100%**
Technical sciences	**3 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	K_W07: Student has organized knowledge with theoretical foundations of computer networks. K_W05: Student has organized knowledge with theoretical foundations of basic program constructions, algorithm implementations, paradigms and programming styles, software verification methods, formal languages, compilers, platforms. K_W08: Student has organized knowledge with theoretical foundations of databases and data warehouses.
2	**Skills**	K_U01: Student is able to acquire information from literature, data bases and other sources; student is able to integrate acquired information, to interpret it, to draw conclusions and to formulate and justify judgments. K_U03: Student is able to create engineer work documentation and to prepare text with the work result discussion.
3	**Social competencies**	K_K02: Student understands and is aware of the importance of nontechnical issues related to computer engineer activity. Student understands the responsibility associated to his engineering decisions.

Assumptions and objectives of the course:

The primary objective of the course is to make students familiar with the key technologies of modern recommender (recommendation) systems.

To enable a student to design and implement his/her own recommendation system, such a system is presented as a special kind of a machine learning system. It is shown how the leading machine learning software libraries and packages may be used for rapid development of a modern, effective and scalable recommender system.

In order to enable a student to objectively evaluate a recommender system and possibly to conduct her/his own research, the standard evaluation methodology (that is widely used within the academia and the industry) is presented together with the key performance measures and their implementations based on the leading software libraries.

An important aim of the course is to introduce students to the issues of recommendation systems development that are crucial from the perspective of a commercially successful deployments ? in particular in intelligent Internet advertising systems and bank credit scoring systems.

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

Knowledge:

1. Student has theoretical and practical knowledge on artificial intelligence and on expert and multi-agent systems. - [K_W09]
2. Student has organized knowledge with theoretical foundations of Internet technologies. - [K_W11]
3. Student has organized knowledge with theoretical foundations of teleinformatics, protocols and services in telecommunication networks. - [K_W15]

Skills:

1. Student is able to create engineer work documentation and to prepare text with the work result discussion. - [K_U03]
2. Student is able to carry out work with web sites and Internet services. - [K_U15]
3. Student is able to design and develop a simple expert or multi-agent system. - [K_U13]

Social competencies:

1. Student understands and is aware of the importance of nontechnical issues related to computer engineer activity. Student understands the responsibility associated to his engineering decisions. - [K_K02]

Assessment methods of study outcomes

Evaluation of the knowledge acquired from the lecture: a written exam.

Evaluation of the projects: the average of three ratings: the quality of the project and its implementation, the quality of the documentation and the quality of the demonstration/presentation.

Course description

Lecture

The key topics are: machine learning algorithms applicable to recommender systems, collaborative filtering, methods of representation and processing of data in highly multi-dimensional vector spaces, hybrid recommendation, context modeling, personalized recommendation, supervised learning (in particular based on gradient boosting, logistic regression and neural networks), commercial recommendation systems, recommendation systems used as components of Internet advertising systems and bank credit scoring systems, the leading software platforms and packages (in particular Scikit-learn, Numpy, Scipy, Vowpal Wabbit, LibFFM) that may be used for rapid development and evaluation of a effective and scalable recommender system. Recent advances in the research on recommendation systems are presented with a special focus on Big Data solutions enabling the application of Natural Language Processing and semantic modeling, and solutions enabling scalable offline processing of incomplete heterogeneous data and effective recommendation generation applicable to real-time systems.

Teaching methods:

- presentation of the theory with frequent references to relevant practical examples of software implementations,
- lecture with multimedia presentation and presentations of Python programming language source code examples with their execution and rapid development/modification,
- students being asked questions during the lectures in order to provoke discussions.

Projects

The student project involves design and implementation of a simple recommendation system by means of publicly available software libraries and components. The projects focus on the use of publicly available test data sets (e.g. MovieLens, HetRec, S3, OAEI, Kaggle CTR prediction and bank credit scoring datasets) and software components developed in several Poznan University of Technology research projects, in particular in the project ?Information-theoretic abductive reasoning for context-based recommendation? [http://ncn6788.cie.put.poznan.pl/] and the project devoted to ML-based bank credit scoring funded by Talex S.A. The work in a student project involves application of the standard evaluation methodology (that is widely used within the academia and the industry) that has been initially developed by the researchers working the fields of machine learning and information retrieval but which nowadays is easily implementable by means of the leading software libraries (Scikit-learn, Numpy, Scipy).

Teaching methods

- Individual work (homework mainly).
- Open source tools and software components (including those developed in Poznan University of Technology research projects) made available to students to support their homework.
- Periodic (once in a few weeks) short presentation of the student?s work progress (each time accompanied by lecturer?s guidance, discussions with other students and the evaluation explicitly provided by the lecturer).
- Short presentation of the final results of the student?s work (accompanied by discussions with other students and the evaluation explicitly provided by the lecturer).

2017 update

A major modification of the whole course description and the bibliography has been provided. In particular several new topics have been introduced including recommendation systems for context-aware personalized ad targeting systems for Internet advertising, ML-based bank credit scoring, a recommendation system as a machine learning system, recent advances in the research on recommendation systems including Big Data solutions enabling the application of Natural Language Processing and semantic modeling, scalable offline processing of heterogeneous data, and effective recommendation generation applicable to real-time systems, software libraries and packages for recommender systems development and evaluation, research and industry methodology of recommender systems evaluation.

Basic bibliography:

1. Kim Falk, Practical Recommender Systems, Manning Publications, www.manning.com/books/practical-recommender-systems, 2017.

2. Francesco Ricci, Lior Rokach, Bracha Shapira, Recommender Systems Handbook (2nd ed.). Springer-Verlag New York, Inc., New York, NY, USA, 2015.

3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The elements of statistical learning : data mining, inference, and prediction, 2nd ed., Springer Series in Statistics, ISBN 978-0-387-84857-0, 978-0-387-84858-7 (e-ISBN), New York, 2016.

4. Szwabe A., Misiorek P., Ciesielczyk M., "Logistic Regression Setup for RTB CTR Estimation", in: Proceedings of the 9th International Conference on Machine Learning and Computing, ICMLC 2017, Singapore, Singapore, pp. 61-70, ACM, New York, USA, DOI = 10.1145/3055635.3056584, 2017, http://dl.acm.org/citation.cfm?id=3056584, http://ncn6788.cie.put.poznan.pl/images/ncn6788_icmlc2017.pdf

Additional bibliography:

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, An Introduction to Information Retrieval, online edition, https://nlp.stanford.edu/IR-book/, https://nlp.stanford.edu/IR-book/pdf/irbookprint.pdf, Cambridge University Press, England, 2009.

2. Szwabe, A., Misiorek, P., Walkowiak, P., Multi-Relational Learning for Recommendation of Matches between Semantic Structures, in: Grana, M., Toro, C., Howlett, R.J., Jain, L.C. (Eds.), Knowledge Engineering, Machine Learning and Lattice Computing with Applications, LNCS/LNAI Volume 7828, 2013, pp. 98-107, http://link.springer.com/chapter/10.1007/978-3-642-37343-5_11, http://ncn6788.cie.put.poznan.pl/images/ncn6788_lnai.pdf

3. Szwabe A., Ciesielczyk M., Misiorek P, Blinkiewicz M., "Application of the tensor-based recommendation engine to semantic service matchmaking", Proceedings of The Ninth International Conference on Advances in Semantic Processing, pp. 116-125, ISBN: 978-1-61208-420-6, July 2015, Nice, France, http://www.thinkmind.org/index.php?view=article&articleid=semapro_2015_5_40_30093, http://ncn6788.cie.put.poznan.pl/images/ncn6788-semapro2015.pdf

Result of average student's workload

Activity	Time (working hours)
1. Lectures	15
2. Project	15
3. Consultations and exam	5
4. Project preparation	25
5. Project report preparation	10
6. Exam preparation	10

Student's workload

Source of workload	hours	ECTS
Total workload	75	3
Contact hours	35	1
Practical activities	50	2