COURSE DESCRIPTION CARD - SYLLABUS

Course name
Analysis and mining of social networks

Course

Field of study
Computing
Area of study (specialization)
Data Processing Technologies
Level of study
Second-cycle studies
Form of study
full-time

Year/semester
2/3
Profile of study
general academic
Course offered in
Polish
Requirements
elective

Number of hours

Lecture
30
Laboratory classes
Other (e.g. online)
Tutorials
Projects/seminars
30

Number of credit points

4

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:

Prerequisites

A student starting this subject should have basic knowledge of Internet technologies and graph theory.

The student should have the ability to solve basic problems in the design of information systems and their implementation, as well as the ability to obtain information from indicated sources. The student should have the ability to use external programming APIs. S/he should be comfortable with the Python programming language. S/he or she should also understand the need to expand his or her competencies / have the willingness to cooperate as part of a team.

Regarding social competence, the student must present such attitudes as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people, and teamwork skills.

Course objective

1. to provide students with basic knowledge of Web 2.0 (social networking and services) concepts and technologies.
2. to develop students' problem-solving skills on how to use and design systems using network data and social networks.
3. to provide students with knowledge of available IT tools (ready-made programs, libraries, APIs) for analysis and exploration of data represented in the form of networks
4. to provide students with the mathematical basics of network data analysis and mining and basic network models
5. to form in students the skills of teamwork.
6. to form in students the ability to obtain information from literature and other sources, integrate them, draw conclusions, and formulate and justify opinions on them through social media.
7. shaping in students the ability to creatively combine data from multiple heterogeneous sources and the ability to use social mechanisms in the created information systems.

Course-related learning outcomes

Knowledge

Student:

- has extended and deepened knowledge of mathematics useful for solving complex computer tasks involving the use of network mechanisms (K2st_W1)
- has structured and theoretically supported general knowledge related to programming aspects of network data processing (K2st_W2)
- has advanced and detailed knowledge related to modeling of phenomena in social networks (K2st_W3)
- has advanced and detailed knowledge of the processes occurring in the evolution cycle of network systems (K2st_W5)
- knows advanced methods, techniques and tools used in solving complex engineering tasks and conducting research work in the field of social networks (K2st_W6)

Skills

Student:

- is able to acquire information from literature, databases and other sources (in the native language and English), integrate them, interpret and critically evaluate, draw conclusions and formulate and fully justify opinions (K2st_U1)
- is able to use analytical, simulation and experimental methods to formulate and solve engineering tasks and simple research problems (K2st_U4)
- is able to assess the usefulness and possibility of using new IT libraries for processing network data (K2st_U6)
- is able to critically analyze existing technical solutions and propose their improvements (K2st_U8)
- is able to assess the usefulness of methods and tools for solving an engineering task involving the construction or evaluation of an information system or its components, including recognizing the limitations of these methods and tools; (K2st_U9)
- is able - using, among others, conceptually new methods - to solve complex IT tasks using community mechanisms, including atypical tasks and tasks with a research component (e.g. diffusion processes in networks); (K2st_U10)

Social competencies

Student:

- understands that in computer science, knowledge and skills become obsolete very quickly, (K2st_K1)
- understands the importance of using social network analysis techniques in solving research and practical problems (K2st_K2)

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:

(a) in terms of lectures: on the basis of answers to questions on the material discussed in previous lectures,

b) in terms of project classes: on the basis of the evaluation of the current progress of the tasks,

Summative evaluation:

a) in the scope of lectures, verification of the assumed learning outcomes is realized by evaluation of knowledge and skills on the basis of quizzes published after each lecture

b) in the scope of project classes, verification of the established learning outcomes is realized by evaluation of the student's presented report on the realization of the project, with the presentation having the character of a public defense of the project in front of all the students of the course.

Obtaining additional points for activity during classes, among others for:

- discussion of additional aspects of the issue,

- efficiency of application of the acquired knowledge during the solution of the assigned problem,

- ability to cooperate as part of a team practically implementing a detailed project task

Programme content

The lecture program covers the following topics:

Introduction to social networks, history and development of sociometry, examples of real social networks. Measures of centrality in networks: centrality by degrees of vertices, centrality by agency, centrality by. proximity, network diameter, modularity in networks, algorithms for finding communities, correlations of vertex degrees, scale-free networks and phenomena, power laws and their mathematics, examples of phenomena described by power laws, mechanism of formation of power distributions, models of network formation: Erdos-Renyi random network model, Watts-Strogatz small worlds model, Barabasi-Albert preferential attachment model, micro- and macro-evolution of networks, models of information spread in networks, general SIR model and its modifications, network density phenomenon, percolation phenomenon in networks. Social network influence modeling and influence/trust propagation algorithms, edge prediction and recommendation, statistical social network models, learning dense vector representations for graph data, graph neural networks. Graph databases.

Project classes include a series of 10 meetings to illustrate the issues and technologies discussed in the lecture. Part of the meetings is devoted to learning individual tools (Pajek, Gephi, visone, NetLogo) and libraries (NetworkX, igraph, PyGeometric), then a seminar meeting takes place, during which students (individually or in groups) present selected topics for credit projects. The last part of the class is strictly project-based, during which students work on credit projects. All credit projects are shown at the end of the semester in the form of a public presentation.

The program of project classes includes the following topics:

Study of networks using the Pajek program: generation of random networks, determination of vertex evaluation measures, visualization of networks, analysis of overall network structure. Network visualization using Gephi and visone programs, determination of simple measures for vertices and edges, visualization using the determined measures. Network analysis and exploration using NetworkX and igraph libraries. Generating dense vector representations using graph2vec and DeepWalk algorithms. Data analysis using the graph database Neo4J.

Teaching methods

Lecture: multimedia presentation, seminar with students' presentations

Project: programming examples, small individual programming exercises

Bibliography

Basic

1. Agata Fronczak, Piotr Fronczak, Świat sieci złożonych. Od fizyki do Internetu. Wydawnictwo Naukowe PWN 2009
2. Mark Newman, Networks: An Introduction. Oxford University Press, 2010
3. Albert-Laszlo Barabasi, Network Science, Cambridge University Press, 2016

Additional

1. Programming Collective Intelligence. Building Smart Web 2.0 Applications, Toby Segaran, O'Reilly, 2007
2. Networks, Crowds and Markets: Reasoning About a Highly Connected World, David Easley, Jon Kleinberg, Cambrige University Press, 2010
3. Social Network Analysis: Methods and Applications. Stanley Wasserman, Katherine Faust, Cambridge University Press 1994
4. Models and Methods in Social Network Analysis, P.J. Carrington, J. Scott, S. Wasserman, Cambridge University Press 2005
5. Social Network Analysis: A Handbook, John P. Scott, SAGE Publications, 2000

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Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4.0
Classes requiring direct contact with the teacher	60	2.0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exams, project preparation)[1]	40	2.0

[1] niepotrzebne skreślić lub dopisać inne czynności