POZNAN UNIVERSITY OF TECHNOLOGY
EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)
pl. M. Skłodowskiej-Curie 5, 60-965 Poznań

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Process Mining

Course

Field of study Computing	Year/Semester 1/2
Area of study (specialization) Intelligent Information Technologies	Profile of study general academic
Level of study Second-cycle studies	Course offered in Polish
Form of study full-time	Requirements compulsory

Number of hours

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

Number of credit points

5

Lecturers

Responsible for the course/lecturer:	Responsible for the course/lecturer:
Tomasz Pawlak, PhD	

Prerequisites

A student starting this course should have basic knowledge of formal models for various technical problems, the life cycle of information systems, architecture of distributed systems, and economics. He should also have the ability to obtain information from the indicated sources and be ready to cooperate within the team.

Course objective

1. Provide students with basic knowledge about the use of modeling tools, execution management, and process analysis in distributed systems.
2. Developing students' problem-solving skills related to analysis and design of distributed processes using the technologies used in business.
3. Developing students' skills in analysis and diagnostics of the work of distributed processes using tools used in business.
4. Teaching students the skills of teamwork, analytical thinking, conclusions based on observations, and analytical models.

Course-related learning outcomes

Knowledge

1. The student has an ordered, theoretically founded general knowledge in the field of the architecture of industrial systems in a distributed environment [K2st_W1].
2. The student has ordered and theoretically founded general knowledge related to key issues in the field of process mining [K2st_W2].
3. The student has theoretically founded detailed knowledge related to selected issues in the field of process mining, such as: design, implementation and analyzing of systems managing the execution of processes [K2st_W3].
4. The student has advanced and detailed knowledge of the life cycle processes of hardware or software information systems [K2st_W5].
5. The student knows advanced methods, techniques and tools used in solving complex tasks and conducting research in the field of process mining [K2st_W6].

Skills

1. The student is able to obtain information from literature, databases and other sources (in Polish and English), integrate them, interpret and critically evaluate them, draw conclusions and formulate and exhaustively justify opinions [K2st_U1].
2. The student is able to formulate and test hypotheses related to business processes [K2st_U4].
3. When formulating and solving engineering tasks, the student is able to integrate knowledge from various areas of computer science (and, if necessary, also knowledge from other scientific disciplines) and apply a systemic approach, also taking into account non-technical aspects [K2st_U5].
4. The student is able to assess the usefulness and the possibility of using new achievements (methods and tools) and new IT products for the analysis, verification and optimization of business processes [K2st_U6].
5. The student is able to evaluate the usefulness of the methods and tools for solving the engineering task consisting in the evaluation of the information system or its components, including the limitations of these methods and tools [K2st_U9].
6. The student is able to determine the directions of further learning and realize the process of self-education, including other people [K2st_U16].

Social competences

1. The student understands that in computer science, knowledge and skills very quickly become obsolete [K2st_K1].
2. The student understands the importance of using the latest knowledge in the field of computer science in solving research and proctical problems [K2st_K2].
3. The student understands the importance of popularizing the latest achievements in the field of computer science [K2st_K3].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:

a) in the field of lectures:

- on the basis of answers to questions about the material discussed in the lectures,
b) in the field of laboratories:
- based on the assessment of the current progress in the implementation of laboratory tasks,
Summative assessment:
a) in the field of lectures, verification of the assumed learning outcomes is carried out by:
- assessment of knowledge and skills demonstrated in a written exam consisting of:
- a set of closed questions, from which each question can be answered with one correct answer out of four possible. For each correct answer 1 point is obtained, and for each wrong answer 1/3 point is deducted.
- A set of open-ended questions for which you can get from 2 to 4 points.
To obtain a grade of 3.0, a minimum of 51% of points should be obtained, 3.5 - 61%, 4.0 - 71%, 4.5 - 81%, 5.0 - 91%.
b) in the field of laboratories, verification of the assumed learning outcomes is carried out by:
- assessment of the implementation of project tasks including modeling tasks, execution and analysis of processes occurring in distributed systems, partially performed during classes, and partially as part of homework,
- timely realization of tasks;
Obtaining additional points for activity during classes, especially for:
- realization of additional tasks,
- discussion of additional aspects of the issue,
- the effectiveness of applying the acquired knowledge while solving a given problem,
- the ability to cooperate as part of a team practically carrying out a detailed task in the laboratory,
- remarks related to the improvement of teaching materials.

Programme content

The lecture program covers the following topics:
1. Introduction to distributed business processes, process science, process mining, business process management, management methodology: lean management, six sigma.
2. Business process modeling methodologies: transition systems, Petri nets, workflow systems, YAWL, BPMN, EPC, causal nets, process trees. Methods of verification and analysis of processes based on models.
3. Introduction to data mining: basics of statistical inference, machine learning, supervised and unsupervised learning, methods of assessing knowledge models, discovering local patterns: association rules, sequences and episodes.
4. Preparation of data for analysis: ETL process, typical data formats, preparation challenges, data quality assessment.
5. Basic algorithms for discovering models of distributed processes: algorithm? and its varieties
6. Advanced algorithms for discovering models of distributed processes: Heuristic Miner, evolutionary algorithms, algorithms based on state regions, algorithms based on regions and formal languages, Inductive Miner.
7. Models of mathematical programming: modeling with the use of expert knowledge, discovering models from data.

8. Verification of the compliance of the business process with the model and / or domain knowledge, ways of diagnosing the causes of deviations from the model.
9. Alternative business process perspectives: resource, cost and efficiency perspective.

The laboratory program covers the following topics:

1. Workflow systems: Process Maker.
2. ProM tool: analyze event logs, discover business process models, analyze business process models and improve processes.
3. Disco Tool: analyze event logs, discover business process models, analyze business process models and improve processes.
4. Mathematical programming: modeling processes and systems using the mathematical programming paradigm.

Teaching methods

Lecture: multimedia presentation.
Laboratory: problem solving, practical exercises, team work, demonstration.

Bibliography

Basic

Wil van der Aalst, Process Mining: Data Science in Action, Second Edition, Springer, 2016, http://link.springer.com/978-3-662-49851-4 (online access from university computers).

Additional

1. H. Paul Williams, Model Building in Mathematical Programming, Fifth Edition, Wiley, 2013.
2. Gopal K. Kanji, 100 Statistical tests, Third Edition, SAGE Publications, 2006.
3. Peter Flach, Machine Learning: The Art. Of Science of Algorithms that Make Sense of Data, Cambridge University Press, 2012.
4. Tomasz P. Pawlak, Krzysztof Krawiec, Automatic synthesis of constraints from examples using mixed integer linear programming, European Journal of Operational Research 261:1141-1157, 2017.
5. Tomasz P. Pawlak, Krzysztof Krawiec, Synthesis of Constraints for Mathematical Programming with One-Class Genetic Programming, IEEE Transactions on Evolutionary Computation 23(1):117-129, IEEE Press, 2019.
6. Patryk Kudła, Tomasz P. Pawlak, One-class synthesis of constraints for Mixed-Integer Linear Programming with C4.5 decision trees, Applied Soft Computing 68:1-12, 2018.
7. Tomasz P. Pawlak, Synthesis of Mathematical Programming models with one-class evolutionary strategies, Swarm and Evolutionary Computation 44:335-348, Elsevier, 2019.
8. Daniel Sroka, Tomasz P. Pawlak, One-Class Constraint Acquisition with Local Search, GECCO '18, pp. 363-370, ACM, 2018.
9. Documentation of Process Maker system: https://www.processmaker.com/resources
10. Documentation of ProM system: http://www.promtools.org

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,0
Classes requiring direct contact with the teacher	62	2,5
Student's own work (literature studies, preparation for laboratory classes, preparation for exam, project preparation) [1]	60	2,5

[1] delete or add other activities as appropriate