University of Gdańsk

Subject card

Subject name and code	Graph and Network Theory, PG_00203629		
Field of study	Informatics		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2026/2027
Education level	Master's studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	1	ECTS credits	5.0
Learning profile	academic	Assessment form	exam
Conducting unit			
Name and surname of lecturer (lecturers)	Subject supervisor	dr Hanna Furmańczyk	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	30.0	0.0	0.0	60

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	60	0.0	65.0	125

Subject objectives

The aim of the course is to deepen students' knowledge of graph theory and network models, with a particular focus on advanced properties of graphs, graph algorithms, and optimization problems. The course prepares students to model and analyze complex computer science problems using methods from graph theory and to select appropriate algorithms and techniques for solving them.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[INFMU2_W01] has in-depth knowledge of the branches of mathematics necessary for the study of computer science; has a good understanding of the role and importance of the construction of mathematical reasoning	The student knows and understands the mathematical foundations of graph theory and the role of formal reasoning in the analysis of the properties of graphs, networks, and graph algorithms.	[SW4] test/exam - oral or written
[INFMU2_W09] knows and understands formal models of data representation and structures (e.g. graphs, relational and non-relational models), knows the applications of mathematical models and data structures in solving practical problems, understands the connections between theory (e.g. graphs) and practical data processing systems (e.g. databases, Big Data systems)	The student knows and understands advanced graph models and their application in modeling, analyzing, and solving computer science and networking problems.	[SW4] test/exam - oral or written [SW5] implementation of a problem task
[INFMU2_U01] is able to formulate, analyze and solve complex problems related to computer science by selecting and applying appropriate mathematical methods and tools	The student is able to model complex computer science problems using graphs and to select and apply appropriate algorithms and methods from graph theory to analyze and solve them.	[SU5] implementation of a problem task

Subject contents	**Review of Basic Concepts in Graph Theory** • classes of graphs, • graph representations, • basic properties and invariants of graphs. **Advanced Properties of Graphs** • network connectivity and resilience, • planar graphs, • spanning trees, • graph decompositions and their applications. **Graph Operations and Their Applications** • graph operations, • sums of graphs, • products of graphs (Cartesian, strong, tensor, lexicographic), • properties of products. **Flows and network problems** • maximum flow, • minimum cut, • the Max-Flow Min-Cut theorem, • applications in network design. **Advanced graph algorithms** • algorithms for shortest paths, • matchings in graphs, • reachability problems, • algorithms for directed graphs. **Graph Coloring and Related Problems** • vertex and edge coloring, • perfect graphs, • applications of graph coloring. **Optimization Problems on Graphs** • domination, • coverage, • independent sets, • cliques, • location problems. **Complexity of graph problems** • polynomial-time and NP-hard problems, • exact algorithms, • approximation algorithms, • heuristics and metaheuristics. **Graphs in network modeling** • computer networks, • transportation networks, • logistics networks, • social networks.
Prerequisites and co-requisites	
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
written assignment	51.0%	50.0%
implementation tasks	51.0%	20.0%
laboratory project	51.0%	30.0%

Recommended reading	Basic literature	1. **J. Wojciechowski, K. Pieńkosz**, *Grafy i sieci*, PWN, Warszawa, 2014. 2. **R. Diestel**, *Graph Theory*, 6th ed., Springer, 2024. 3. **J.A. Bondy, U.S.R. Murty**, *Graph Theory*, Springer, 2008.

	Supplementary literature	1. **D.B. West**, *Introduction to Graph Theory*, 2nd ed., Prentice Hall, 2001. 2. **R.K. Ahuja, T.L. Magnanti, J.B. Orlin**, *Network Flows: Theory, Algorithms, and Applications*, Prentice Hall, 1993. 3. Selected academic articles provided by the teacher.
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	

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