University of Gdańsk

Subject card

Subject name and code	, PG_00178995						
Field of study	Mathematics						
Date of commencement of studies	October 2024		Academic year of realisation of subject	2025/2026			
Education level	Bachelor's studies		Subject group	Optional subject group			
Mode of study	full-time studies		Mode of delivery	at the university			
Year of study	2		Language of instruction	Polish			
Semester of study	4		ECTS credits	6.0			
Learning profile	academic		Assessment form	exam			
Conducting unit							
Name and surname of lecturer (lecturers)	Subject supervisor		dr Rafał Lutowski				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	30.0	0.0	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		10.0		80.0	150
Subject objectives	The purpose of the course is to familiarize students with the basic algorithms of computational group theory and the GAP program.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[MATL3_K01] is ready to accept the limitations of his/her own knowledge and understands the need for further education	The student can recognize the limits of their knowledge in algorithmic methods of group theory and the use of the GAP system, and demonstrates readiness to independently deepen their competencies in this area.	[SK8] observation of student's independent or team work
[MATL3_K06] is ready to formulate opinions on basic mathematical issues	The student can critically evaluate and formulate an opinion on algorithmic aspects of group theory, particularly regarding decidability problems and computational complexity.	[SK8] observation of student's independent or team work
[MATL3_K04] is ready to understand and appreciate the importance of intellectual honesty in one's own and other people's actions; is willing to act ethically	The student understands the importance of intellectual honesty in scientific and programming work, including the use of existing algorithms and sources, and can act in accordance with the principles of academic ethics.	[SK8] observation of student's independent or team work
[MATL3_K02] is ready to precisely formulate questions to deepen his/her own understanding of a given topic or to find missing elements of reasoning	The student can formulate precise questions that support solving problems in group theory using the GAP system, particularly to deepen understanding of algorithm behavior and interpretation of results.	[SK5] implementation of a problem task [SK8] observation of student's independent or team work
[MATL3_U09] is able to plan how to solve a specific problem and prepare a correct record of this solution, providing strict and precise justification for the correctness of his reasoning	The student can construct mathematical arguments in the field of computational group theory, including proving theorems and refuting hypotheses by building constructions and counterexamples, also using the GAP system.	[SU4] test/exam - oral or written [SU8] observation of student's independent or team work
[MATL3_W09] knows and understands the role and importance of proof in mathematics, as well as the concept of the importance of assumptions	The student understands the importance of precise mathematical reasoning in computational group theory, can construct and analyze such reasoning, and recognizes its role in algorithm design and result verification, including through the use of the GAP system.	[SW4] test/exam - oral or written [SW5] implementation of a problem task
[MATL3_U08] is able to formulate definitions and theorems in an understandable way, both orally and in writing, and present correct mathematical reasoning regarding the acquired issues	The student can construct proofs in the field of computational group theory, using tools from other areas of mathematics when necessary, such as linear algebra, number theory, or mathematical logic.	[SU4] test/exam - oral or written [SU5] implementation of a problem task

Subject contents

1. Definition and selected properties of groups
2. Group actions: arbits and stabilizers
3. Permutation groups:
   - stabilizer chains
   - Schreiera-Sims algorithm
   - ,,backtrack" algorithms
   - natural actions and decompositions
   - primitive groups
   - composition series
4. GAP - groups, algorithms, programming
   - examples of theoretical concepts
   - GAP kernel - extending functionality

Prerequisites and co-requisites

Basic knowledge of group theory and related algebraic objects.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
observation of the student's attitude	51.0%	0.0%
test	51.0%	100.0%

Recommended reading

Basic literature

1. Alan F. Beardon, *Algebra and Geometry*, Cambridge University Press, 2005
2. Alexander Hulpke, *Notes on Computational Group Theory*, https://www.math.colostate.edu/~hulpke/CGT/cgtnotes.pdf
3. Various authors, documentations and tutorials for GAP, https://www.gap-system.org/Doc/doc.html

	Supplementary literature	1. Holt, D. F., Eick, B., & O'Brien, E. A. (2005). *Handbook of Computational Group Theory*. Chapman & Hall/CRC
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Determine the orbit of a group action. 2. Determine the stabilizer of a group action. 3. Determine stabilizer chain.	
Work placement	Not applicable	

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