University of Gdańsk

Subject card

Subject name and code	Computational Group Theory, PG_00174263						
Field of study	Mathematical Modeling and Data Analysis						
Date of commencement of studies	October 2024		Academic year of realisation of subject	2025/2026			
Education level	Master's studies		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	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		0.0	60
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
[MMiADMU2_K02] is ready to precisely formulate questions to deepen his 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
[MMiADMU2_K01] is ready to recognize the limitations of his own knowledge and is ready to continue his 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
[MMiADMU2_W04] knows and understands the theoretical basis of computational methods and IT techniques used to solve problems in a selected field of mathematics	The student understands the basic computational techniques and programming principles used in computational group theory; they can use tools such as GAP effectively, with awareness of both their capabilities and limitations.	[SW5] implementation of a problem task
[MMiADMU2_K05] is ready to independently search for information in literature, also in foreign languages	The student can independently search for and analyze scientific literature, including in foreign languages, related to algorithmic problems in group theory and their applications.	[SK8] observation of student's independent or team work
[MMiADMU2_U07] is able to define his interests and develop them; in particular, is able to establish contact with specialists in their field, e.g. understand their lectures intended for young mathematicians	The student is able to identify and develop their interests in computational group theory through independent study, participation in specialist lectures, and engagement with the academic community; using the GAP system, they are capable of constructing examples for more advanced problems in group theory and gaining deeper insight into the presented topics.	[SU5] implementation of a problem task [SU8] observation of student's independent or team work
[MMiADMU2_K04] is ready to understand and appreciate the importance of intellectual honesty in the actions of himself and others; is ready 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
[MMiADMU2_U11] can evaluate, at a basic level, the usefulness of mathematical methods and IT tools	The student knows the possibilities of GAP, in particular, is aware of areas of application of the package.	[SU5] implementation of a problem task [SU8] observation of student's independent or team work

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
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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