University of Gdańsk

Subject card

Subject name and code	Parallel Programming, PG_00193539		
Field of study	Bioinformatics		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2028/2029
Education level	Bachelor's studies	Subject group	Optional subject group 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	3	Language of instruction	Polish
Semester of study	5	ECTS credits	3.0
Learning profile	academic	Assessment form	credit
Conducting unit	Faculty of Chemistry -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. Cezary Czaplewski	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	0.0	0.0	30.0	0.0	0.0	30

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	30	0.0	45.0	75

Subject objectives

1. The student acquires the ability to effectively design and conduct parallel computations.
2. To familiarize the student with available parallel programming tools, in particular MPI and multiprocessing libraries.
3. The student acquires basic programming skills using MPI and multiprocessing libraries

Learning outcomes

Course outcome	Subject outcome	Method of verification
[BIOINL3_W01] Has knowledge of computer science technologies, with particular emphasis on programming	The student recognizes and characterizes parallel architectures, parallel libraries, parallel programming tools, and knows MPI and multiprocessing libraries.	[SW2] presentation/project/paper/ report
[BIOINL3_U01] Graduate is able to program using modern programming tools, including tools dedicated to bioinformatics	The student assesses the usefulness of parallel processing to solve a given problem, runs parallel applications in batch and interactive mode, analyzes source codes using MPI and multiprocessing libraries, creates simple parallel codes using MPI and multiprocessing libraries.	[SU2] presentation/project/paper/ report

Subject contents

Parallel processing as an essential tool in bioinformatics. Types of architectures for parallel computing. Computations in shared and distributed memory systems. Scalability of parallel computing: Amdahl's law. Running parallel tasks on computing clusters, queuing systems. Application of the MPI and multiprocessing libraries in Python programs. Point to point communication: safety and avoiding deadlock. Collective communication. Groups and communicators. Inter-communicators. Data types and user operators in MPI. Virtual topologies. Evaluating the effectiveness of parallelization and profiling parallel programs. Comparison of the MPI and multiprocessing libraries.

<table>
<tr><td>Prerequisites and co-requisites</td><td>Prerequisite:

• Ability to work in Unix
• Python programming skills

Formal requirements:

• Python with the basics of algorithms
• Numerical methods for bioinformaticians
• Mathematical methods of bioinformatics</td></tr>
<tr><td>Assessment methods and criteria</td><td><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>raports</td><td>51.0%</td><td>50.0%</td></tr>
<tr><td>project</td><td>51.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>• MPI for Pyton https://mpi4py.readthedocs.io/en/stable/
• W. Gropp, E. Lusk, A. Skjellum, Using MPI. Portable Parallel Programming with the Message-Passing Interface, The MIT Press, Cambridge, 1999.
• W. Gropp, E. Lusk, R. Thakur, Using MPI-2. Advanced Features of the Message-Passing Interface. The MIT Press, Cambridge, 1999.</td></tr>
<tr><td>Supplementary literature</td><td>• I. Foster, Designing and Building Parallel Programs, Addison Wesley, 1995
• M. Snir, S. Otto, S. Huss-Lederman, D. Walker, J. Dongarra, MPI: the Complete Reference, The MIT Press, 1995
• MPI Forum: http://www.mpi-forum.org</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td></td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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