University of Gdańsk

Subject card

Subject name and code	Programming, PG_00193434		
Field of study	Quantum Information Technology		
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
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	English
Semester of study	1	ECTS credits	3.0
Learning profile	academic	Assessment form	credit
Conducting unit			
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Piotr Mironowicz	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	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

The aim of this course is to provide a student a comprehensive overview of programming methodology that can be useful in further independent research in quantum information

Learning outcomes

Course outcome	Subject outcome	Method of verification
[QITL3_W02] knows and understands on deepened level key and selected advanced detailed issues in the field of quantum information technology, including methods of their research and development, and their applications in the context of dynamic technological changes, in particular in the area of information processing, cryptography and the development of advanced computing systems		
[QITL3_W01] knows and understands in depth selected facts, objects and phenomena, as well as the methods and theories related to them, explaining the complex relationships between them, constituting advanced general knowledge in the field of quantum information technology, as well as the scientific research methodology specific to this discipline and its importance in the context of contemporary directions of development of science and technology		

<table>
<tr><td>Subject contents</td><td>Review and systematics of programming languages. Imperative and declarative programming. History and labor market. Programming environments.Program structure in C ++, Python, Matlab.Basic constructions. Variables, loops, conditional statements, functions, I / O operations, operators.Object-oriented programming. Classes. Basic data structures. Array, list, heap, map, graph.Code organization. Comments, headers, libraries, naming conventions. Programming Pragmatics. Programming styles. Version control systems.Doxygen.Recursion. Dynamic programming. Basic algorithms. Searching, sorting, graph searching.STL library in C ++. Design patterns. Processes and threads. Multi-threaded programming. Data Representations. XML. Sparse matrices. COO andCRS formats.Functional programming.Numerical Methods. Newton-Raphson method, Simpson method, Runge-Kutta method, matrix decompositions.Numpy and scipy packages in Python. Matlab QETLAB package.Linear and semi-definite programming. Solvers.Computational models. Turing machine. Church's thesis. Computational and memory complexity of algorithms. Complexity classes P, NP, NPC,PSPACE. Compilation process and parameters. Debugging and profiling. Unit tests.Code optimization techniques. Language interoperability. MEX files in Matlab. Extension modules in Python.CISC and RISC architectures. Flynn taxonomy. MMX, SSE, AVX instruction sets. Programming on graphic cards. CUDA, PyTorch.Virtual machines and emulators. Bytecode in Python. Assembler and low-level code optimization.BPP, BQP, QMA complexity classes. Quantum programming languages</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>None.</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>laboratory part: test</td><td>51.0%</td><td>50.0%</td></tr>
<tr><td>lecture part: test</td><td>51.0%</td><td>50.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>None.</td></tr>
<tr><td>Supplementary literature</td><td>None.</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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