COURSE DESCRIPTION CARD - SYLLABUS

Course name
Introduction to Quantum Computing [S1Cybez1>WdOK]

Course

Field of study
Cybersecurity

Year/Semester
3/5

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
16

Laboratory classes
16

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

The student starting this subject should have knowledge and skills in calculus, linear algebra, computational complexity theory and should know basic principles of algorithm design and analysis. Moreover, the student should present such attitudes as: honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

The aim of the course is to present to students the basic principles of quantum computers, design and analysis of quantum algorithms and complexity of quantum computations.

Course-related learning outcomes

Knowledge:
1. The student knows and understands the basic principles of quantum computers. [K1_W02]
2. The student knows and understands the basic models of quantum computations. [K1_W05]
3. The student knows and understands the mathematical methods used to describe quantum algorithms. [K1_W07]
4. The student knows and understands the differences between classical and quantum computers.

[K1_W06]
6. The student knows and understands the methods of describing and designing quantum algorithms. [K1_W09]
7. The student knows and understands the capabilities and limitations of quantum computers. [K1_W06]

Skills:
1. The student is able to fluently use and integrate information obtained from literature and electronic sources, in Polish and in English. [K1_U01]
2. The student is able to integrate and interpret obtained information, draw conclusions, formulate and justify his/her opinions. [K1_U04]
3. The student is able to analyze quantum algorithms. [K1_U05]
4. The student is able to design and implement simple quantum algorithms. [K1_U02]
5. The student is able to evaluate the usefulness of quantum computers for solving particular computational problems. [K1_U06]

Social competences:
1. The student is ready to learn throughout the whole life and improve his/her competences. [K1_K01]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

In terms of lectures on the basis of a test.
In terms of laboratory classes on the basis of a current assessment of students' work and on the basis of the reports on the projects done during the classes.
In each form of the course assessment, the grade depends on the number of points the student earns relative to the maximum number of required points. Earning at least 50% of the possible points is a prerequisite for passing. The relationship between the grade and the number of points is defined by the Study Regulations. Additionally, the course completion rules and the exact passing thresholds will be communicated to students at the beginning of the semester through the university's electronic systems and during the first class meeting (in each form of classes).

Programme content

The course concerns selected issues related to computations performed using quantum computers.

Course topics

The lectures covers the following topics:
1. The idea of quantum computing.
2. Mathematical foundations of quantum information processing.
3. Quantum gates and circuits.
4. Types of quantum algorithms.
5. Basic quantum algorithms.
6. Fundamentals of quantum computer programming.
7. Quantum computational complexity.
8. Quantum computer architectures.
As part of the laboratory classes students solve problems related to the issues discussed during the lectures.

Teaching methods

Lecture: multimedia presentation.
Laboratory classes: solving exercises in the classroom, discussion with students, describing the results in the form of reports.

Bibliography

Basic:
1. Chris Bernhardt. Obliczenia kwantowe dla każdego. PWN, Warszawa 2020.
2. Mika Hirvensalo. Algorytmy kwantowe. Wydawnictwa Szkolne i Pedagogiczne, Warszawa 2004.

3. Noson S. Yanofsky, Mirco A. Mannucci. Quantum Computing for Computer Scientists. Cambridge University Press, Cambridge 2008.

Additional:
1. Scott Aaronson. Quantum Computing since Democritus. Cambridge University Press, Cambridge 2015.
2. Richard P. Feynman. Przetwarzanie informacji. Feynmana wykłady. PWN, Warszawa 2022.
3. Eric R. Johnston, Nicholas Harrigan, Mercedes Gimeno-Segovia. Komputer kwantowy. Programowanie, algorytmy, kod. Helion SA, Gliwice 2021.

Breakdown of average student's workload

	Hours	ECTS
Total workload	57	2,00
Classes requiring direct contact with the teacher	32	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	25	1,00