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NAWA POLISH NATIONAL AGENCY FOR ACADEMIC EXCHANGE

MODULE DESCRIPTION CARD – SYLLABUS

This module is a part of the Intensive International Education Programs in the field of the … organised at Poznan University of Technology as part of the „IMPACT – Innowacyjne Międzynarodowe Programy w AI, Cyberbezpieczeństwie i Teleinformatyce" project implemented SPINAKER Program of the National Agency for Academic Exchange, financed by the European Social Development Fund 2021–2027 (ESDF).

Module name:	Number of hours:	Lecturer:
Introduction to Quantum Computing	10	Piotr Formanowicz, Prof.

Module Descriptions:

The module introduces students to the basic concepts of quantum computing. It explains the idea of exploiting quantum phenomena to perform computations. The module presents the physical foundations of quantum computing and discusses the capabilities and limitations of quantum computers. It also covers quantum gates and circuits, the idea of basic quantum algorithms, quantum computer technologies, and the perspectives of quantum computing.

Purpose of the support under Module:

The overall objective of the Innovative International Education Program in Artificial Intelligence is to introduce students without deep knowledge of quantum physics to the field of quantum computing. It presents the concept of using quantum phenomena to build quantum computers and design quantum algorithms.

The specific objective of the module is to provide competencies and promote activities carried out at the Poznań University of Technology in the area of quantum computing, including:

- physical foundations of quantum computing,
- bits and qubits,
- quantum gates and circuits,
- classical and quantum computational complexity,
- capabilities and limitations of quantum computing,
- the idea of basic quantum algorithms,
- quantum computer technologies.

Method of support under Module:

Support within the module is provided with the participation of the instructor and divided into the following elements:

- 6-week self-study program using teaching materials provided by the instructor on the e-learning platform;
- 6 weeks of support from the instructor in the form of online consultations using tools that enable meetings to be held;

- a test to verify the acquisition of competences.

Module-related learning outcomes:

Descriptions of the new competences:

The primary goal of the module is to introduce students without deep knowledge of quantum physics to the field of quantum computing. Participants gain knowledge about the basic concepts and methods of quantum computing. They understand how quantum computational cuircuits work as well as the capabilities and limitations of quantum computers.

Knowledge:

1. Student has knowledge of physical phenomena used in quantum computing.
2. Student understands the idea of using quantum phenomena to perform computations.
3. Student has knowledge of classical and quantum computational complexity theory.
4. Student understands the capabilities and limitations of quantum computers.
5. Student has knowledge of basic quantum gates and circuits.
6. Student understands the generall ideas of basic quantum algorithms.
7. Student has general knowledge of quantum computer technologies.

Skills:

1. Student is able to analyze basic quantum circuits and algorithms.
2. Student is able to assess the possibility of using quantum computers in various fields.
3. Student is able to design a simple quantum circuit.

Social competences:

1. Student understands that quantum computing is a rapidly developing interdisciplinary field of science and recognizes the need for continuous learning.
2. Student is prepared to work in interdisciplinary teams.

Criteria for verifying learning outcomes

Learning outcomes are assessed using an on-line multiple-choice test that evaluates student's knowledge and understanding of quantum computing concepts. A minimum of 50% of the answers must be correct to pass.

Method of verification/validation of learning outcomes

Verification is conducted on the basis of an on-line multiple-choice test delivered on the dedicated e-learning platform. The test is conducted individually, without access to supporting materials, and evaluates the extent to which the student has achieved the intended knowledge. The results are automatically recorded and validated according to predefined assessment criteria.

Workload

25 h (including work with teaching materials provided by the lecturer, consultation, and the student's own work) – 1 ECTS point

Level of the European Qualifications Framework