Computer Science

Study branch: Quantum Informatics

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Faculty	Faculty of Electrical Engineering and Computer Science
Type of study	Follow-up Master
Language of instruction	English
Code of the branch	S02
Regular period of the study	2 years
Cost	50,000 CZK per semester
Department	Department of Computer Science
Coordinator	prof. RNDr. Václav Snášel, CSc.

About study programme

The Quantum Computer Science specialization is designed for students who want to be at the forefront of future technologies and delve into one of the fastest-growing and most challenging fields in contemporary computer science. The program will introduce you to the world of quantum algorithms, quantum hardware, and computational principles that are fundamentally changing the way we think about information processing. You will gain in-depth theoretical knowledge and practical skills in quantum computing, quantum information theory, and quantum cryptography, based on an understanding of the physical and mathematical foundations of quantum technologies. You will learn to formulate tasks suitable for quantum processing, design and analyze quantum algorithms and quantum circuits, and work with modern quantum simulators and available quantum hardware. You will understand the limitations of current quantum platforms and be able to assess the effectiveness of quantum solutions compared to classical methods. Emphasis is placed on linking theory with practice, experimental verification of designs, and the ability to adapt selected procedures to specific technical and research tasks. The program will prepare you to work in interdisciplinary teams, teach you to present your research findings in an international context, and guide you toward independently monitoring current developments and pursuing continuous professional growth. It also includes critical thinking about the social, ethical, and security implications of quantum technologies, which will play a key role in the future, for example, in the areas of data security and cryptography. Graduates find employment in research and development teams at technology companies, scientific institutions, and innovative startups focused on quantum technologies. They can work as quantum algorithm developers, quantum cryptography specialists, or researchers, and are also well prepared to continue their doctoral studies.

Graduate's employment

Graduates of the Quantum Computer Science specialization are prepared to work in research and development teams focused on quantum computing, quantum cryptography, and advanced information processing methods. They will find employment primarily in institutions and companies developing quantum hardware and software, in technology startups, and in scientific and research organizations dealing with quantum technologies. Thanks to their knowledge of the principles of quantum computing and their ability to work with quantum simulators and real hardware, graduates can hold positions as researchers, quantum algorithm developers, quantum cryptography specialists, or data analysts specializing in quantum methods. The program also provides a solid foundation for continuing on to doctoral studies and participating in international research projects.

Study aims

The Quantum Computer Science specialization allowed graduates to focus on quantum computer science, i.e., quantum algorithms, quantum hardware, and related computational principles. As part of this specialization, graduates deepened their knowledge in the

areas of quantum computing models, quantum information theory, quantum cryptography, and the fundamentals of the physical principles of quantum data processing. The knowledge they acquired enables them to find employment in the developing field of quantum technologies.

Graduate's knowledge

Graduates of the Quantum Computer Science specialization will acquire in-depth knowledge and skills in the field of quantum computing and its applications. They understand the principles of quantum mechanics and the mathematical structures of quantum theory and are able to apply advanced quantum algorithms and simulation methods. They can program quantum systems, design and analyze quantum circuits, understand the limitations of current hardware, and are familiar with its possible uses. Graduates are able to distinguish themselves in the fields of quantum computing, quantum cryptography, quantum simulations, and applications of quantum technologies in industry. At the engineering level, they are able to explain the principles of selected algorithms and methods, parameterize them, and adapt them to the needs of the tasks at hand, and are able to identify their advantages and limitations. Graduates find wide application in technology companies, research institutions, and in follow-up doctoral studies, and have the potential to actively contribute to the development of quantum technologies of the future.

Graduate's skills

Graduates of the Quantum Computer Science specialization are able to design, analyze, and implement quantum algorithms using modern quantum simulators and computing platforms. They can formulate tasks suitable for quantum processing, understand their mathematical formulation, and assess the effectiveness of quantum solutions in comparison with classical methods. Graduates are able to use available quantum hardware and simulators for experimental verification of designs and for research activities in the field of quantum technologies. They are able to combine theoretical knowledge with practical skills and contribute to the development of new approaches in the field of quantum computing and cryptography.

Graduate's general competence

Graduates of the Quantum Computer Science specialization are able to collaborate with experts in the fields of computer science, mathematics, and physics in solving complex technical and research tasks. They are able to accurately formulate professional conclusions, interpret experimental results, and present them in an international context.
They are able to independently search for and critically evaluate new findings in the field of quantum technologies, follow current developments in the field, and adapt to new methodological and technological approaches. They are aware of the social, ethical, and security implications of using quantum computing methods and are prepared to take responsibility for their decisions and the work of their professional team.

Professions

- Academic staff member
- Quantum HW–SW integration engineer
- Quantum technologies specialist
- Hybrid quantum-classical systems developer
- Quantum simulation engineer
- Quantum cryptography specialist
- Quantum data analyst
- Researcher
- Quantum computing researcher
- Quantum algorithm developer
- Quantum systems architect
- Quantum Information Scientist
- R&D engineer

- Quantum software engineer

Hard skills

- Hybrid quantum-classical computations
- Comparison of quantum and classical algorithms
- Quantum simulators
- Security aspects of quantum technologies
- Quantum error correction
- Quantum information theory
- Computational complexity
- Quantum circuits
- Quantum cryptography
- Mathematical foundations of quantum computing
- Experimental work with quantum hardware
- Quantum circuit design and optimization
- Quantum programming
- Quantum algorithms
- Quantum computational models
- Fundamentals of quantum physics

Study curriculum

- form Full-time (en)