Quantum Computing

Module-No./Abbreviation | Credits | Workload | Term | Frequency | Duration
CE-W08/QC | 3 CP | 90 h | 3rd Sem. | Winter term | 1 Semester

Courses
Quantum Computing

Contact hours | Self-Study | Group Size
2 SWS (30 h) | 60 h | No Restrictions

Prerequisites
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Learning goals / Competences:
After successfully completing the module, the students
- are enabled to design and create programs for quantum computers,
- can critically evaluate quantum systems and quantum algorithms,
- can assess the benefit of using quantum effects in computations.

Content
The lecture covers the theory and application of quantum computing from a computer science perspective with a focus on the usage of today’s quantum hardware. The relevant basics of quantum mechanics including superposition, measurement, interference, entanglement and mathematical notation are introduced. The characteristics of quantum bits and registers are discussed, and the construction and properties of quantum gates and quantum circuits presented. Prominent examples for quantum algorithms are surveyed including algorithms based on quantum Fourier transformation (e.g. Shor’s factoring), quantum search (e.g. Grover), quantum solution of linear systems of equations (e.g. HHL) and quantum machine learning. Current quantum computer hardware as well as quantum error correction are discussed. An introduction to quantum programming languages and environments will be provided. Hands-on programming exercises and self-implemented quantum circuits in study projects are used to discuss and illustrate the theoretical content. Implementations are tested on quantum simulators and cloud-based quantum hardware.

Teaching methods / Language
Block seminar (equiv. to 2 SWS) / English

Mode of assessment
Study project and oral examination

Requirement for the award of credit points
Passed final project and passed oral examination (100%)

Module applicability
MSc. Computational Engineering

Weight of the mark for the final score
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Module coordinator and lecturer(s)
Prof. Dr. A. Vogel, Assistants

Further information