DD2367 Quantum Computing for Computer Scientists 7.5 credits

Kvantberäkning för dataloger

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

This official course syllabus is valid from the autumn semester 2023 in accordance with decision by the head of school: J-2022-2153.Date of decision: 09/10/2022

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Computer Science and Engineering

Specific prerequisites

Knowledge in algebra and geometry, 7.5 higher education credits, equivalent to completed course SF1624.

Knowledge and skills in programming, 6 credits, equivalent to completed course DD1337/DD1310-DD1319/DD1321/DD1331/DD100N/ID1018.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After passing the course, the student shall be able to

- describe complex numbers and complex vector spaces for quantum computing
- describe superposition of states, non-locality effects and probabilistic laws
- compare the advantages and disadvantages of classical data processing with quantum computing
- generalize the concept of bit, classical gate, and registers to qubit, quantum gates, and quantum registers
- list, formulate and describe key algorithms in quantum computing
- describe hardware that can realize quantum calculations

in order to design quantum algorithms and programs that can run on current and next-generation quantum computers.

Course contents

The course is organised in three modules that cover the basics of programming of quantum processors (QPU). The first module covers the fundamentals of quantum computing, including quantum bits and quantum gates and realization in hardware. The second module presents quantum algorithm primitives, such as quantum arithmetic and logic, amplitude amplification, and phase estimation. The third module introduces the main QPU applications, such as quantum search, Shor's factorization algorithm and quantum machine learning.

Examination

- LAB1 - Laboratory work, 2.0 credits, grading scale: P, F
- LAB2 - Laborative work, 2.0 credits, grading scale: P, F
- LAB3 - Laborative work, 2.0 credits, grading scale: P, F
- PRO1 - Project work, 1.5 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.