03-IMAT-IRQ	Introduction to Reversible and Quantum Computing

Lehrform *(teaching format)* / **SWS** *(hours per week)*: 2VL + 2UE

Kreditpunkte *(credit points)*: 6

Turnus *(frequency)*: usually, summer term
Inhaltliche Voraussetzungen *(content-related prior knowledge/skills)*: NONE

Sprache *(language)*: English

Lehrende *(teaching staff)*: AG Rechnerarchitektur (Prof. Dr. Rolf Drechsler et al.)

Studiengang *(degree program)*	Module	Semester
Infornatik (Master)	IMAT, IMVT-SQ	from 1st sem.
Infornatik (Bachelor)	(nur *Freie Wahl*)	

Lernergebnisse / *Learning Outcome*:

- Understand and have the ability to explain the functionality of reversible and quantum gates
- Understand and have the ability to explain the process of synthesizing reversible circuits
- Know and understand optimization techniques for synthesis process of reversible circuits
- Understand and have the ability to explain several well-known quantum algorithms (e.g. Shor's algorithm, Grover's algorith, see below for more)
- Know and understand various approaches for compiling quantum circuits
- Ability to perform basic mathematical operations necessary for quantum and reversible computing

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Inhalte / *Contents*:

Quantum Computing is an emerging technology that exploits the quantum mechanical properties to solve certain problems which are considered complex for classical computers. The emergence of quantum computers in recent times has motivated researchers to investigate and develop algorithms and CAD tools for compiling quantum circuits to such platforms. This course introduces students to the recent topics in quantum computing. This course will also cover Qiskit Software, which is an open-source software development kit for creating and running programs and algorithms.

- Module 1: Mathematical Background and Formalisms
- Module 2: General Introduction to reversible and quantum computing, particular emphasis on reversible and quantum gates
- Module 3: Synthesis and optimization techniques for reversible circuits as stepping stone for compiling quantum computers
- Module 4: In-depth study of well-known quantum algorithms, e.g. Shor's algorithm, Grover's algorithm, Quantum Phase Estimation algorithm, Deutsch Jozsa's algorithm
- Module 5: Various approaches for compiling quantum circuits

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Hinweise *(remarks)*: The table lists only the primary / most specific modules to which this course is assigned.