Quantum Algorithm Engineering (QAE)

Bridging the Gap to Industrial Applications

Stefan Hillmich, Sonja Bruckner, Mathias Gartner, Rudolf Ramler, Robert Wille
{stefan.hillmich, sonja.bruckner, mathias.gartner, rudolf.ramler, robert.wille}@scch.at

scch { software competence center hagenberg }

"Our vision for QAE is to bridge the gap between the applications and the low-level quantum software ecosystem."

Quantum Combinatorial Optimization

- Identify Problem Classes
- Novel Algorithm Variants
- Stochastic Optimization

Expected results:

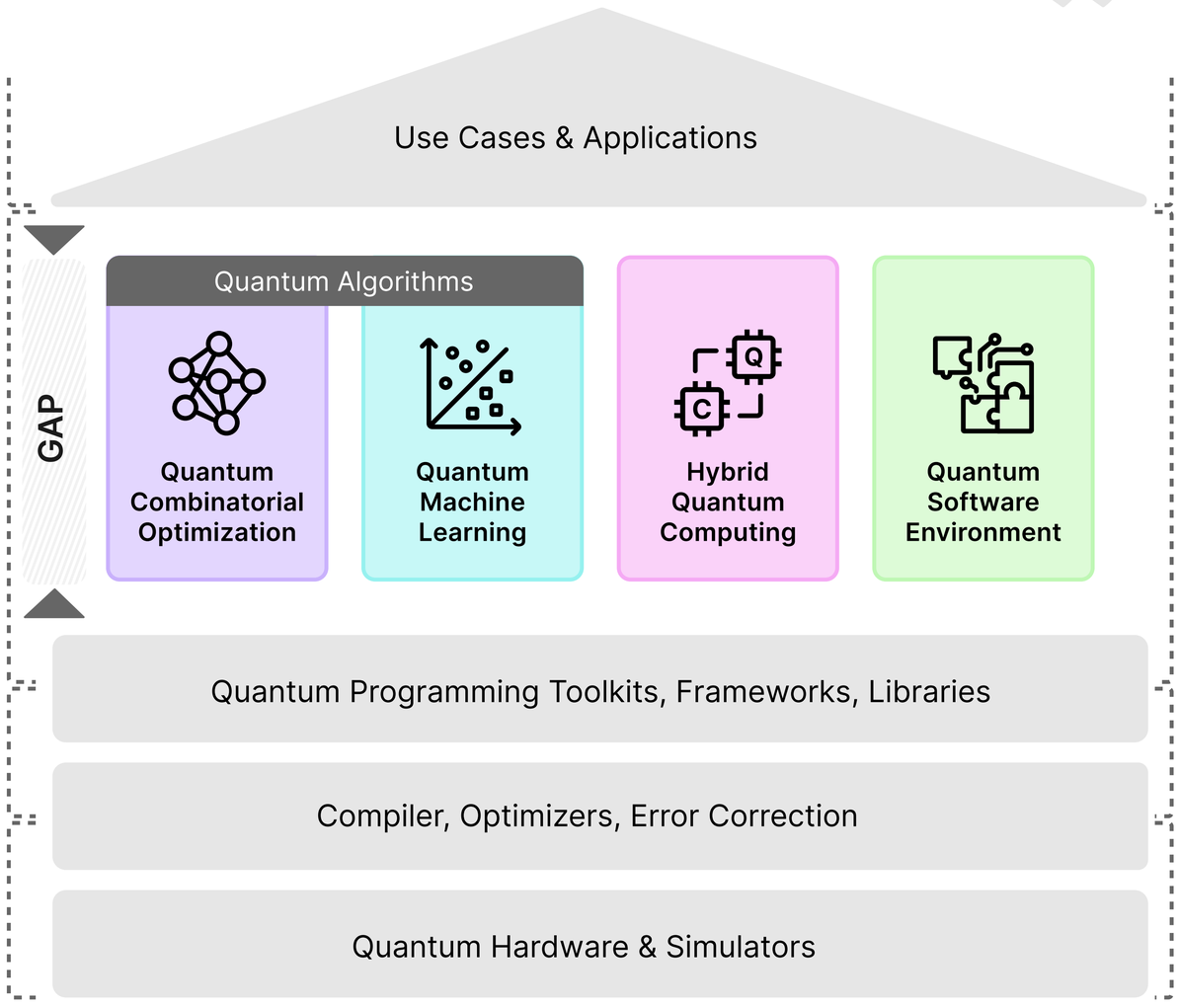
- Categorization of problem classes and applicability
- Novel variants of QAOA algorithms and ansatz circuits
- Trade-off between ansatz com-plexity/efficiency and solution quality
- Integration into test framework and application-centric tools

Quantum Machine Learning

- No-go Theorems
- Classical Shadows
- Fully Quantum QML

Expected results:

- Theoretical results on Classical Data/Quantum Algorithm
- Applications for Quantum Data/ Classical Algorithm
- Reduced requirements on quantum hardware for data acquisition
- Fully quantum-based learning



Hybrid Quantum Computing

- Workflow Language
- Hybrid Benchmark Suites
- Performance Models

Expected results:

- Hybrid quantum-classical workflow definition language
- Hybrid benchmarking suite
- Performance models for quantum hardware
- Runtime management for hybrid quantum-classical workflows

Quantum Software Environment

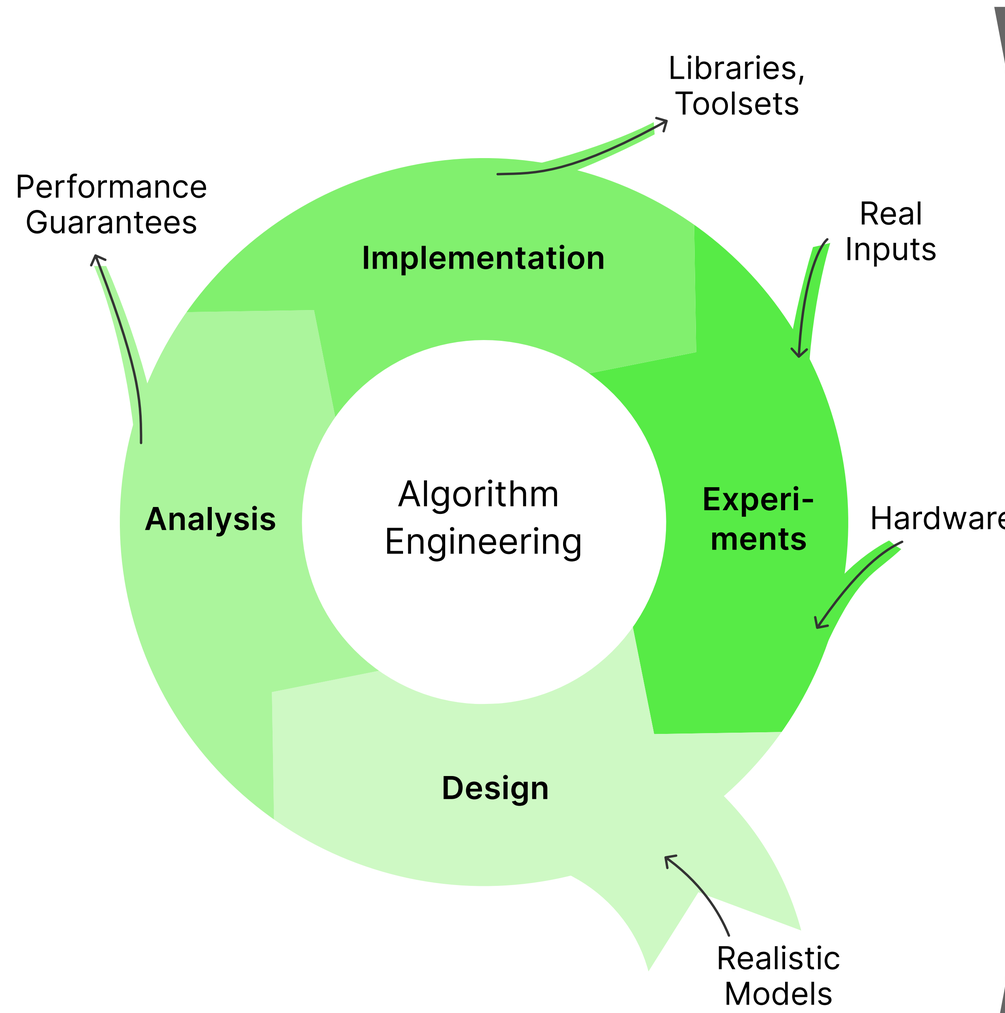
- Modelling Language
- Block-based Engineering
- Synthesis Pipeline

Expected results:

- Hybrid quantum modeling language
- Block-based algorithm engineering method
- Hybrid function/state specification language
- Learning-based synthesis engine
- Integration of the developed methods into larger software stacks

Introduction

Quantum computing is rapidly advancing, in both hardware and software development. However, there's a significant gap between the potential of quantum computing and its practical applications. **QAE** aims to bridge this gap by connecting industry with the quantum ecosystem and developing tools to facilitate the use of quantum computing in various domains. This project will involve extensive basic research into quantum algorithms, their applicability, and the development of software methods and tools. By completing the quantum computing landscape, this project will drive technological innovation, create new jobs, and provide competitive advantages for industry and businesses.



Key Goals

G1 Demonstrate the (non-)utility of quantum algorithms for relevant use cases.

G2 Establish software engineering for quantum computing to enable efficient, maintainable, and reusable software development.

G3 Make quantum computing more accessible for industry applications.

Software Competence Center Hagenberg GmbH
Softwarepark 32a, 4232 Hagenberg, www.scch.at

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