Quantum Computing

**The new world of computing
& data processing**

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# Quantum Computing: The Next Big Thing?

Quantum Computing is a new computing paradigm that uses the power of quantum mechanics to solve problems that are intractable on classical computers. Quantum computers promise to solve certain problems faster and more accurately than classical computers. Two important concepts in quantum computing are superposition and entanglement.

Superposition: In classical computing, a bit is either 0 or 1. In quantum computing, a qubit can be in a combination of these basis states, such that both states are encoded in a single qubit.

Entanglement: Entanglement is a phenomenon in which two or more qubits are linked together in such a way that they share the same fate. This means that, if you measure the state of one qubit, you will instantly know the state of the other qubits.

Quantum computing has the potential to revolutionize a wide range of industries, including:

- **Quantum Combinatorial Optimization:** optimize a wide array of tasks, such as supply chains and transportation networks.
- **Quantum Machine Learning:** train machine learning models that are more accurate and efficient than those that can be trained on classical computers.
- **Quantum Material Science:** simulate the behavior of molecules, which could lead to the development of new drugs and materials.
- **Time Series Forecasting:** solve problems in forecasting, such as portfolio optimization.
- **Hybrid Quantum Computing:** quantum computers will work in tandem with classical ones, requiring efficient orchestration.
- **Quantum Software Environment:** It becomes crucial to provide appropriate software tools and engineering concepts to efficiently utilize the power of quantum computing.
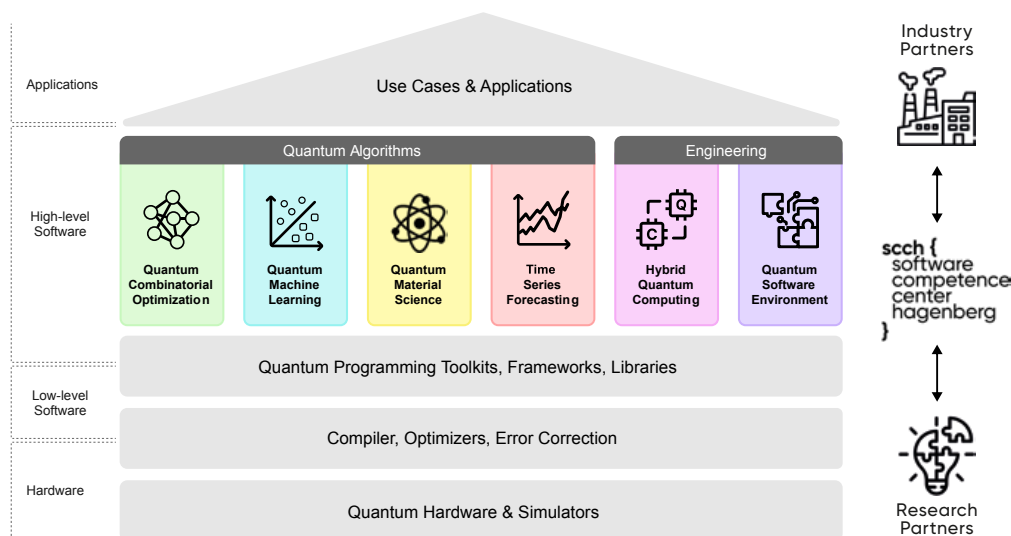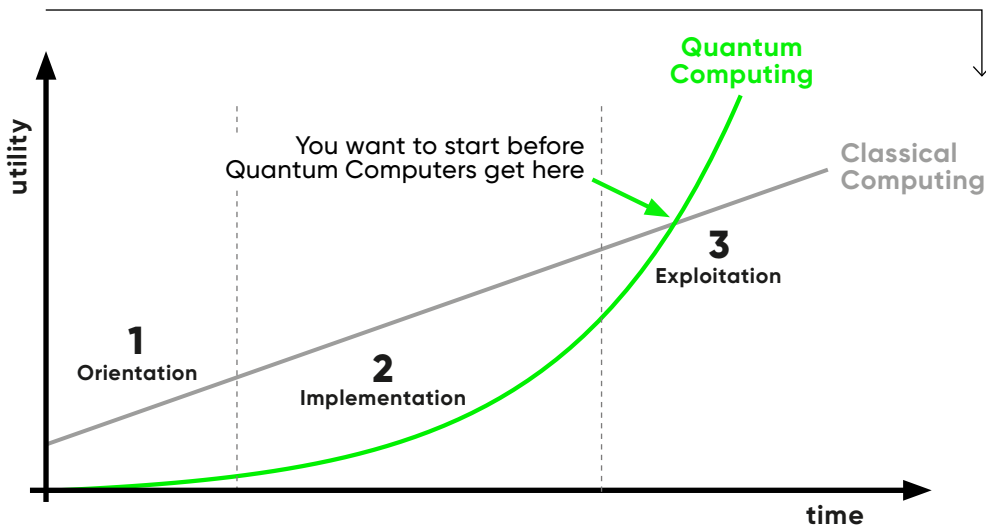

Ready for Quantum Computing?

In our work we aim to asses and implement applications for future quantum computers. This involves workshops to convey the basics of quantum computing, identifying strategic use cases, and realizing proof-of-concept algorithms, and to work out strategies for practical application. To this end, we collaborate with the Johannes Kepler University Linz and the Technical University of Munich, working on industrial applications for partners, ranging from SMEs to large corporations.

Software Competence Center Hagenberg (SCCH)

We are an independent COMET research centre with currently 125 employees in the field of data and software science. As one of the European spearheads in technology research and development, we are pursuing an ambitious agenda in the field of quantum computing: we want to close the gap between the first industrial applications and real quantum computers. Embedded in an international network of partners from science and industry, we are developing solutions that make quantum computing accessible to commercial companies.

Your Way to Quantum Computing

utility

You want to start before
Quantum Computers get here

**Quantum
Computing**

**Classical
Computing**

1
Orientation

2
Implementation

3
Exploitation

time

*Quantum computers
will arrive in practice in
the next few years. It is
important to prepare
for this today and build
up the knowledge to
benefit when the hard-
ware is available.*

Prof. Dr. Robert Wille

1. Orientation
- Build knowledge
- Identify goals

2. Implementation
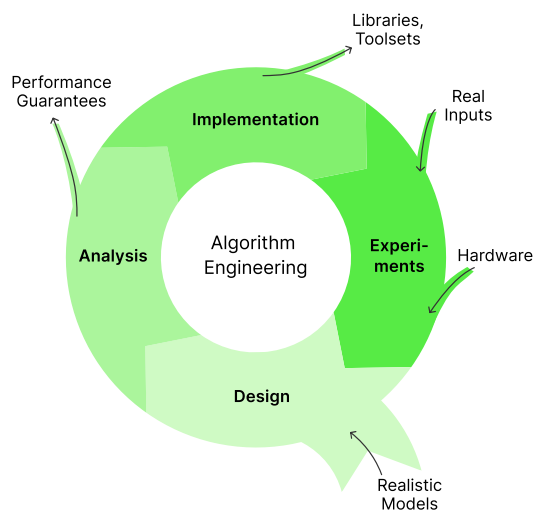- Define strategy
- Research on applications

3. Exploitation
- Obtain market advantage
- Improve on solution

Challenges of the Industry

- **Identification of suitable tasks:** Not every task or problem is suitable for quantum computers, making it important to focus the effort on the most promising ones.

- **Building expertise:** Albeit quantum computers have a high potential, using that requires an appropriate understanding of how to use them.

- **Utilize advantage:** Finally, successfully utilizing the advantage of quantum computers is based on identification of tasks and building expertise before they surpass classical computers.

Libraries,
Toolsets

Performance
Guarantees

Real
Inputs

Implementation

Algorithm
Engineering

Experi-
ments

Hardware

Analysis

Design

Realistic
Models

Applications

Logistics | Scheduling | Regression | Classification

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You need help?

We support you in becoming acquainted with the „quantum world" by providing:

- **Expertise** in quantum computing (from basic research foundations to applications)
- **Workshops** on the basic concepts and initial strategies to get started
- **Consulting** on the potential applicability of individual solutions
- **Joint projects** to realize initial „test balloons" or entire applications
- **Support in applying for funding** e.g., provided by FFG or other national/international programs

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