Applied Quantum Computing at the Jülich Supercomputing Centre

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Quantum computing and quantum annealing are new, innovative ways of computing for some of the most complex problems with potential applications in simulation, optimization and machine learning. The expectations for the use of quantum computers and quantum annealers in science and industry are high. Although it will still take many years for quantum computing technology to become fully mature, an early entry into the practical use of this new disruptive technology is of great urgency.

Practical application requires the integration of quantum computers into existing HPC infrastructures in the form of quantum-classical hybrid computing models. The “Jülich UNified Infrastructure for Quantum computing (JUNIQ)”, a quantum computer user facility which is currently being set up at the Jülich Supercomputing Centre, meets these needs. Within JUNIQ, user support and training in HPC and quantum computer usage will be provided, software tools, modelling concepts and algorithms will be developed, and it will play an important role in the development of prototype applications.

We discuss some prototype applications in optimization and machine learning. We present results of benchmarking optimization algorithms for quantum computers and quantum annealers and of implementing support vector machines, supervised machine learning algorithms for classification and regression problems, on quantum annealers.