

## Graduation Project Proposal

### **QAL-HPC/SC: QAL for Supercomputers and High-Performance Computing**

QAL (Quantum Algorithms Lab) is an innovative visual interactive app that is currently under development for researching and teaching quantum algorithms and related mathematical fields. For more info on QAL, check <https://q-info.github.io/QAL-Lite>.

As a visual app, QAL presents much 2D and 3D graphics, whose calculations need much computing power. Linear algebra calculations in QAL (e.g., matrix multiplications) need further computing power. Both essential features of QAL degrade its performance severely when presenting large quantum algorithms (i.e., ones with a large number of digits/parts or a large number of steps).

**Project Description:** QAL is currently implemented as a regular web app, which makes QAL suited for running on any general computing device. Running QAL, as is, on a supercomputer or a high-performance computing (HPC) system (such as those at Bibliotheca Alexandrina, SRTA-City, or elsewhere) will likely result in some performance benefits. Having a version of QAL that is *tailored* to run on a supercomputer (a specific one or a general HPC or parallel computer) will likely result in large performance gains, however. In this graduation project, students will be responsible of putting their software development skills towards building a version (or versions) of QAL that are more suited for making use of the capabilities of supercomputers and high-performance computing systems. (Extra: Incorporate speeding-up ideas from Robert Hundt's book [QC4P].)

**Note:** This project can be combined with the [Julia-QAL project](#).

**Team Size:** 2-3 members.

**Main Technologies:** Mainly JavaScript or [TypeScript](#), but possibly also one or more of C/C++, [Julia](#), [R](#), [SciPy](#), or [Matlab](#).

**Prerequisites:** Excellent software development skills. Good knowledge of general math, particularly of linear algebra, is a plus, but not absolutely necessary.

**Frameworks:** QAL is currently implemented as a client-side web app that uses few simple libraries and frameworks (e.g., well-known JavaScript libraries such as jQuery, jQueryUI, ... etc.). How these libraries are used in QAL can be explained to the students.

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