

Aangeboden projecten: Details project

Amortized Quantum Data Structures (drs. D. Abma)

1 Nov 2022

1.1 Proposal

Thesis project proposal

1.2 Project Title

Amortized Quantum Data Structures

1.3 Project Description

As with classical algorithms, quantum algorithms often use data structures to store sets of objects in such a way that insertions, deletions, and lookups can be done efficiently. One example is the quantum algorithm for element distinctness (also called the collision problem) described in Section 8.3.2 of Ronald de Wolf's lecture notes. If one wants to account for all operations of this algorithm, not only the number of queries to the input, one needs to describe how sets are stored.

However, as the state of a quantum algorithm can be in a superposition of different sets, there are a number of restrictions on data structures used in quantum algorithms, beyond what is required for classical algorithms. One example is that, while classical algorithms can use data structures with low amortized complexity (see here, or here), quantum algorithms have been thought to require worst-case data structure analysis, because even if one branch of the superposition terminates early, there may be other branches that take the worst-case time.

A recent paper shows how to use quantum subroutines in superposition, without always incurring worst-case complexity. In this project, we will try to apply these results to analyze the use of classical data structures with good amortized complexity in quantum algorithms, such as the element distinctness algorithm. If successful this work could open the door to having significantly more freedom in choosing and designing data structures for use in quantum algorithms.

1.4 Work environment

QuSoft at CWI, Amsterdam.

1.5 Expectations

To be decided later with the supervisors, but ideally interested students have completed (some of the) quantum computing and quantum information courses.

Duration

- **MSc Information Studies and MSc Logic: 6 months**

- **MSc Software Engineering: 3 months**

- **MSc Computational Science: 8 months**

1.10 Programmes

Master Logic (6 months), Master Computational Science (8 months)

1.11 Project Contact

Subhasree Patro MSc (subhasre@cwi.nl, QuSoft - CWI)

1.12 Number of Students

1

2. Research Tags

Please choose a maximum of three individual tags.

Note: it is not possible to submit the form if more than 3 research tags are selected

2.1 Amsterdam Machine Learning Lab

2.2 Computational Science Lab

2.3 Computer Vision

2.4 Digital Interactions Lab

2.5 Intelligent Data Engineering Lab

2.6 Information Retrieval Lab

2.7 Language Technology Lab

2.8 Multimedia Analytics Lab Amsterdam

2.9 Quantitative Healthcare Analysis

- 2.10 Theory of Computer Science Algorithms and datastructures, Quantum computing
- 2.11 Complex Cyber Infrastructure
- 2.12 Security by Design
- 2.13 Multiscale Networked Systems
- 2.14 Parallel Computing Systems
- 2.15 Socially Intelligent Artificial Systems
- 2.16 Video and Image Sense Lab
- 2.17 Natural Language Processing & Digital Humanities
- 2.18 Theoretical Computer Science (ILLC) Algorithms and Complexity
- 2.19 Formal Semantics and Philosophical Logic

3.1 Imported project id

3.2 Copied project id