Homework 2

Quantum Turing machine

announced 24. 3. 2023, due 7. 4. 2023 (prior to the lecture as a zip file in Brute)

In the fourth lecture, we have seen that a simulator of a Turing machine can be written in a couple of lines of Python. In this homework assignment, you can get 10 points for all of:

- implementing a simulator in Python of one of the model of quantum computing, which we have seen so far.
- implementing one or more sample circuit (e.g. Hadamard on 2 qubits followed by a CNOT), again in Python, on top,
- preparing a short document illustrating the circuit and the outputs (e.g. in PDF).

For inspiration, you may want to consider `https://github.com/Qiskit/qiskit-aer/tree/main/src/simulators/statevector`, which is a simulator of quantum circuits. If you would like to develop a simulator of a quantum Turing machine (based on the Turing machine simulator?) or the Arora/Barak model, you are most welcome.

You can also get 10 additional points, if you complete one of the following:

- develop your own simulator for the stabilizer formalism (cf. `https://arxiv.org/pdf/2103.02202.pdf`) in as few lines of Python as possible, perhaps taking inspiration from `https://www.scottaaronson.com/chp/`
- develop a method for taking a unitary matrix and estimating how few Clifford circuits and non-Clifford circuits you need to implement it and producing the corresponding Clifford circuits.

These points are optional, in that you can collect 100 points without collecting these 10.