Quantum Information and Computing
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From 6 February 2024 – to 6 March 2024

1) Consider the problem of mapping a general Matrix Product State to a quantum circuit. Present what an MPS is and the possible uses of such a procedure.
2) Using qtealeaves and qmatchatea understand how to evolve an MPS using a quantum circuit;
3) Following [1] write the mapping from a general bond dimension 2 MPS to a quantum circuit. In particular, make use of the MPS class of qtealeaves. You may have to implement a reduced density matrix for 2 sites.
4) Following [2] write the iterative mapping from a general bond dimension to a quantum circuit
5) Discuss the length of the circuit versus the fidelity for some states, comparing it to the exact mapping given by qiskit. Some interesting states might be random states at fixed bond dimension or ground states of the Ising model while varying the coupling constant.

By the due date please submit both the code and the presentation of the final project. The presentation has to cover the topics detailed above, including the theory part. There is no limit to the number of slides however, the final presentation should last 20 minutes.

[1] https://arxiv.org/abs/1908.07958

[2] https://arxiv.org/abs/2209.00595