Implement a fast Clifford simulator using the bit-vector representation on GPU

The Stabilizer representation presented here allows us to efficiently evaluate Clifford circuits (circuits whose only rotations are by $k\pi/4$ for integer k. The method boils down to bitwise operations on very wide bit-strings, highly suited for data-parallel execution on e.g. GPU and multi-GPU.

This project suggests to implement a Clifford circuit simulator using the bit-vector representation. We suggest to start with a pure Haskell implementation, then add a GPU backend using e.g. Futhark.

It is possible to do the pure Clifford simulator during the mini-project - further work can explore the extensions of the Stabilizer representation to general quantum circuits and states.

Literature:

Gottesman: The Heisenberg Representation of Quantum Computers
Garcia et al.: On the Geometry of Stabilizer States
Gidney: Stim: a fast stabilizer circuit simulator