WON0008 – Introduction to Quantum Computing (Cohort) – Spring 2023

QC Seminar 5

Assignments – Quantum Neural Networks and Quantum Circuit Born Machines

1. Run *notebook_qcbm.ipynb* and generate the final results for the current settings. Also generate a plot of the cost function values. Use the CirqSimulator() in Cell 10.

2. Re-run the notebook but switch out the *qcbm* object with the *new_qcbm* object in Cell 4 (i.e. new QCBM with "COBYLA" instead of "L-BFGS-B" optimizer for parameter optimization) and plot the new distribution of errors and cost function values.

3. Now switch to the use of a quantum backend (i.e. use method *create_ibmq_runner* in Cell 10), increase the number of shots to ***n_shots = 5000*** with ***estimation_method = CvarEstimator(alpha=0.5).*** Choose ***n_layers=3*** and "L-BFGS-B" optimizer. Do you see a change in the distribution of errors or cost function values?

4. Extra: Run notebook ***pennylane_qgans.ipynb*** in a local conda or pip environment (you will have to ***pip install pennylane*** and ***torch***). Increase the parameters to ***n_qubits = 8*** and ***n_depth = 10*** and re-run and observe how the generated images change. Reduce the learning rates to ***lrG = 0.1*** and ***lrD = 0.005*** and increase the number of iterations to ***num_iter = 1000.*** See whether the loss value significantly decreases.