Quantum Computing 2025 - Exercise Sheet 6

Quantum Phase Estimation

Quantum Phase Estimation is an algorithm developed to estimate the phase θ of given Unitary U with eigenvalues $e^{2i\pi\theta}$.

1. *Implement the Quantum Phase Estimation algorithm for the T-gate*

$$T = \begin{bmatrix} 1 & 0 \\ 0 & e^{i\pi/4} \end{bmatrix}$$

considering the target state $|1\rangle$*, to show that it correctly estimates the phase as* $\theta = \frac{1}{8}$ *only using* $n = 3$ *ancilla qubits. Additionally show that we get the same result with* $n = 4$ *qubits, and that the precision is worse with* $n = 2$ *qubits.*