CS 5001 Homework - 3

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Problem 1   The Fourier transformation circuit with $n = 4$ needs a $\Lambda(\sqrt{T})$ (control-$\sqrt{T}$) gate. Could you decompose this into single qubit and CNOT gates? Can you construct $\sqrt{T}$ using only H, T, X, Y gates?

Problem 2   Recall Simon's problem. You are given a function $f : \{0,1\}^n \rightarrow \{0,1\}^n$ and promised that it is either one-to-one or two-to-one. Can you present this problem as a period finding problem over some "domain"?

Problem 3   Given the unitary S and the eigen-state $|1\rangle$, determine the eigen-phase using the phase estimation procedure by implementing it using the IBM-Q platform.

Problem 4   Implement Grover's search (in IBM-Q) (by creating the G operator) for a two-bit function $f_x : \{0,1\}^2 \rightarrow \{0,1\}$ such that $f(x) = 1$ and $f(y) = 0$ for $y \neq x$. The user gives you x as input.