Homework 3

Due On: March 18, 2021 3:30PM (CST)

Problem 1 Impliment the Deutsch–Jozsa algorithm in python without using qiskit. That is, write your own code for the tranformations and the projection operations. For the orcale gate (U_f) choose a function f as follows: with probability half decide whether f will be constant or balanced. f is constnat let $\forall x \in \mathbb{B}^n$ $f(x) = 0$ or 1 with probability half. If f is balanced, choose a permutation π of $\{0, \ldots, 2^n - 1\}$ unifromly at random. (figure out how you can do this) Example, say $n = 2$, $\pi = (12)(03)$. Let for $x \in \mathbb{B}^n$, x_b be the integer corresponding to the binary string x (Example $x = 1101$ then $x_b = 13$). Then define f as follows. $f(x) = 0$ if $\pi(x_b)$ is even, else $f(x) = 1$. In the above example $f(00) = \pi(0) \mod 2 = 3 \mod 2 = 1$. Similarly, $f(01) = 0, f(10) = 1$ and $f(11) = 0$. Now you can impliment f (atcually U_f) as a python function. Then using your hadamard transform, measurements and U_f complete the quantum circuit for the Deutsch–Jozsa algorithm. Again, all this must be implimented as python functions. Test your circuit for at least 10 different f's; take n to be as large as your system allows. Also, print out the histogram of the amplitudes of state just before applying the measurement. For this work with smaller n's (around 5-10).