Lab14

1. In the lecture, we saw cases 1 and 2 in the implementation of the Deutsch algorithm. In this exercise, you will do it for cases 3 and 4. Define oracles for each case. Build the circuit of the algorithm. Render the result for each case.

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2. Let's consider the NAND function: f(00) = 1 and f(01)=f(10)=f(11)=0.

a. Is this function balanced, constant, or neither of them?

b. What is the matrix of the oracle associated with this function?

c. In Strange, implement the Deutsch-Jozsa algorithm for this function. Render the result. What is the result of measuring the first output qubit?

Answer:

a) Not balanced, not constant

b)

a x2 x1	000	001	010	011	100	101	110	111
000	0	0	0	0	1	0	0	0
001	0	1	0	0	0	0	0	0
010	0	0	1	0	0	0	0	0
011	0	0	0	1	0	0	0	0
100	1	0	0	0	0	0	0	0
101	0	0	0	0	0	1	0	0
110	0	0	0	0	0	0	1	0
111	0	0	0	0	0	0	0	1

c) 50% - not balanced, not constant

3. Let's have a function f(x0 x1 … xn-1) = z that receives an n-bit input and returns a 1-bit output.

a. How many different input values can you pass to f?

b. How many different output values can f return?

c. How many different functions like f can be defined? That is, a function that receives an n-bit input and returns a 1-bit output.

d. How many of those functions are constant?

e. How many of those functions are balanced.

Answer:

a) 2^n

b) 2

c) 2^(2^n)

d) 2

e) a! / (b! * (a-b)!); where: a = 2^n; b = 2^(n-1)