Quiz Assignment 4

(Deadline : 4th, October 2020)

Instructions

- The quiz contains 10 questions, for a total of 20 points.
- The score for each question is given next to each question, there are no negative marks.
- Each question has only one correct choice, unless specified otherwise.
- All qubit states/operations are given in the big endian notation.

Questions

1. It is always possible to copy the state of one qubit into another qubit. **[1 point]**

a) True b) False

2. A quantum gate is a physical object and the qubit state changes when it interacts with this object. **[1 point]**

a) True b) False

3. A classical computer is required in order to use a quantum computer. **[1 point]**

a) True b) False

4. The quantum oracle of an n-bit Boolean function requires a quantum computer with exactly n-qubits. **[1 point]**

a) True b) False

5. The operation performed on the two-qubit system in the quantum circuit shown in (Figure 1) is: **[2 points]**

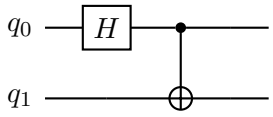

Figure 1: Circuit for Question 5

a) $(H \otimes I) \circ \text{CNOT}$ b) $(H \otimes H) \circ \text{CNOT}$

c) $\text{CNOT} \circ (H \otimes I)$ d) $\text{CNOT} \circ (I \otimes H)$

6. The operation performed on the two-qubit system in the quantum circuit shown in (Figure 2) is: **[2 points]**

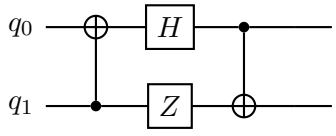

Figure 2: Circuit for Question 6

a) $\text{CNOT}_0^1 \circ (H \otimes Z) \circ \text{CNOT}_0^1$ b) $\text{CNOT}_1^0 \circ (H \otimes Z) \circ \text{CNOT}_0^1$

c) $\text{CNOT}_0^1 \circ (H \otimes Z) \circ \text{CNOT}_1^0$ d) $\text{CNOT}_1^0 \circ (H \otimes Z)$

7. The operation performed by the gates in the shaded area of the quantum circuit in (Figure 3) is: **[1 points]**

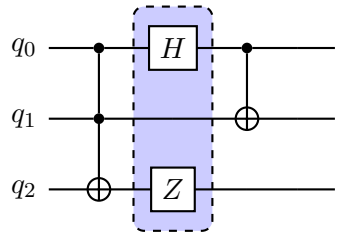

Figure 3: Circuit for Question 7

a) $(Z \otimes I \otimes H)$

b) $(H \otimes Z)$

c) $(H \otimes I \otimes Z)$

d) $(H \otimes Z \otimes I)$

8. The resultant state for the quantum circuit shown in (Figure 4) is: **[3 points]**

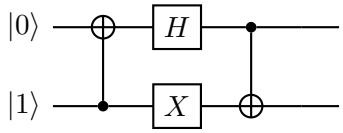

Figure 4: Circuit for Question 8

a) $\frac{1}{\sqrt{2}}(|00\rangle + |11\rangle)$

b) $\frac{1}{\sqrt{2}}(|00\rangle - |11\rangle)$

c) $\frac{1}{\sqrt{2}}(|00\rangle - |01\rangle)$

d) $\frac{1}{\sqrt{2}}(|00\rangle - |10\rangle)$

9. The resultant state for the quantum circuit shown in (Figure 5) is: **[4 points]**

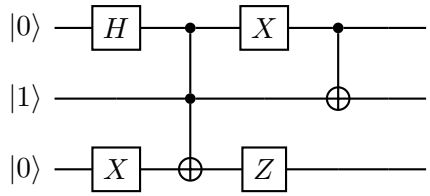

Figure 5: Circuit for Question 9

a) $\frac{1}{\sqrt{2}}(|000\rangle - |111\rangle)$

b) $\frac{1}{\sqrt{2}}(|010\rangle - |101\rangle)$

c) $\frac{1}{\sqrt{2}}(|011\rangle - |101\rangle)$

d) $\frac{1}{\sqrt{2}}(|100\rangle - |111\rangle)$

10. The Boolean function represented by the oracle given in (Figure 6), where $x_0, x_1 \in \{0, 1\}$ and $+$ denotes the XOR operation. More than one option may be correct: **[4 points]**

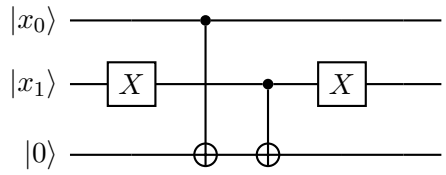

Figure 6: Circuit for Question 10

a) $x_0 + \overline{x_1}$

b) $\overline{x_0 + x_1}$

c) $\overline{x_0} + \overline{x_1}$

d) $1 + x_0 + x_1$