

CS 1511 Homework 19

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37.

38. The Toffoli gate takes 3 bits. If the first two bits are set 1, it performs a NOT on the third bit. Otherwise, they stay the same.

It is Universal.

NOT = 1, 1, A \rightarrow performs NOT A.

AND = $I_1, I_2, 0 \rightarrow$ performs an AND on I_1, I_2

We can make a NAND gate because we take an AND gate and a NOT gate after that.

OR = OR can be built from a NAND gate (NOT AND). Take the two inputs and put them into two NAND gates. Take the outputs of those NAND gates and input them into another NAND gate. This will output the value of an OR gate.

39 a.
$$\begin{bmatrix} 1/\sqrt{2} & 1/\sqrt{2} \\ 1/\sqrt{2} & -1/\sqrt{2} \end{bmatrix} \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} 1/\sqrt{2} & 1/\sqrt{2} \\ 1/\sqrt{2} & -1/\sqrt{2} \end{bmatrix} = \begin{bmatrix} 1/\sqrt{2} & 1/\sqrt{2} \\ 1/\sqrt{2} & -1/\sqrt{2} \end{bmatrix} \begin{bmatrix} 1/\sqrt{2} & -1/\sqrt{2} \\ 1/\sqrt{2} & 1/\sqrt{2} \end{bmatrix} =$$
$$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$$
$$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} a \\ -b \end{bmatrix}$$

39 b. a^2

39 c. $(-b)^2$

40 a. When you measure the register, you are not changing the state. You will output the value with the probability defined in v.

40 b.

40 c.

41.