## Individual Homework 1 -- EECS 270, Spring '23 - Answers

1. 

$\left(!A^{*} C\right)+\left(A^{*}!B^{*}!C\right)+\left(B^{*} C\right)$.

| A | B | C | $!\mathrm{A}^{*} \mathrm{C}$ | $\mathrm{A}^{*}!\mathrm{B}^{*}!\mathrm{C}$ | $\mathrm{B}^{*} \mathrm{C}$ | output |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0 | 0 | 0 |  |  |  | 0 |
| 0 | 0 | 1 | 1 |  |  | 1 |
| 0 | 1 | 0 |  |  |  | 0 |
| 0 | 1 | 1 | 1 |  | 1 | 1 |
| 1 | 0 | 0 |  | 1 |  | 1 |
| 1 | 0 | 1 |  |  |  | 0 |
| 1 | 1 | 0 |  |  |  | 0 |
| 1 | 1 | 1 |  |  | 1 | 1 |

2. $F=!a^{*} b+!a * b+a^{*} c^{*}!d+!b$
a) a, b, c, d, (F could be listed here...)
b) !a, a, b, !b, c, !d, (F could be listed here...)
c) !a*b, !a*b, a*c*!d, !b. (Yes, !b is a "product term", see page 55)
3. Just find the 1s. (!a*! $\left.{ }^{*} c\right)+\left(a^{*} b^{*}!c\right)+\left(a^{*} b^{*} c\right)$
4. $\left(!a^{*}!c+!b\right)^{*} c+!\left(a^{*} b\right)=!\left(a^{*} b\right)$

The level of detail needed can be tricky, but as a rule, just use one rule at a time. There are multiple solutions.

| $\left(!a^{*}!c+!b\right)^{*} c+!\left(a^{*} b\right)$ |  |
| :--- | :--- |
| $=!a^{*}!c^{*} c+!b^{*} c+!\left(a^{*} b\right)$ |  |
| $=!a^{*} 0+!b^{*} c+!\left(a^{*} b\right)$ |  |
| $=0+!b^{*} c+!\left(a^{*} b\right)$ |  |
| $=!b^{*} c+!\left(a^{*} b\right)$ |  |
| $=!b^{*} c+!a+!b$ |  |
| $=!a+!b+!b^{*} c$ |  |
| $=!a+!b$ |  |
| $=!\left(a^{*} b\right)$ |  |
|  |  |

5. 


a. By the rules of logic (This one can get nasty, but there is a short parth)
$F=!\left(!\left(a^{*} b\right)^{*}!\left(c^{*} d\right)\right) \quad$ DeMorgan's
$F=!\left(!\left(a^{*} b\right)^{*}!\left(c^{*} d\right)\right)^{*} 1$
Note that G=!F
Identity
So not equal
b.

| $\mathbf{a}$ | $\mathbf{b}$ | $\mathbf{c}$ | $\mathbf{d}$ | $\mathbf{F}$ | $!\left(\mathbf{a}^{*} \mathbf{b}\right)$ | !(c*d) | $!\left(!\left(\mathbf{a}^{*} \mathbf{b}\right)^{*}\left(\mathbf{c}^{*} \mathbf{d}\right) \mathbf{)}\right.$ | $\mathbf{G}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0 | 0 | 0 | 0 |  | 1 | 1 | 0 | 1 |
| 0 | 0 | 0 | 1 |  | 1 | 1 | 0 | 1 |
| 0 | 0 | 1 | 0 |  | 1 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 |  | 1 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 |  | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 |  | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 1 | 0 | 0 | 0 |  | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 |  | 1 | 1 | 0 | 1 |
| 1 | 0 | 1 | 0 |  | 1 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 |

Again, we see F and G are actually inverses of each other.
7. It's a majority gate, which you've seen in lab. $A=m 0 * m 1+m 1 * m 2+m 2 * m 0$ is the formula. You'd need to draw that as gates too.
8. $\mathrm{T}=$ ! N 4
9. $10101 \& 01100=00100$
10. .
a. $\quad \mathrm{C}_{16}$
b. $12_{16}$
c. $\mathrm{A}_{16}$
d. $25_{16}$
e. $571_{8}=101111001_{2}=101111001_{2}=179_{16}$
11. Combinational logic's output depends only on the current inputs. Sequential logic has memory and so depends on prior inputs also.

