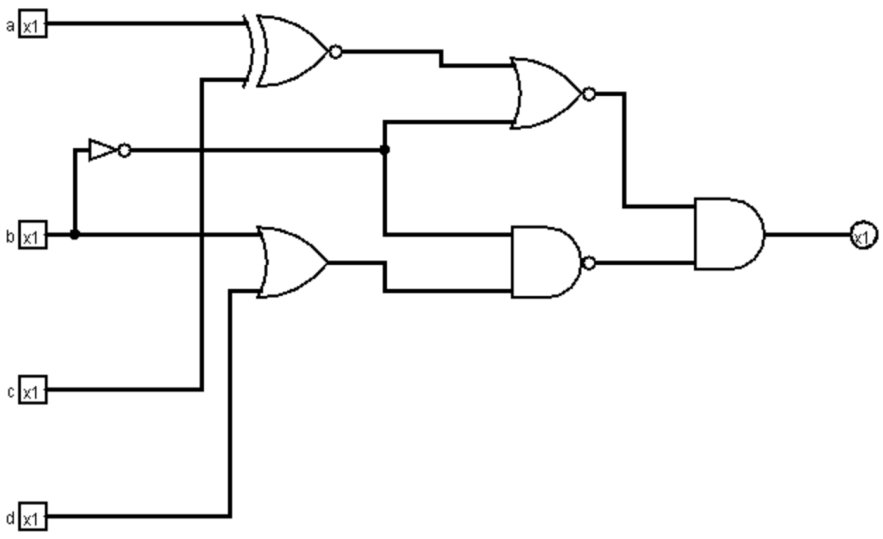
Homework 5

Hamza Kamal

March 6, 2025

Question:

1. Consider the logic gate circuit shown below (5 points)



a. (2 points) Derive a Boolean equation for the output X. You don't need to simplify this equation, but feel free to try!

Answer:

The first gate, which is an XNOR gate with the inputs a and c, gives us:
$\neg(a \oplus c)$

The second gate is an OR gate with inputs b and d, which gives us:
$b \vee d$

The third gate is a NOR gate with the inputs $\neg(a \oplus c)$ and $\neg b$, which gives us:
$\overline{\neg(a \oplus c) \vee \neg b}$

The fourth gate is a NAND gate with the inputs $\neg b$ and $b \vee d$, which gives us:
$\overline{(\neg b) \wedge (b \vee d)}$

The fifth gate is an AND gate with the inputs $\overline{\neg(a \oplus c) \vee \neg b}$ and $\overline{(\neg b) \wedge (b \vee d)}$, which gives us the final equation:
$\overline{\neg(a \oplus c) \vee \neg b} \wedge \overline{(\neg b) \wedge (b \vee d)}$

Question:

b. (3 points) Draw a truth table for the circuit.

Answer:

Truth Table:

a	b	c	d	x
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1
