Recitation 9/25

Welcome back! :)

Vote Ash, Ahmed, and Garrett for best recitation TAs

Schedule for Today

- Connecting circuits and boolean algebra
- Logic Gates
- CMOS
- User input demo in C (echo.c)

Boolean Algebra

Boolean rules

- Identity
  - A & 1 = A
  - A & 0 = 0
  - A | 1 = 1
  - A | 0 = A
  - ~~A = NOT NOT A = A
- Associative
  - A & (B & C) = (A & B) & C
  - A | (B | C) = (A | B) | C
- Distributive
  - A & (B | C) = (A & B) | (A & C)
  - A | (B & C) = (A | B) & (A | C)
- More Identity
  - A & A = A
  - A | A = A
  - A & ~A = 0
  - A | ~A = 1
- De Morgan's Law
  - ~(A & B) = ~A | ~B
  - ~(A | B) = ~A & ~B

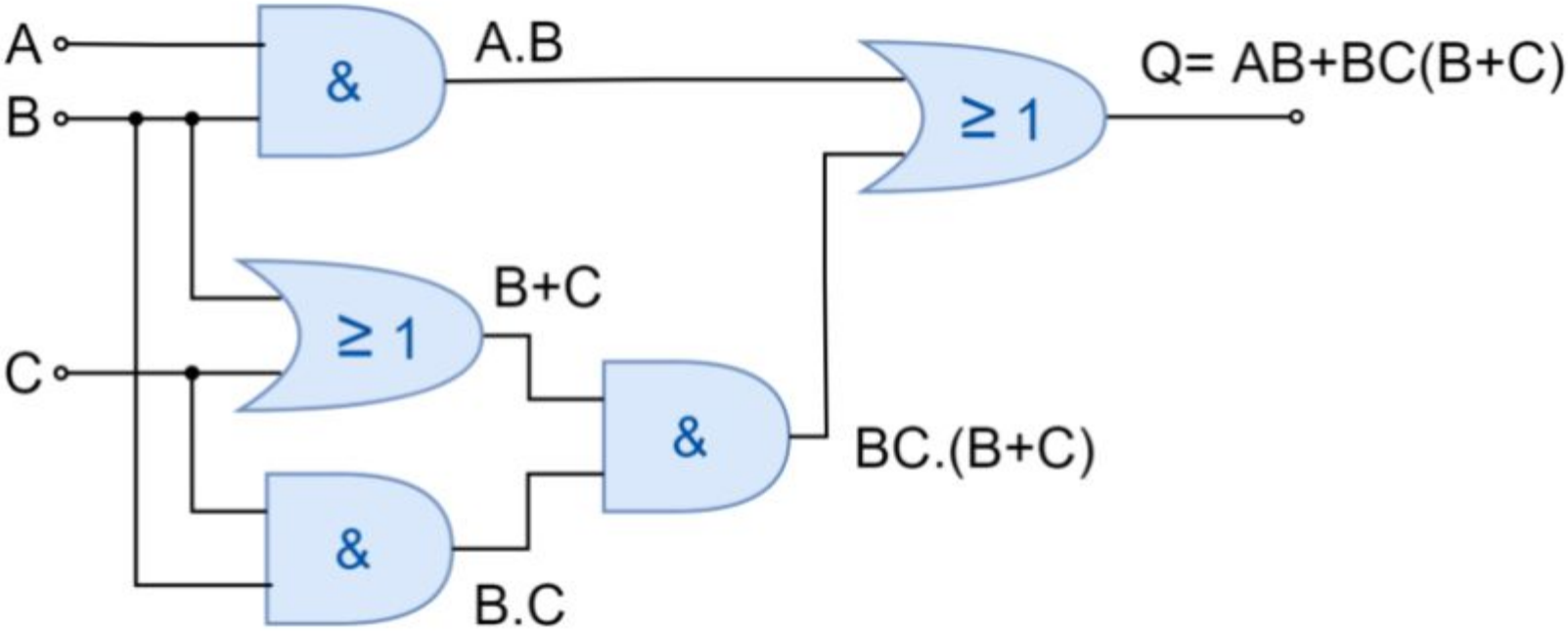
Other formats you might see:

A & B → A * B or A ∧ B

A | B → A + B or A ∨ B

~A → !A or A’ or ¬ A

Intuitively, you can think of A * B as saying “both A **and** B have to be 1 for this not to be 0” and A + B as saying “only one of these have to be 1 for this to be greater than 0”.


A
B
C
&
A.B
≥ 1
B+C
&
BC.(B+C)
&
B.C
≥ 1
Q= AB+BC(B+C)

Simplify: Z = A & ((A | ~A) I ~B)

$$Z = A \,\&\, ((A \mid \sim A) \,I\, \sim B)$$

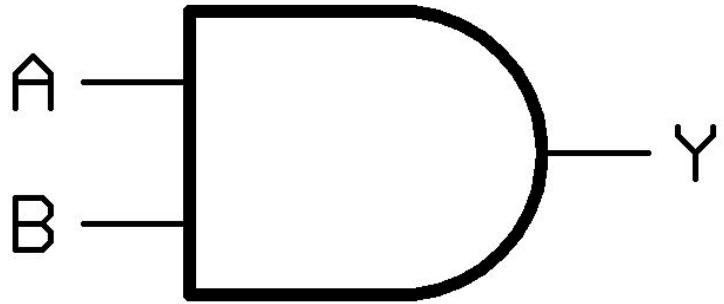
$$Z = A \,\&\, (True \,I\, \sim B)$$

$$Z = A \,\&\, True = A$$

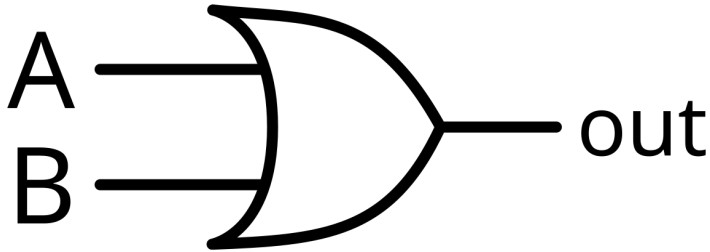
Logic Gates

Symbols

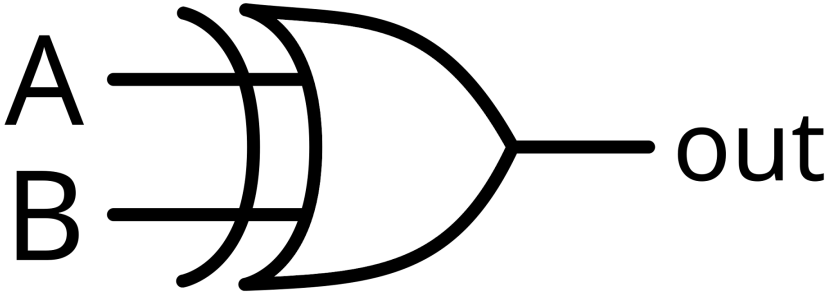
AND Gate



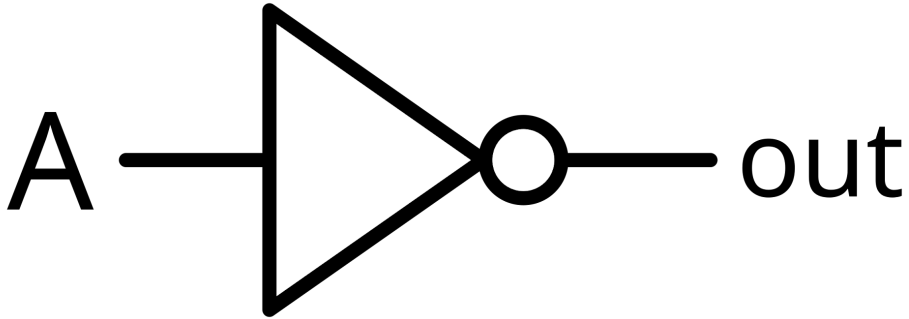
OR Gate



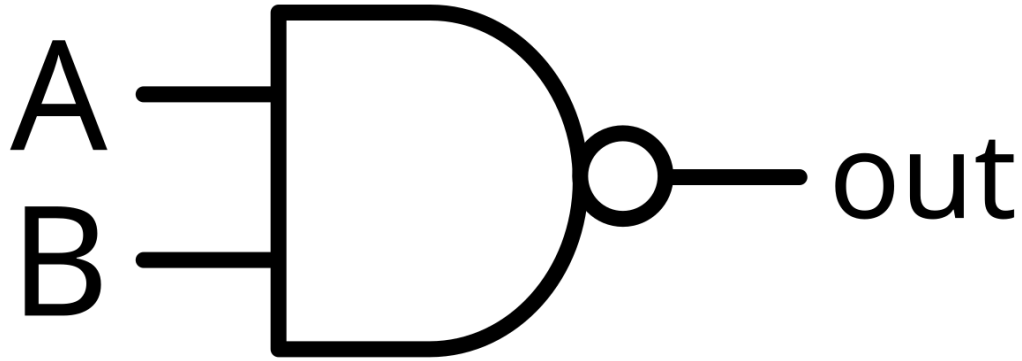
XOR Gate



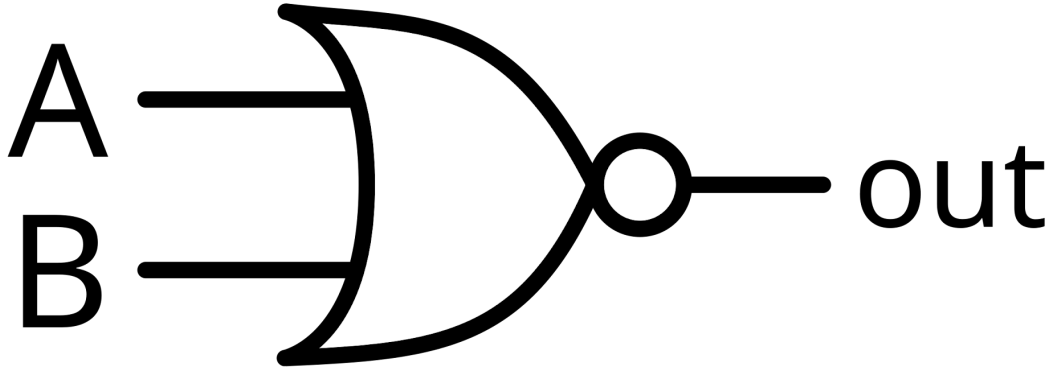
NOT Gate



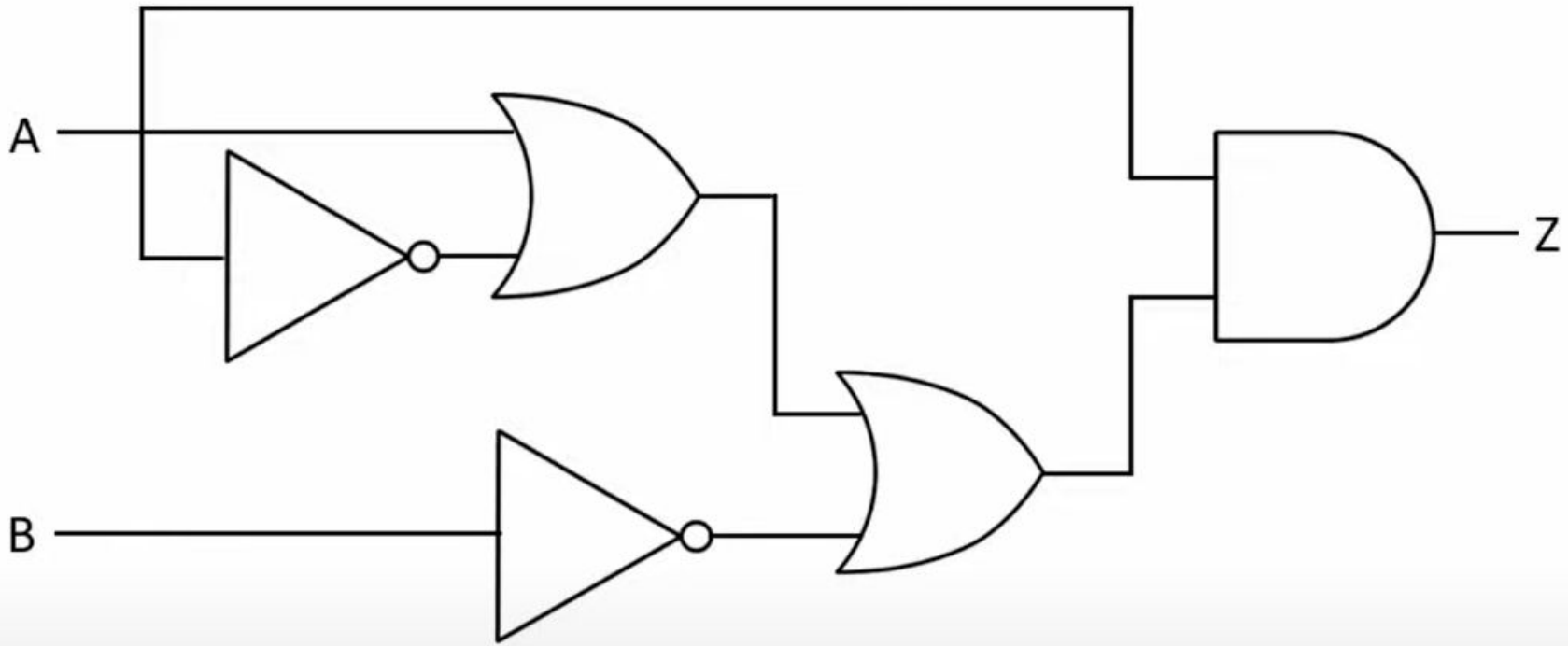
NAND Gate



NOR Gate



Write a truth table for Z:

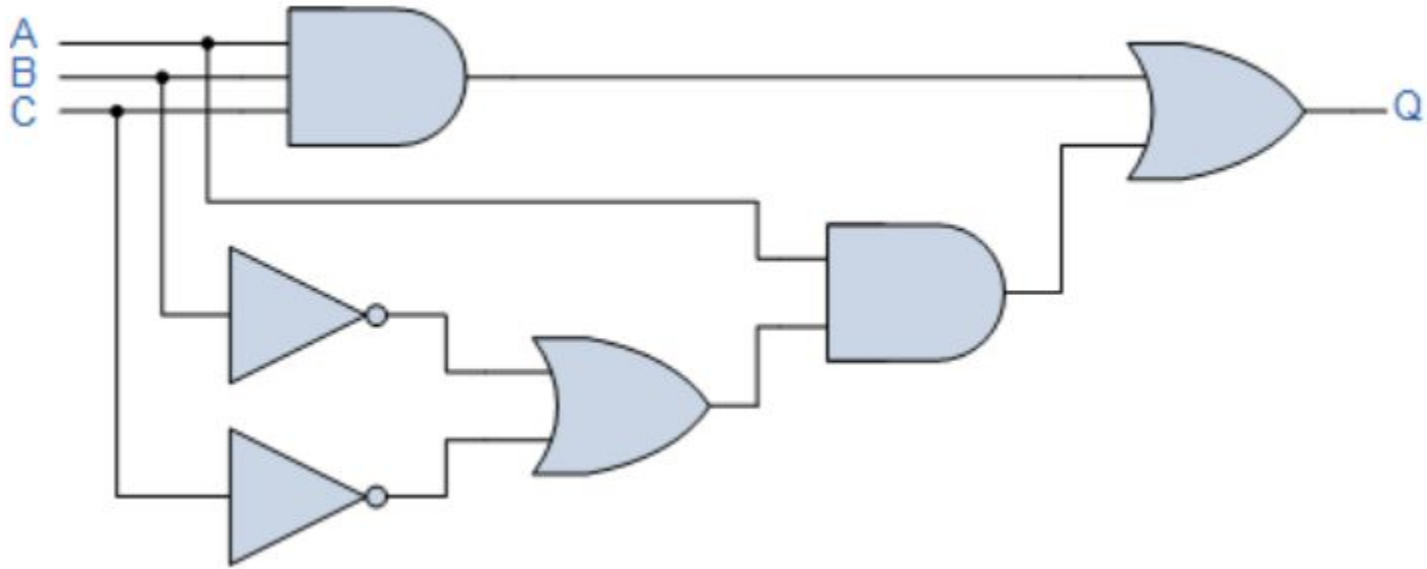


A	B	Z
0	0	0
0	1	0
1	0	1
1	1	1

So Z = A???????

…yes

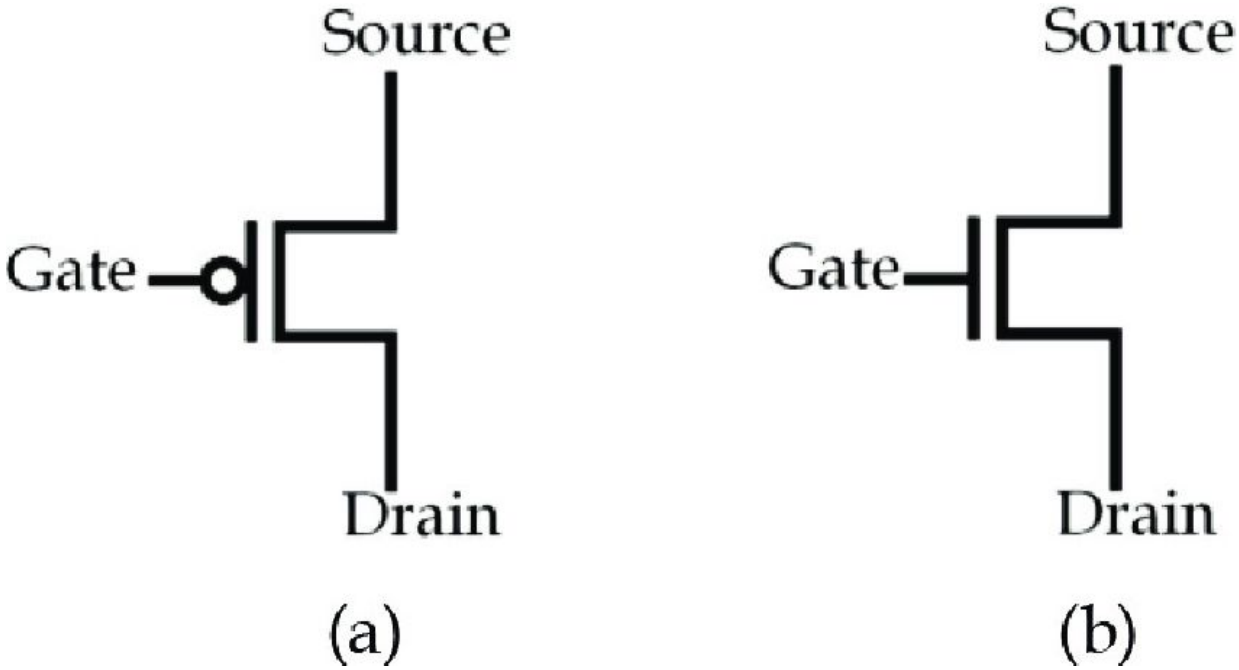
Write a truth table for:



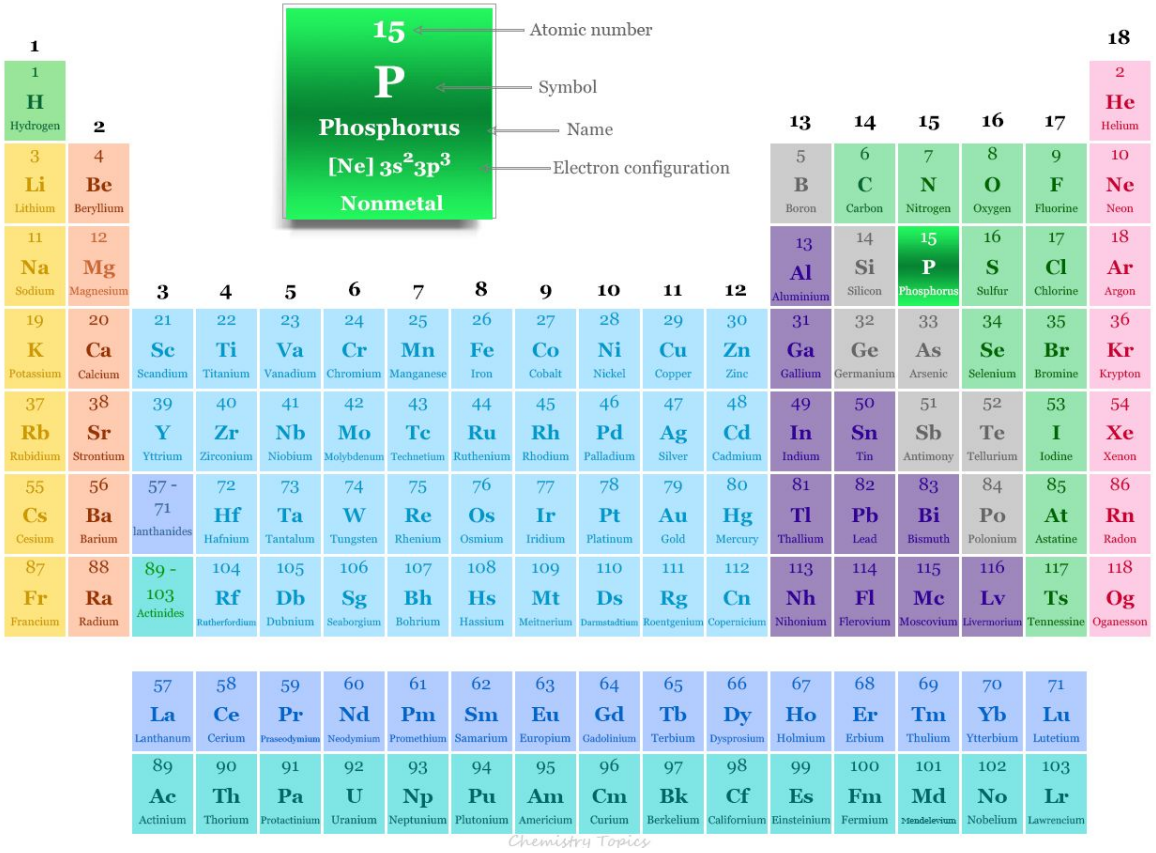
Answer: only for people who go to recitation

Transistor Review

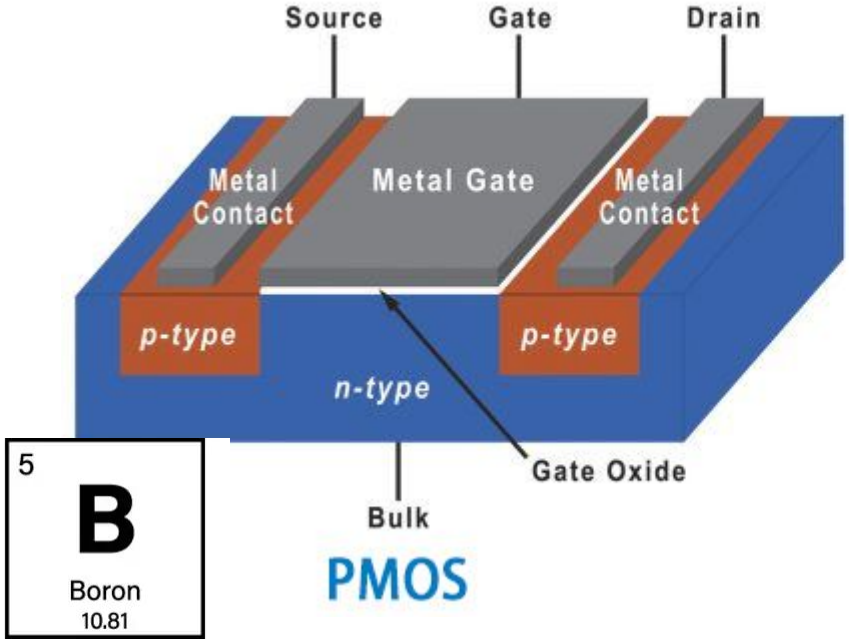
Label & Conditions?

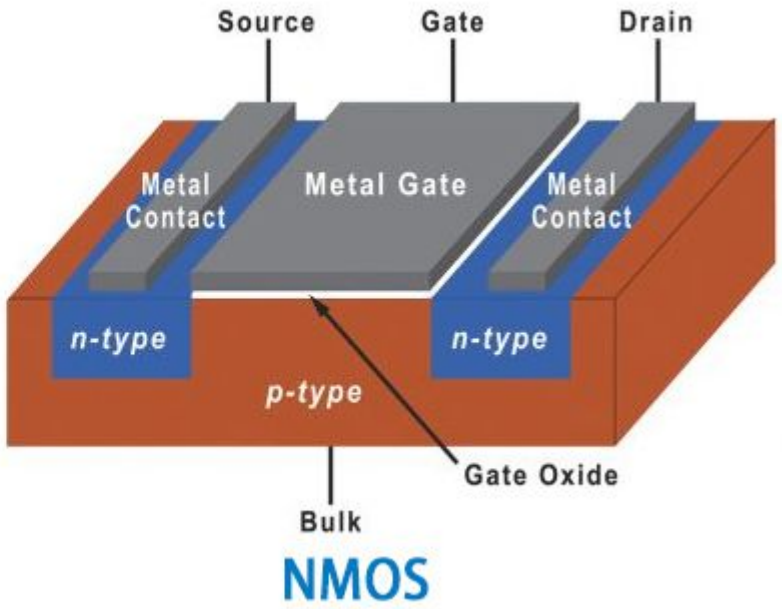


A little Chemistry



A little Chemistry

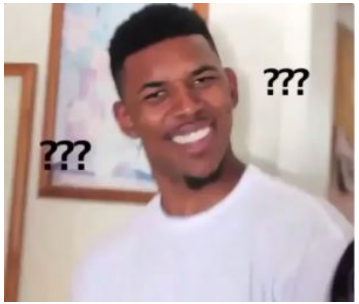


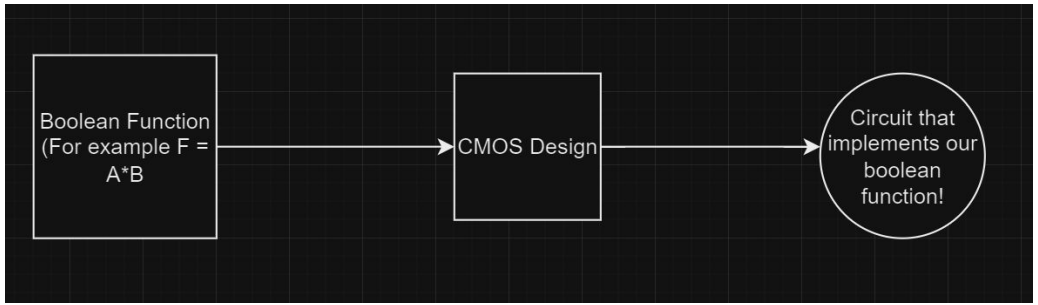


CMOS

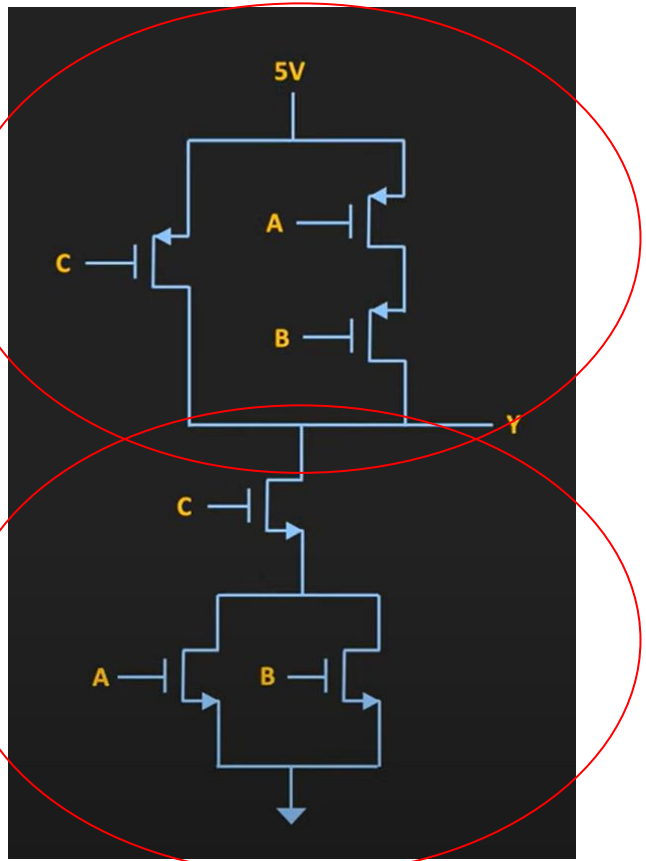
So what is CMOS and what's its purpose?

- CMOS: Complementary Metal Oxide Semiconductor





Parts of a CMOS network!



Pull Up Network

Pull Down Network

A Simple Example: AND2

1) **Boolean function: Y = (A*B)**

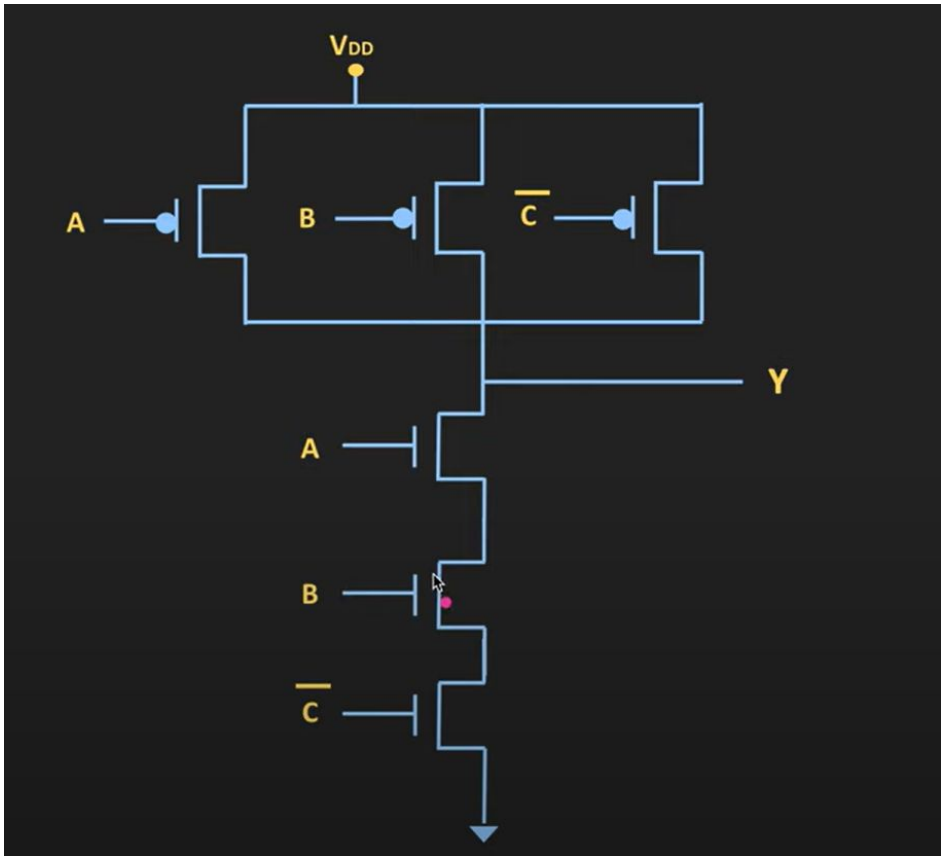
2) **Truth Table:**

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

3) **PUN**

4) **PDN**

Going from CMOS -> Function



To connect Ground to Y:

A = B = ~C = 1

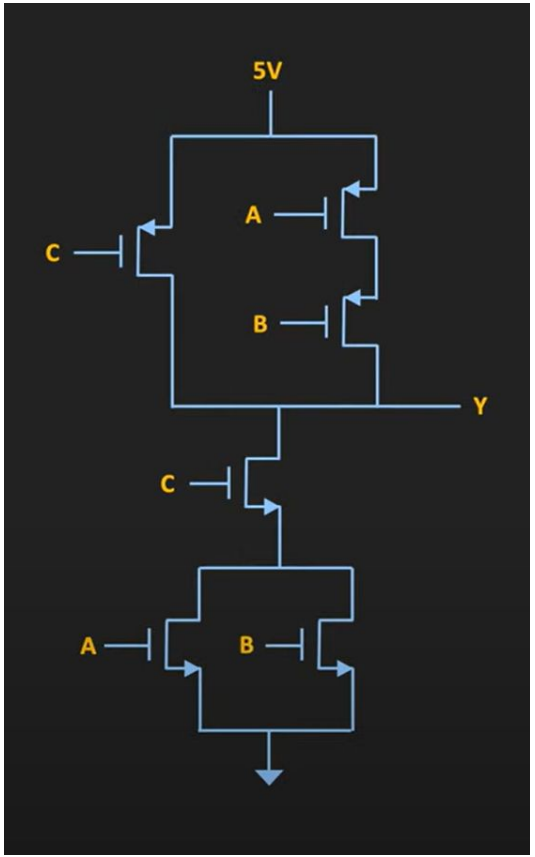
Therefore: GND -> Y = A & B & ~C

Invert this expression: ~(A & B & ~C)

Optional Simplify: ~A | ~B | C

Going from Function -> CMOS

- Y = C’ + (A’*B’)



If you're looking for this code, it's in edpost #589 titled "Recitation today!"

Demo: echo.c

This is helpful for HW03