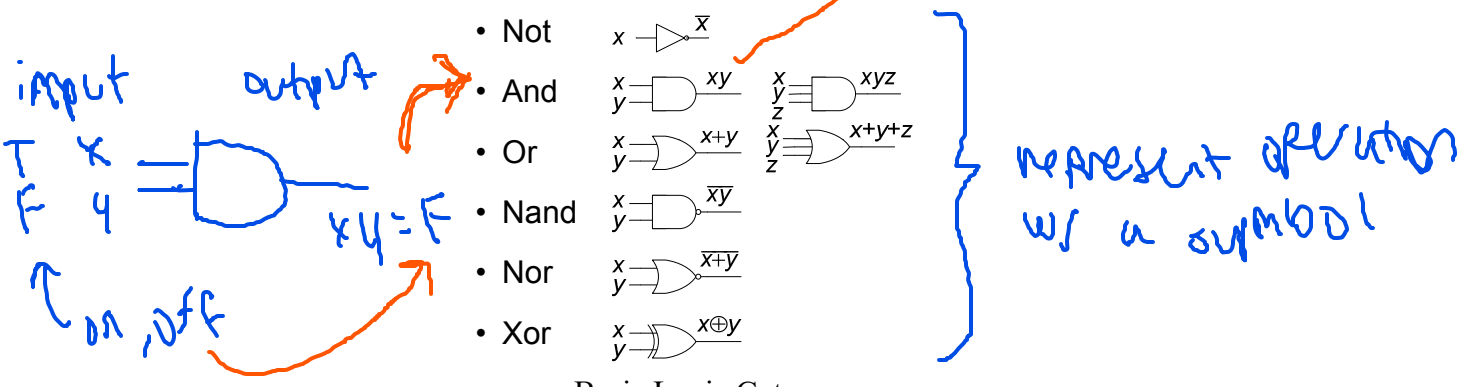
PROBLEM OF THE DAY 7c
Logic Gates and Circuits
(Material from http://homepage.cs.uiowa.edu/~hzhang/c19/ch01c.pdf)

1. Logic Gates: Physical devices that perform Boolean operations are called *logic gates*.



Basic Logic Gates

2. Circuits: Logic gates can be combined into a *circuit* to perform more complicated Boolean expressions.

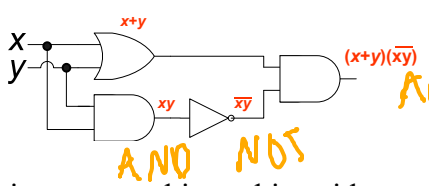
Example: Build a circuit to perform the Boolean operation Xor using only And, Or, and Not logic gates.

Solution:

Implementing XOR

- $p \oplus q \equiv (p \vee q) \wedge \neg(p \wedge q)$
- $x \oplus y \equiv (x + y)(\overline{xy})$

x	y	xy	x⊕y
1	1	1	0
1	0	0	1
0	1	0	1
0	0	0	0

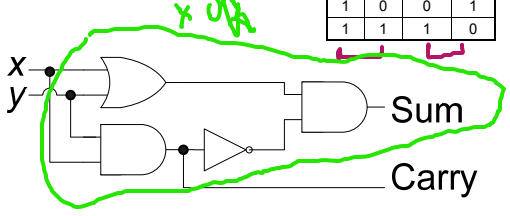


3. Half-Adder: The following circuit sums two binary bits with carry.

The half-adder

- Sum = *x* XOR *y*
- Carry = *x* AND *y*

x	y	Carry	Sum
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0



Exercise: Build a circuit to compute the Boolean expression $(x + \overline{y} \cdot (x + \overline{z}))z$.