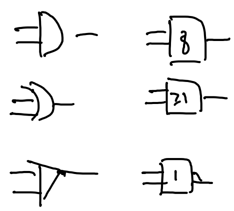
Lecture 2

Wednesday, September 2, 2015 09:59



AND
OR
NOT

any circuit "universal"

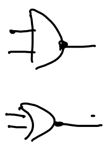
Notation

$A \wedge B$

$A \vee B$

$\bar{A}$

less efficient, but easier to understand



NAND
NOR

Also "universal"

← just this also universal

← just this also universal

Notation

$\overline{A \wedge B}$ $(A|B)$

$\overline{A \vee B}$ $(A \rightarrow B)$

$A|B$, NAND notation "Sheffer Stroke"
$A \rightarrow B$, NOR notation "Pierce Arrow"

Boolean Algebra

$+ \vee$ $\cdot \wedge$

$X + 0 = X$ $X \cdot 0 = 0$
$X + 1 = 1$ $X \cdot 1 = X$
neutral elements

$X + X = X$ $X \cdot X = X$

$\overline{(\bar{x})} = X$

MANY MORE

$X + \bar{X} = 1$ $X \cdot \bar{X} = 0$

$X + Y = Y + X$ $X \cdot Y = Y \cdot X$

$X + Y + Z = (X + Y) + Z = X + (Y + Z)$
$X \cdot Y \cdot Z = (X \cdot Y) \cdot Z = X \cdot (Y \cdot Z)$

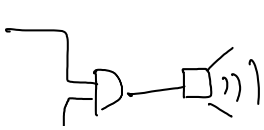
$X \cdot (Y + Z) = X \cdot Y + X \cdot Z$
$X + (Y \cdot Z) = (X + Y) \cdot (Y + Z)$
distributive laws

$\overline{X \cdot Y} = \bar{X} + \bar{Y}$
$\overline{X + Y} = \bar{X} \cdot \bar{Y}$
DeMorgan's Law

Beep Circuit

$B = \bar{C} \cdot I$

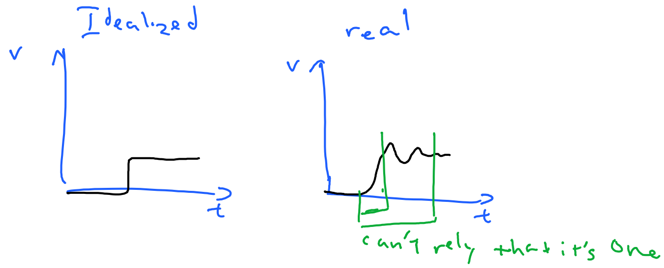
I Ignition



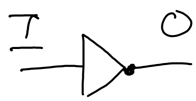
B

C Closed 

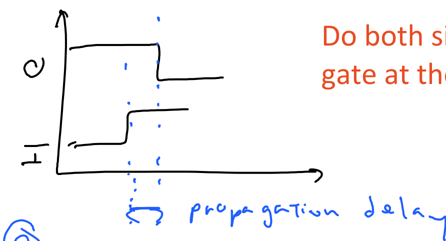
Actual Gates



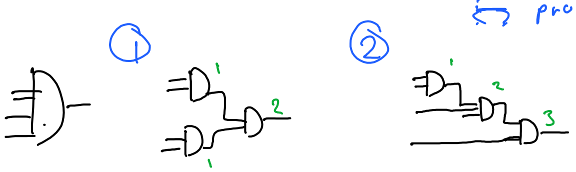
"Propagation Delay" - how much time does it take from getting a stable input to a stable output. Greater than 0



Considering propagation delay, option 1 is better than 2



Do both signals have to hit the gate at the same time?

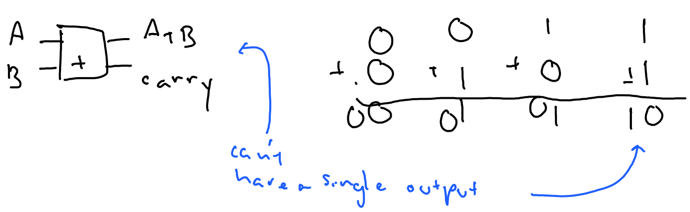


How do I build a circuit?

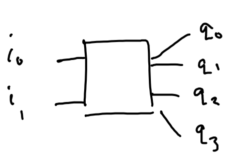
COMBINATIONAL CIRCUITS

Just pure functions, no notion of time, just worried about inputs and outputs

M inputs, N outputs. $f: \mathbb{B}^m \to \mathbb{B}^n$



<u>2-to-4 Decoder</u>



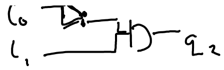
Actually 4 little circuits

I_0	I_1	Q_0	Q_1	Q_2	Q_3
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1

$q_0 = \bar{i_0} \cdot \bar{i_1} = \overline{i_0 + i_1}$

$q_1 = i_0 \cdot \bar{i_1}$

$q_2 = \bar{c}_0 \cdot c_1$



$q_3 = c_0 \cdot c_1$