

Last time

- Bin. ops. : add & sub.
- Hex & Oct
- Negative #'s
 - signed mag.
 - one's comp.
 - two's comp.
- Logic gates

Today

- Recap & finish two's comp.
- Logic gates

Next time

- Logic &
Boolean
Algebra

Logic & Logic Gates

$$\begin{array}{r} a: \quad 101 \\ b: \quad + 110 \\ \hline 1011 \end{array}$$

$$\begin{array}{r} \quad \quad \quad 1 \\ \quad \quad \quad 1 \\ \quad \quad \quad 1 \\ + \quad 101 \\ \hline 1100 \end{array}$$

carry bit

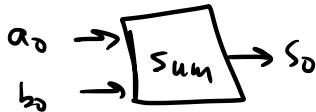
sum bit

a_0	b_0	s_0
0	0	0
0	1	1
1	0	1
1	1	0

sum bit

a_0	b_0	c_0
0	0	0
0	1	0
1	0	0
1	1	1

carry bit



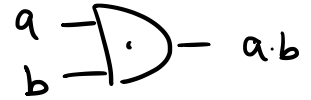
truth tables

AND, OR, NOT

0: 0V F no current open
1: +5V T current closed

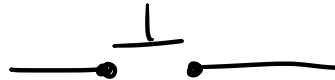
a	b	a AND b
0	0	0
0	1	0
1	0	0
1	1	1

$a \wedge b$, $a \cdot b$

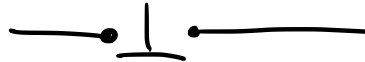


Digression:

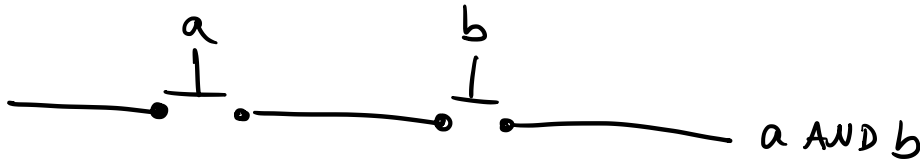
switches



normally open
push to close
switch



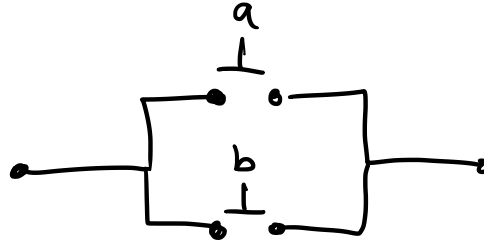
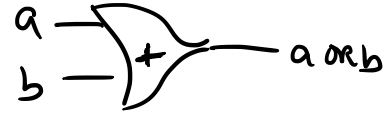
normally closed
push to open
switch



OR

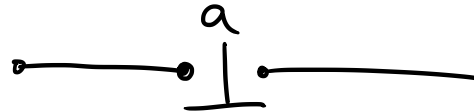
a	b	a OR b
0	0	0
0	1	1
1	0	1
1	1	1

OR + , $a \vee b$



NOT

a	NOT a
0	1
1	0



NOT $\neg a$ $\overline{a}$ $a \rightarrow \neg a$

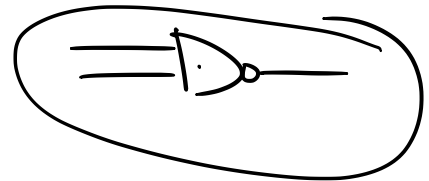
XOR

a	b	a XOR b
0	0	0
0	1	1
1	0	1
1	1	0



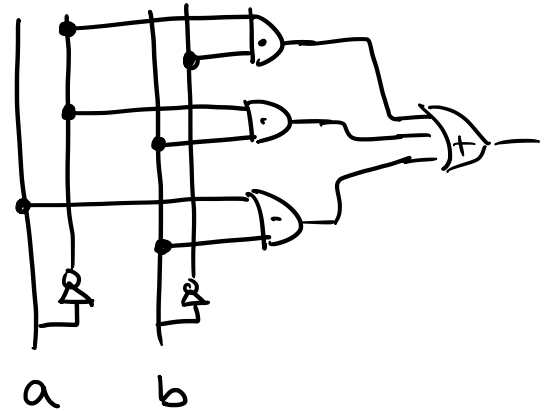
NAND

a	b	a NAND b
0	0	1
0	1	1
1	0	1
1	1	0



E.g. DNF construction

a	b	out	out'
0	0	1	0
0	1	1	0
1	0	0	1
1	1	1	0



$$\equiv (\neg a \wedge \neg b) \vee (\neg a \wedge b) \vee (a \wedge b)$$



DNF : Disjunctive Normal Form



$$\neg(a \wedge \neg b)$$

?

$$\equiv \neg a \vee b$$



Half-adder

<u>input</u>		<u>outputs</u>	
a	b	s	c
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

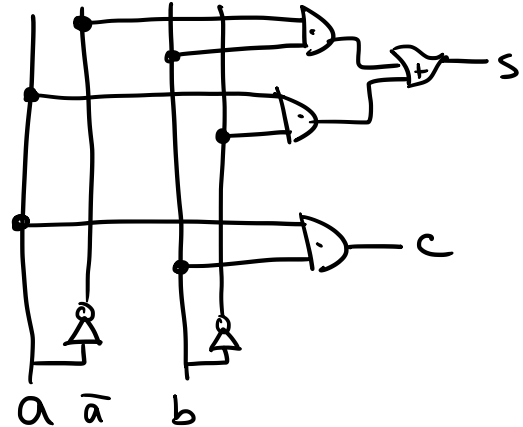
DNF construction:

$$S = (\neg a \wedge b) \vee (a \wedge \neg b)$$

$$C = a \wedge b$$

$$\begin{array}{r} a \quad 1 \ 0 \ 1 \\ b \quad 0 \ 1 \ 1 \\ \hline \end{array}$$

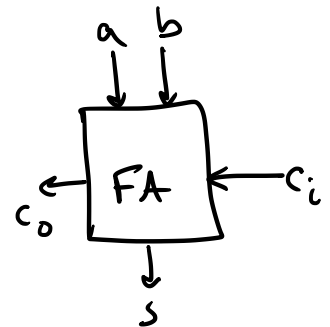
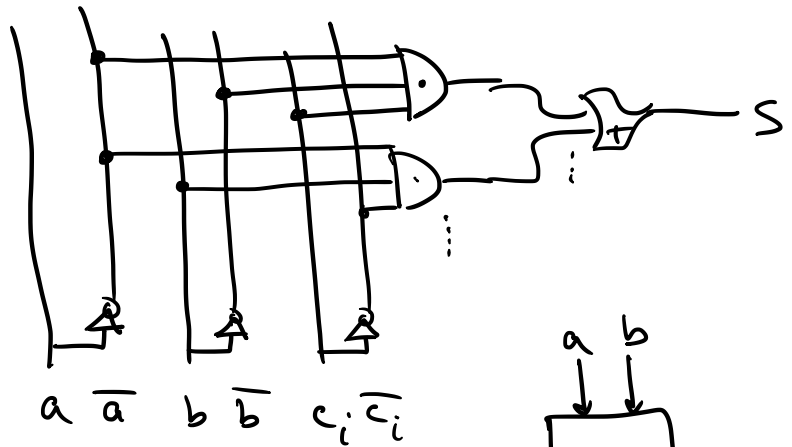
0



Full-adder

$$\begin{array}{r}
 1 \quad 1 \\
 1 \quad 0 \quad 1 \\
 + \quad 1 \quad 1 \quad 1 \\
 \hline
 1 \quad 1 \quad 0 \quad 0
 \end{array}$$

a	b	c _i	s	c _o
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	0



$$\begin{array}{r}
 1011 \\
 + 1100 \\
 \hline
 10111
 \end{array}$$

