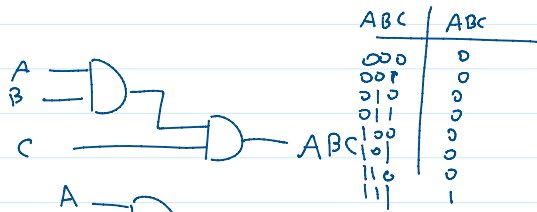


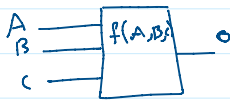
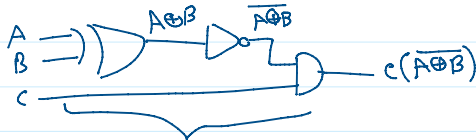
Lecture 2

Thursday, August 29, 2024 8:56 AM

Multiple gates



ABC	$A \oplus B$	$A \oplus B \oplus C$
000	1	0
001	1	0
010	0	0
011	0	0
100	0	0
101	0	0
110	1	0
111	1	1

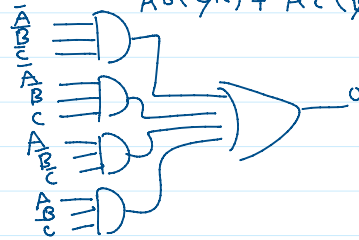


Ex

ABC	output (0)
000	1 ✓
001	1 ✓
010	0
011	0
100	0
101	0
110	0
111	0

$$O = \overline{A}\overline{B}\overline{C} + \overline{A}\overline{B}C + A\overline{B}\overline{C} + A\overline{B}C$$

$$= \overline{A}\overline{B}(\overline{C} + C) + A\overline{B}(\overline{C} + C)$$

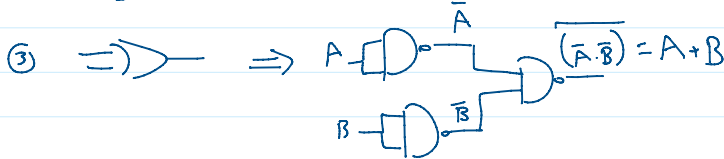
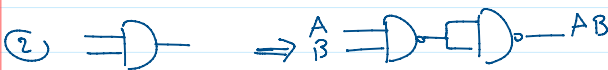


BC	00	01	11	10
A=0	1	1	0	0
A=1	0	0	1	1

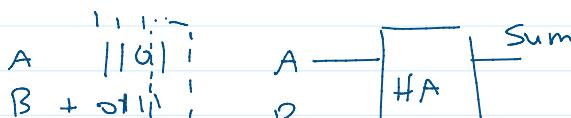
$$O = \overline{A}B + A\overline{C}$$

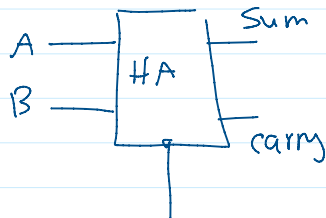
- {AND, OR, NOT} are universal gates
- {NAND} is a universal gate

AB	\overline{AB}
00	1
01	1
10	1
11	0

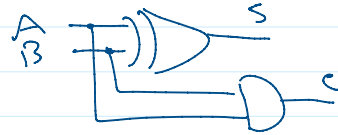


Half Adders



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


AB	S	C
00	0	0
01	1	0
10	1	0
11	0	1



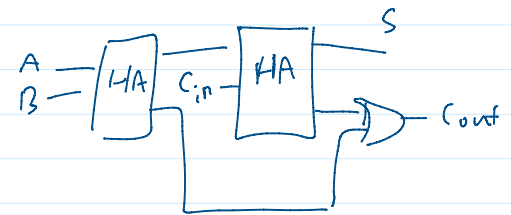
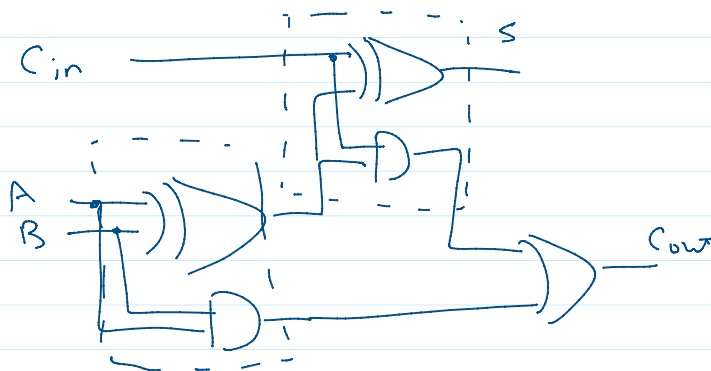
Full Adder

ABC _{in}	S	C _{out}
000	0	0
001	1	0
010	1	0
011	0	1
100	1	0
101	0	1
110	0	1
111	1	1

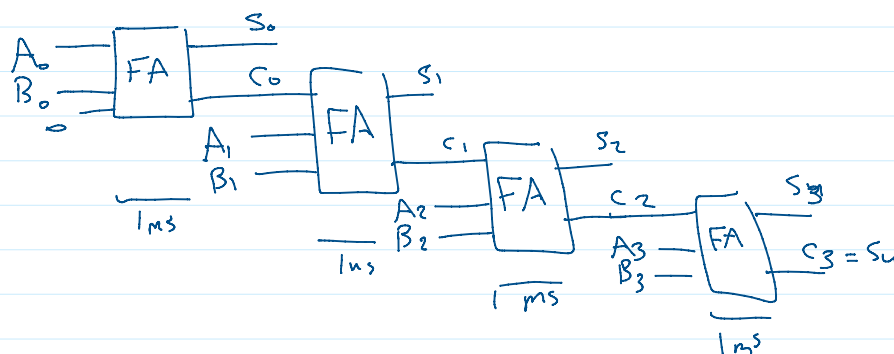


$$S = \bar{A}\bar{B}C_{in} + \bar{A}B\bar{C}_{in} + A\bar{B}\bar{C}_{in} + ABC_{in}$$

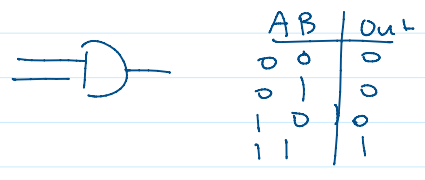
$$C_{out} = \bar{A}BC_{in} + A\bar{B}C_{in} + AB\bar{C}_{in} + ABC_{in}$$



4-bit Ripple Carry Adder

$$\begin{array}{r} 111 \\ 1011 \\ + 0111 \\ \hline 11010 \end{array}$$


Reversible Gates



AB	C	AB	$C \oplus AB$
00	0	00	0
00	1	00	1
01	0	01	0
01	1	1	1
10	0	1	0
10	1	1	1
11	0	1	1
11	1	1	0

