DeMorgan's Law example

- If $F = (XY+Z)(\overline{Y}+\overline{X}Z)(X\overline{Y}+\overline{Z})$,

AND

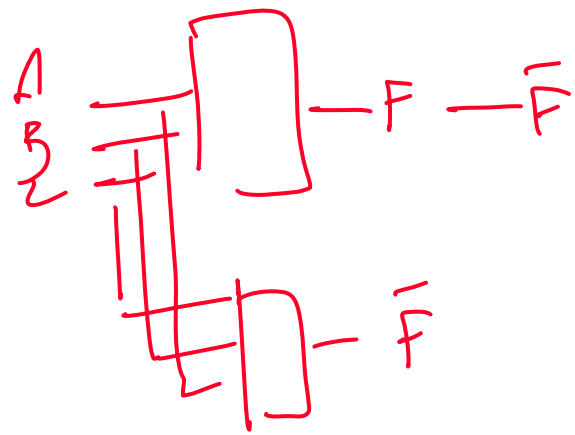
$$\overline{F} = \overline{(XY+Z)(\overline{Y}+\overline{X}Z)(X\overline{Y}+\overline{Z})}$$

$$= \overline{(XY+Z)} + \overline{(\overline{Y}+\overline{X}Z)} + \overline{(X\overline{Y}+\overline{Z})}$$

$$= (\overline{XY})(\overline{Z}) + \overline{\overline{Y}} \cdot \overline{\overline{X}Z} + \overline{X\overline{Y}} \cdot \overline{\overline{Z}}$$

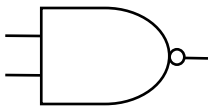
$$= (\overline{X}+\overline{Y})\overline{Z} + Y(\overline{\overline{X}}+\overline{Z}) + (\overline{X}+\overline{\overline{Y}}) \cdot Z$$

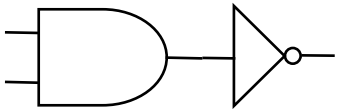
$$= (\overline{X}+\overline{Y})\overline{Z} + Y(X+\overline{Z}) + (\overline{X}+Y)Z$$



NAND and NOR Gates

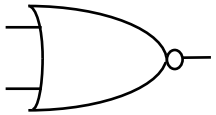
NAND Gate: NOT(AND(A, B))

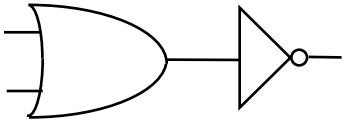




X	Y	X NAND Y
0	0	1
0	1	1
1	0	1
1	1	0

NOR Gate: NOT(OR(A, B))



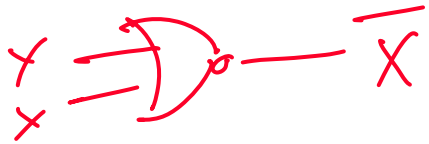
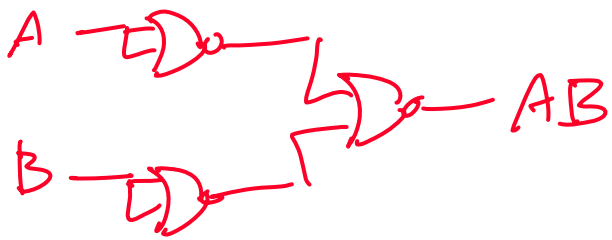
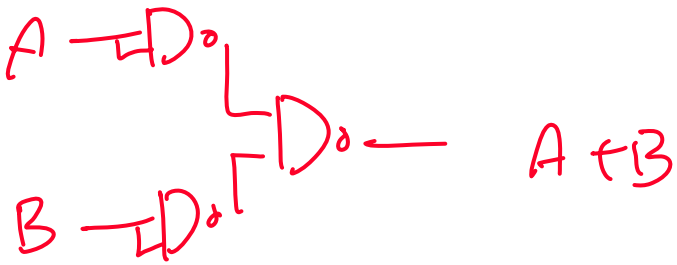
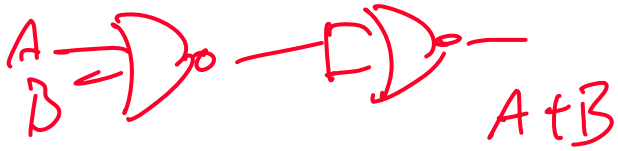


X	Y	X NOR Y
0	0	1
0	1	0
1	0	0
1	1	0

NAND and NOR Gates

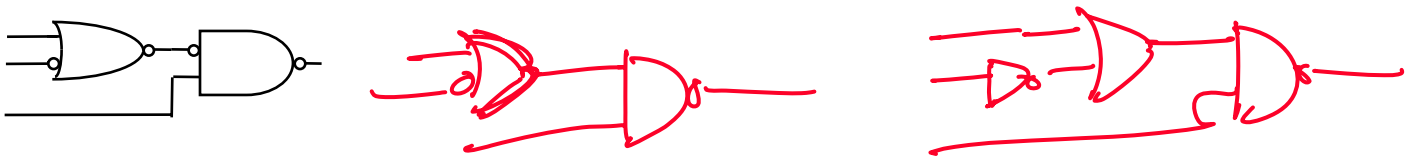
NAND and NOR gates are universal

can implement all the basic gates (AND, OR, NOT)

	NAND	NOR
NOT		
AND		
OR		

Bubble Manipulation

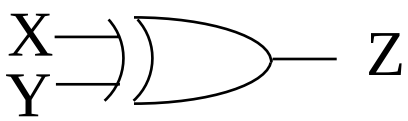
Bubble Matching



DeMorgan's Law

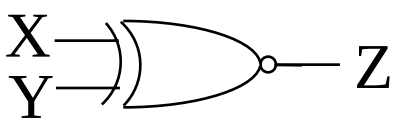
XOR and XNOR Gates

XOR Gate: Z=1 if X is different from Y



X	Y	Z
0	0	0
0	1	1
1	0	1
1	1	0

XNOR Gate: Z=1 if X is the same as Y



X	Y	Z
0	0	1
0	1	0
1	0	0
1	1	1

Boolean Equations to Circuit Diagrams

- $F = XYZ + \overline{X}Y + XY\overline{Z}$

$= y(xz + \overline{x} + x\overline{z})$

$= y(x + \overline{x})$

$= y$

- $F = XY + X(WZ + W\overline{Z})$

$= xy + xw$

$= x(y + w)$