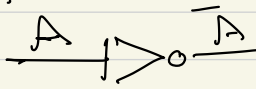


Lecture 11

7/10/20

$$\overline{01} = 1$$

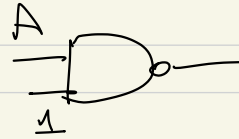
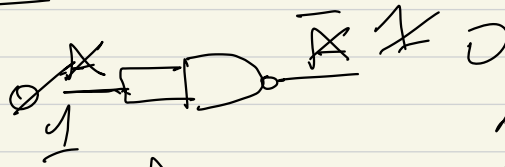
① NOT



$$A=1, \bar{A}=0$$

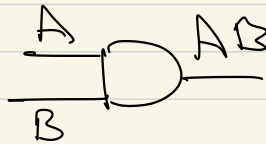
$$A=0, \bar{A}=1$$

$$\overline{A \wedge A} = \bar{A}$$



A	B	
0	0	1
0	1	1
1	0	1
1	1	0

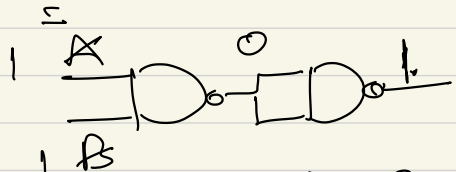
② AND



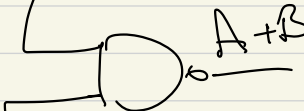
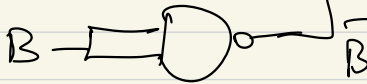
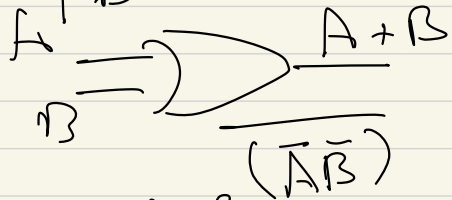
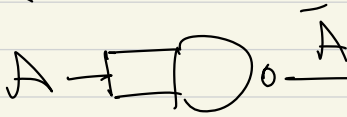
$$A=1$$

$$B=1$$

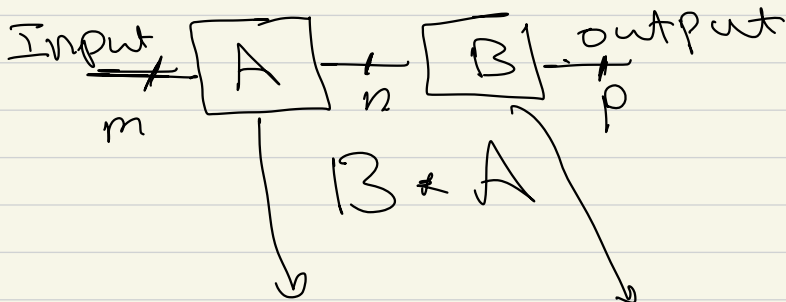
$$AB=1$$



③ OR



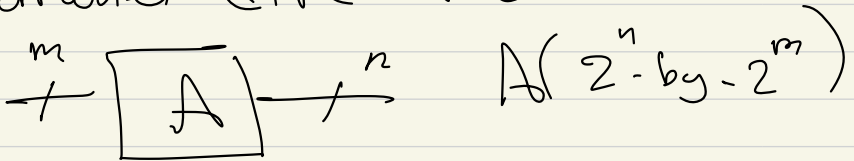
* IF we combine gates in sequence we call it a sequential circuit



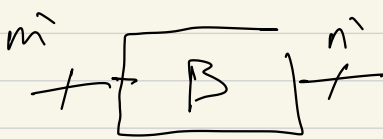
$$2^n \text{ by } 2^m \quad 2^p \text{ by } 2^n$$

$$B \circ A = (2^p \text{ by } 2^n) (2^n \text{ by } 2^m) \\ = (2^p \text{ by } 2^m)$$

* Parallel circuit \rightarrow gates



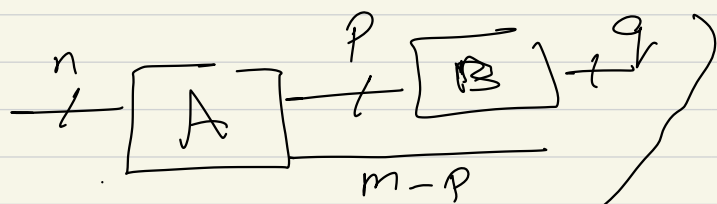
$$A (2^n \text{ by } 2^m)$$



$$B (2^n \text{ by } 2^m)$$

$$A \otimes B (2^{n+n} \text{ by } 2^{m+m})$$

Ex



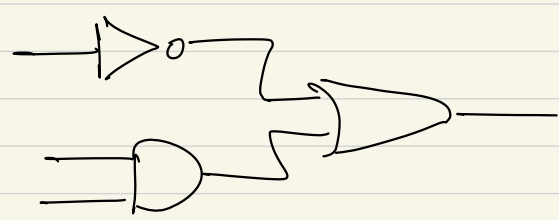
A is 2^m -by- 2^n

B is 2^p -by- 2^p

I is 2^{m-p} by 2^{m-p}

$$(B \otimes I_{m-p}) \cdot A$$

Ex



OR (NOT & AND)

ch. 5.3 Reversible gates

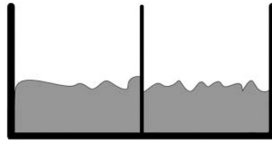


Figure 5.1. Tub with water in no state.



$|0\rangle$

$|1\rangle$

Figure 5.2. Tub with water in state $|0\rangle$ and state $|1\rangle$.

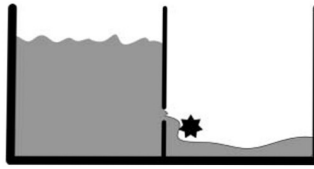


Figure 5.3. State $|0\rangle$ dissipating and creating energy.

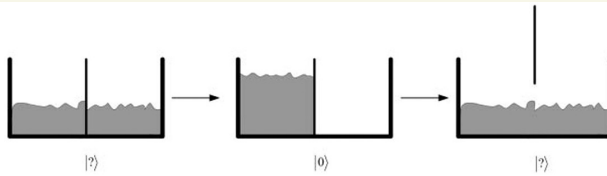


Figure 5.4. Reversibility of writing.



writing is reversible

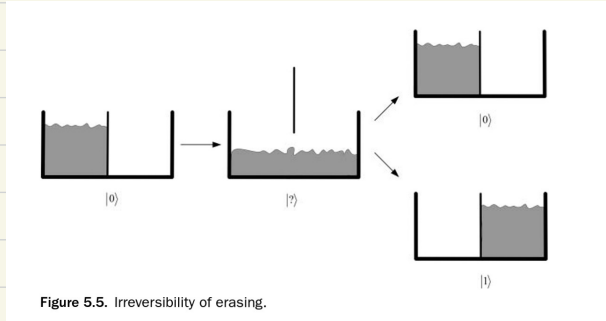


Figure 5.5. Irreversibility of erasing.

Erasing is irreversible
 \sim \sim dissipate energy

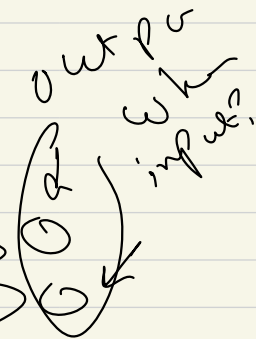
* AND is not irreversible

\rightarrow OR \sim \sim ?

AND is -

0	0	0
0	1	0
1	0	0
1	1	1

$A=0, B=0 \Rightarrow$
 $A=0, B=1 \Rightarrow$



$$\begin{array}{cc|c} 0 & 0 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 1 \end{array}$$

~~→~~ is reversible

$$\begin{array}{c|c} 0 & 1 \\ 1 & 0 \end{array}$$

* CNOT