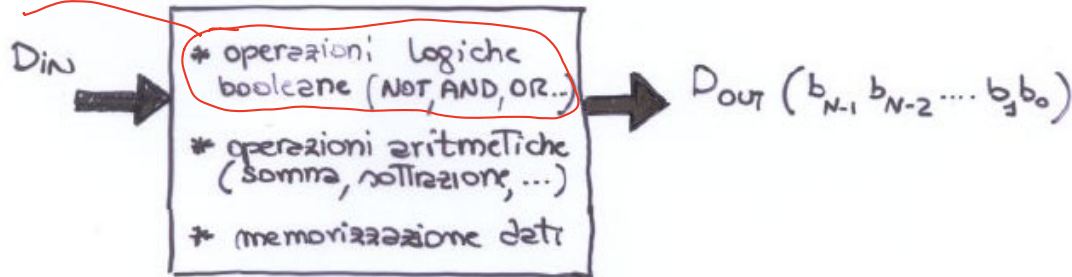


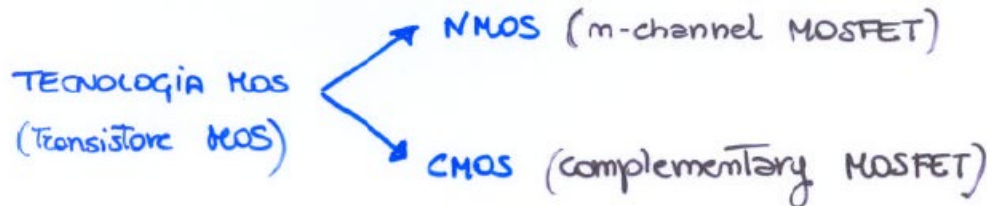
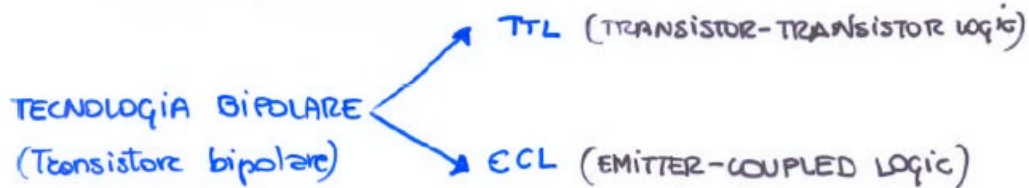
# LOGICA CMOS

## \* SISTEMA DIGITALE

IN QUESTO CORSO



## \* FAMIGLIE LOGICHE

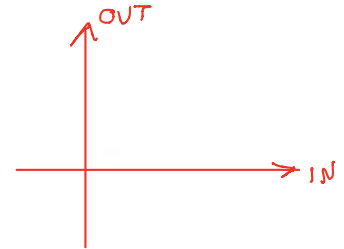


# COME SI ANALIZZA UNA PORTA LOGICA?

1. funzione logica svolta  
 $y = f(A, B, C, \dots)$

2. Caratteristica ingresso-uscita

3. Dissipazione di potenza }  
4. Velocità di risposta } PRODOTTO  
(RITARDO x CONSUMO)



# INVERTITORE LOGICO (NOT GATE)

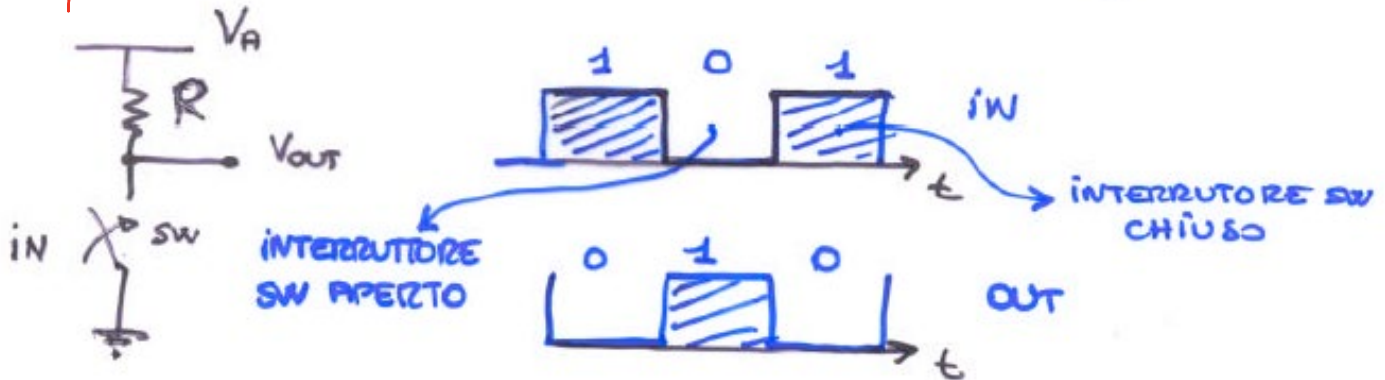


simbolo elettrico

| iN | OUT |
|----|-----|
| 0  | 1   |
| 1  | 0   |

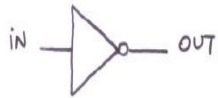
funzione logica

esempio



# INVERTITORE LOGICO (NOT GATE)

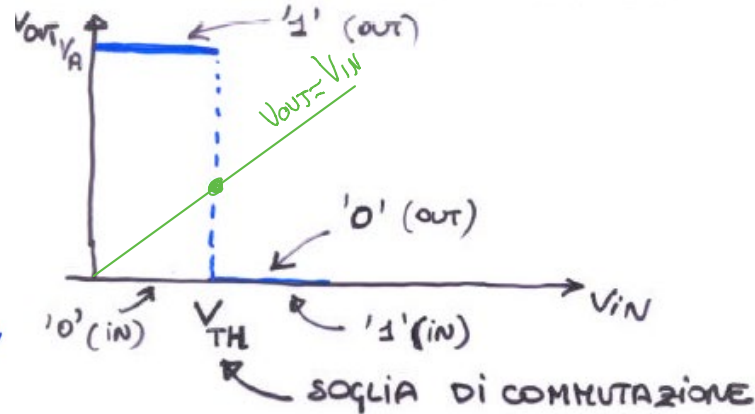
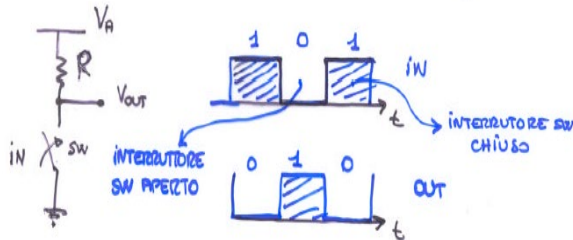
→ CARATTERISTICA DI TRASFERIMENTO "IDEALE"



simbolo elettrico

| IN | OUT |
|----|-----|
| 0  | 1   |
| 1  | 0   |

funzione logica



- $V_{IN} < V_{TH} \Rightarrow$  SW APERTO  $\Rightarrow I_R = 0 \doteq I_H$

$$\hookrightarrow V_{OUT} = V_A - R I_R' = V_A$$

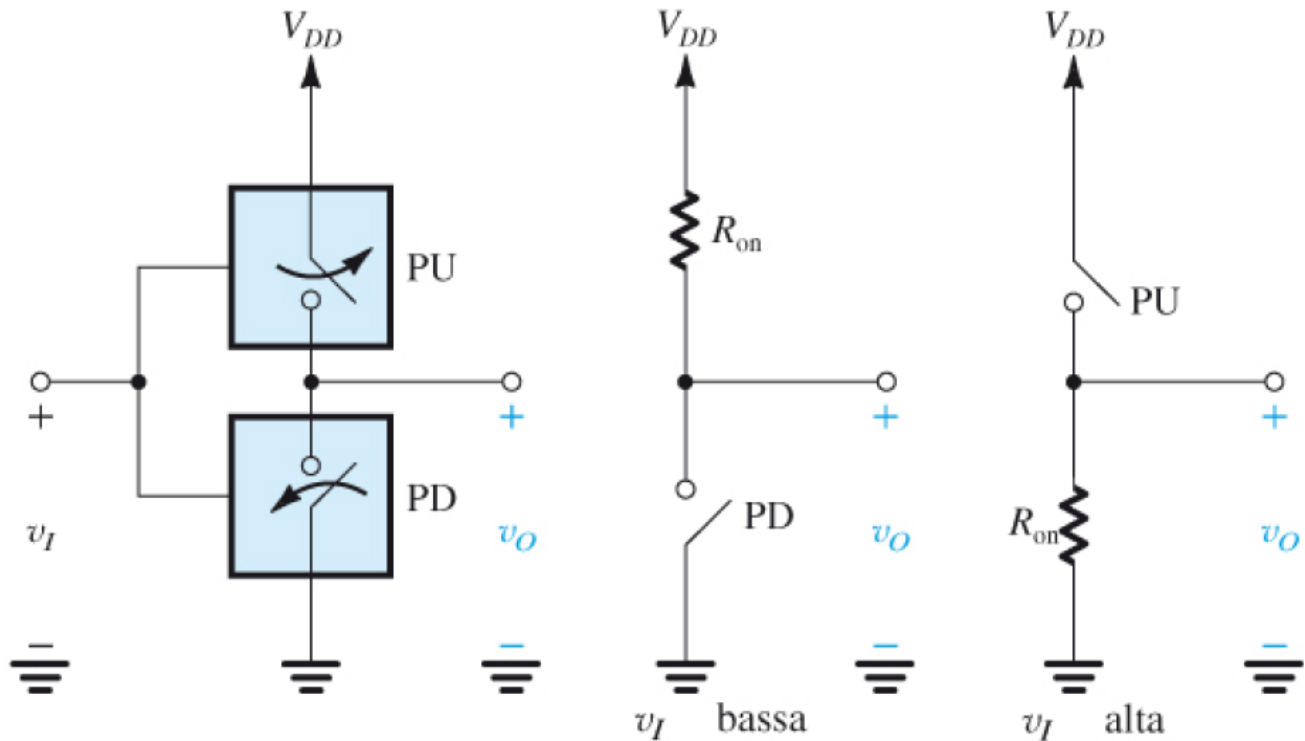
- $V_{IN} > V_{TH} \Rightarrow$  SW CHIUSO  $\Rightarrow$  USCITA CORTOCIRCUITATA A MASSA

$$\hookrightarrow V_{OUT} = 0 ; I_R = \frac{V_A}{R} \doteq I_L$$

↓  
DISSIPAZIONE DI POTENZA STATICA

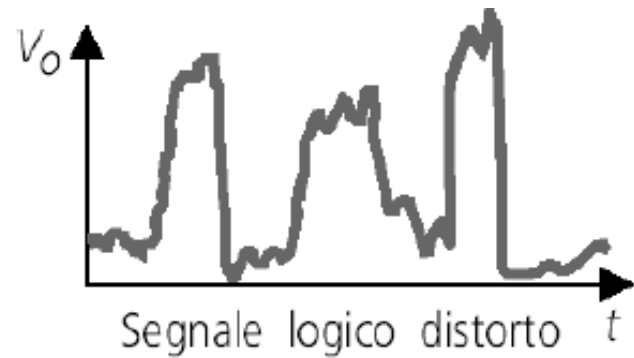
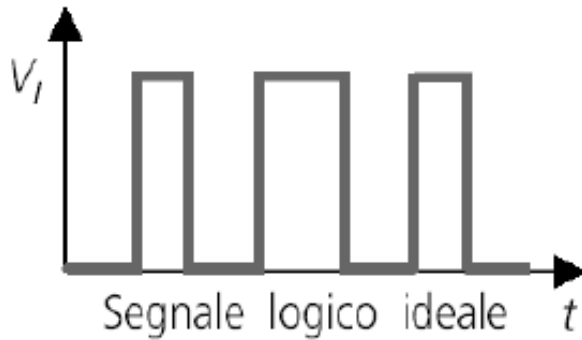
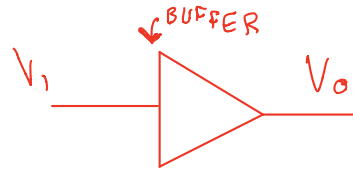
$$P_{STAT} = V_A \frac{I_L + I_H}{2} = \frac{1}{2} V_A^2 \frac{1}{R}$$

# INVERTITORE LOGICO A 2 INTERRUTTORI



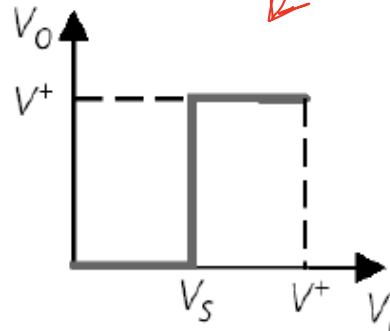
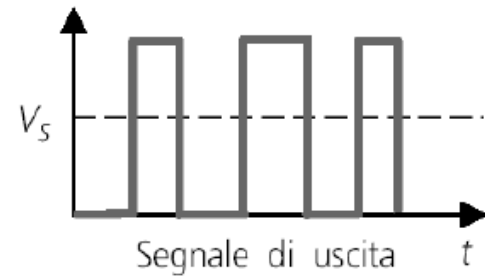
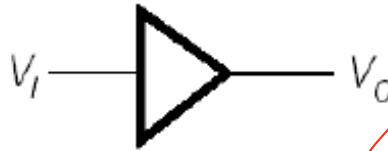
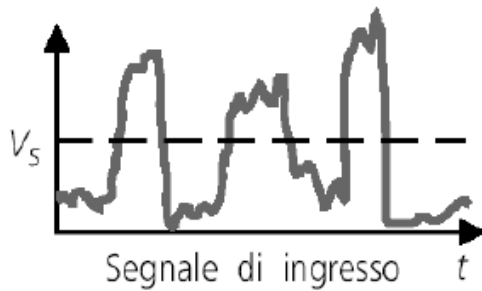
- ✓ La rete di pull-up e' costituita da un interruttore controllato in tensione che si chiude quando  $V_I$  e' bassa. La rete di pull-down e' costituita da un interruttore controllato in tensione che si apre quando  $V_I$  e' bassa.
- ✓ La dissipazione di potenza statica e' nulla

# SEGNALE LOGICO



# BUFFER LOGICO

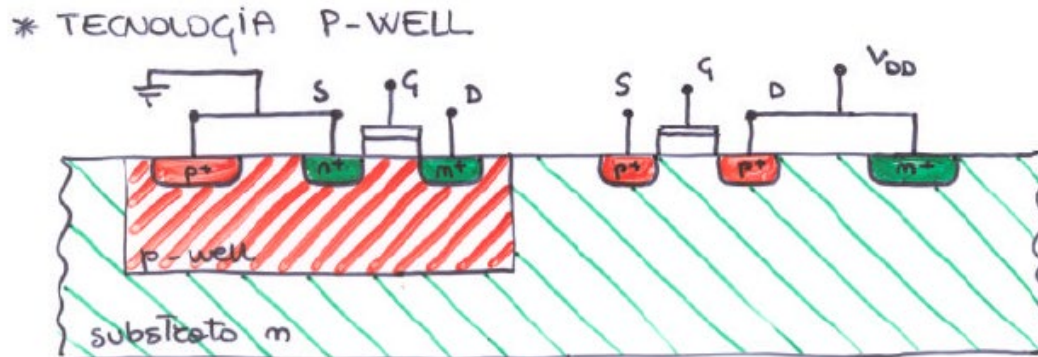
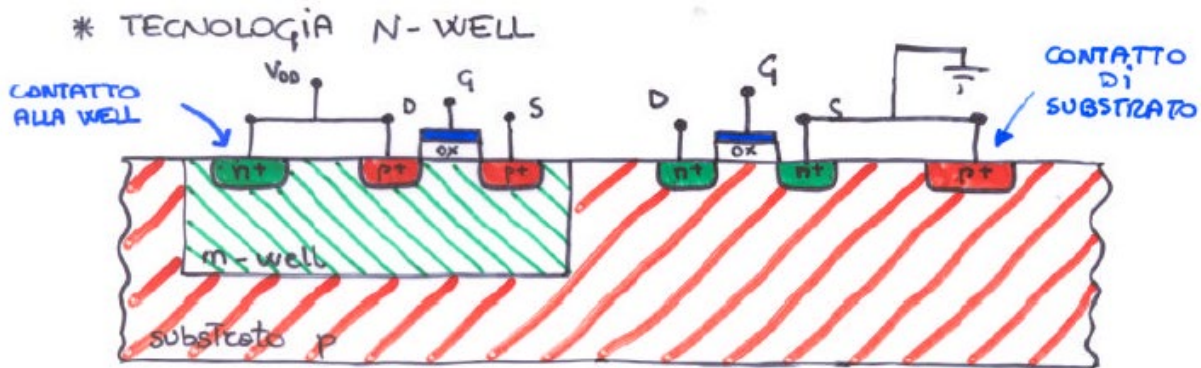
*rigenerazione dei livelli logici*



Caratteristica di trasferimento

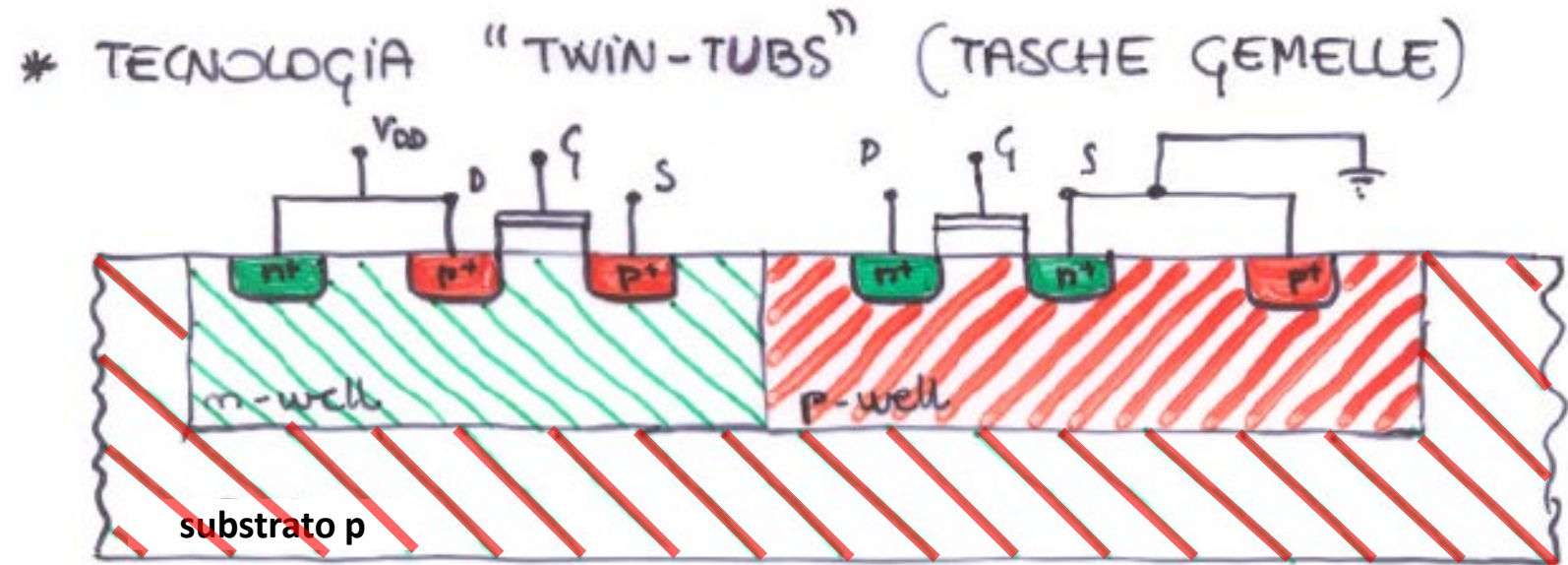
# TECNOLOGIE CMOS

## (Complementary Metal Oxide Silicon)





# TECNOLOGIE CMOS (Complementary Metal Oxide Silicon)

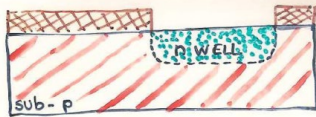


# TECNOLOGIA DI FABBRICAZIONE DI CIRCUITI INTEGRATI - PROCESSO CMOS

1) OSSIDAZIONE DEL WAFER DI SILICIO (mediante processo termico)



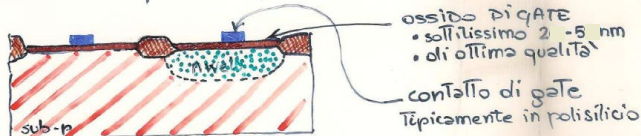
2) REALIZZAZIONE DELLA "TASCA" n (n-WELL)



3) OSSIDAZIONE SELETTIVA per definire le regioni dei diversi dispositivi



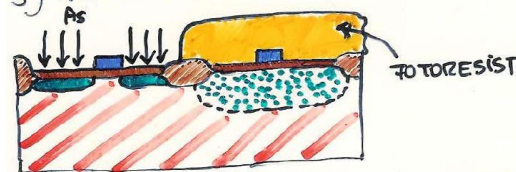
4) OSSIDAZIONE DI GATE E REALIZZAZIONE DEL CONTATTO DI GATE



5) IMPIANTAZIONE DEI SOURCE E DRAIN DI TIPO P



5) IMPIANTAZIONE DEI SOURCE E DRAIN DI TIPO N



6) STRUTTURA FINALE CON LE METALLIZZAZIONI

