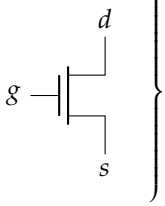
COMS10015 quick(ish) reference hand-out: transistors and logic gates

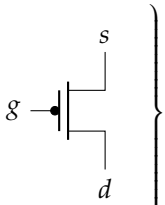
Definition: informal

N-MOSFET :



$$\rightsquigarrow \begin{cases} g = V_{dd} = 5\text{V} \Rightarrow \text{transistor is activated, } s \text{ and } d \text{ connected} \\ g = V_{ss} \simeq GND = 0\text{V} \Rightarrow \text{transistor is deactivated, } s \text{ and } d \text{ disconnected} \end{cases}$$

P-MOSFET :



$$\rightsquigarrow \begin{cases} g = V_{ss} \simeq GND = 0\text{V} \Rightarrow \text{transistor is activated, } s \text{ and } d \text{ connected} \\ g = V_{dd} = 5\text{V} \Rightarrow \text{transistor is deactivated, } s \text{ and } d \text{ disconnected} \end{cases}$$

Definition: formal

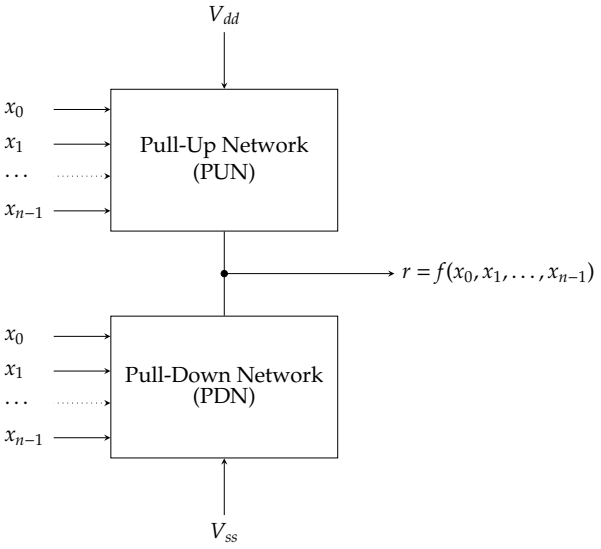
Definition 1. *An* **N-MOSFET** *(or* **N-type MOSFET**, *or* **N-channel MOSFET**, *or* **NPN MOSFET**) *is constructed from N-type semi-conductor terminals and a P-type body:*

- *applying a potential difference to the gate widens the conductive channel, meaning source and drain are connected (i.e., act like a conductor); the transistor is activated.*
- *removing the potential difference from the gate narrows the conductive channel, meaning source and drain are disconnected (i.e., act like an insulator); the transistor is deactivated.*

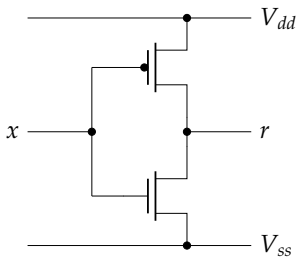
Definition 2. *A* **P-MOSFET** *(or* **P-type MOSFET**, *or* **P-channel MOSFET**, *or* **PNP MOSFET**) *is constructed from P-type semi-conductor terminals and an N-type body:*

- *applying a potential difference to the gate narrows the conductive channel, meaning source and drain are disconnected (i.e., act like an insulator); the transistor is deactivated.*
- *removing the potential difference from the gate widens the conductive channel, meaning source and drain are connected (i.e., act like a conductor); the transistor is activated.*

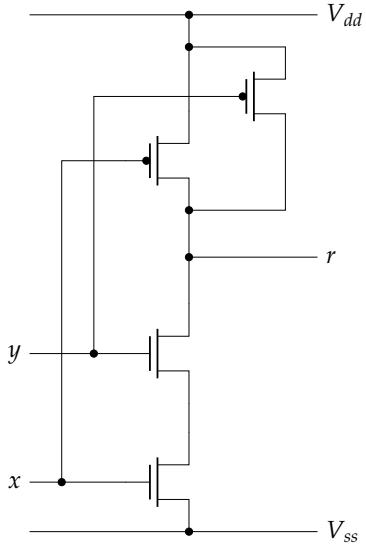
Design framework



Logic gates: NOT



Logic gates: NAND



Logic gates: NOR