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

Definition: informal

$$\textbf{N-MOSFET} \quad : \quad \rightsquigarrow \quad \begin{cases} g = V_{dd} & = 5\text{V} \Rightarrow \text{transistor is} \quad \text{activated,} \; s \text{ and } d \quad \text{connected} \\ g = V_{ss} \simeq GND & = 0\text{V} \Rightarrow \text{transistor is deactivated,} \; s \text{ and } d \; \text{disconnected} \end{cases}$$

$$\textbf{P-MOSFET} \quad : \quad \rightsquigarrow \quad \begin{cases} g = V_{ss} \simeq GND & = 0\text{V} \Rightarrow \text{transistor is} \quad \text{activated,} \; s \text{ and } d \quad \text{connected} \\ g = V_{dd} & = 5\text{V} \Rightarrow \text{transistor is deactivated,} \; s \text{ and } d \; \text{disconnected} \end{cases}$$

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:*
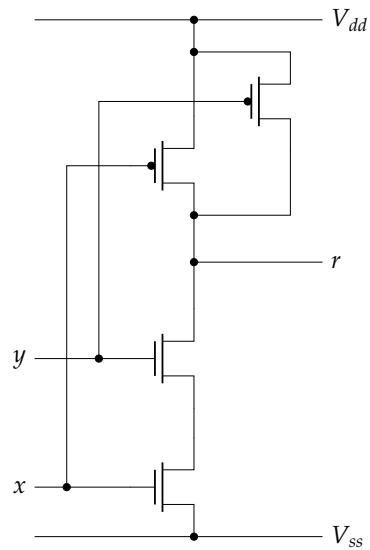
- *applying a potential difference to the gate widens the conductive channel, meaning source and drain are connected (i.e., act like a conductor); the transistor is activated.*
- *removing the potential difference from the gate narrows the conductive channel, meaning source and drain are disconnected (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
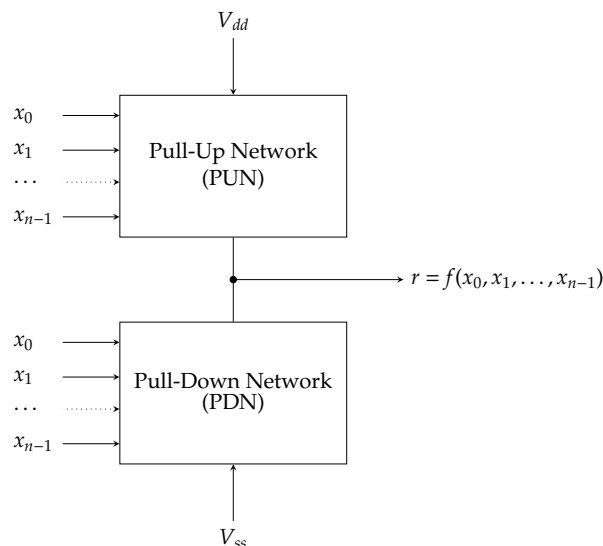
Logic gates: NOT
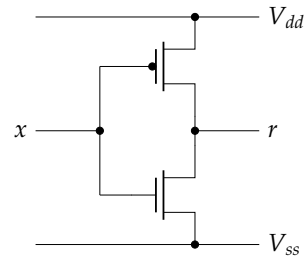
Logic gates: NAND

Logic gates: NOR