

# CSE 251

# Electronic Devices and Circuits

## Lecture 1



Inspiring Excellence

**Course instructor:**

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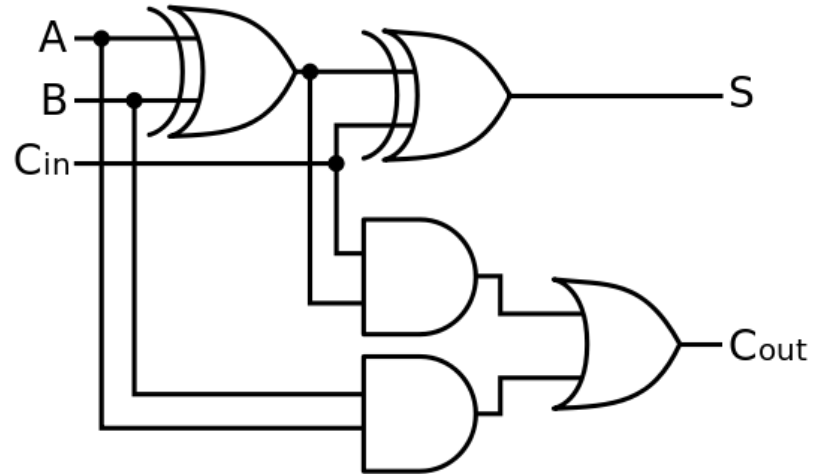
*Email: [ankan.ghosh@bracu.ac.bd](mailto:ankan.ghosh@bracu.ac.bd)*

## Mathematical Operations

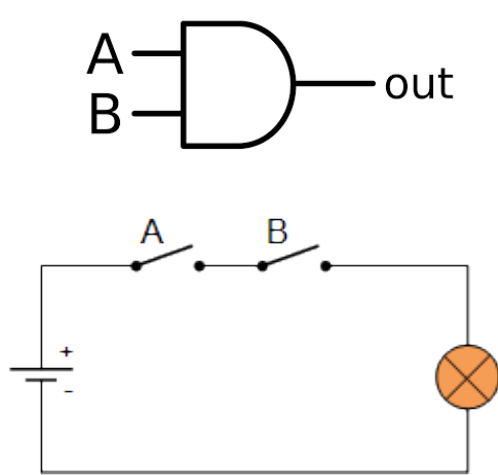
- Addition:  $4 + 5 \rightarrow 9$        $(0100 + 0101 \rightarrow 1001)$
- Subtraction:  $10 - 9 \rightarrow 1$        $(1010 + 0111 \rightarrow 0001)$
- Multiplication:  $5 \times 4 = 4 + 4 + 4 + 4 + 4 = 20$
- Division:  $10 / 2 = 2$  can be subtracted from 10, 5 times

# Digital Logic Circuit

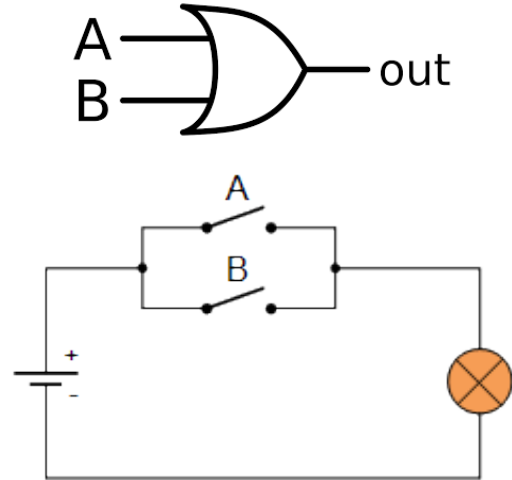
**Addition:**  $4 + 5 \rightarrow 9$  ( $0100 + 0101 \rightarrow 1001$ )



# Logic gates are basically switches



**AND Gate**



**OR Gate**

The faster you can operate these switches, the faster you can complete the functions!!!

# How can we make these switches?

- **Mechanical switch**

- Bulky and heavy
- Mechanical wear over time
- Noisy
- Ultra slow
- Requires lots of energy to operate



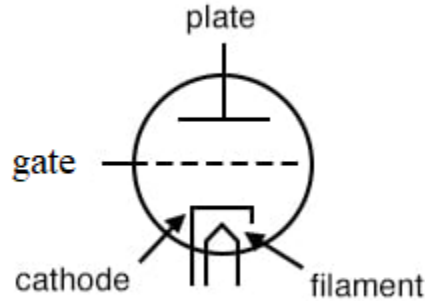
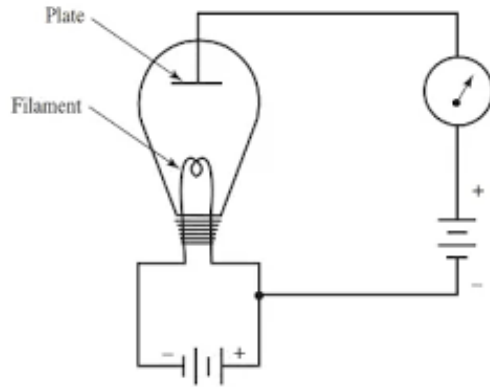
**SPST  
Switch**



**Electromechanical  
Relay**

# How can we make these switches?

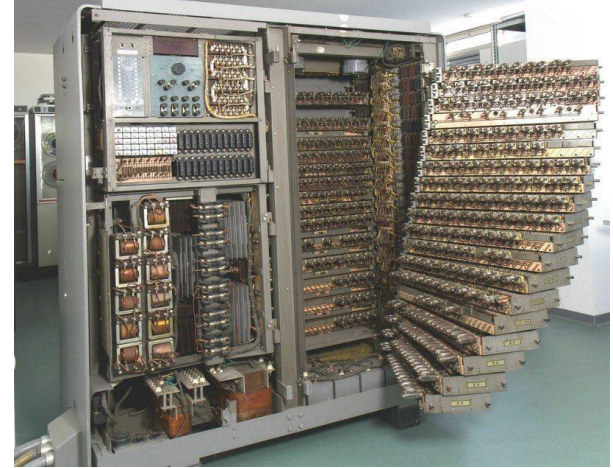
- **Vacuum tube**



- To ensure current passes along one direction and stops flowing in the other direction
- Gate allows us to control this is a more robust way

# How can we make these switches?

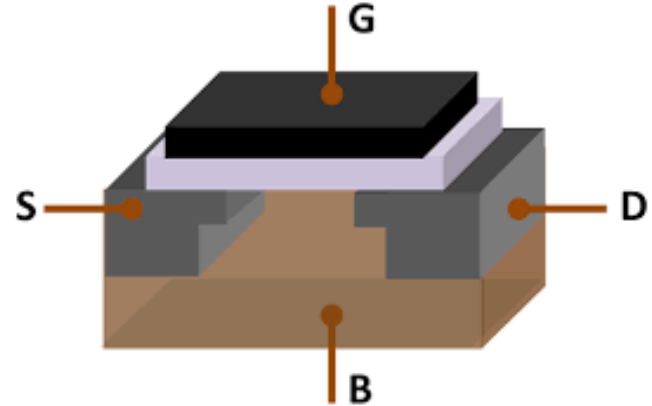
- **Vacuum tubes**
  - Bulky
  - Lots of energy
  - Not scalable



# How can we make these switches?

- **Electronic switches**

- No moving parts
- Scalable
- High speed

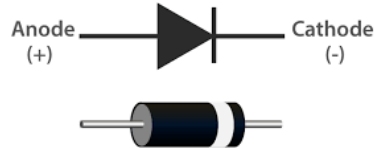


**5GHz computer → 5 billion operations per second !!!**

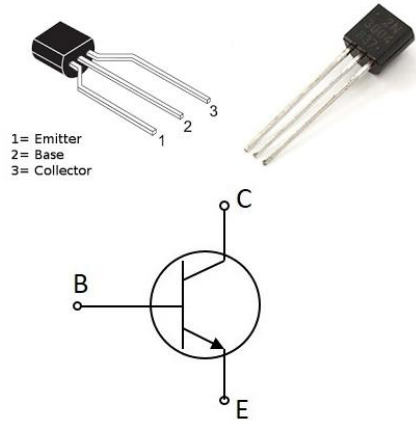


# What are electronic circuits?

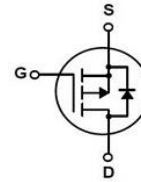
- Any circuit consisting of semiconductors.



Diode



BJT



MOSFET

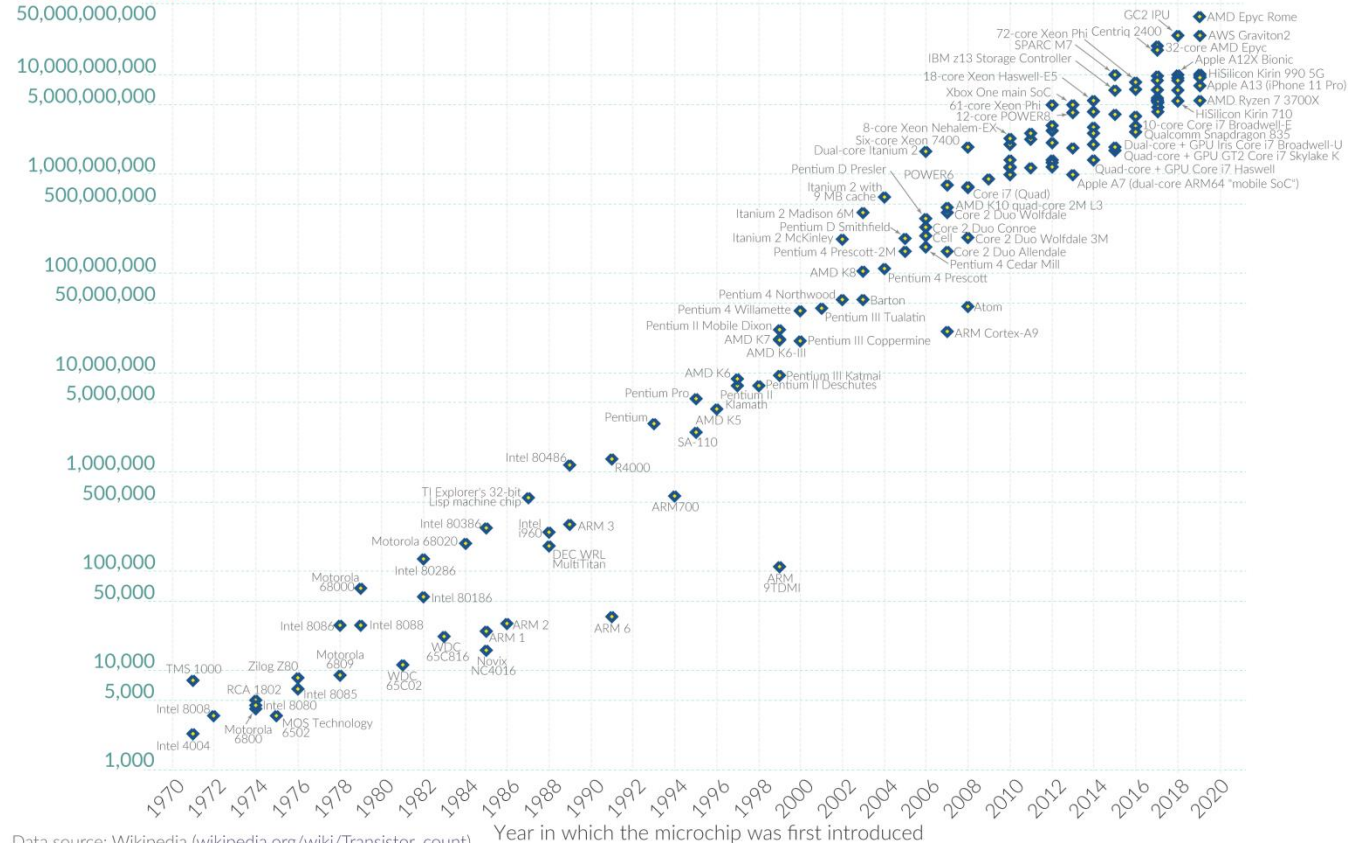


# Moore's Law: The number of transistors on microchips doubles every two years

Moore's law describes the empirical regularity that the number of transistors on integrated circuits doubles approximately every two years.

This advancement is important for other aspects of technological progress in computing – such as processing speed or the price of computers.

## Transistor count



Data source: Wikipedia ([wikipedia.org/wiki/Transistor\\_count](https://wikipedia.org/wiki/Transistor_count))

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# Why do we need electronic circuits?

## **Digital Electronics**

- Boolean logic
- Addition, subtraction, multiplication, division

## **Analog Electronics**

- Amplifiers, radio transmitter and receivers, modulator

## **Power Electronics**

- Motor control
- AC to DC conversion or vice versa
- HVDC circuits
- Charge control circuits