Moore's Law

Moore's Law is an observation made by Gordon Moore in 1965.
It states that the density, i.e. the number of transistors on integrated circuit, will roughly get doubled in every 2 years.

The observation made by Moore was more or less accurate till mid 2000s due to excellent research done in the field of computer hardware.

But nowadays, transistor density has reached a saturation point known as **Power Wall.**

Power Wall

As we increase transistor density in ICs, more power is consumed.

With increase in power consumption, the amount of heat generated also increases. Fans present in processor can only remove certain amount of heat using air cooling technique. If heat generated increases a certain threshold then circuit would melt.

Power/Temperature Problem

- Transistors consume power when they switch
- Increasing transistor density leads to increased power consumption
    - Small transistors use less power, but density scaling is faster
- High power leads to high temperature
- Air cooling (fans) can only remove so much heat

Dynamic Power

P = α * CFV2

- α is percent of time switching
- C is capacitance (related to size)

- F is the clock frequency (to make CPU fast, increase F but it also increase P)
- V is voltage swing (from low to high)
- Voltage is important
- 0 to 5V uses much more power than 0 to 1.3 V (Reducing voltage significantly reduces power)

Dennard Scaling

- Voltage should scale with transistor size
- Keeps power consumption, and temperature, low
- Problem: Voltage can't go too low
    - Must stay above threshold voltage of transistor
    - Noise problems occur (difficult to distinguish b/w low and high voltage)
- Problem: Doesn't consider leakage power - transistor leaks of power even when it is not switching especially because of thin insulators in highly dense processors.
- Dennard scaling must stop

Now ICs contains multiple cores and programs run in parallel or concurrently in single core.