Unit 1 - Hardware

Microprocessors & CPUs

What is a microprocessor?

- The **brain** of the computer, the microprocessor is responsible for organizing and executing every instruction.

- Microprocessors contain the following components:
  - **CPU** (Central Processing Unit)
  - **Cache Memory**

CPUs

- The **CPU** interprets commands from the program that is currently running. These may involve:
  - Arithmetic operations
    - Adding, Subtracting, Multiplying, or Dividing
  - Moving data between components
    - Sending packets of data to the WiFi hardware
  - Switching context between programs
    - Loading a website on Chrome, then responding to keystrokes in Word, then going back to Chrome, etc.

Cores

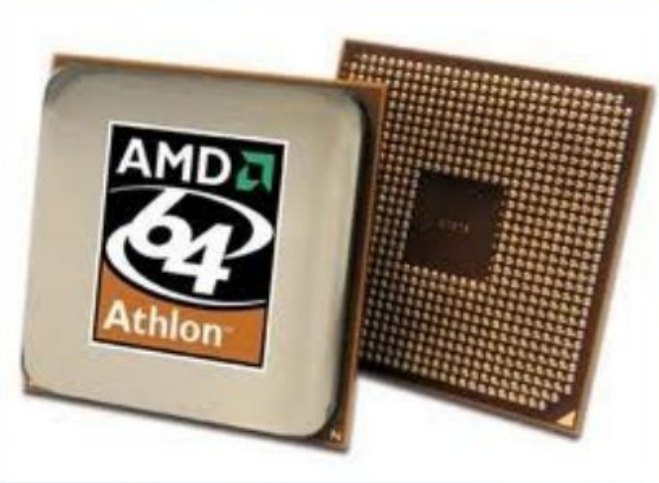
- A microprocessor can have more than one CPU or *core.*

- More *cores* means more operations happening at one time. This helps when trying to run multiple programs at one time (or for processing one program that has multiple events).

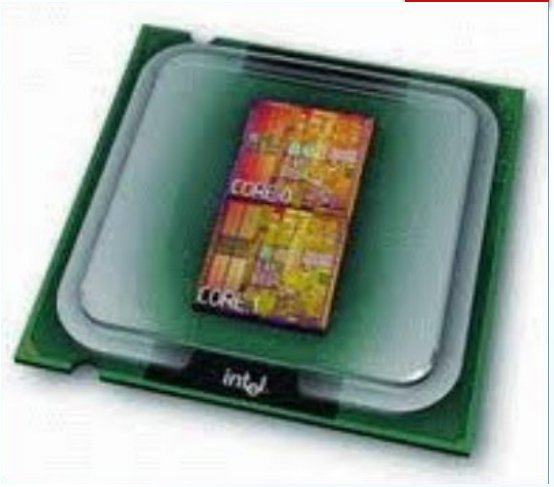
- A processor with one core is called *single core*, two cores is *dual core*, and, most recently, processors can have up to eighteen cores (Intel Core i9-7980X)

- Windows **10** can support up to a max of **32** cores for **32**-bit Windows and **256** cores for **64**-bit Windows.

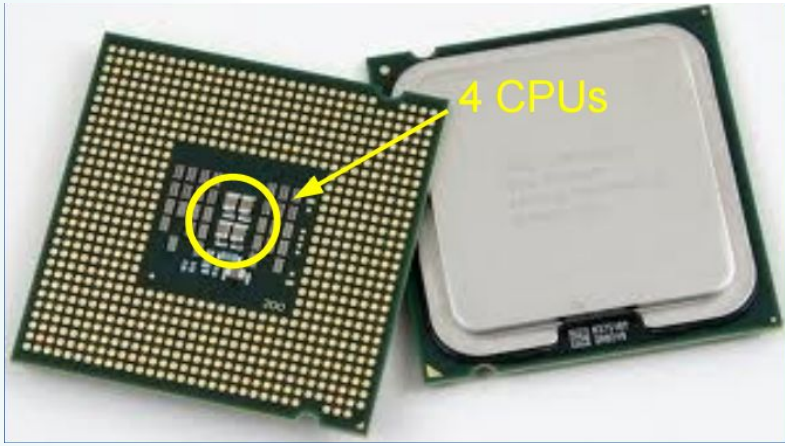
Cores



Single Core



Dual Core



Quad Core

Do gamers need multiple cores?

Do gamers need multiple cores?

Short Answer: No. You can't split many gaming tasks into smaller tasks. You must complete one task before beginning another in most games.

Long Answer: Check out this YouTube video.

How do we measure speed?

- The *clock speed* indicates how many operations can be performed in one second.

1 Hz = 1 operation per second

1 MHz = 1 million operations per second

1GHz = 1 billion operations per second

How do we measure speed?

- **Example:**

  A quad-core 4GHz processor *can* be as fast a single-core 16GHz processor.

  (4 cores) x (4Ghz each) = 16GHz

However, this isn't usually true, in practice!
Can you think of why?

Hyper-Threading

- *Intelligent scheduling* that allows a single core to act like a multi-core processor. This is done by keeping the processor busy with *active programs* so that programs that are taking a long time do not bog down the processor.

- Video: https://www.youtube.com/watch?v=wnS50lJicXc

- Not useful for gaming!

Cache Memory

- The CPU needs *fast* storage for short-term data that it is currently working with.

- This memory is called *cache memory.*

- Cache memory is *very fast* and *very expensive.*

- Cache memory is on the microprocessor next to the CPUs (RAM is stored elsewhere, therefore slower).

Types of Cache Memory

- Level 1 (L1) Cache
  - smallest but fastest memory available
  - each core has its own L1 cache
- Level 2 (L2) Cache
  - slower but larger
  - each core also has its own L2 Cache
- Level 3 (L3) Cache
  - slowest and largest
  - shared by all cores

How It's Made: Microprocessors

https://www.youtube.com/watch?v=F0HpiwDDALU

Bored? Make a CPU in Minecraft!

https://www.youtube.com/watch?v=yuMlhKI-pzE