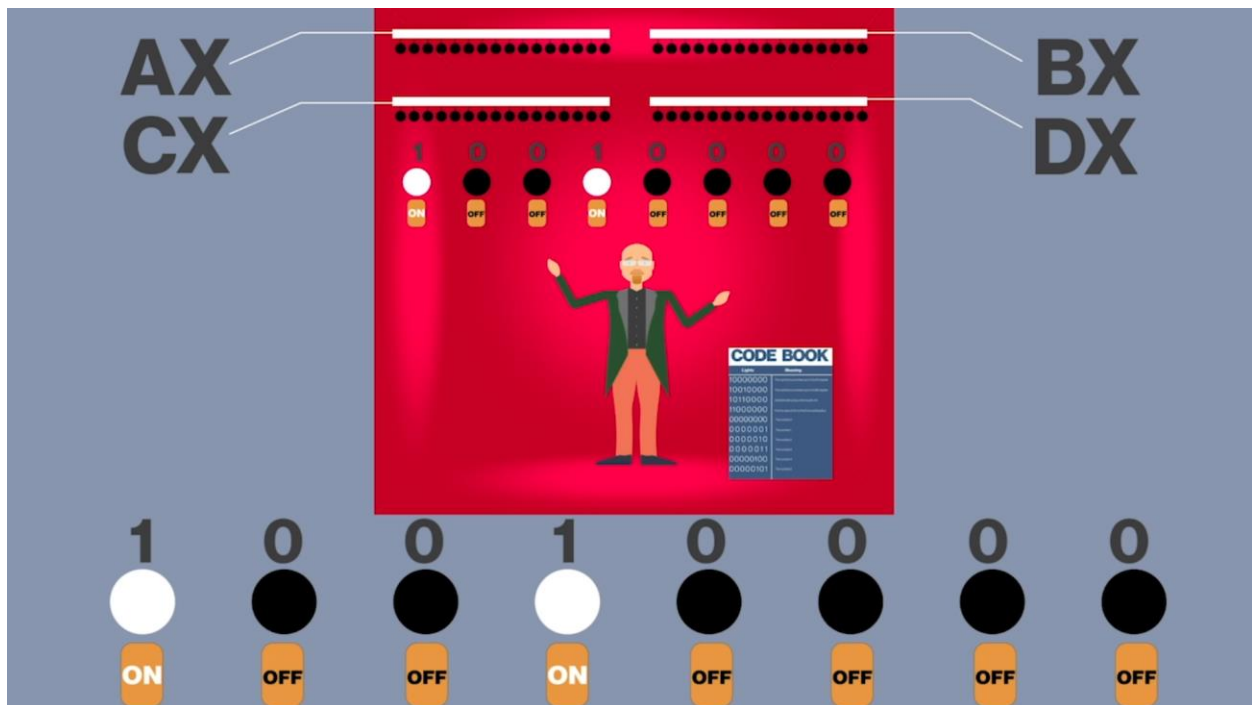


### What is a CPU?

- Central processing units run programs
- Every CPU has internal features to process commands
- Every CPU runs code based on a specific machine language
- CPUs use pipelines to optimize the processing commands



EDB (External Data Bus) - lightbulb communication device from outside to inside the box with the worker inside of it (enables you to communicate with the Man in the Box)

This is **NOT the Kernel** (Kernel is the Core of the OS!!)

Bus - Set of conductors carrying data and control signals

4 General Purpose Registers - AX; BX; CX; DX

### Modern CPUs

We can measure the capability of the CPU by how many tasks per second they can do

#### Clock Speeds

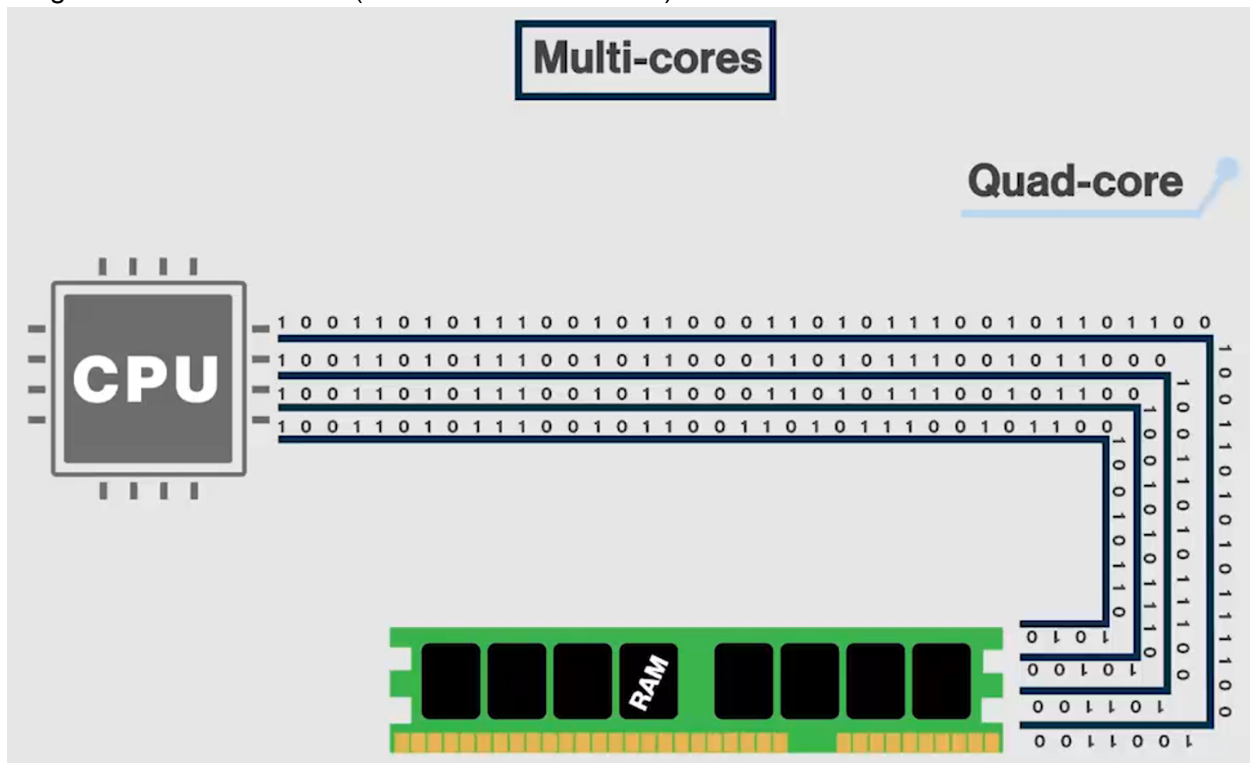
1 hertz (Hz) = 1 cycle per second

1 megahertz (MHz) = 1 million cycles per second

1 gigahertz (GHz) = 1 billion cycles per second (most common for clock speeds)

CPU Cores – multiple processors on 1 Chip

## Single-core vs Multi-cores (Dual-core & Quad-core)



Multiple Cores (Multiple Pipelines) - Handle multiple pieces of code at a time, rather than 1 piece of code with only 1 Core/Pipeline



Raspberry Pi - Advanced Risk Machine (ARM)  
For a Reduced Instruction Set Computing (RISC)  
resulting in a much higher speed of processing, and reduced workload

ARM Chips are also found in the Macbook Pro, Air, and Macbook Mini, etc

Accelerated Processing Unit (APU) - CPU with graphics cards built in

## CPU-Z

The screenshot shows the CPU-Z application window with the 'CPU' tab selected. The processor is an AMD Ryzen 7 2700X. Key details include the code name 'Pinnacle Ridge', 12 nm technology, 105.0 W Max TDP, and 1.400 V Core Voltage. The specification section identifies it as an eight-core processor with 8 cores, 16 threads, and a stepping of 2. The clock section shows a core speed of 3972.88 MHz, a multiplier of x39.75, and a bus speed of 99.95 MHz. The cache section shows L1 Data (8 x 32 KBytes, 8-way), L1 Inst. (8 x 64 KBytes, 4-way), Level 2 (8 x 512 KBytes, 8-way), and Level 3 (2 x 8 MBytes, 16-way). The bottom of the window shows 'CPU-Z Ver. 2.01.0.x64' and buttons for 'Tools', 'Validate', and 'Close'.

Processor			
Name	AMD Ryzen 7 2700X		
Code Name	Pinnacle Ridge	Max TDP	105.0 W
Package	Socket AM4 (1331)		
Technology	12 nm	Core Voltage	1.400 V
Specification	AMD Ryzen 7 2700X Eight-Core Processor		
Family	F	Model	8
Ext. Family	17	Ext. Model	8
Stepping	2		
Revision	PiR-B2		
Instructions	MMX(+), SSE, SSE2, SSE3, SSSE3, SSE4.1, SSE4.2, SSE4A, x86-64, AES, AVX, AVX2, FMA3, SHA		

Clocks (Core #0)		Cache	
Core Speed	3972.88 MHz	L1 Data	8 x 32 KBytes 8-way
Multiplier	x 39.75	L1 Inst.	8 x 64 KBytes 4-way
Bus Speed	99.95 MHz	Level 2	8 x 512 KBytes 8-way
Rated FSB		Level 3	2 x 8 MBytes 16-way

Selection	Cores	Threads
Socket #1	8	16

CPU-Z Ver. 2.01.0.x64 Tools Validate Close

Code Name "Pinnacle Ridge" is the name of the Microarchitecture

Base Speed = 100MHz (Motherboard Speed)

Multiplier = 40

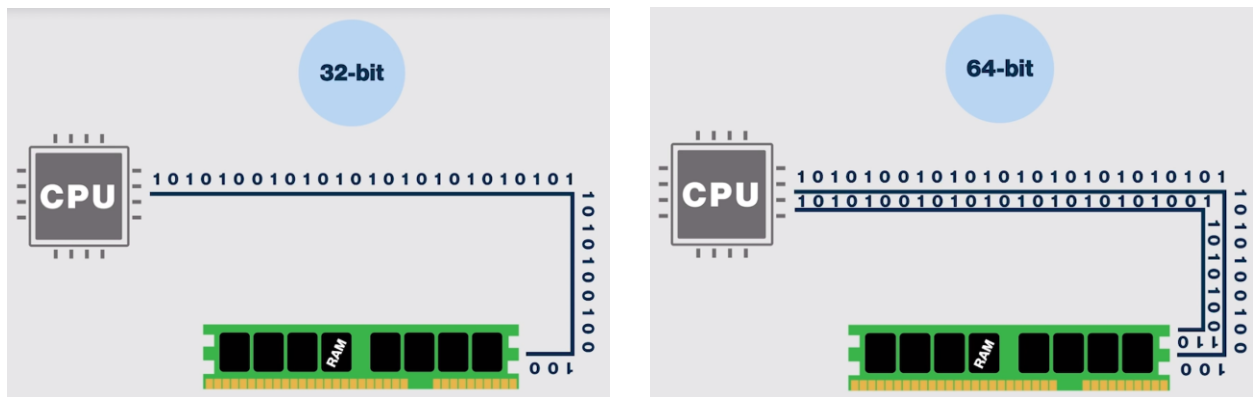
## 32-Bit vs 64-Bit Computing

Amount of Data the CPU can handle

x86 (32-Bit) - .....for the exam, just know there's also Intel Architecture, 32-bit (IA-32)

x64 (64-Bit) - greater data handling, improved graphics performance, better security

Almost all modern hardware & software supports 64-bit systems  
and are backwards compatible with 32-bit systems



Instruction Set Architecture (ISA)	Supports 32-bit applications?	Supports 64-bit applications?
X86	Yes	No
X86-64	Yes	Yes
x64		

## Choosing the Right CPU

- CPUs designed for laptops - features for better power consumption & battery usage
- Higher-end CPUs - more cores & faster clock speed
- Intensive tasks such as 3D gaming & video editing benefit from CPUs with extra cores
- Some CPUs are unlocked & can be overclocked

What type of system do you want?

What's the primary use of the computer?

How long do you want this system to last?

pcpartpicker.com

Overclocking - Special Motherboards have the ability to talk to a CPU telling it to set the Metronome Up, but this makes systems unstable (There would be a lot more heat coming from the CPU, which would require the Cooling Unit to work harder too)  
Just keep the “knob” where it is -no need to turn it up

## CPU Generations and Architecture

- Intel and AMD are the main brands for CPUs
- The higher a CPU's tier, the better the performance
- Generation gives good indicator of the CPU's age
- Model refers to the performance of the CPU
- Suffix denotes whether the CPU is unlocked or has integrated graphics

Multithreading – parallel computing on a certain task



<https://techgamesnews.com/cpus/>

## CPU Cooling

There's no other piece of hardware in our PC that generates more heat than the CPU  
Keeping temperatures under control is key for a system's longevity

Overheating – leads to system instability and may experience Intermittent Shutdowns

Heat Sink - Anything that can take heat from another device

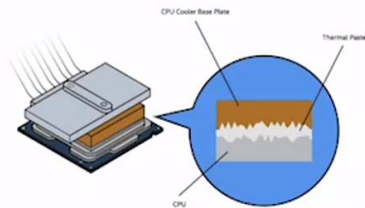
Heat is transferred into these metal fins & pipes to transfer heat from the CPU

Thermal Paste & Pads - used to fill in gaps & provide better thermal conductivity  
between CPU & heat sink

Use a pea-size amount.

If you have over-spill,

use a cleaning kit (thermal material remover or 70% isopropyl alcohol)



Fans (air-cooling) - 120mm to 180mm

Bigger Fans don't have to turn as fast, so they don't create as much noise

Liquid cooling - higher thermal transfer capabilities than air-cooling

General Rule - Pull Cool Air In from the front & top of the system,  
and Push the Hot Air Out (typically with the Power Supply)  
(We could have Fans on the back to help pull the hot air out)  
-Make sure you have good airflow!

## Installing and Troubleshooting the CPU

Always use electrostatic discharge (ESD) prevention methods when handling CPUs

Land Grid Array (LGA) and Pin Grid Array (PGA) are the 2 most common types of CPU sockets

LGA (lands) - Intel

PGA (pins) - AMD

Zero-Insertion Force (ZIF) mechanism - secures the CPU into the motherboard's CPU socket

Align the Orientation notch on the CPU with the notch on the Socket

Troubleshooting a Non-functional CPU – check all connections!

Make sure the fan, heat sink, and CPU itself are seated properly before proceeding