COAL Notes - Day 1 (Simple English)

Lecture 1: Registers, Cache, Architecture, and RAM

1. Registers and Cache (Small Fast Memory in CPU)

- Registers are very small and very fast storage inside the CPU.

- They hold data that the CPU is currently using.

- Example: If CPU is adding 2 numbers, they will first go into registers.

- Cache is like a helper memory near CPU. It keeps recently used data ready.

    - L1 Cache: Closest and fastest.

    - L2 Cache: A little slower, more space.

    - L3 Cache: Shared by all CPU cores.

Difference Between Register and Cache:

Feature	Register	Cache
Location	Inside the CPU core	Near the CPU (between CPU and RAM)
Speed	Fastest memory	Very fast (slightly slower than registers)
Size	Very small (few bytes)	Bigger (KB to MB)
Used for	Data CPU is using right now	Recently used data/instructions
Controlled by	Programmer/Compiler	Automatically by hardware
Example	Adding numbers directly in CPU	Keeping recently used variables close to CPU

2. Von Neumann Architecture (Basic Computer Design)

- A computer is made from CPU, memory, and input/output devices.

COAL Notes - Day 1 (Simple English)

- Both data and instructions (code) are stored in the same memory.

- CPU gets both data and instructions from memory using a "bus".

- This design is called Von Neumann Architecture.

3. Internal Buses (Wires for Communication Inside Computer)

- Buses are like roads for data inside the computer.

  - Address Bus: Tells where to send or get data from memory.

  - Data Bus: Carries the actual data.

  - Control Bus: Sends signals like "read" or "write".

- More bits in a bus = more power and speed.

4. RAM Logical Structure (How RAM is Organized)

- RAM stores data temporarily when your computer is running.

- It is made of cells. Each cell has a unique address.

- RAM is accessed in blocks. Size of blocks depends on system (32-bit or 64-bit).

- When power is off, RAM is cleared.

5. 32-bit vs 64-bit Systems (How Big Data Can Be)

- 32-bit means CPU can handle 32 bits of data at once.

- 64-bit means CPU can handle 64 bits of data at once.

- 64-bit systems can use more RAM and are faster for heavy tasks.

- Most modern computers are 64-bit now.

| Feature | 32-bit | 64-bit |

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COAL Notes - Day 1 (Simple English)

| Register size | 32 bits | 64 bits |

| Max RAM | Around 4 GB | Very large (TBs) |

| Used in | Old systems | New systems, laptops |

| Word size | 4 bytes | 8 bytes |