Computer System Architecture & OS Performance – Part II

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Lesson Plan

- Introduction
- Random Access Memory (RAM)
- RAM Types
- Memory Packaging
- Role of RAM in Computer Performance
- Role of Storage Capacity in Computer Performance
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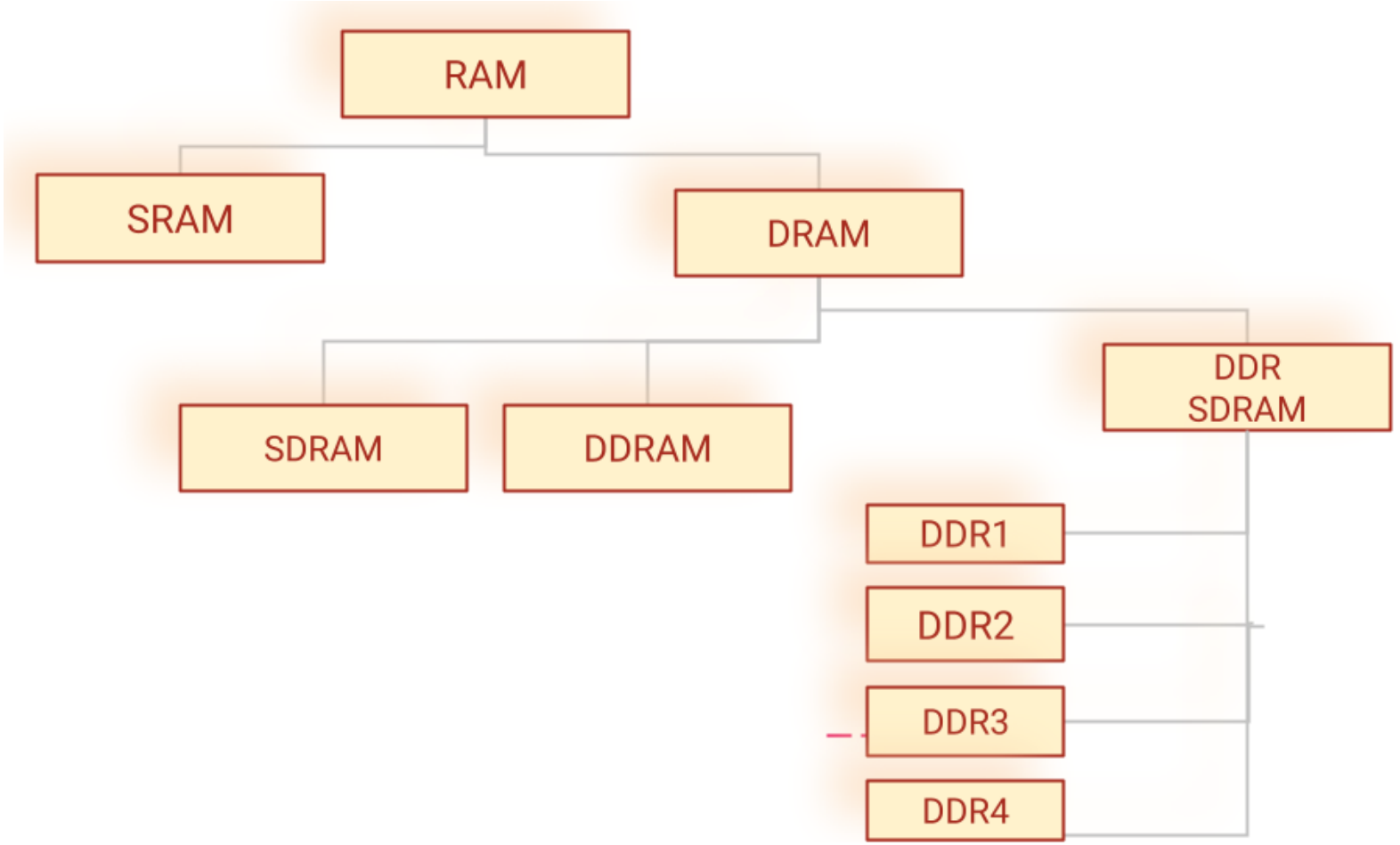
Introduction

- When the computer boots, parts of the operating system and drivers are loaded into memory, which allows the CPU to process instructions faster and speed up the boot process.
- After the operating system is loaded, programs opened by the user are also loaded into memory. If too many programs are open, the computer swaps the data in the memory between the RAM and the hard disk drive.
- A computer's performance is largely attributed to the amount of memory contained within it. If a computer does not have the recommended memory to run the operating system and its programs, it results in slower performance. The more memory a computer has, the more information and software it can load and process quickly.

Random Access Memory (RAM)

- RAM is the internal memory of the computer for storing data, programs, and program results.
- RAM is volatile. Data stored in it is lost when we switch off the computer or if there is a power failure.
- There are two main types of RAM
  - SRAM (Static RAM)
  - DRAM (Dynamic RAM)

RAM Types



RAM Types Cont.

- **SRAM (Static RAM)**

SRAM is made up of four to six transistors. It keeps data in the memory as long as power is supplied to the system unlike DRAM, which has to be refreshed periodically.

- **DRAM (Dynamic RAM)**

DRAM allows to storage of each bit of data in a separate capacitor within a specific integrated circuit. DRAM needs to be refreshed with voltage regularly. Else it loses the information stored on it.

RAM Types Cont.

SRAM	DRAM
The access time of SRAM is low.	The access time of DRAM is high.
It uses flip-flops to store each bit of information.	It uses a capacitor to store each bit of information.
It does not require periodic refreshing to preserve the information.	It requires periodic refreshing to preserve the information.
The cost of SRAM is high.	The cost of DRAM is less.
It has a complex structure.	Its structure is simple.
It requires low power consumption.	It requires more power consumption.

RAM Types Cont.

Types of DRAM

- **Synchronous DRAM (SDRAM)**

Synchronises the memory speed with CPU clock speed so that the memory controller knows the exact clock cycle when the requested data will be ready. This allows the CPU to perform more instructions at a given time. Typical SDRAM transfers data at speeds up to 133 MHz.

- **Rambus DRAM (RDRAM)**

It was popular in the early 2000s and was mainly used for video game devices and graphics cards, with transfer speeds up to 1 GHz.

RAM Types Cont.

Types of DRAM

- **Double Data Rate SDRAM (DDR SDRAM)**

DDR SDRAM is a type of synchronous memory that nearly doubles the bandwidth of a Single Data Rate (SDR) SDRAM running at the same clock frequency by employing a method called "double pumping," which allows the transfer of data on both the rising and falling edges of the clock signal without any increase in clock frequency.

DDR1 SDRAM has been succeeded by **DDR2, DDR3**, and most recently, **DDR4 SDRAM**. Although operating on the same principles, the modules are not backward-compatible. Each generation delivers higher transfer rates and faster performance.

Memory Packaging

Memory is available in various physical packaging.

- **Single In-Line Memory Module (SIMM)**

These modules were widely used from the late 1980s to the 1990s and are now obsolete.

- **Dual In-Line Memory Module (DIMM)**

Current memory modules come in DIMMs. "Dual in-line" refers to pins on both sides of the modules. A DIMM originally had a 168-pin connector supporting a 64-bit data bus, which is twice the data width of SIMMs. The wider bus means that more data can pass through a DIMM, translating to faster overall performance. Latest DIMMs based on fourth-generation Double Data Rate (DDR4) SDRAM have 288-pin connectors for increased data throughput.

Role of RAM in Computer Performance

- Larger RAM space translates to more computing power.
- PC can benefit from adding more RAM.
- With increased RAM, the apps can function properly without competing for workspace. The Operating System (OS) no longer needs to perform increased code and data swapping between the resource access memory and the hard drive. Swapping is a common cause of poor processing performance.
- Increased RAM enhances the ability to multitask using resource-intensive apps.
- RAM has two main attributes that affect the computer's performance.
  - Memory Capacity
  - Memory Speed

Role of RAM in Computer Performance Cont.

Memory Capacity

- The number of GBs a memory module has can increase the programs that can run simultaneously.
- But before upgrading the RAM, a user must ensure that the operating system will support the new amount of memory.
- The capacity of memory a computer can have depends on the motherboard installed in the computer and the operating system.
- Most motherboards will support either two or four memory modules, but the type and amount of memory can differ widely from one motherboard to another.

Role of RAM in Computer Performance Cont.

Memory Capacity Cont.

- Capacity of the RAM of a computer can hold depends on the running version of the operating system, which depends on the CPU.
- Most of the 32-bit Windows and Linux / Unix operating systems supports up to 4 GB of memory.
- 64-bit systems support up to 128 GB.
- Also, Windows 10 Pro, Education, and Enterprise allow as much as 2 TB.

Role of RAM in Computer Performance Cont.

Memory Speed

- The amount of time that RAM takes to receive a request from the processor and then read or write data. The faster the RAM, the faster the processing speed.
- Faster RAM increases the speed at which memory transfers information to other components which makes the computer much more efficient.
- RAM speed is measured in Megahertz (MHz), millions of cycles per second so that it can be compared to the processor's clock speed.
- The speed of the processor and the bus speed of the computer motherboard is the limiting factors on the speed of RAM installed in the computer.

Role of Secondary Storage in Computer Performance

- Secondary storage or secondary memory is a type of computer memory that is used to store data and programs that can be accessed or retrieved even after the computer is turned off.
- Secondary memory is non-volatile and can store data and programs for extended periods of time.
- Secondary memory plays an important role in modern computing systems and is essential for storing large amounts of data and programs.
- The size of the hard drive installed in a computer is measured in Gigabytes (GB) and Terabytes (TB).

Role of Secondary Storage in Computer Performance Cont.

- Disk or storage space affects the overall performance of a computer system. It stores the Operating System and other files that a computer and its users need.
- The more space on a disk, the faster the performance of the disk. Specifically, the read/write speed of a disk is affected by how much free space it has.
- Also, the free space on a computer's disk affects the speed of booting and how fast it can open applications.

Role of Secondary Storage in Computer Performance Cont.

- As we continue to store files on a drive, the used space grows toward the maximum capacity.
- Hard drive starts splitting files and storing them wherever it can once it's running low on space. This results in low performance since scattered files must all be read from their locations before using them.
- When the disk runs out of storage space, it won't be able to store more files. In addition, the computer will boot slower, open programs slower, and an overall slowdown will set in.
- In extreme situations, if the disk partition where the OS is installed becomes full, the OS may not boot.

Role of Secondary Storage in Computer Performance Cont.

- Temporary files affect both used space and free space on a drive. When uninstalling an application from the computer, it leaves behind some junk files. Also, temporary files and cookies from web browsers gather over time.
- These files may be hiding in different directories for a long time. Some temporary files may need third-party applications to scan and remove them.
- Therefore, as long as these files remain undetected, they keep affecting the available space on a storage drive.

Role of Secondary Storage in Computer Performance Cont.

- Normally, 15% to 20% free space should be enough for a hard disk drive. That should be enough to prevent any significant slowdown in the operation of the computer.
- Following actions can help to release more disk space on the computer.
  - Uninstall applications that are no longer in use
  - Delete or backup unnecessary files
  - Occasionally empty the computer's recycle bin
  - Scan and clean temporary files, cached data, and browser cookies

Q&A

- Time for your questions and queries ...

Activity

- Discuss about secondary storage devices and their classification.

Thank you!