SNS COLLEGE OF ENGINEERING

(Autonomous)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Computer Organization and Architecture

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Computer Architecture

Computer architecture refers to the design and structure of a computer system at a high level, focusing on the way various hardware components are interconnected and how they interact to perform tasks.

•**Concerns:** Computer architecture deals with designing the overall system's layout, including the CPU, memory, buses, input/output devices, and their interconnections.

•**Focus:** It is concerned with the high-level structure of the computer, including the instruction set architecture (ISA), which defines the set of instructions that the CPU can execute.

Computer Organization

1.Computer Organization: Computer organization refers to the way the various hardware components of a computer system are arranged and interact to perform specific tasks. It deals with the low-level design aspects, such as how data is stored, accessed, and manipulated within the computer system. It focuses on the internal details of the hardware components and their interactions, including:

- **Memory Organization**: How memory is organized, accessed, and managed within the system.
- **Instruction Set Architecture (ISA)**: The set of instructions that a computer's CPU can execute, including the format of those instructions and the operations they perform.
- **Data Path**: The path that data takes through the various functional units of the CPU, including the arithmetic logic unit (ALU) and registers.
- **Control Unit**: The component responsible for coordinating the execution of instructions, fetching them from memory, and controlling the data flow within the CPU.

How Computers work

1. **Input**: Users provide data and instructions to the computer through input devices like keyboards, mice, and touchscreens. This input is converted into a format that the computer can process.
2. **Processing**: The Central Processing Unit (CPU) is the "brain" of the computer. It executes instructions stored in memory. The CPU consists of an Arithmetic Logic Unit (ALU) for performing calculations and logical operations, and a Control Unit (CU) that coordinates and manages the execution of instructions.
3. **Memory**: Computers use memory to store data and instructions that the CPU needs to access quickly. The memory hierarchy includes registers (fastest, but smallest storage), cache (small but faster than main memory), and main memory (larger but slower than cache). Secondary storage devices like hard drives and solid-state drives provide larger but slower storage capacity.

How Computers work cont..

4. **Storage**: Data that needs to be preserved even when the computer is turned off is stored on non-volatile storage devices, like hard drives or SSDs. These devices use magnetism or semiconductor technology to store data.
5. **Processing Cycle**: The computer follows a sequence of steps known as the "fetch-decode-execute" cycle: - **Fetch**: The CPU fetches the next instruction from memory. - **Decode**: The fetched instruction is decoded to determine what operation needs to be performed. - **Execute**: The CPU performs the operation or task indicated by the instruction. - **Write-back**: If necessary, the results of the operation are stored back in memory or registers.
6. **Binary Representation**: Computers use binary code (0s and 1s) to represent data and instructions. This binary representation is the foundation of all digital computing.
7. **Logic Gates and Circuits**: Computers process information using logic gates, which are electronic circuits that manipulate binary data based on Boolean logic (AND, OR, NOT). These gates are combined to create more complex circuits that perform mathematical operations, comparisons, and other tasks.

How Computers work cont..

8. **Software and Operating Systems**: Software provides the instructions that tell the hardware what to do. Operating systems manage hardware resources and provide a user-friendly interface for users to interact with the computer.
9. **Output**: Once the CPU processes data, the results are sent to output devices like monitors, printers, or speakers. These devices convert the processed data into a format that is understandable to humans.
10. **Clock Speed**: The clock speed of a computer's CPU determines how many instructions it can execute per second. Higher clock speeds generally lead to faster processing, but other factors like the number of cores, cache size, and architecture also impact performance.
11. **Parallel Processing**: Modern computers often have multiple CPU cores that can work in parallel, performing different tasks simultaneously. This increases overall processing speed and efficiency.In essence, computers operate based on the interaction of hardware components that follow well-defined instructions and manipulate binary data.

How does CPU executes the Instruction

The Central Processing Unit (CPU) executes instructions in a computer system through a series of well-defined steps. This process is known as the instruction execution cycle or the fetch-decode-execute cycle. Here's an overview of how the CPU executes instructions:

1.Fetch Phase:

1. The CPU fetches the next instruction from memory. The memory address of the instruction to be fetched is usually stored in a special register called the **Program Counter (PC)**.
2. The PC points to the memory address of the next instruction to be fetched. After fetching the instruction, the PC is incremented to point to the next instruction in memory.

2.Decode Phase:

1. The fetched instruction is decoded to determine what operation needs to be performed and what operands (data) are involved.
2. The CPU decodes the instruction based on its format and the instruction set architecture (ISA) of the CPU. The ISA defines the format of instructions and the operations they perform.

How does CPU executes the Instruction

4. Execute Phase:

1. The decoded instruction is executed by performing the specified operation on the designated operands.
2. This phase can involve various operations such as arithmetic calculations, logical operations, data movement, and control flow changes.

5. Memory Access (Optional):

1. Some instructions may involve accessing memory to read or write data. In such cases, the CPU performs memory operations, which include reading data from memory or writing data to memory.

6. Write Back Phase (Optional):

1. For instructions that produce a result, the result is written back to the appropriate registers or memory locations.
2. This phase ensures that the changes made by the instruction are properly stored for future use.

How is data transferred between different parts of computer

Data is transferred between different parts of a computer using various communication pathways and protocols. The transfer of data within a computer involves moving information between different hardware components, such as the CPU, memory, storage devices, input/output (I/O) devices, and various buses or channels that facilitate communication.

1.Memory Hierarchy:

1. Data is transferred between different levels of memory hierarchy, including registers, cache memory, main memory (RAM), and storage devices like hard drives or solid-state drives (SSDs).
2. The CPU interacts with these different levels of memory to access and manipulate data. Data transfer is managed through specific memory addressing mechanisms.

How is data transferred between different parts of computer

1.Data Bus:

1. The data bus is a communication pathway that connects the CPU, memory, and other devices like I/O controllers. It's used for transferring data between these components.
2. The width of the data bus (number of lines) determines how much data can be transferred simultaneously. For example, a 64-bit data bus can transfer 64 bits (8 bytes) of data at a time.

2.Address Bus:

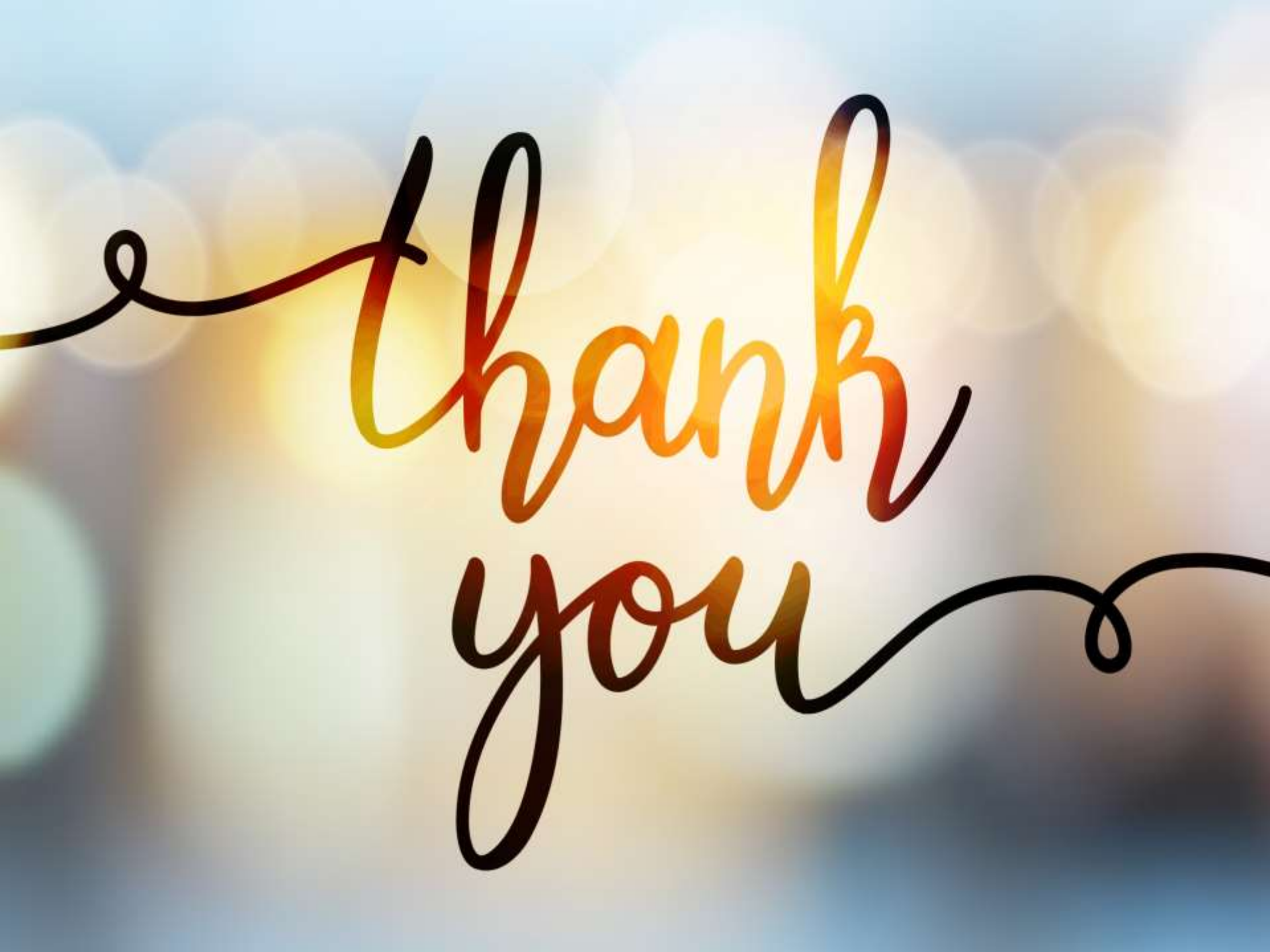
1. The address bus is another pathway that carries memory addresses from the CPU to memory and I/O devices. It's used to specify the location from or to which data needs to be transferred.
2. The width of the address bus determines the maximum addressable memory space. A wider address bus allows access to a larger memory range.

3.Control Signals:

1. Alongside data and addresses, control signals are used to coordinate data transfers and operations. These signals include read, write, enable, and various synchronization signals.

Assessment

1. Difference between Computer Architecture and Organization.
2. List the three types of Busses.
3. What are the different types of Memory.
4. Define ISA.
4. Define DataPath.


thank
you