Computer Organization and Assembly Language

Lecture #04 COAL

Program: BSCS

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Computer Architecture

- Architecture describes what the computer does.
- Deals with functional behavior of computer systems.
- It deals with high-level design issue.
- For designing a computer, its architecture is fixed first.
- Architecture indicates its hardware.
- Design implementation for the various parts of computers.

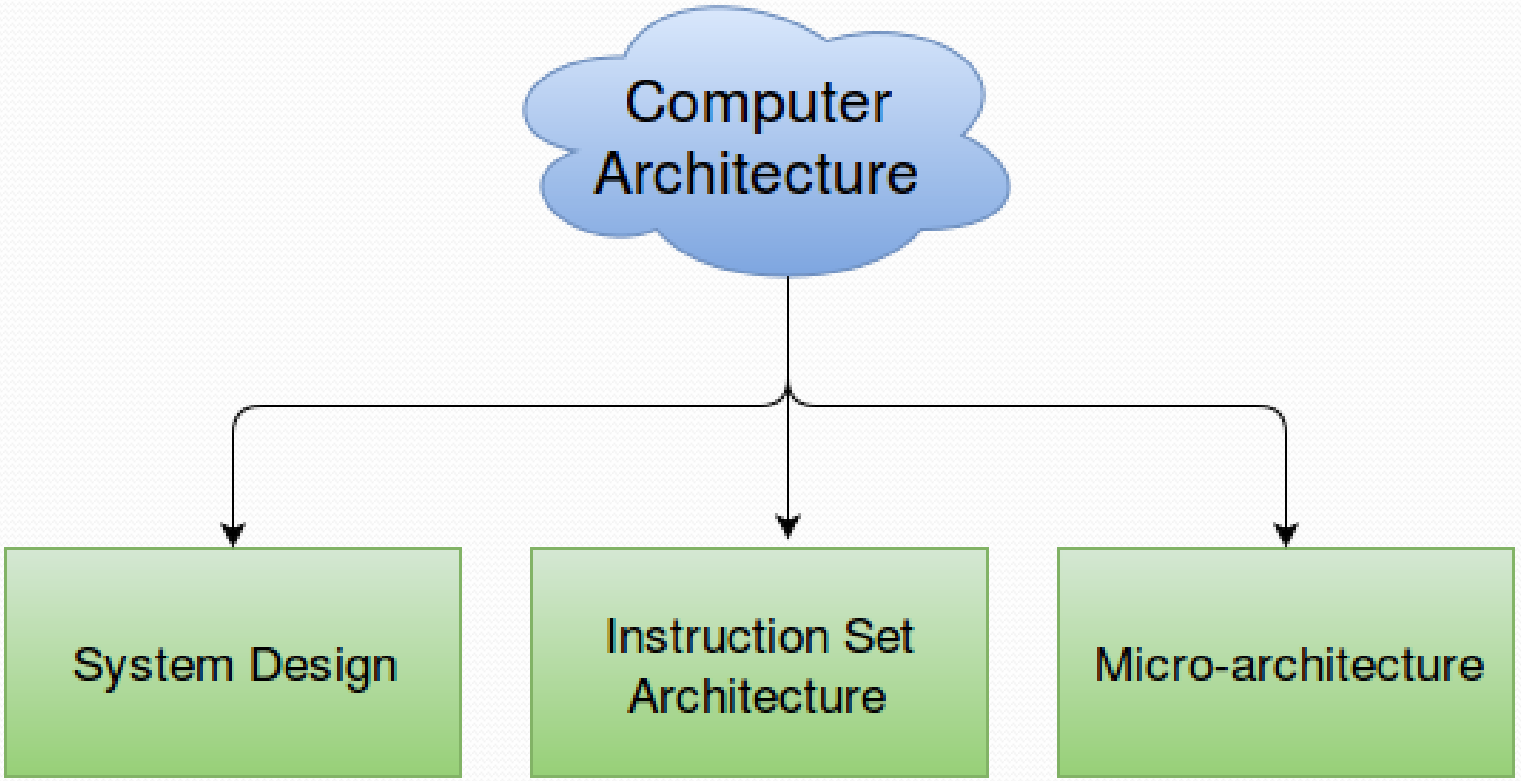
Definition

Computer Organization and Architecture is the study of internal working, structuring, and implementation of a computer system

Computer Organization

- Organization describes how it does it.
- Deals with structural relationship.
- It deals with low-level design issue (logic & circuits)
- Organization indicates its performance.
- For designing a computer, organization is decided after its architecture.
- Operational attributes are linked together and contribute to realize the architectural specification.

Levels Of Computer Architecture



Levels Of Computer Architecture

Level 01:

System Design

System design is the process of defining the elements of a system such as the architecture, modules and components, the different interfaces of those components and the data that goes through that system.

The **goal** of system design is to allocate the requirements of a large system to hardware and software components. The system design activity starts after the system requirements analysis has been completed.

Level 02:

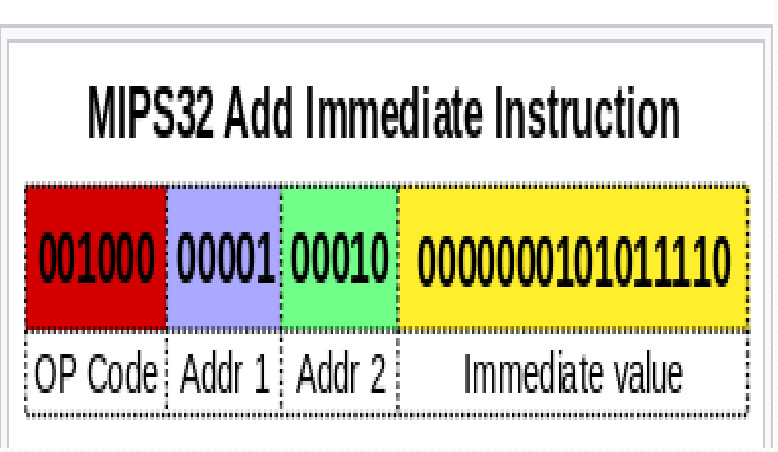
Instruction Set Architecture (ISA):

This is the embedded programming language of the central processing unit. It defines the **CPU's functions** and **capabilities** based on what programming it can perform or process. This includes the word size, **processor register types,** memory addressing modes, data formats and the instruction set that programmers use.

Software

ISA

Hardware



Level 03:

Microarchitecture:

This type of architecture defines the data paths, data processing and storage elements, as well as how they should be implemented in the ISA.

Von Neumann Architecture

- Von Neumann architecture was first published by John von Neumann in 1945.
- His computer architecture design consists of a Control Unit, Arithmetic and Logic Unit (ALU), Memory Unit, Registers and Inputs/Outputs.
- It is based on the stored-program computer concept, where instruction data and program data are stored in the same memory. This design is still used in most computers produced today

CPU

itself has following three components.

Memory or Storage Unit

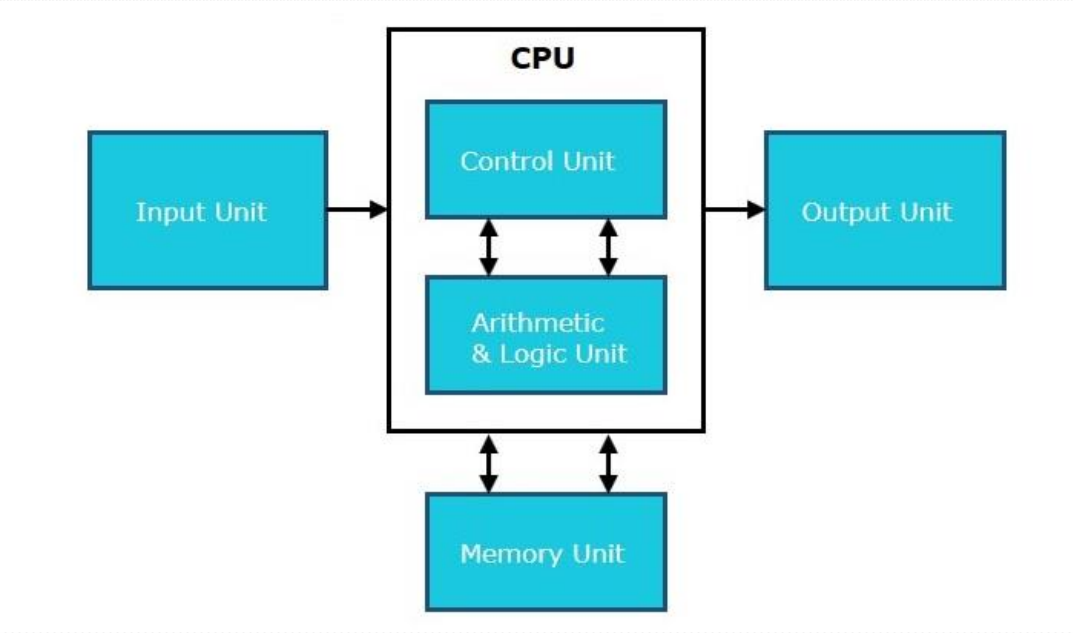
which store both data & instruction

Control Unit

The control unit of the central processing unit regulates and integrates the operations of the computer. It selects and retrieves instructions from the main memory in proper sequence and interprets them so as to activate the other functional elements of the system at the appropriate moment

ALU(Arithmetic Logic Unit)

capable of operating a binary data.



Memory

- It stores all the data and the instructions required for processing.
- It stores intermediate results of processing.
- It stores the final results of processing before these results are released to an output device.
- All inputs and outputs are transmitted through the main memory.

Control Unit

- It obtains the instructions from the memory, interprets them, and directs the operation of the computer.
- It communicates with Input/output devices for transfer of data or results from storage.
- It does not process or store data.

ALU (Arithmetic Logic Unit)

This unit consists of two subsections namely,

- Arithmetic Section (addition, subtraction, multiplication, and division)
- Logic Section (perform logic operations such as comparing, selecting, matching, and merging of data)

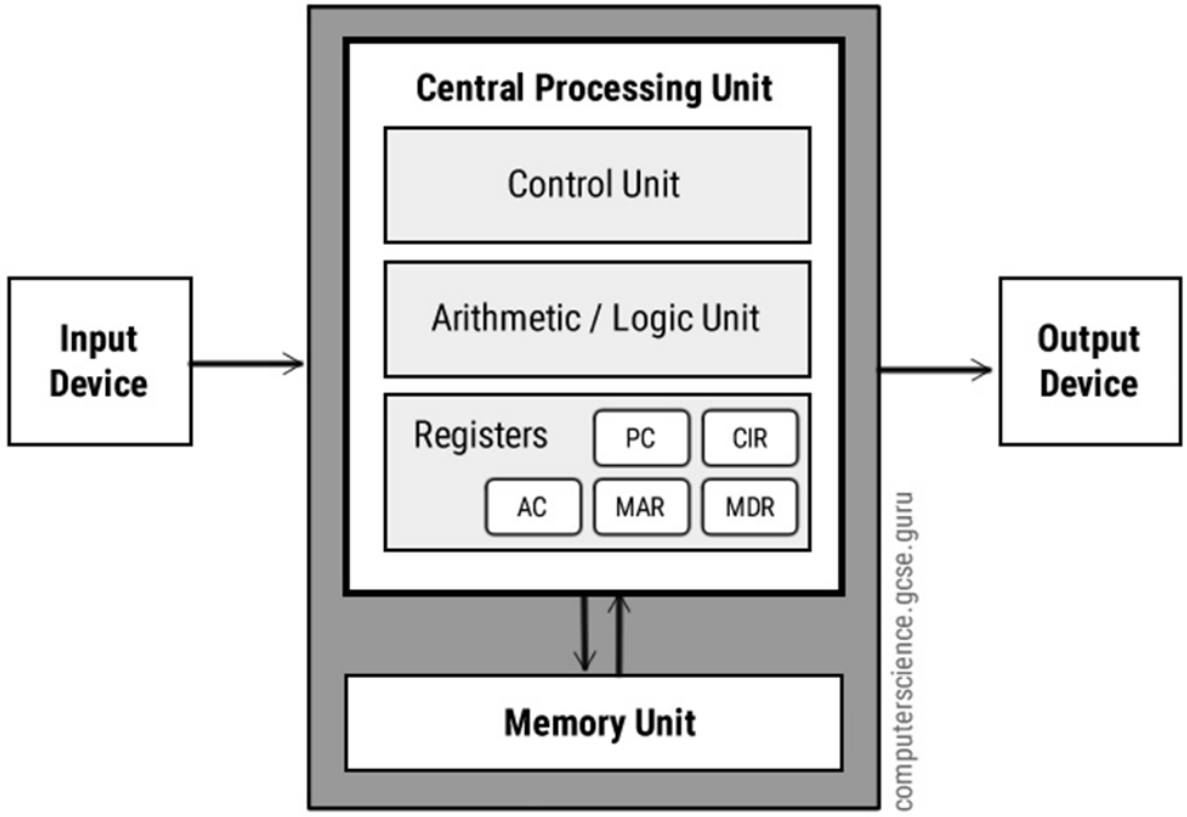
MAR: Memory Address Register --> Hold the memory location of data.

MDR: Memory Data Register --> Hold data that is being transferred to or from memory.

AC: Accumulator --> arithmetic & logical results are stored.

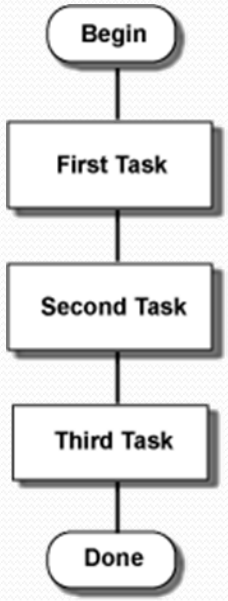
PC: Program Counter --> Instruction to be executed.

CIR: Current Instruction Register --> Contains current instruction during processing



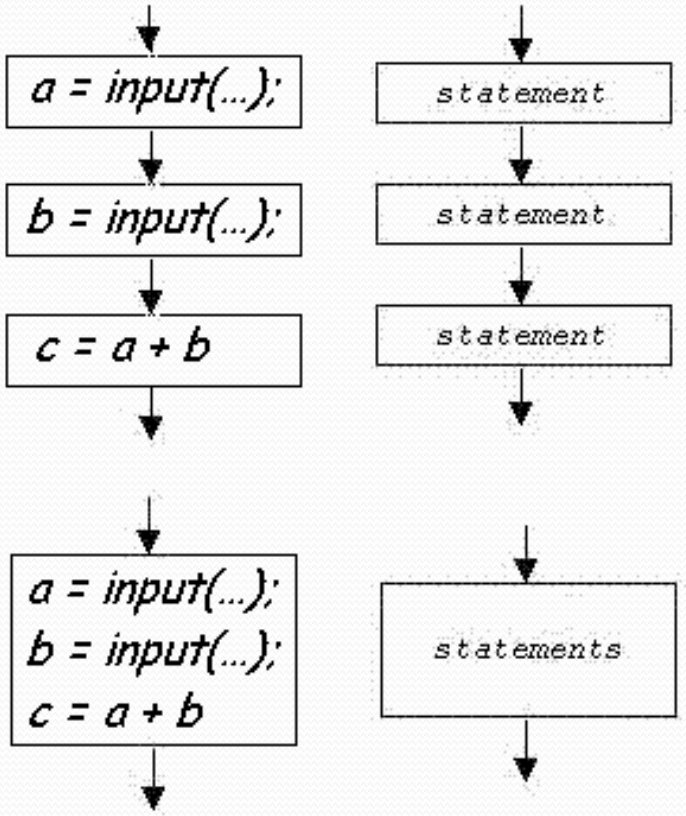
Sequential Execution

A sequence is an ordered list of something. Sequential execution means that each command in a program script executes in the order in which it is listed in the program. The first command in the sequence executes first and when it is complete, the second command executes, and so on.



EXAMPLE:

1. Input the first value and save it as sum.
2. Input the second value and save it as nextValue.
3. Add nextValue to sum.
4. Input the third value and save it as nextValue.
5. Add nextValue to sum.
6. Divide sum by three and save the result as avg.
7. Display the average to the user.



Storing information in binary

- All information stored in a computer must somehow be encoded as a sequence of 0's and 1's, because all storage devices consist of a set of locations that can have one of two possible states. One state represents 0, the other state represents 1.

Introducing binary

- Binary is a base-2 number system, which only uses two digits (0 & 1). It is a system used at the heart of every digital computer, allowing them to encode information, perform arithmetic operations and execute logical control processes.

Bits and binary

- Computers use **binary** - the digits 0 and 1 - to store data. A binary digit, or **bit**, is the smallest unit of data in computing. It is represented by a 0 or a 1. **Binary numbers are made up of binary digits (bits)**, eg the binary number **1001**.
- The circuits in a computer's processor are made up of billions of **transistors**. A transistor is a tiny switch that is activated by the electronic signals it receives. **The digits 1 and 0 used in binary reflect the on and off states of a transistor**.

- Computer programs are sets of instructions. Each instruction is translated into **machine code** - simple binary codes that activate the **CPU**. Programmers write computer code and this is converted by a **translator** into binary instructions that the processor can **execute**.
- All **software**, music, documents, and any other information that is processed by a computer, is also stored using binary.


Thank
you !!!