Lecture 1 - Introduction

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Lecture Outline

- Objective of the course
- Defining Computer Organization and Computer Architecture
- Computer System Structure and Function

Course Objective

Improvement in computer technology in terms of computational power, storage and cost is mainly due to :

- advances in the technology used to build computers
- innovation in computer design

Our objective in this course would be:

- To touch upon both architectural and organizational attributes of a computer system
- Learn how these attributes contribute to build a complete computer system
- We will determine the attributes which are important for a new machine, and then design a machine to maximize performance while staying within cost

Course Objectives

The course aims at exploring the knowledge of hardware support that facilitates efficient computing. The central ideas dicussed are :

- Components of computer system - memory, datapath, control, input, and output
- Data - integers, floating point, characters, bitstream. The actual values and use of data are determined by the program (software) running on the computer.
- Stored program (Von Neuman) model - instructions and data are stored in memory. They can be accessed randomly or sequentially, and can be input or output (read or written in and out, respectively) to increase memory utilization.

Course Objectives

- Design of a computer system - integrating the components to buid a complete system
- Cache for performance enhancement - The phenomenon of locality supports scheduling and prediction of memory accesses, which enables devices like caches to work efficiently.
- Pipeline and Parallelism
- Performance of the computer system

Computer Architecture

- Parameters of a computer system that are visible to a programmer, and that have a direct impact on the logical execution of a program.
- Examples : architectural attributes - instruction set, IO mechanisms, and techniques for addressing memory.

Computer Organization

- Operational units and their interconnections that realize the architectural specifications.
- Examples : organizational attributes - hardware details transparent to the programmer, such as control signals, interfaces between the computer and peripherals, and the memory technology used.

Computer System

The computer system is described as a hierarchic system.
A hierarchic system is a set of interrelated subsystems, each of latter, in turn, hierarchic in structure until we reach some lowest level of elementary subsystem.

- The designer need only deal with a particular level of the system at a time.
- At each level, system consists of set of components and their interrelations.
- The behaviour at each stage depends on a simpified, abstracted characterization of the system at next lower level.
- At each level, the designer is concerned with structure and function

Computer Abstraction

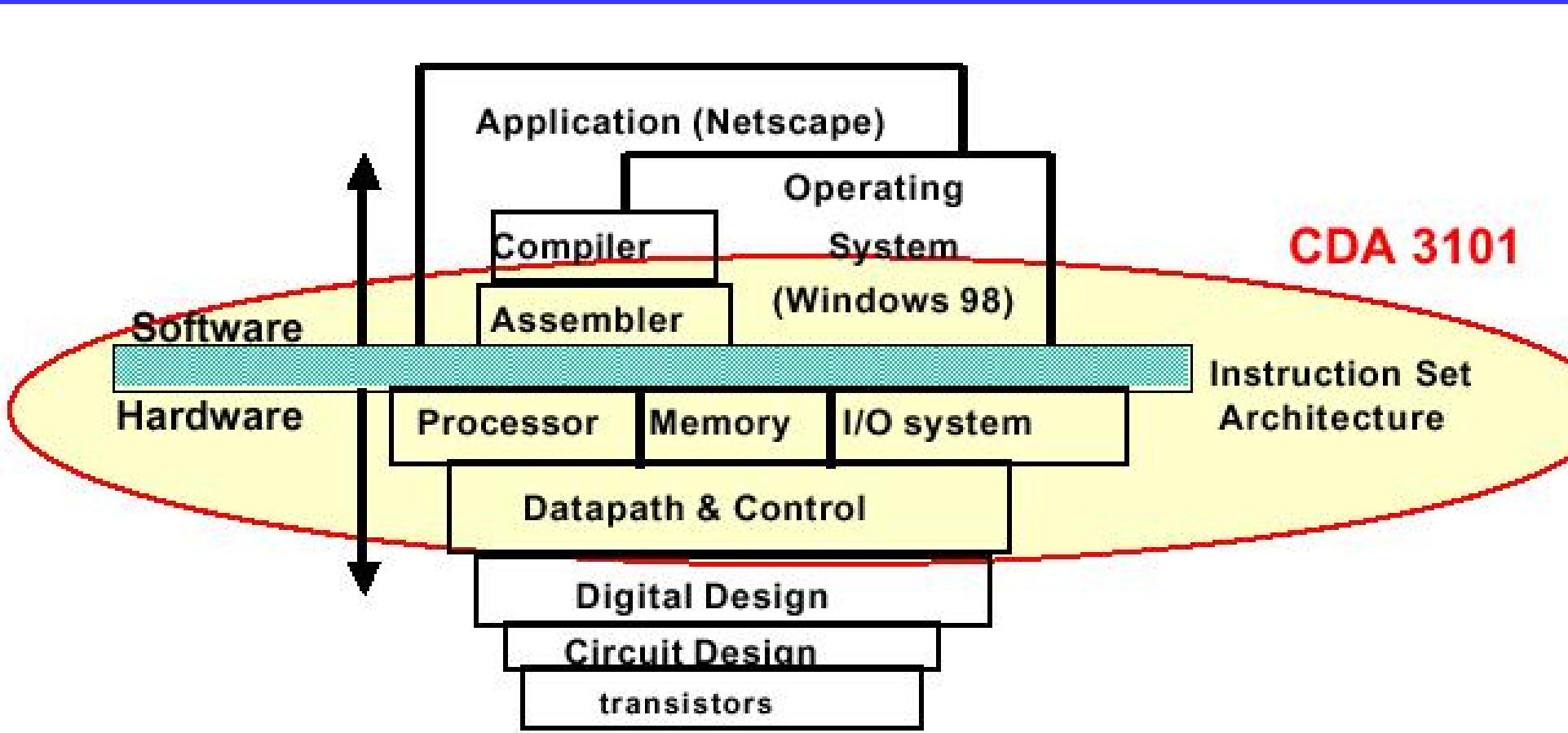


Figure : Levels of abstraction in computer system

Computer Abstraction

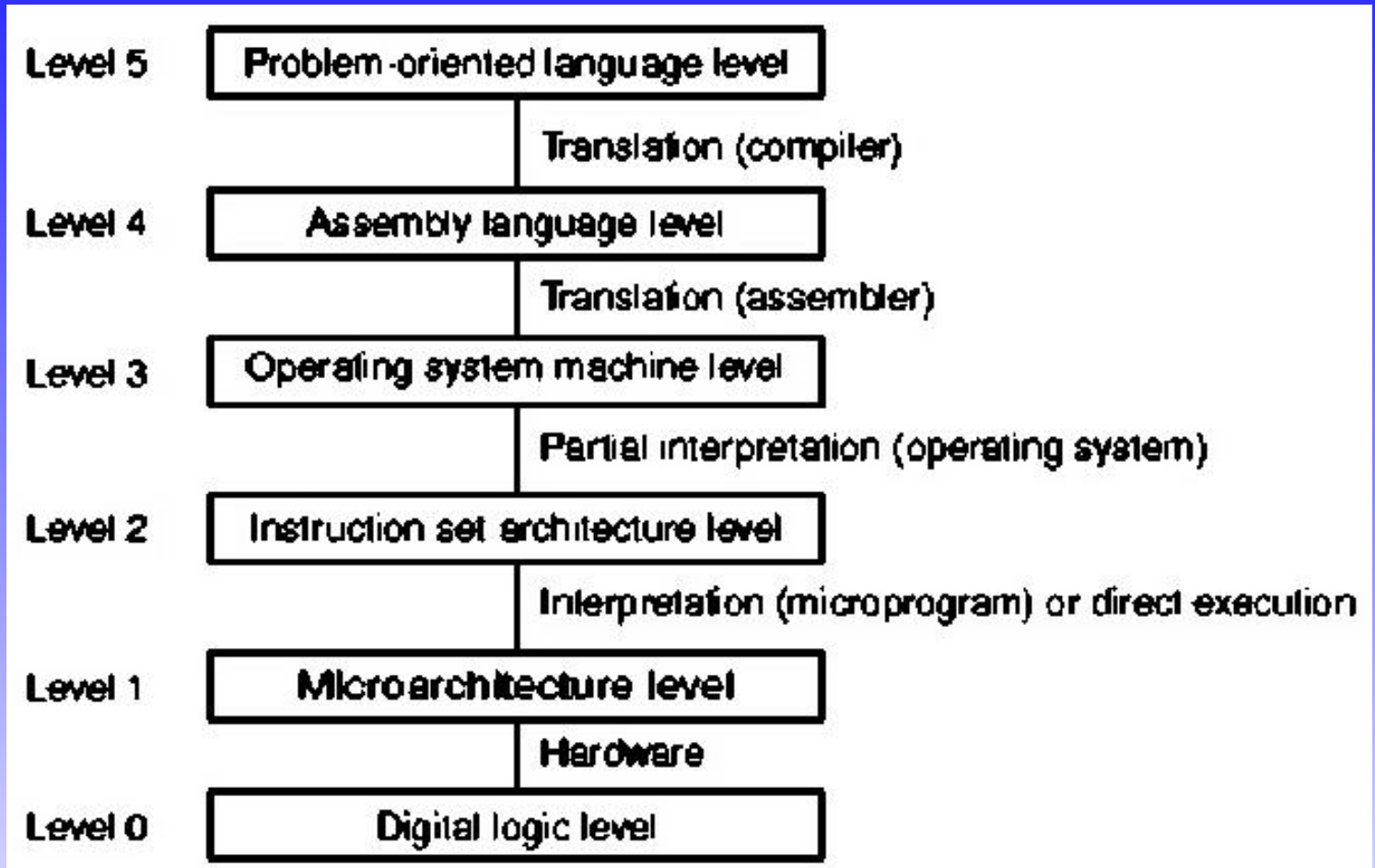


Figure : Another view of Levels of abstraction in computer system

Computer Abstraction

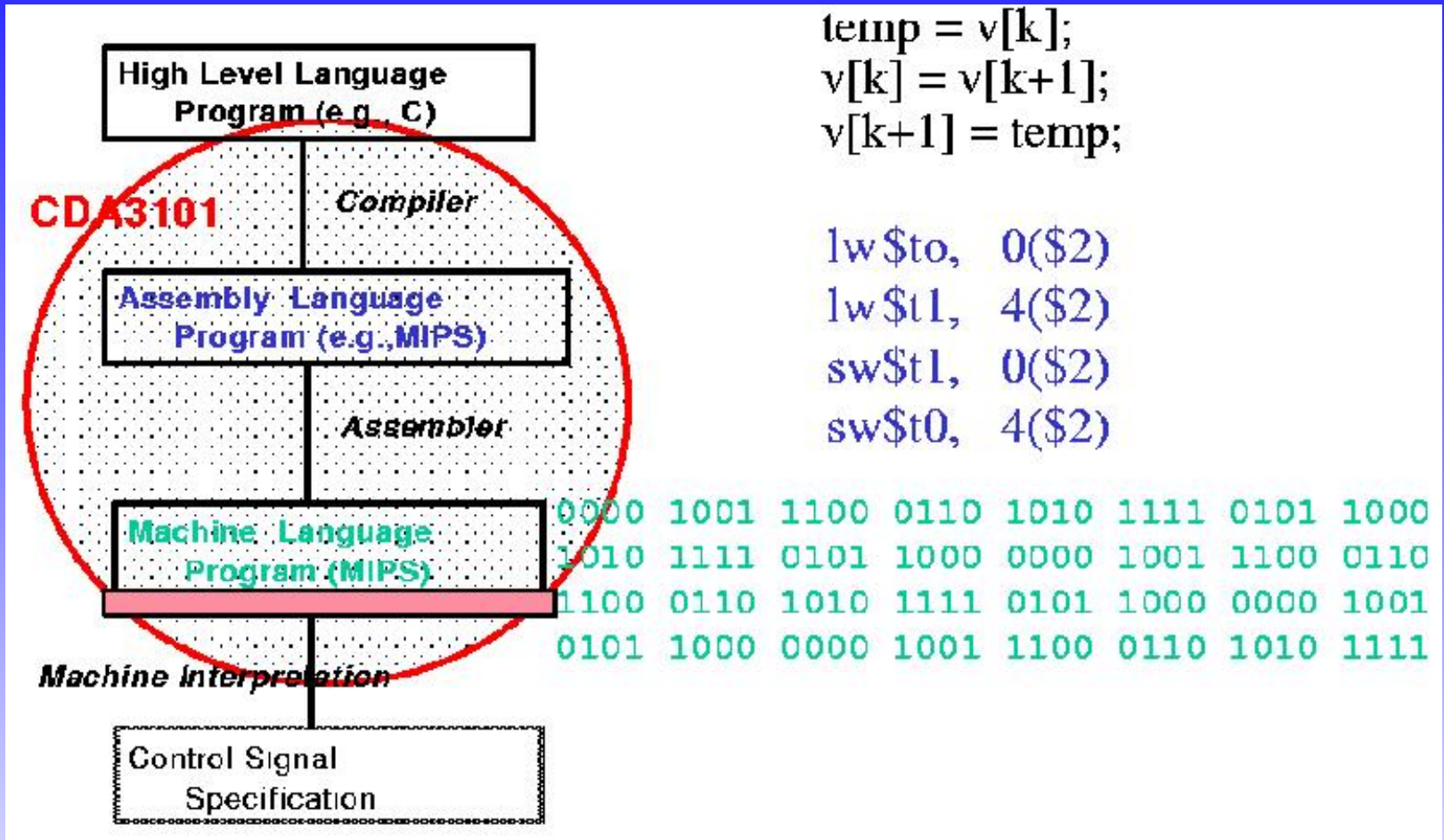


Figure : Another view of Levels of abstraction in computer system

Computer System

- Structure : The way in which components are interrelated
- Functions : The operation of each individual component as part of the structure

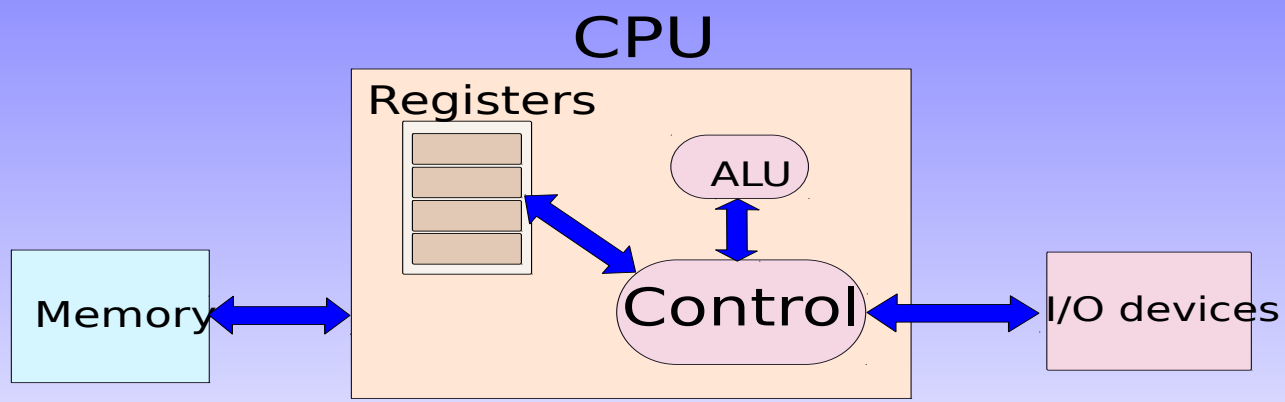
Functions:

- Data Processing
- Data Storage
- Data Movement
- Control

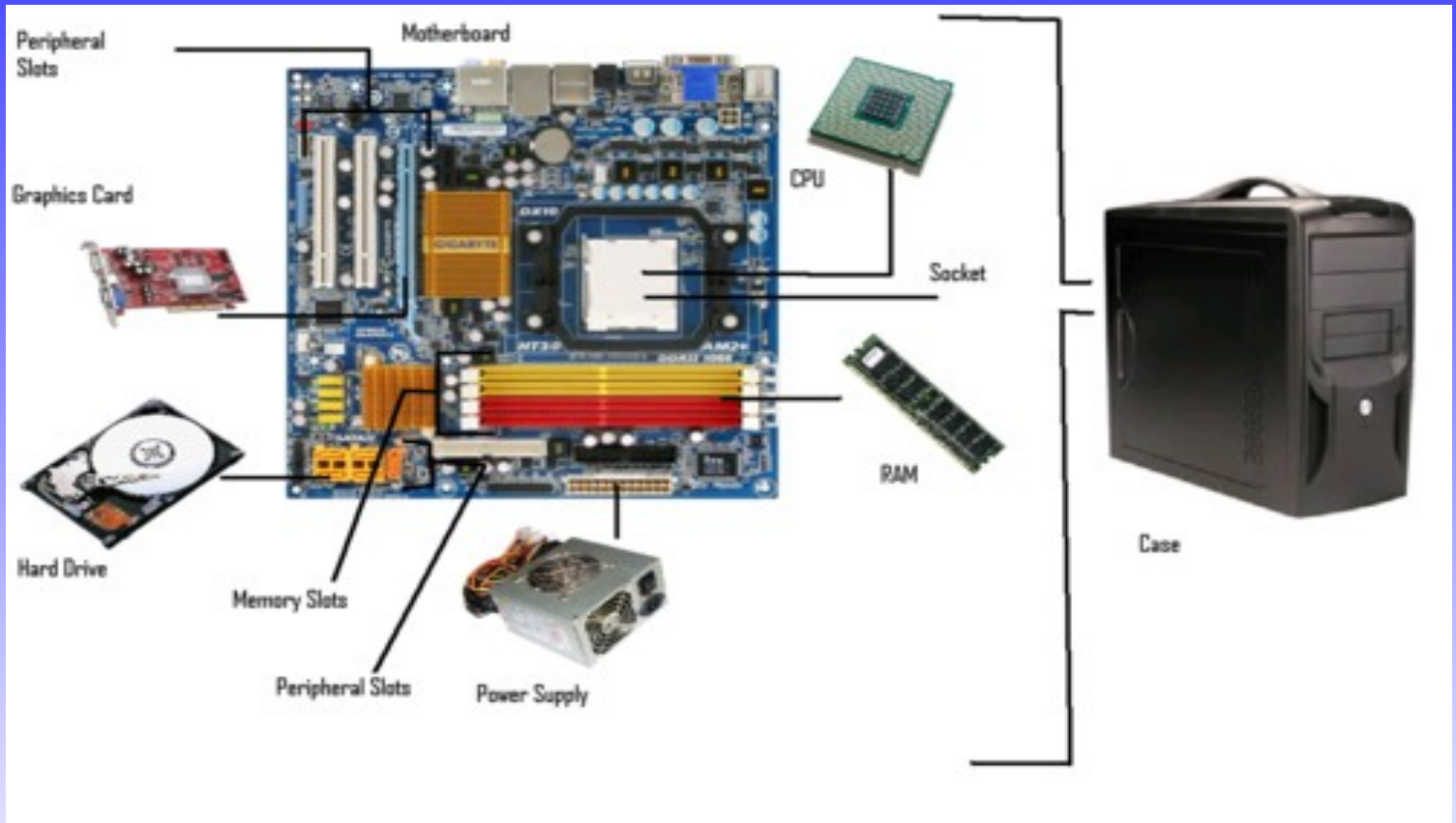
Computer System Structure

The model of a computer can be described by four basic units in high level abstraction. These are:

- Central Processing Unit
- Input Unit
- Output Unit
- Memory



Computer System Structure



Computer System

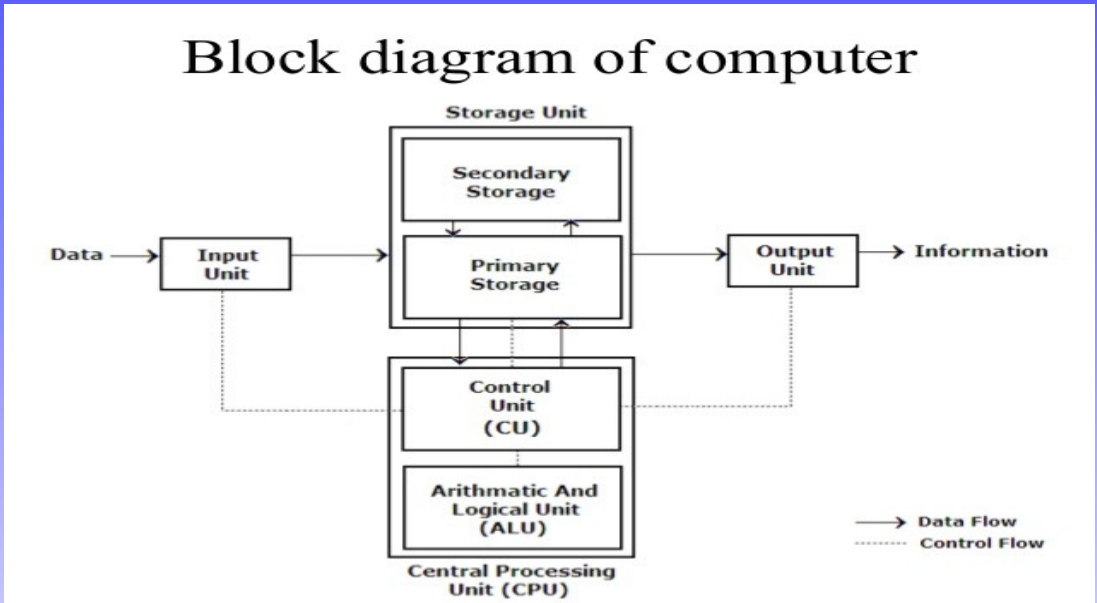
Central Processor Unit (CPU) :

Basic blocks of CPU

- The program control unit has a set of registers and control circuit to generate control signals.
- The execution unit or data processing unit contains a set of registers for storing data and an Arithmetic and Logic Unit (ALU) for execution of arithmetic and logical operations.
- In addition, CPU may have some additional registers for temporary storage of data.

Computer System

Central Processor Unit (CPU) :



Computer System

Input Unit

With the help of input unit data from outside can be supplied to the computer. Program or data is read into main storage from input device or secondary storage under the control of CPU input instruction.

Computer System

Output Unit

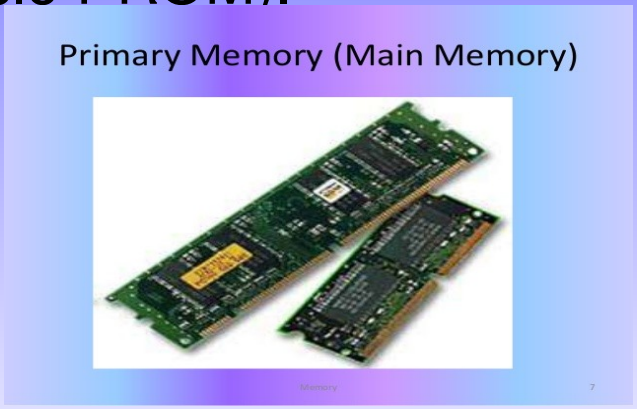
With the help of output unit computer results can be provided to the user or it can be stored in storage device permanently for future use. Output data from main storage go to output device under the control of CPU output instructions.

Computer System

Primary Memory

Memory unit is used to store the data and program. CPU can work with the information stored in memory unit. This memory unit is termed as primary memory or main memory module. These are basically semi conductor memories.

- Volatile Memory : RAM (Random Access Memory).
- Non-Volatile Memory : ROM (Read only Memory), PROM (Programmable ROM) EPROM (Erasable PROM), EEPROM (Electrically Erasable PROM).



Computer System

Secondary Memory

Secondary memories are non volatile memory and it is used for permanent storage of data and program. Example of secondary memories: Hard Disk, Floppy Disk, Magenetic Tape, CD-ROM, pen drive

Instructing the Computer

- Write a program in a high level language say in C
- Compile it into a format that the computer understands
- The compiled code is stored in memory
- CPU fetches the compiled code sequentially from memory ito its registers
- executes the code using Arithmetic and Logic Unit on instructions from the Control Unit