

CS8491

COMPUTER ARCHITECTURE

UNIT I

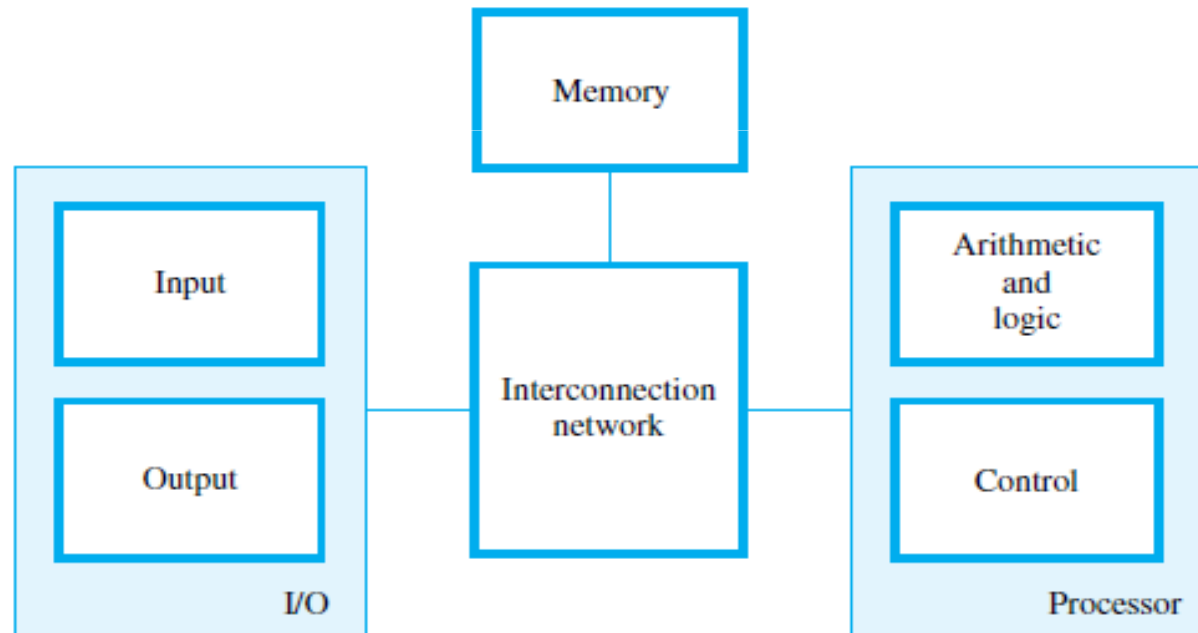
BASIC STRUCTURE OF A COMPUTER SYSTEM

- Syllabus
 - Functional Units – Basic Operational Concepts – Performance
 - Instructions: Language of the Computer – Operations, Operands – Instruction representation – Logical operations – decision making – MIPS Addressing.
- Text Books
 - David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014. - Chapter 2
 - Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012. - Chapter 1

Functional Units

Functional Units

- **Five functional units**
 - Input
 - Memory
 - Arithmetic and logic
 - Output
 - Control units



Basic functional units of a computer.

Functional Units

- **Input unit :**
 - Computers accept coded information through input units
 - Keyboard
 - Whenever a key is pressed, the corresponding letter or digit is automatically translated into its corresponding binary code and transmitted to the processor
 - Touchpad, Mouse, Joystick, Trackball, Microphones, Cameras
 - Digital communication facilities, such as the internet
 - The information received from input unit is stored in the computer's memory, either for later use or to be processed immediately by the arithmetic and logic unit

Functional Units

- **Output unit:**
 - Send processed results to the outside world
 - *Printer*
- **Input-output (I/O) unit**
 - Graphic displays
 - Showing text and graphics as output
 - Through touch-screen capability as input

Functional Units

- **Processor :**
 - ALU and main control circuits
 - Program stored in the memory specify the processing step
 - **Information**
 - ***Program (Instructions)***
 - Group of instructions (program) performs a task
 - Specify the arithmetic and logic operations to be performed (add, sub)
 - govern the transfer of information within computer and between computer and I/O devices (load, store)
 - ***Data***
 - numbers and characters used as operands by the instructions
 - Program and data are stored in the memory
 - Coded using binary coding or Ascii coding

Functional Units

- **Control Unit**
 - Coordinated the operation of all five units
 - Nerve centre
 - Sends control signals to other units and senses their states
 - Generate the *timing signals that govern the transfers and* determine when a given action is to take place

Functional Units

- **Arithmetic and Logic Unit**
 - Most operations are executed in ALU
 - Addition, subtraction, multiplication, division, or comparison of numbers
 - EG:
 - Addition - Two numbers located in the memory are to be added
 - Both numbers are brought into the processor register
 - Addition is carried out by the ALU
 - The sum is then stored in the memory or retained in the processor for immediate use

Functional Units

- **Memory Unit**
 - The function of the memory unit is to store programs and data.
 - Two classes
 - Primary
 - Secondary

Functional Units

- **Primary Memory**

- Main memory
- Fast memory
- Store programs while they are being executed
- Semiconductor storage cells, each capable of storing one bit of information
- Handled in groups of fixed size called words
- One word can be stored or retrieved in one basic operation
- The number of bits in each word is referred to as the word length of the computer, typically 16, 32, or 64 bits
- Distinct address is associated with each word location

Functional Units

- **Primary Memory**
 - Random-access memory (RAM)
 - The time required to access one word is called the memory access time.
 - This time is independent of the location of the word being accessed.
 - It typically ranges from a few nanoseconds (ns)
 - Expensive and does not retain information when power is turned off

Functional Units

- **Cache Memory**
 - Smaller, Faster
 - Contained on the processor chip
 - Hold sections of a program and data that are currently being executed
 - Increase the speed of execution
 - Information in cache
 - At the start of program execution, the cache is empty
 - All program instructions and any required data are stored in the main memory
 - As execution proceeds, instructions are fetched into the processor chip, and a copy of each is placed in the cache
 - If these instructions are available in the cache, they can be fetched quickly during the period of repeated use

Functional Units

- **Secondary Storage**
 - Less expensive
 - Permanent *secondary storage*
 - *Larger Size*
 - Access times for secondary storage are longer than for primary memory.
 - *Magnetic disks, optical disks (DVD and CD), and flash memory*

Functional Units

- **Interconnection network:**
 - provides the means for the functional units to exchange information and coordinate their actions.

Functional Units

- The operation of a computer can be summarized as follows:
 - The computer accepts information in the form of programs and data through an input unit and stores it in the memory
 - Information stored in the memory is fetched under program control into an arithmetic and logic unit, where it is processed
 - Processed information leaves the computer through an output unit
 - All activities in the computer are directed by the control unit