Computer Organization & Architecture (KCS-302)

Unit -1 :- Introduction: Functional units of digital system & their interconnections, buses, bus architecture Types of buses and bus arbitration, Register, bus & memory transfer, Process organization, general Register organization, stack organization and addressing modes

computer organization & Architecture
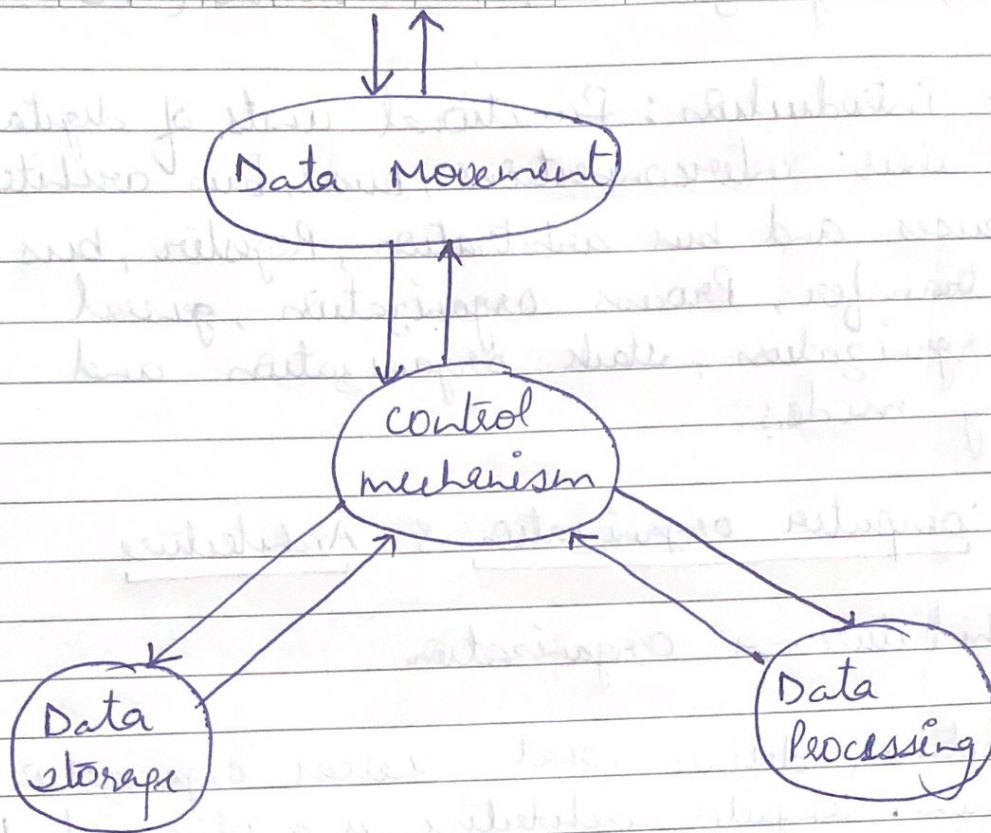
Architecture + Organization

- Architecture defines what whereas organization defines how. computer architecture is a blueprint for design & implementation of computer. Computer organization is how operational parts of a computer system are linked.

Basic functioning of computer :—

Computer
Function   structural
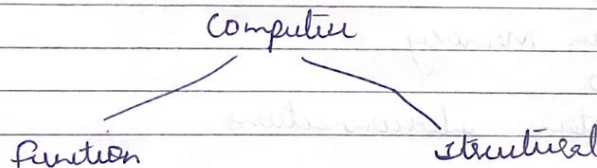
functions of computer :—

① Data Processing
② Data storage
③ Data movement
④ control — control controls above three functions

```
        ┌──────────────────┐
        │  Data Movement   │
        └──────────────────┘
                 ↕
        ┌──────────────────┐
        │     Control      │
        │    mechanism     │
        └──────────────────┘
         ↙              ↘
  ┌──────────┐      ┌──────────┐
  │   Data   │      │   Data   │
  │ storage  │      │Processing│
  └──────────┘      └──────────┘
```

__structural components:__ - There are 4 main structured components:-

- CPU
- Main Memory
- I/O
- system interconnections

- CPU structural components
    - control unit
    - Arithmetic & logic unit
    - Registers
    - CPU interconnections

Computer Architecture	Computer Organization
① describes what the computer does	describes how it does it
② CA deals with functional behaviour of computer system.	CO deals with structural relationship.
③ It deals with high level design issues	It deals with low level design issues
④ Architecture indicates its hardware	4 It indicates its performance
⑤ Also called instruction set architecture	Also called micro-architecture
⑥ comprises logical functions such as instruction sets, registers, data types and addressing modes.	consists of physical units like circuit design, pheripheral & adders
⑦ cordinates b/w the hardware & s/w of the system	handles the segments of n/w in a system.

- eg intel x86 same basic architecture 8086, 80186, 80286

- IBM system/370 share same basic structure
- code compatibility exists backwards
- Pentium & seleron share same architecture b/w different organization.

High level

```
┌─────────────────────────┐
│  Application Program     │
└─────────────────────────┘
            ↕
┌─────────────────────────┐
│  Application Design      │          software
└─────────────────────────┘
            ↕
┌─────────────────────────┐
│  System Design           │
└─────────────────────────┘
            ↕
┌─────────────────────────┐
│  Computer Design         │
└─────────────────────────┘
            ↕
┌─────────────────────────┐
│  logic Design            │          Hardware
└─────────────────────────┘
            ↕
┌─────────────────────────┐
│  circuit Design          │
└─────────────────────────┘
            ↕
┌─────────────────────────┐
│  computer component      │
└─────────────────────────┘
```

computer architecture

computer Organization

low level.

Two basic type of computer architecture :-
    stored program concept was introduced.
  - Von neumann architecture
  - Harward architecture

Von-neumann architecture is also known as Princeton architecture. In von-neumann architecture, a memory is used to store instructions & data. The bottleneck of von-neumann architecture is instruction fetch and a data operation cannot occur at the same time because they share a common bus.

```
              ┌─────┐
              │ CPU │
              └─────┘
                 ↑
┌─────┐          │          ┌────────┐
│ I/P │←─────────┴─────────→│ output │
└─────┘          │          └────────┘
                 ↕
             ┌────────┐
             │ Memory │
             └────────┘
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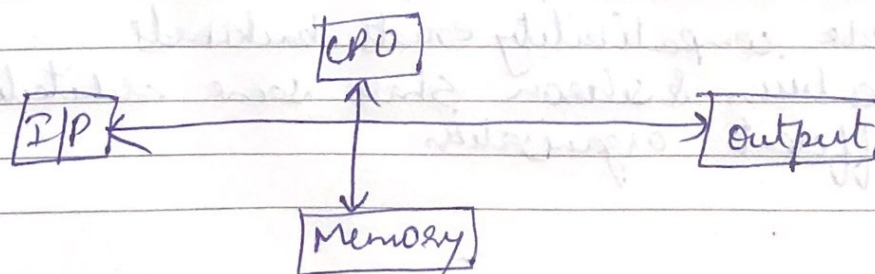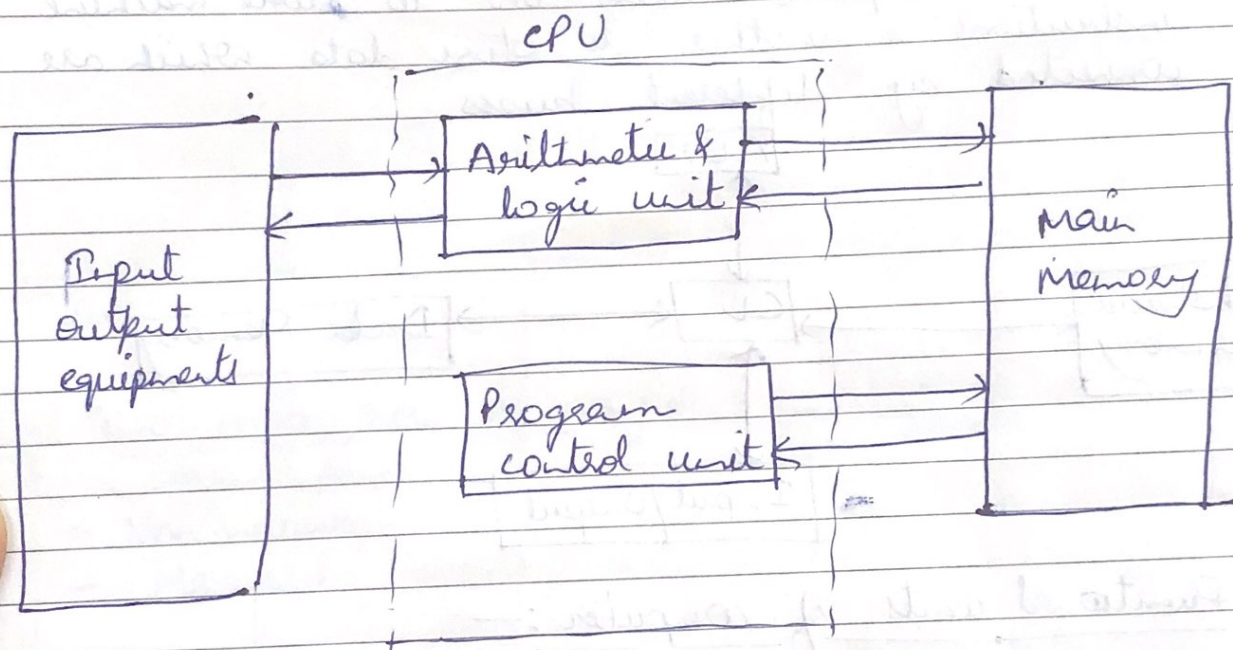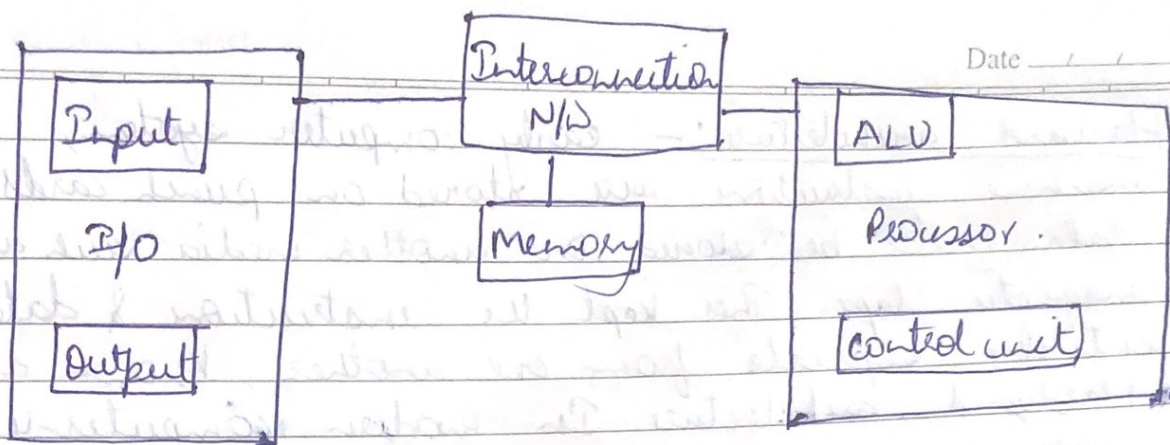
Harward architecture :- early computer systems, machine instructions were stored on punch cards & data could be stored on another media such as magnetic tape. This kept the instruction & data entirely separate from one another, known as Hardward architecture. In modern computer, this approach can be achieved by using a CPU with two separate units one to store machine instructions & another to store data which are connected by different buses.
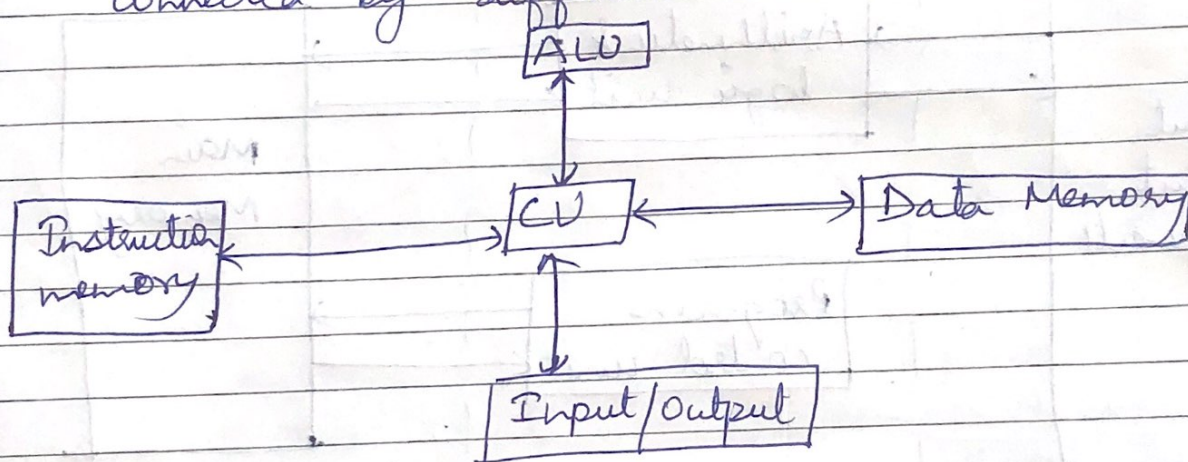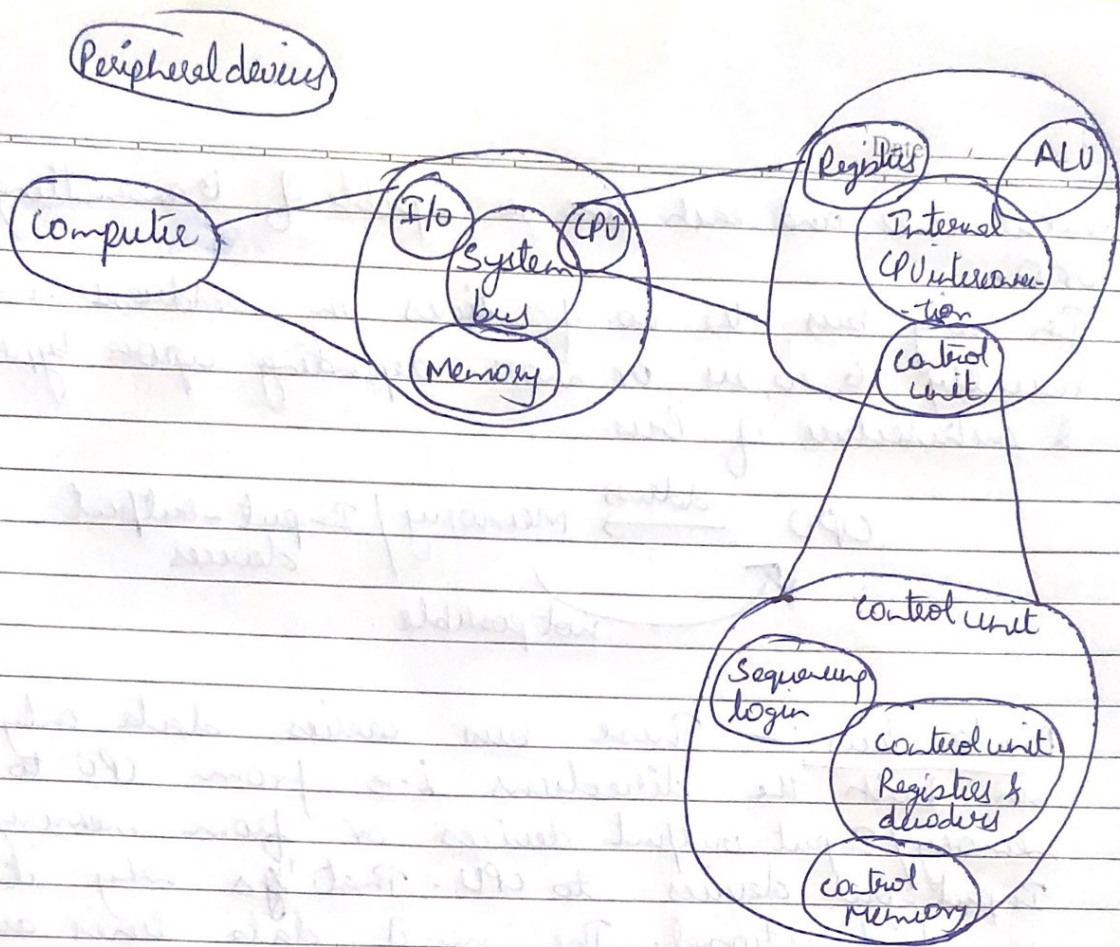

Functional units of computer :-

There are five basic functional units :-

① Input unit
② output unit
③ Processing unit (CPU)
④ Memory to store intermediate results — Primary / Secondary
⑤ Control unit

```
┌─────────────┐      ┌──────────────┐      ┌─────────────┐
│ ┌─────────┐ │      │Interconnection│      │ ┌─────┐     │
│ │ Input   │ │──────│    N/W       │──────│ │ ALU │     │
│ └─────────┘ │      └──────┬───────┘      │ └─────┘     │
│    I/O      │         ┌───┴────┐         │  Processor. │
│             │         │ Memory │         │ ┌──────────┐│
│ ┌─────────┐ │         └────────┘         │ │Control unit││
│ │ Output  │ │                            │ └──────────┘│
│ └─────────┘ │                            └─────────────┘
└─────────────┘
```

CPU

```
┌──────────┐      ┌─────────────────┐      ┌──────────┐
│          │─────→│ Arithmetic &    │─────→│          │
│          │      │ logic unit      │←─────│          │
│          │←─────└─────────────────┘      │  Main    │
│  Input   │                               │  memory  │
│  output  │                               │          │
│equipments│←─────┌─────────────────┐─────→│          │
│          │      │ Program         │      │          │
│          │      │ control unit  ←─│←─────│          │
│          │      └─────────────────┘      └──────────┘
└──────────┘
```

Peripheral devices

Computer — I/O — System bus — CPU — Memory

Internal CPU interconnection — Registers — ALU — Control unit

Control unit — Sequencing logic — Control unit Registers & decoders — Control Memory

Bus: — Bus is a subsystem that is used to transfer data & other information b/w devices. A bus is a communication pathway and is a shared transmission medium. A bus is nothing bt high speed internal connection.

There are 3 types of buses:-

1) **Address Bus:** — carries memory addresses from processor to other components such as primary storage and input/output devices. The address bus is used to enable the device to locate the (MM) Physical address to communicate read/write commands. The address bus is unidirectional.

Typically, a bus consist of multiple lines which are either in the form of wires or

metal lines and each line is capable of transmitting 1 or 0.

In any bus, the no. of lines in address are usually 16, 20, 24 or more depending upon type & architecture of Bus.

CPU $\xrightarrow{\text{address}}$ Memory / Input-output devices

not possible.
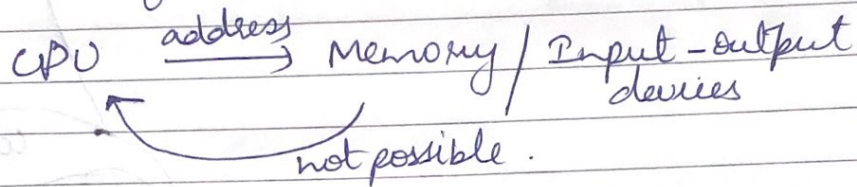
Data bus :— These bus carries data only in both the directions i.e from CPU to memory / Input-output devices or from memory / Input-out devices to CPU. That's why it is bidirectional. The no. of data lines are either 8, 16, 32 or more depending on size of bus.

Control bus :— It is used by CPU to communicate with other devices within the computer. It is unidirectional / bidirectional in nature. The control bus carries commands from CPU and return status signals from the devices