Structure & Organisation of Computer Systems

Lecture 2

Computer Function

- The basic function performed by a computer is execution of a program, which consists of a set of instructions stored in memory. The processor does the actual work by executing instructions specified in the program.

- Can see a computer as a device that transforms data
  - ☐ Accept data
  - ☐ Store data
  - ☐ Process data as desired
  - ☐ Retrieve the stored data
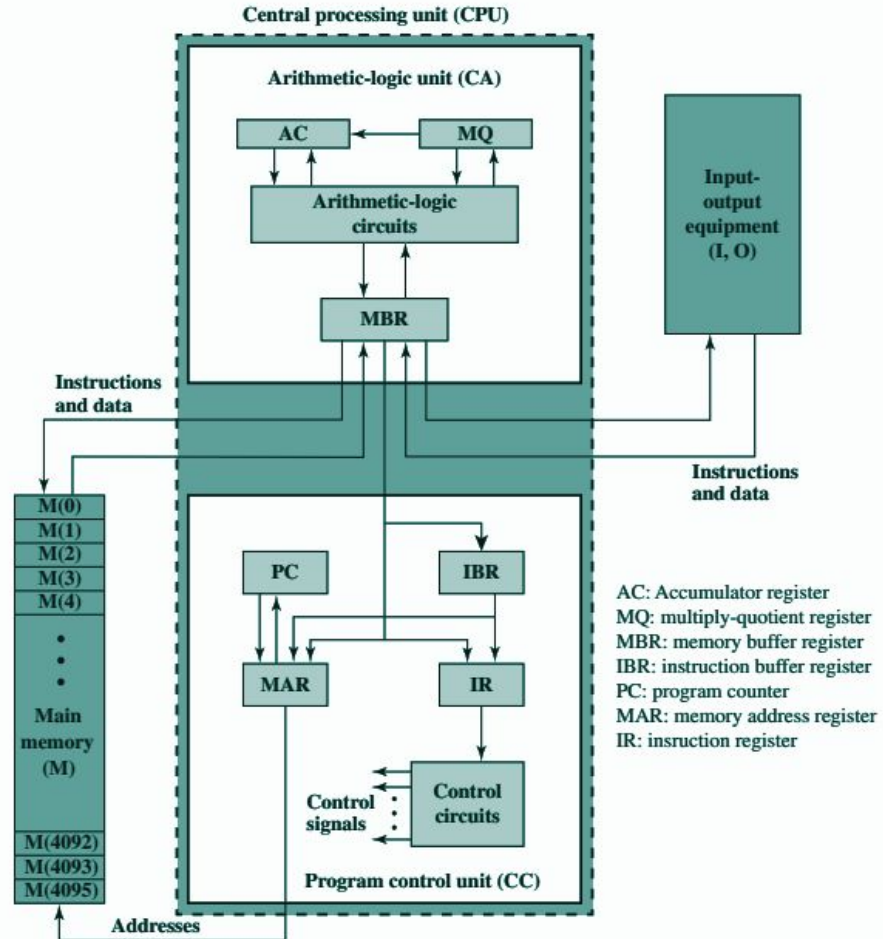 - ☐ Print the result in desired format

Figure 1.6   IAS Structure

AC: Accumulator register
MQ: multiply-quotient register
MBR: memory buffer register
IBR: instruction buffer register
PC: program counter
MAR: memory address register
IR: insruction register

Basic Computer Organization

Every computer contains five essential elements or units:

- ☐ Arithmetic and Logic Unit (ALU)

- ☐ Memory

- ☐ Control Unit

- ☐ Input Unit

- ☐ Output Unit
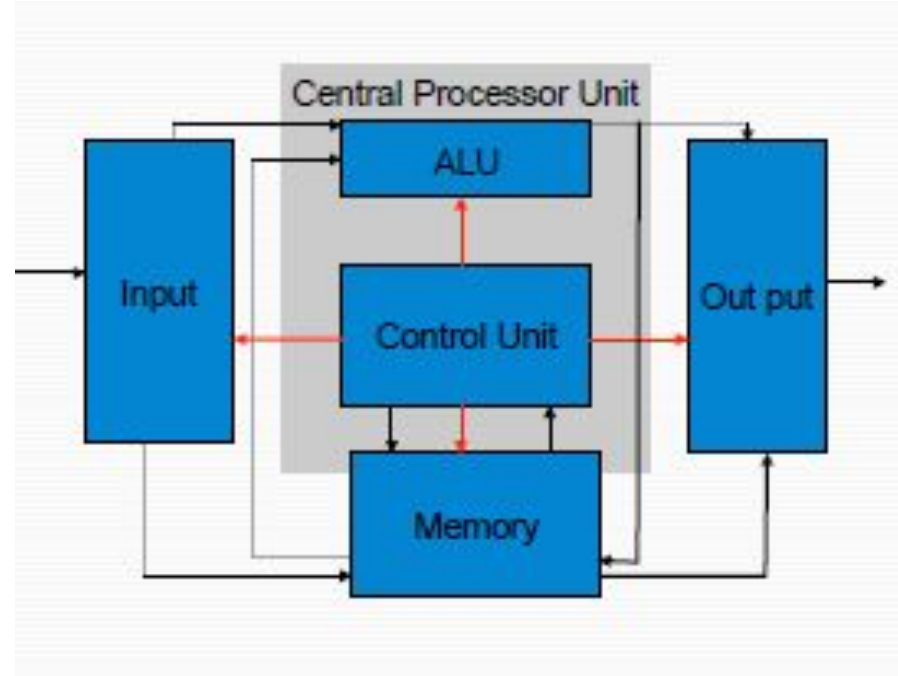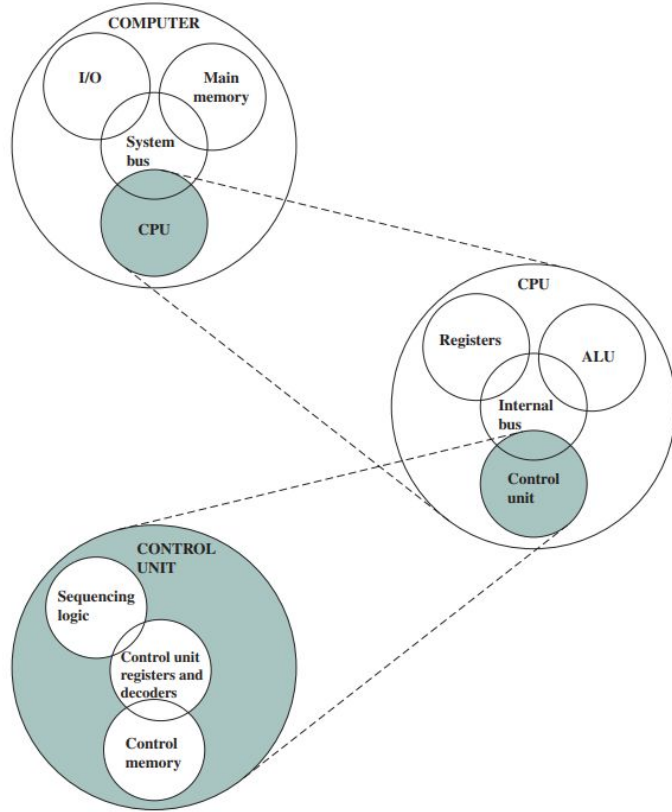
The Computer: Top-Level Structure

- **Input:** This is the process of entering data and programs in to the computer system.

- **Storage (Memory):** The process of saving data and instructions permanently is known as storage (Memory).

- **Processing:** The task of performing operations like arithmetic and logical operations is called processing.

- **Output:** The process of producing results from the data for getting useful Information.

- **Control:** It takes care of step by step processing of all operations in side the computer.

Computer System

Hardware

RAM

- **"main" memory, which is fast, but volatile...**
- **▢ analogous to a person's short-term memory.**
- ▢ many tiny "on-off" switches: for convenience

Disk

- Secondary Memory (Disk):
- Stable storage using magnetic or optical media.
- **▢ Analogous to a person's long-term memory.**
- **▢ Larger capacities**
- **▢ Slower to access than RAM.**

The Bus

- Connects CPU to other hardware devices.
- Analogous to a person's spinal cord.
- Speed measured in megahertz (like the CPU), but
- typically much slower than the CPU...
- The bottleneck in most of today's PCs.

Cache

- While accessing RAM is faster than accessing secondary memory, it is still quite slow, relative to the rate at which the CPU runs.
- To circumvent this problem, most systems add a fast cache memory to the CPU, to store recently used instructions and data.

Software

OS

- The OS acts as the "manager" of the system, making sure that each hardware device interacts smoothly with the others.
- It also provides the interface by which the user
- interacts with the computer, and awaits user input if
- no application is running.
- Examples: MacOS, Windows UNIX, Linux, Solaris, ...

Application Software

- Applications are non-OS programs that perform some
- useful task, including word processors,
- spreadsheets, databases, web browsers, C++ compilers, ...

Putting it all together
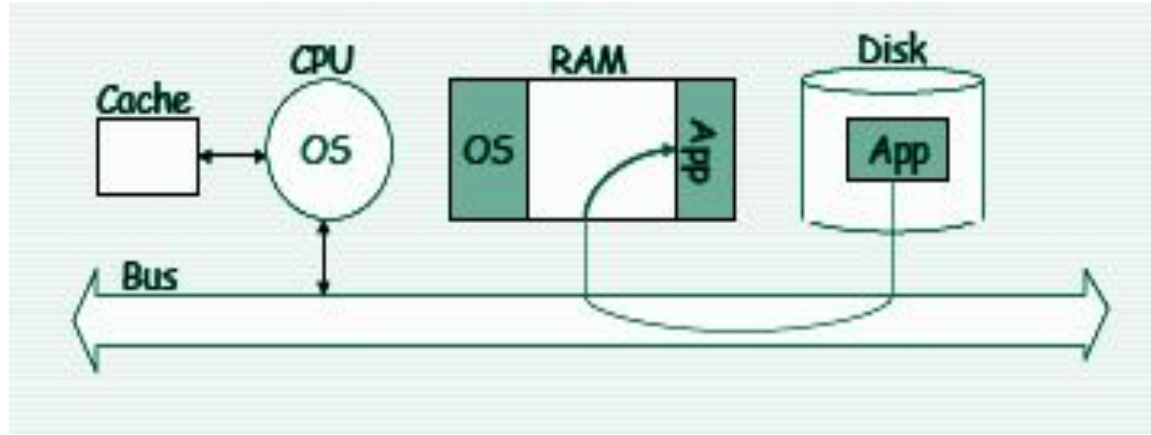
- The operating system (OS) is loaded from secondary memory into main memory when the computer is turned on, and remains in memory until the computer is turned off.

- Programs are stored (long-term) in secondary memory, and loaded into main memory to run, from which the CPU retrieves and executes their Statements.

- Programs and applications that are not running are stored on disk.

- When you launch a program, the OS controls the CPU and loads the program from disk to RAM.

- The OS then relinquishes the CPU to the program, which begins to run.

Bus

Address Bus

- Used to specify the address of the memory location to Access.

- Each I/O devices has a unique address. (monitor, mouse, cd-rom)

- CPU reads data or instructions from other locations by specifying the address of its location.

- CPU always outputs to the address bus and never reads from it.

Data Bus and Control Bus

- Data :-
  - Actual data is transferred via the data bus.
  - When the cpu sends an address to memory, the memory will send data via the data bus in return to the cpu.
- Control :-
  - Collection of individual control signals.
  - Whether the cpu will read or write data.
  - CPU is accessing memory or an I/O device
  - Memory or I/O is ready to transfer data

I/O Bus or Local Bus

- In today's computers the the I/O controller will have an extra bus called the I/O bus.

- The I/O bus will be used to access all other I/O devices connected to the system.

- Example: PCI bus

Random Access Memory

- Dynamic RAM (DRAM)

- Static RAM (SRAM)

- Synchronous dynamic random access memory (SDRAM)

- Double data rate synchronous dynamic random access memory
(DDR SDRAM)

Read Only Memory

- Masked ROM

- Programmable ROM (PROM)

- Erasable PROM (EPROM)

- Electrically Erasable Programmable

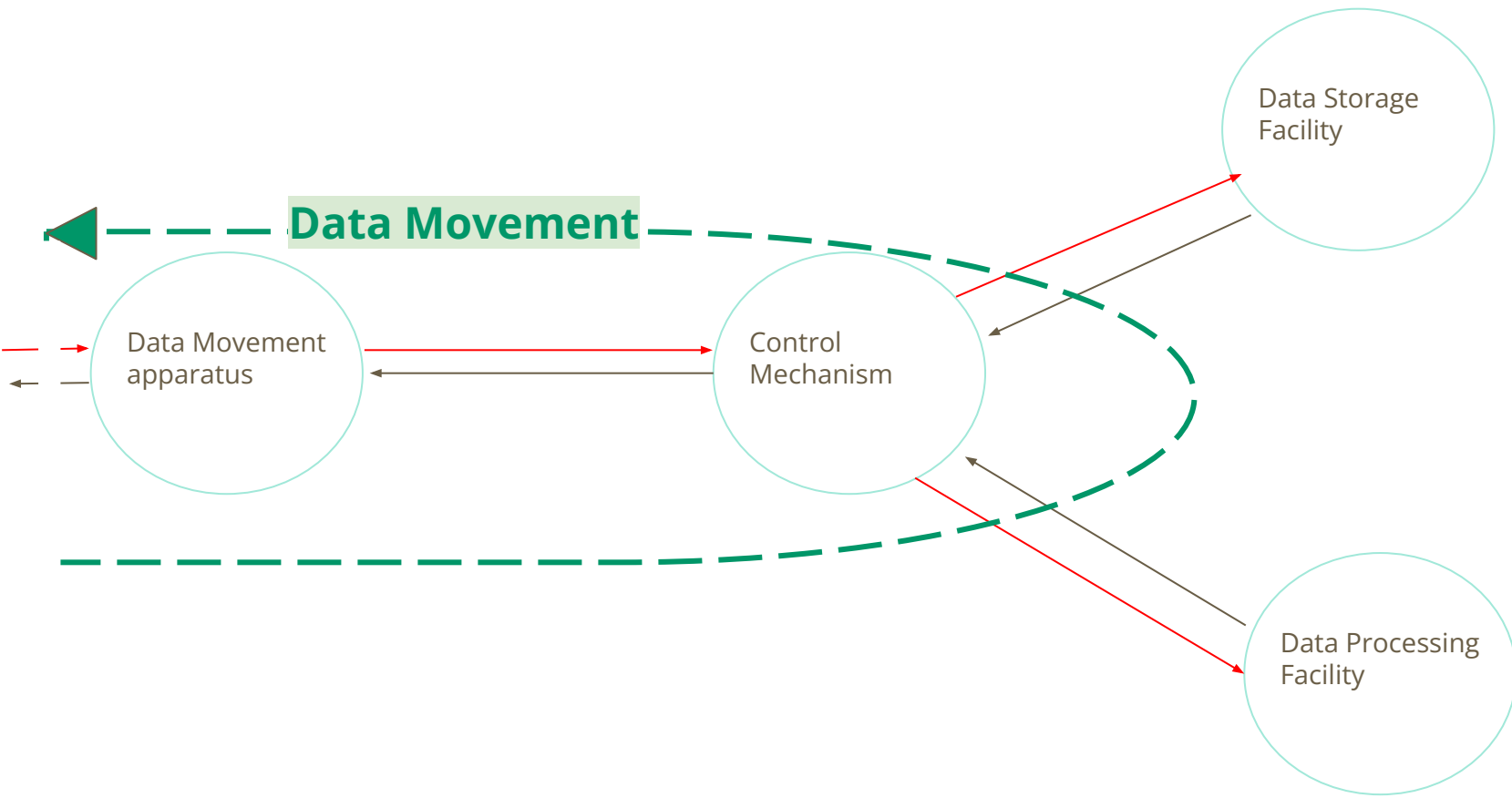 (EEPROM)

Structure & Function

Structure:
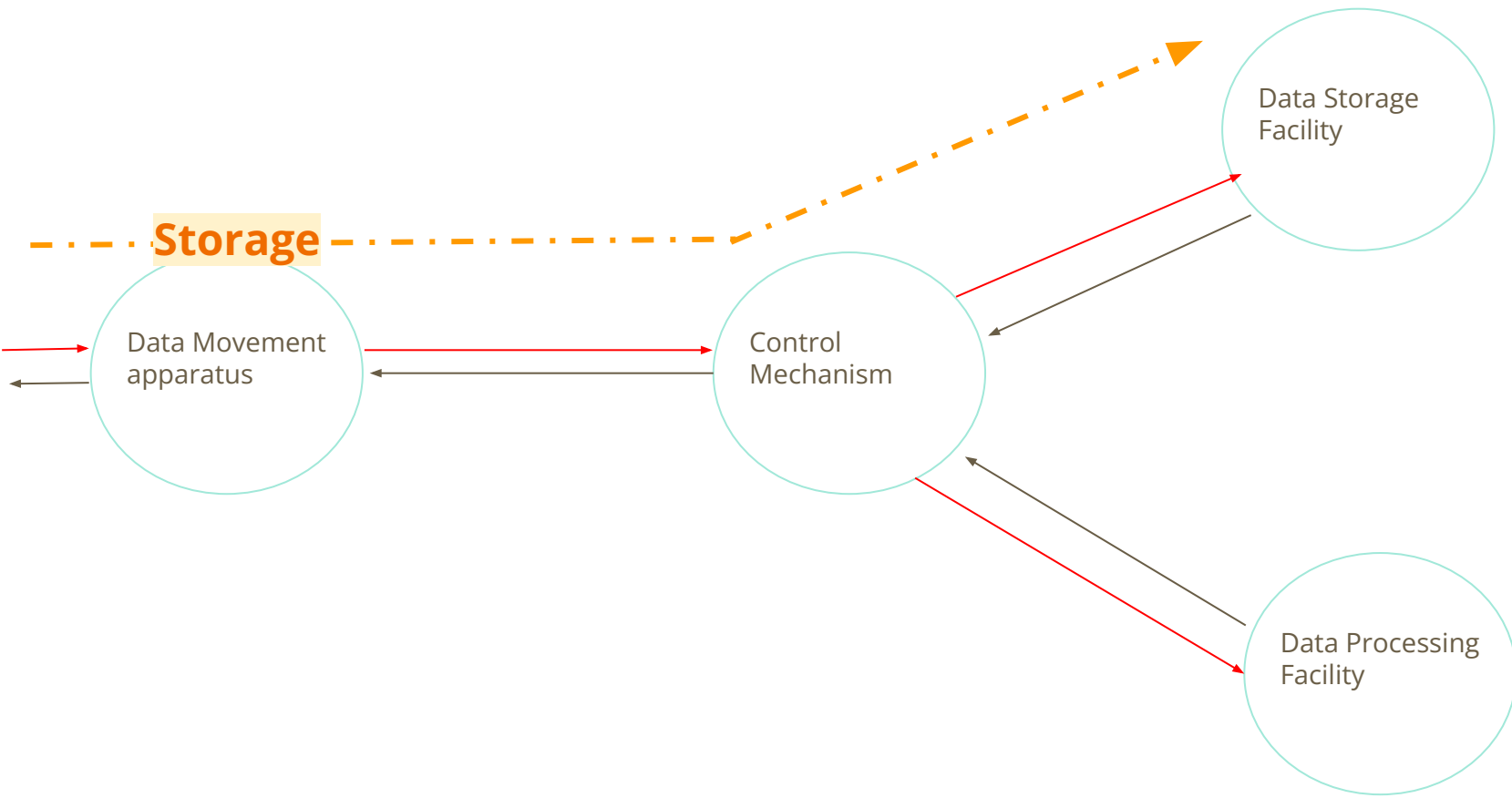*Way in which one component is related to each other*

Function:
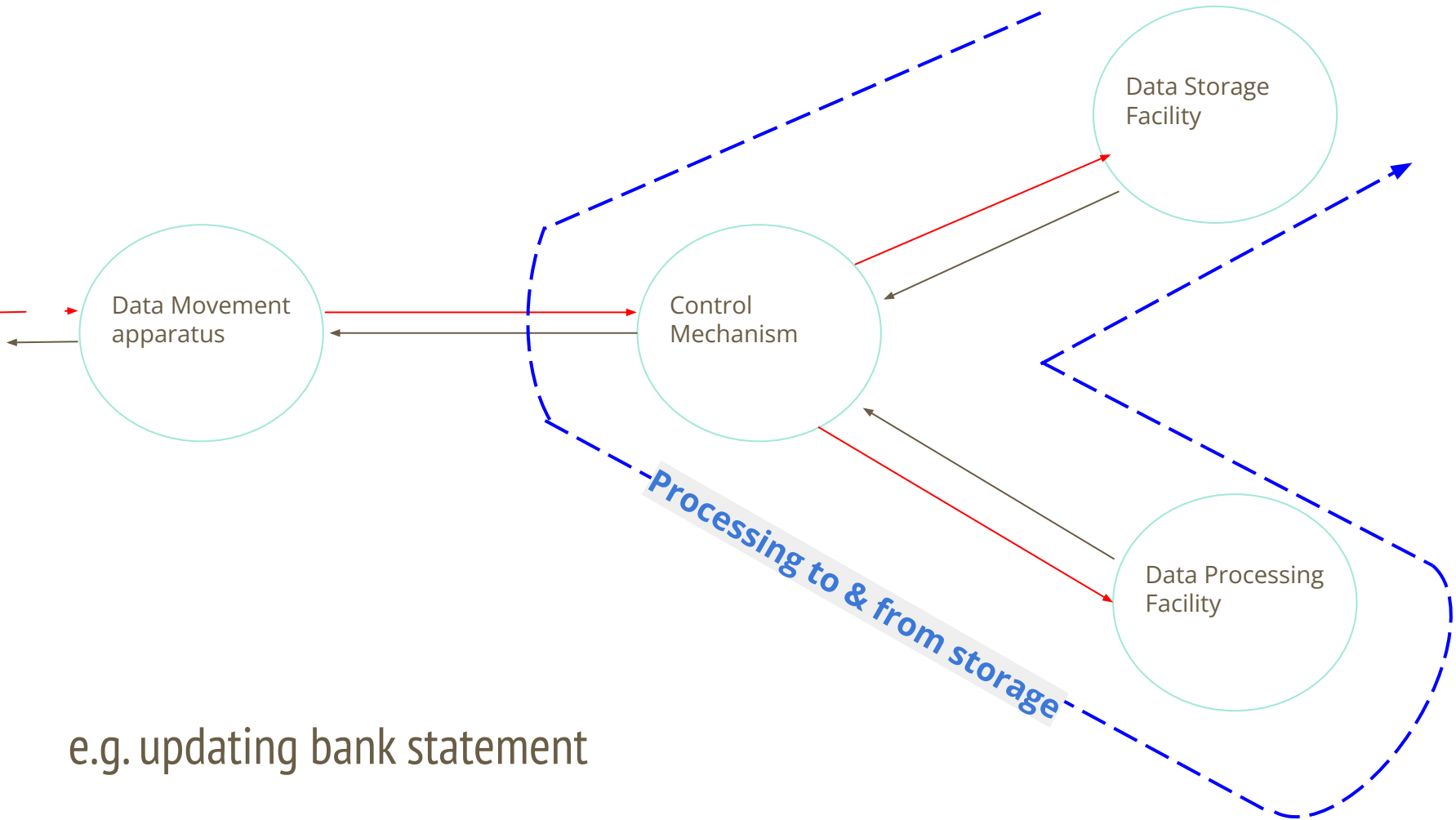*Operation of individual components as part of the structure*

- Computer functions are:
  - ☐ Data processing
  - ☐ Data storage
  - ☐ Data movement
  - ☐ Control *(very important function)*

Data Movement

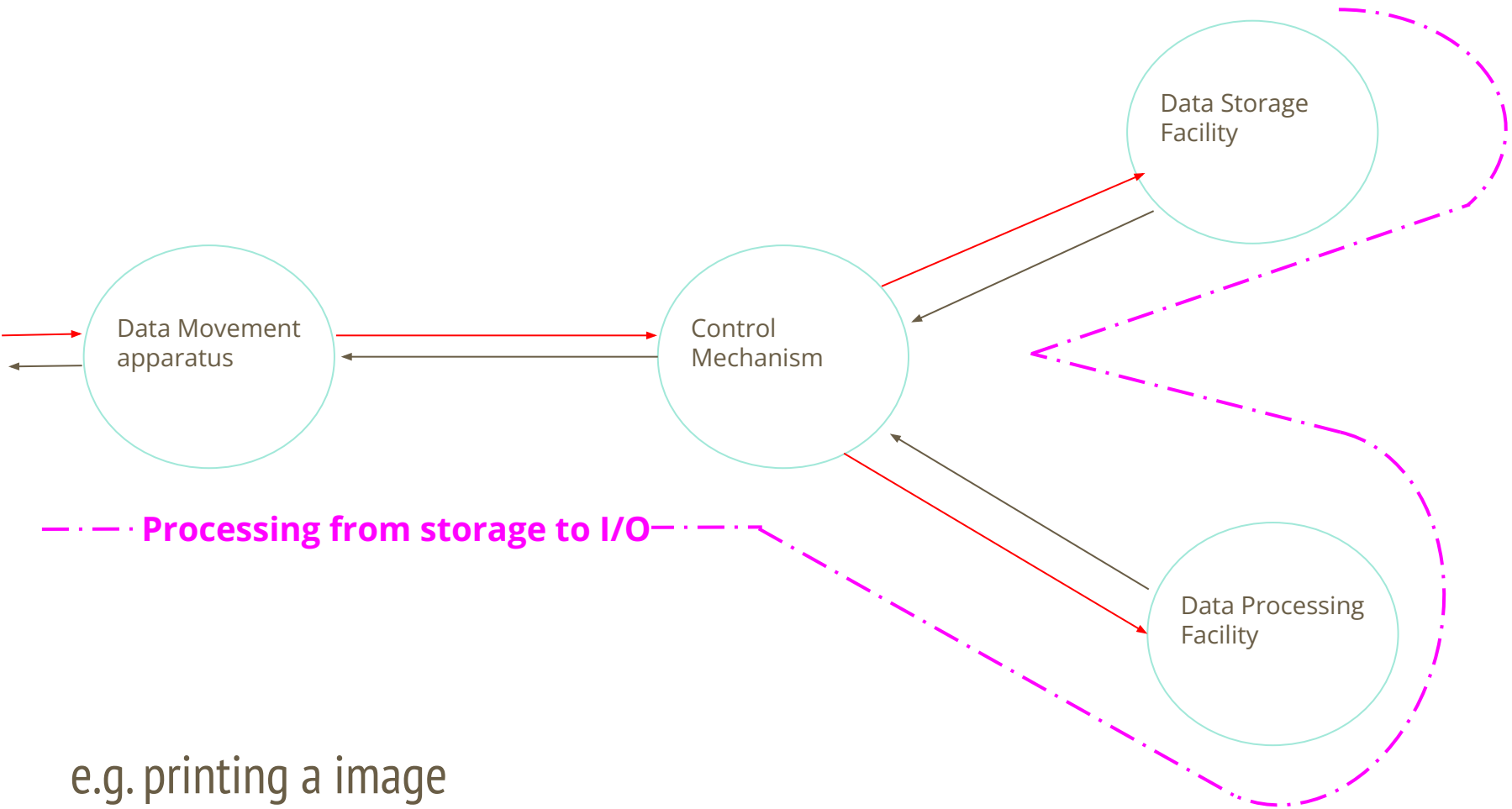Data Storage Facility

Data Movement apparatus

Control Mechanism

Data Processing Facility

Eg: Keyboard to Screen

Storage

Data Storage
Facility

Data Movement
apparatus

Control
Mechanism

Data Processing
Facility

Eg: Internet download to disk

Data Storage Facility

Data Movement apparatus

Control Mechanism

Data Processing Facility

Processing to & from storage

e.g. updating bank statement

Data Storage Facility

Control Mechanism

Data Movement apparatus

Data Processing Facility

Processing from storage to I/O

e.g. printing a image

Questions

1. What, in general terms, is the distinction between computer organization and computer architecture?

2. What, in general terms, is the distinction between computer structure and computer function?

3. What are the four main functions of a computer?

4. List and briefly define the main structural components of a computer.

5. List and briefly define the main structural components of a processor.