Unit 1 Introduction

The hardware of the computer is usually divided into three major parts, as shown in Fig. 1-1.

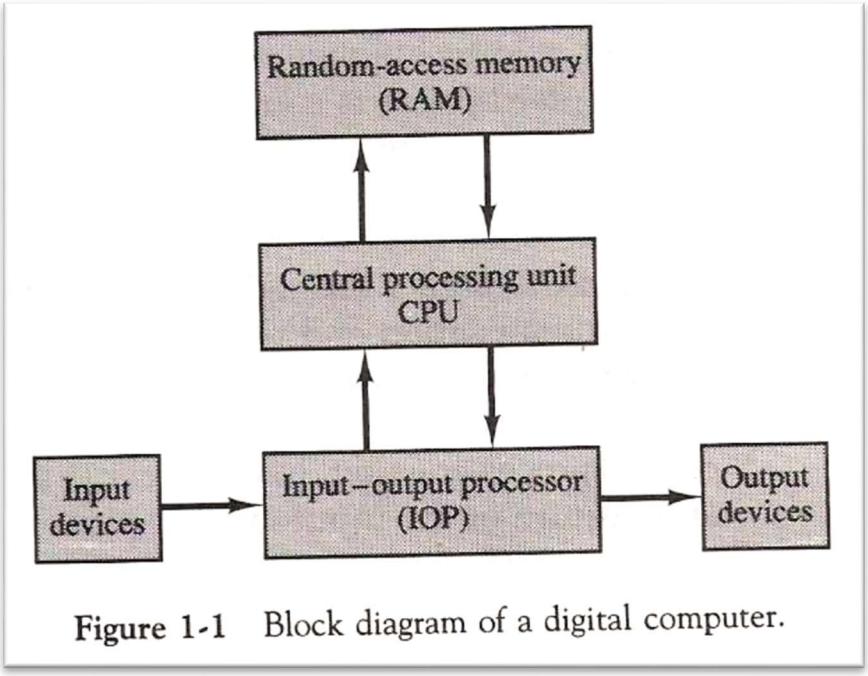


Figure 1-1 Block diagram of a digital computer.

The central processing unit (CPU) contains an arithmetic and logic unit for manipulating data, a number of registers for storing data, and control circuits for fetching and executing instructions. The memory of a computer contains storage for instructions and data. It is called a random-access memory (RAM) because the CPU can access any location in memory at random and retrieve the binary information within a fixed interval of time. The input and output processor (IOP) contains electronic circuits for communicating and controlling the transfer of information between the computer and the outside world. The input and output devices connected to the computer include keyboards, printers, terminals, magnetic disk drives, and other communication devices.

This subject provides the basic knowledge necessary to understand the hardware operations of a computer system. The subject is sometimes considered from three different points of view, depending on the interest of the investigator. When dealing with computer hardware it is customary to distinguish between what is referred to as computer organization, computer design, and computer architecture.

Computer organization is concerned with the way the hardware components operate and the way they are connected together to form the computer system. The various components are assumed to be in place and the task is to investigate the organizational structure to verify that the computer parts operate as intended.

Computer design is concerned with the hardware design of the computer. Once the computer specifications are formulated, it is the task of the designer to develop hardware for the system. Computer design is concerned with the determination of what hardware should be used and how the parts should be connected. This aspect of computer hardware is sometimes referred to as *computer implementation.*

Computer architecture is concerned with the structure and behavior of the computer as seen by the user. It includes the information formats, the instruction set, and techniques for addressing memory. The architectural design of a computer system is concerned with the specifications of the various functional modules, such as processors and memories, and structuring them together into a computer system.

A Classification of Computer Architecture:

1) Von Neumann Machines:

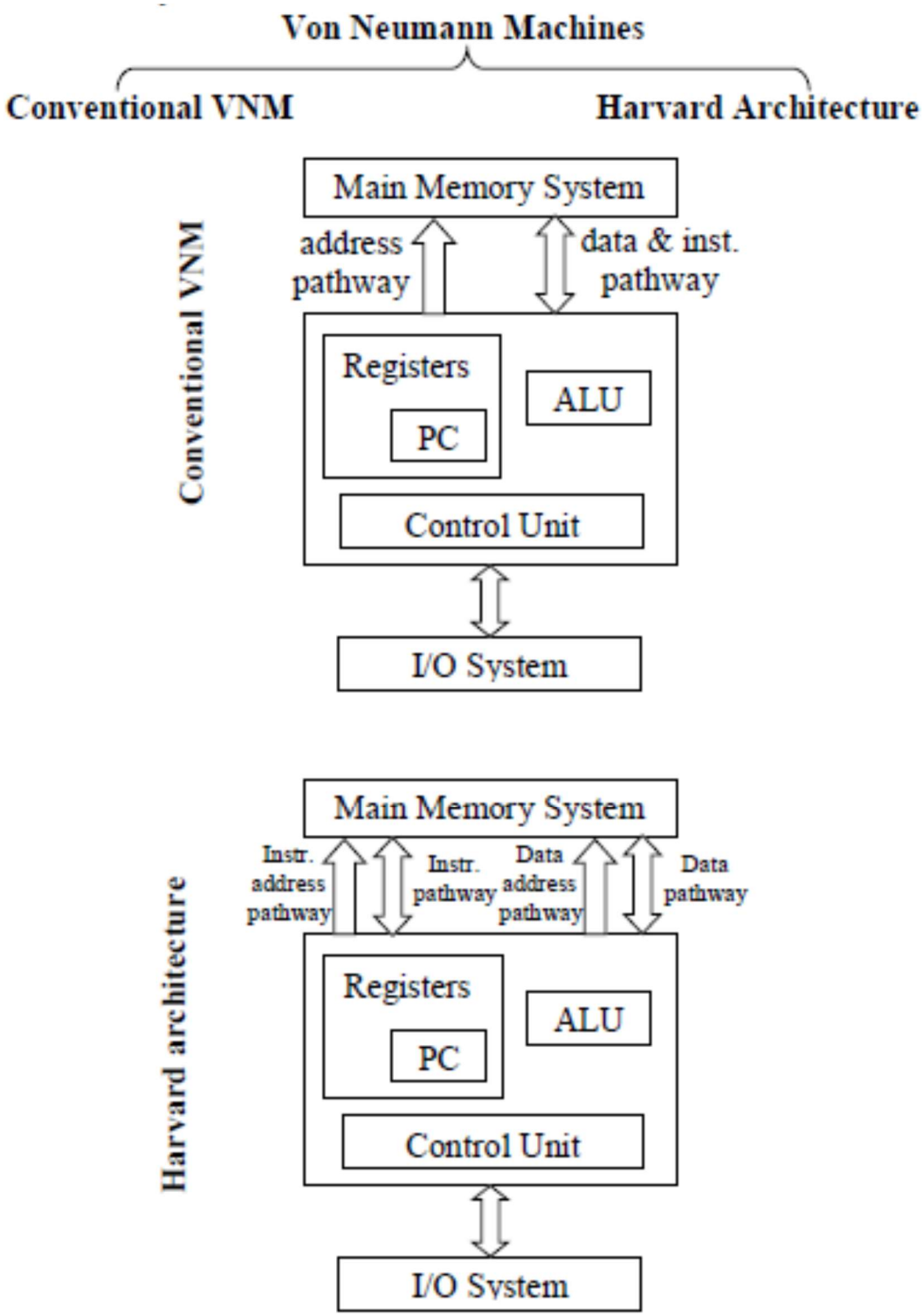
Von Neumann Machines meet the following criteria:

1. It has three basic hardware subsystems:
   a. CPU
   b. Main Memory System
   c. I/O System
2. It is a stored-program computer. The main memory system holds the program that controls the computer's operation and the computer can manipulate its own program more or less as it can any other data in memory.
3. It carries out instruction sequentially. The CPU executes or at least appears to execute one program at a time.
4. It has or at least appears to have a single path between the main memory system and the control unit of the CPU.

There are two types of Von Neumann Machines:

1. Conventional Von Neumann Machines provide one pathway for addresses and a second pathway for data & instruction.
2. Harvard Architecture: are a class of VNM similar to conventional computers except that they provide independent pathways for data addresses, data, instruction

addresses and instructions. Harvard architectures allow the CPU to access instruction and data simultaneously.



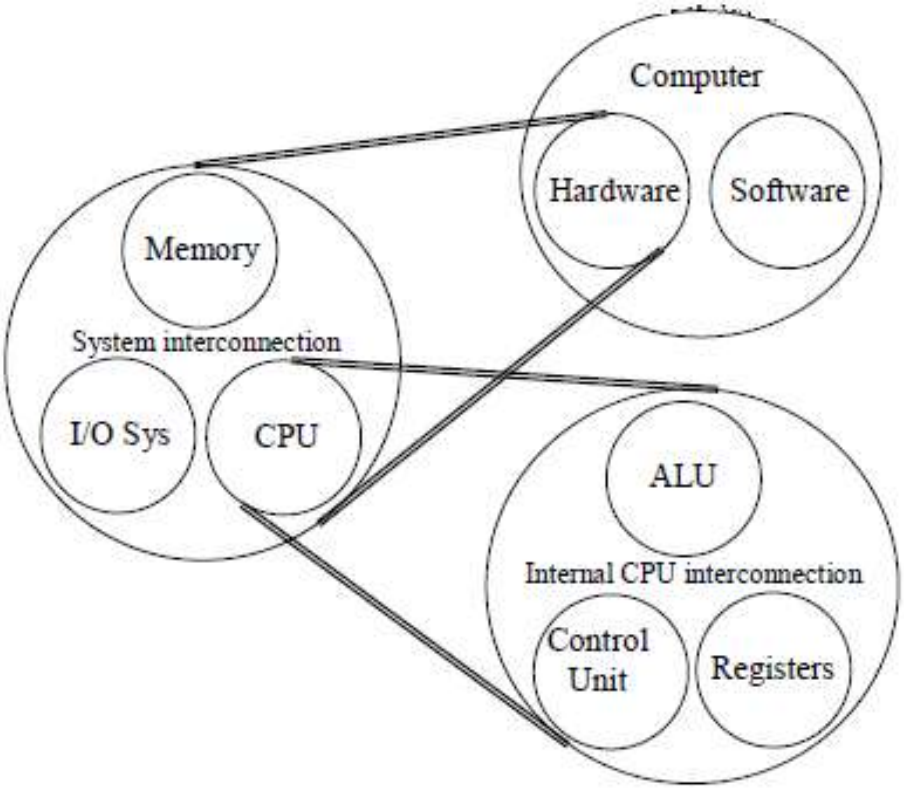
The main parts of the CPU:

1-Control Unit: which controls the operation of the computer.

2-Arithmetic & Logic Unit (ALU): which performs arithmetic, logical and shift operations to produce results.

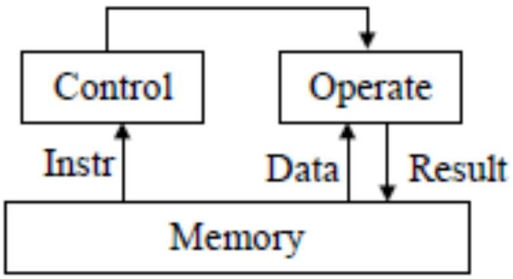
3-Register Set: which holds various values during the computer's operations.

4-Program Counter (PC) (Instruction Pointer IP): which holds the main memory address of an instruction.

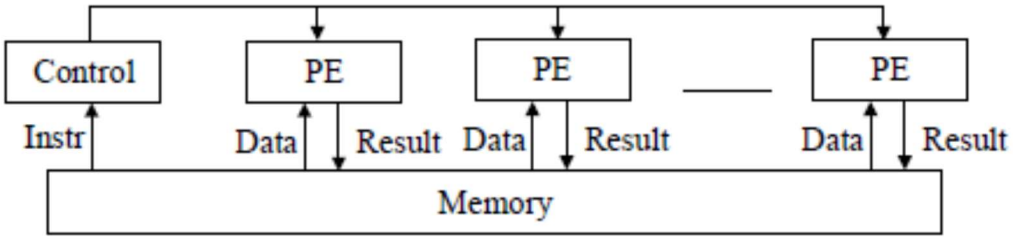


2) Non Von Neumann Machines:

A) Single Instruction stream, Single Data stream (SISD) The Von Neumann architecture belong to this classification. SISD computers have one CPU that execute one instruction at a time & fetch or stores one item of data at a time.



B) Single Instruction stream, Multiple Data stream (SIMD) SIMD machine have a CU that operates like a VNM (i.e. it executes a single instruction stream). But have more than one PE (Processor Element). The CU generates the control signals for all of the PEs, which execute the same operation on different data items.



C) Multiple Instruction stream, Single Data stream (MISD) Logically machines in this class would execute several different programs on the same data item. There are currently no such machines.

D) Multiple Instruction stream, Multiple Data stream (MIMD) MIMD machine also called Multiprocessors. They are more than one independent processor, and each processor can execute a different program on its own data.