7-Introduction to Computer Architecture

Most computers have similar architectures that combine software and hardware.

- **Hardware**

The term hardware refers to the physical components of your computer such as the system unit, mouse, keyboard, monitor, processors, memory and peripheral devices etc...

- **Software**

The software is the collection of instructions which makes the computer work. For instance, when you type in words via the keyboard, the software is responsible for displaying the correct letters, in the correct place on the screen. Software is held either on your computer's hard disk, CD-ROM, DVD or on a diskette (floppy disk) and is loaded (i.e. copied) from the disk into the computers RAM (Random Access Memory), as and when required.

Software includes the operating system which controls the computer hardware and application software, such as word processing, spreadsheets, etc…

+ Input devices

Input devices allow you to input information to the computer and include things such as the keyboard and mouse.

+ Output devices

Output devices allow you to output information from the computer and include the printer and the monitor.

+ Peripheral device

A peripheral device is any device which you can attach to your computer. Thus, you could attach a scanner or modem to the back of your system unit.

♦ Main Parts of a Personal Computer

1- The System Unit

The "system unit" is the name given to the main PC box which houses the various elements which go together to make up the PC. For instance within the system unit is the computer system's motherboard, which contains all the main components, such as the CPU. The system unit also houses items such as the hard disk, the floppy disk and CD-ROM drives etc.

2-The System (Mother) Board

The system (mother) board is contained within your system unit and all the vital computer systems plug directly into the system board. The CPU is normally housed on your system board along with all the other electronic components. Other items such as the hard disk are attached to the system board, either directly or via cables. These boards are getting smaller and smaller as the components become more integrated.

3-The CPU

The CPU (Central Processing Unit) is normally an Intel Pentium (or equivalent) and it is one of the most important components within your computer. It determines how fast your computer will run and is measured by its MHz or GHz speed. Thus, a 2 GHz Pentium is much faster than say a
GHz Pentium CPU. It is the CPU which performs all the calculations within the computer, when running programs such as word-processors, spreadsheets and databases.

4-Memory (RAM)

The RAM (Random Access Memory) within your computer is where the operating system is loaded to when you switch on your computer and also where your applications are copied to when you start an application, such as a word processor or database program. When you create data, (e.g. letters and pictures), these are initially created and held in RAM and then copied to disk when you save the data. As a rule of thumb, the more RAM you have installed in your computer the better.

5-ROM-BIOS

The ROM-BIOS (Read Only Memory - Basic Input Output System) chip is a special chip held on your computer's system (mother) board. It contains software which is required to make your computer work with your operating system, for instance it is responsible for copying your operating system into RAM when you switch on your computer.

6-Serial Port

The serial port is a socket located at the back of your computer which enables you to connect items to the computer, such as a modem. They are commonly labeled as COM1 or COM2.

7-Parallel Port

The parallel port is a socket located at the back of your computer which enables you to connect items to the computer, such as a printer. It is commonly labeled as LPT1 or LPT2.

8-Universal Serial Bus (USB)

The Universal Serial Bus is a relatively new item within the PC. You will see one or more USB sockets at the back of the system unit, allowing you to plug in devices designed for the USB. These devices include printers, scanners and digital cameras.

♦ Computer hardware

Computer based information system (CBIS) are composed of hardware, software, databases, people, telecommunications, and procedures. The components are organized to input, processing, output data and information. Physical equipment used for the input, processing, output and storage activities of computer system.

It consists of the following:
- Central processing unit (CPU)
- Memory (primary and secondary storage)
- Input technology
- Output technology
- Communication technology

1-The Central Processing Unit

The central processing unit (CPU) perform the actual computation inside any computer, the CPU is a microprocessor for example, Pentium III) made up of millions of microscopic transistors embedded in a circuit on a silicon wafer or chip. Examples of specific microprocessor.

The microprocessor has different portions which perform different functions:

1-**Control Unit**: this controls the flow of information.
2-**Arithmetic Logic Unit** (ALU) performs arithmetic calculations.
3-**Registers**: which store very small amount of data and instructions for short period of time.

* Control unit

-Direct and coordinates all units of the computer to execute program steps.
-Direct and coordinate all operation of the computer systems.
These operations include;

1- Control to the input and output devices.
2- Entry and retrieval of information from memory.
3-Routing of information between the memory, arithmetic and logic unit

Control unit automatically coordinates the operation of the entire computer system, although the control unit does not performed any actual processing on the data, it acts as a central nervous system uses to sent control signal to other units.

*Arithmetic and Logic Unit (ALU)

Perform the processing of data including arithmetic operation such as addition, subtraction, multiplication, division and logic operation including comparison (ex. A<B) and sorting.

*Register

Register are devices capable of storing information, receiving data from other areas within the computer and transferring information as directed by the control unit, it is used for temporary storage of data or instruction and the most important register are :

1- Program counter (PC): it contains the address of the next instruction to be executed.
2- Instruction register (IR): it contains the instruction being executed.
3-Address register (AR) : holds the address of memory location.

2-Computer Memory

There are two basic categories of memory:

A)Primary storage (main memory): The memory is the part of the computer that holds information (data and instruction) for processing so name because small amounts of data and information that will be immediately used by the CPU are stored there.

The specific functions of main memory are to hold (store):

1- All data to be processed.
2- Intermediate result of processing.
3-Final result of processing.

B-Secondary Storage: where much larger amount of data and information (an entire software program, for example) are stored for extended period of time.

- **Memory Capacity**

Bit: All computers work on a binary numbering system, i.e. they process data in ones or zeros. This 1 or 0 level of storage is called a bit. Often hardware is specified as a 32-bit computer, which means that the hardware can process 32 bits at a time. Software is also described as 16 bit, 32 bit or 64 bit software.

CPU process only 0s and 1s, all data are translated through computer languages into series of these binary digits, or bits.

Eight bits are needed to represent a character. This 8-bit string is known as a byte. The storage capacity of a computer is measured in bytes. The hierarchy of byte memory capacity is as follows:

1- Byte: A byte consists of eight bits.

2- Kilobyte: A kilobyte (KB) consists of 1024 bytes.

3- Megabyte: A megabyte (MB) consists of 1024 kilobytes, (1024*1024) byte or 1,048,576 byte) approximately 1,000,000 bytes.

4- Gigabyte: A gigabyte (GB) consists of 1024 megabytes, (1024*1024*10240byte) or (1,073,741,824 byte), approximately 1,000,000,000 bytes.

5- Terabyte: A terabyte (TB) consists of approximately 1,000,000,000,000 bytes.

A: There are four main types primary (main) memory:

1-**Registers:** are part of CPU, they have the least capacity, storing limited amounts of instructions and data only immediately before and after processing.

2-Random Access Memory (RAM): it stores more information than registers and is farther away from the CPU, but it stores less than secondary storage and is much closer to the CPU than is the secondary storage. When you start most software programs on your computer, the entire program is brought from secondary storage into RAM.

As you use the program, small parts of the programs instructions and data are sent into the instructions as close to the CPU. Again, getting the data and instructions as close to the CPU as possible is key to the computer's speed, as is the fact that the RAM is a type of microprocessor chip. As we shall discuss later, the chip is much faster (and more costly) than are secondary storage devices.

3-Cashe Memory: many modern computer applications (Microsoft office 98, for example) are very complex and have huge numbers of instructions .it takes considerable RAM capacity (usually a minimum 16MB) to store the entire instruction set. Or you may be using an application that exceeds your RAM. in that case, your computer has to go into secondary storage to retrieve the instruction. to alleviate this problem, software is often written in smaller blocks of instruction. As need, these blocks can be brought from secondary storage into RAM; this is still slow however, cashe memory is the place closer to the CPU where the computer can temporarily store those blocks used most often. Those used less often remain in RAM until they are transferred to cache; those used infrequently stay stored in secondary storage. Cashe memory is faster than RAM. Because, the instructions travel a shorter distance to the CPU.

4-Read Only Memory (ROM)

Most people who use computers have lost precious data at one time due to a" computer crash" or power failure. What is usually lost is whatever is in RAM, cashe, or the registers, this loss occurs because these types of memory is volatile.
Read-only-memory (ROM) is the place (a type of chip) where certain critical instructions are safeguarded.ROM is nonvolatile and retains these instructions when the power to the computer is turned off. The (read only) means that these instructions can be read only by the computer and cannot be changed by the user.

B) Secondary Storage (Backing Storage)

Secondary storage is designed to store very large amounts of data for extended periods of time .secondary storage can have memory capacity of gigabyte or more; only small portions of the data are placed in primary storage at any one time.

Secondary storage **has the following Characteristics:**

1-it is nonvolatile
2-it takes much more time to retrieve data from secondary storage than it does from RAM
3-it much more cost effective than primary storage
4-it can take place on a variety of media each with its own technology, as is cussed below:

a) Magnetic tape
b) Magnetic disc
c) Magnetic diskette (floppy disc)
d) Optical discs