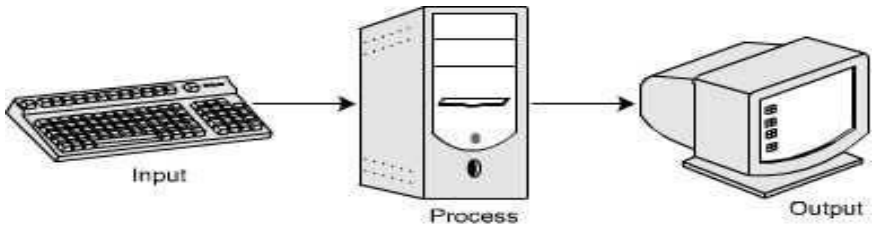
CHAPTER 1: Introduction of Computers

What is a Computer?

An electronic device that stores, retrieves, and processes data, and can be programmed with instructions. A computer is composed of hardware and software, and can exist in a variety of sizes and configurations

Hardware & Software

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



The software is the instructions that make the computer work. 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

WHAT ARE THE COMPONENTS OF A COMPUTER?

Computers are made up of two parts: the hardware and the software.

Hardware: The physical equipment required to create, use, manipulate and store electronic data.

Software: The computerised instructions that operate a computer manipulate the data and execute particular functions or tasks.

All computers require the following hardware components:

Central processing unit (CPU): The chip or chips at the heart of a computer that enable it to process data also known as a processor.

Memory: An area within a computer system that holds data waiting to be processed.

Storage device: The place where a computer puts data.

Input devices: the devices that allow data and instructions to enter a computer (such as a keyboard, mouse, and scanner)

Input: Any resource required for the functioning of a process, in the course of which it will be transformed into one or more outputs.

Out-put devices: the devices that allow information to be represented (that is, given out) to the user, such as a display screen or printer)

Output: The product of the transformation of inputs by a process.

The central processing unit (CPU) is the heart of the computer. It carries out all of the instructions given in a program, such as a word processing or spreadsheet program. The CPU consists of one or more chips (another name for "integrated circuits").

Chip: A small piece of semi-conducting material (such as silicon) about 1 centimetre (¼ inch) square on which an integrated circuit is embedded. An integrated circuit is a number of electronic components joined together to form a path for electricity. Central processing unit chips contain the circuits representing the CPU.

A ***microprocessor*** is a particular type of chip. The original IBM personal computer used the Intel 8088 microprocessor. Most of today's microcomputers are designed around a microprocessor from one of two product families: x86 or Power. The 80286, 80386, and 80486 models that followed were referred to by the

last three digits, 286, 386, and 486. For the next generation, however, Intel broke with tradition and introduced the Pentium in 1993. In 1997, it introduced the Pentium II to address multi-media applications, and most recently the Pentium III to address the new opportunities provided by access to large volumes of information on the World Wide Web. Other manufacturers of chips (such as Cyrix) produce chips of similar power and capabilities.

The faster the processor in a computer, the more quickly the computer will perform operations.

The most common type of memory that most users are familiar with is 'main memory' or 'RAM' (random-access memory). Random access memory (RAM): An area in the computer system unit that temporarily holds a user's data, operating system instructions and program instructions. The word 'main' is used to distinguish it from external mass storage devices such as the hard drive or disk drives. Note that the term 'mass storage' refers to various techniques and devices for storing large amounts of data; mass storage is distinct from memory because it retains data even when the computer is turned off. Thus mass storage is sometimes referred to as 'auxiliary storage'.

HOW DOES A COMPUTER WORK?

A computer functions in the following manner:

• The computer accepts input. Computer input is whatever is entered or fed into a computer system. Input can be supplied by a person (such as by using a keyboard) or by another computer or device (such as a diskette or CD-ROM). Some examples of input include the words and symbols in a document, numbers for a calculation, and instructions for completing a process, pictures, and so on.

• The computer performs useful operations, manipulating the data in many ways. This manipulation is called processing. Examples of processing include performing calculations, sorting lists of words or numbers, modifying documents and pictures according to user instructions, and drawing graphs. A computer processes data in the CPU.

Process: A systematic series of actions a computer uses to manipulate data.

• The computer stores data. A computer must store data so that it is available for processing. Most computers have more than one location for storing data (the hard drive or C:\, and the floppy drive or A :\). The place where the computer stores the data depends on how the data is being used. The computer puts the data in one place while it is waiting to be processed and another place when it is not needed for immediate processing. The storage of data in the computer is called 'online storage' while the storage of data on computer tapes, diskettes or CD-ROMs is called 'offline storage'

• The computer produces output. Computer output is information that has been produced by a computer. Some examples of computer output include reports, documents, music, graphs, and pictures. Output can be in several different formats, such as paper, diskette, or on screen. A computer receives data as input, processes it, stores it and then produces output.

END OF CHAPTER - 1

CHAPTER 2: Microprocessor

A **microprocessor** incorporates the functions of a computer's central processing unit (CPU) on a single integrated circuit,[1] or at most a few integrated circuits.[2] It is a multipurpose, programmable device that accepts digital data as input, processes it according to instructions stored in its memory, and provides results as output. It is an example of sequential digital logic, as it has internal memory. Microprocessors operate on numbers and symbols represented in the binary numeral system.

The advent of low-cost computers on integrated circuits has transformed modern society. General-purpose microprocessors in personal computers are used for computation, text editing, multimedia display, and communication over the Internet. Many more microprocessors are part of embedded systems, providing digital control of a myriad of objects from appliances to automobiles to cellular phones and industrial process control.

A silicon chip that contains a CPU. In the world of personal computers, the terms *microprocessor* and CPU are used interchangeably. At the heart of all personal computers and most workstations sits a microprocessor. Microprocessors also control the logic of almost all digital devices, from clock radios to fuel-injection systems for automobiles.

Three basic characteristics differentiate microprocessors:

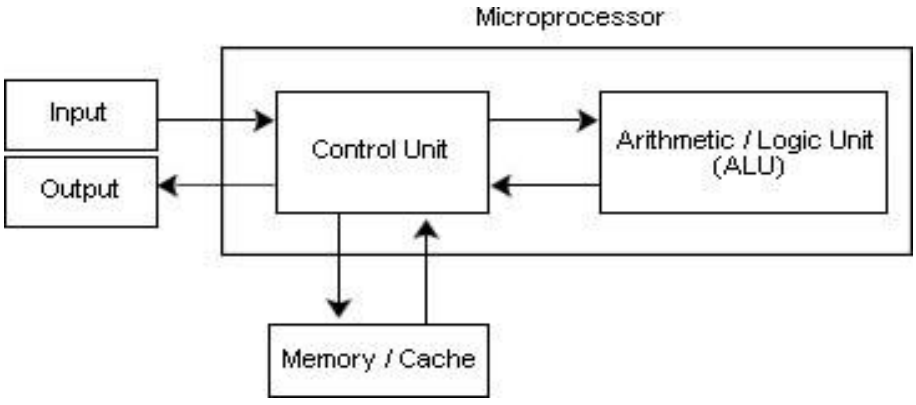
1. **Instruction set**: The set of instructions that the microprocessor can execute.
2. **Bandwidth:** The number of bits processed in a single instruction.
3. **Clock speed:** Given in megahertz (MHz), the clock speed determines how many instructions per second the processor can execute.

In both cases, the higher the value, the more powerful the CPU. For example, a 32-bit microprocessor that runs at 50MHz is more powerful than a 16-bit microprocessor that runs at 25MHz.

In addition to bandwidth and clock speed, microprocessors are classified as being either RISC (reduced instruction set computer) or CISC (complex instruction set computer).

Working of the Microprocessor

- Accepts data
- Processes data
- Stores data
- Sends output data



Parts of microprocessor

- Arithmetic and Logic Unit
- Control Unit - Controls the flow of the data and information to other units of the microprocessor
- Prefetch Unit – Analyzes incoming data and looks in instruction cache for instructions of how to process it. Once its instructions are found it assigns data a unique memory address so it can be accessed later.
- Instruction and Data Cache – Stores instructions and data temporarily. Instruction cache determines how microprocessor will function and respond to external commands.
- Bus Unit - Connects the internal units of the microprocessor like the control unit and prefetch unit.
- Decode Unit – Converts instructions into binary digital code that can be understood and processed by ALU.
- Registers - Store data required by the ALU

Speed of Microprocessor

- Depends on number of instructions it processes
- Bandwidth (32/64 bit)
- Clock speed (GHz)
- Number of transistors built into it

Multitasking/Multiprocessing

Multitasking means the processor time is divided into no. of tasks

- Enables the processor to run multiple program simultaneously
- Reduces the processor idle time
- Multiprocessing means parallel processing used for simultaneously running more than one process by multiple processing units
- Each processing unit runs independently and may or may not have individual cache memory
- Most effective when used with application software

Interface of Microprocessor

- Steps followed by the microprocessor to interface with a device:
  - Checks the status of the device.
  - Requests the device for transferring data.
  - The device sends the data request to the microprocessor.
  - The microprocessor sends the required data to the device.

FSB/BSB

- FSB interfaces between the L2 cache on processor to the north bridge of motherboard
- Also known as system bus or memory bus
- Speed at which CPU communicates with RAM
- BSB interfaces between L1 cache on processor with L2 cache
- BSB is faster than FSB

Operating Voltage of Microprocessor

- Lowering the operating voltage decreases the power consumption
- Less power consumption, system is less expensive to run and more battery life
- Less voltage of the equipment generates less heat
- Processors that run cooler give better performance
- Operating voltage range is 1.5 to 2.9V

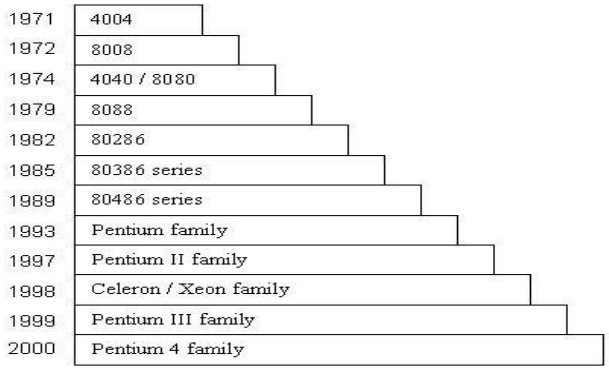
Packaging of microprocessor

- **Types of microprocessor packaging:**
  - Pin Grid Array (PGA) - Mainly used with modern high speed microprocessors due to the enhanced thermal and electrical properties of the ceramic material
  - Staggered Pin Grid Array (SPGA) – Pins are staggered rather than arranged in standard rows and columns. Allows to move the pins closer and decrease the size of chip
  - Single edge contact (SEC) and single edge processor packaging (SEPP) - SEC cartridge incorporates the back side bus and L2 cache internally. It was a cost effective method for integrating L2 cache into the processor. A less expensive of the SEC is the single edge processor (SEP) package without fancy plastic cover
  - LGA - One of the main problems that had plagued Socket 478 processors was broken pins. The solution Intel engineers came up with was to remove the pins from the CPU, replace them with a denser array of gold contact points, and relocate the pins into the CPU socket itself. These changes have made the LGA775 Intel Pentium 4 processor a little more durable, while allowing connector density to increase without radically enlarging the package size. Conversely, the new socket 775 is now extremely fragile.

Types of microprocessor

- Based on the number of instructions built into it, they can be classified as:
  - Complex Instruction Set Computing (CISC) – Many instructions built into it which saves processing time for performing tasks otherwise it has to be retrieved from RAM. However it affects the performance of the microprocessor because more time is taken to process the instruction and also the space available on the microprocessor for processing reduces. To overcome this problem more transistors need to be built into the microprocessor
  - Reduced Instruction Set Computing (RISC) – Have limited instructions built into it which requires few transistors to be built into the microprocessor. Saves the space in the microprocessor and cheaper as compared to CISC processor. This processor is favorable for scientific purposes where limited instructions are required

Microprocessor Time line



Intel Pentium Microprocessor

- **Designed to work with everyday applications**
  - Word processors
  - Spreadsheets
  - Multimedia applications
  - Games
- **Versions**
  - Pentium I
  - Pentium II
  - Pentium III
  - Pentium IV

Pentium-1

- Released in 1993
- First chip from the fifth generation of microprocessors
- Has a 5-stage data pipeline for executing instructions to perform multiple calculations simultaneously
- A pipeline allows multiple instructions to be processed at the same time. While one stage of an instruction is being processed, other instructions may be undergoing processing at a different stage. Without a pipeline, each instruction would have to wait for the previous one to finish before it could even be accessed

Pentium-II

- Released in 1997
- Available on a daughter card that has L2 cache
- Has a 14-stage data pipeline for executing instructions

Pentium-III

- Released in 1999
- Has a unique Processor Serial Number (PSN) embedded in the chip
- Has a 10-stage data pipeline for executing instructions
- Has 70 more instructions built into it which enhances processing of graphical information

Pentium-IV

- Released in 2000
- Enables to work with applications that require a lot of processing such as digital photography
- Has a 20-stage data pipeline for executing instructions
- Also available in the following editions:
  - Hyper-Threading (HT)
  - HT Extreme

Hyper-threading

- Developed by Intel, hyper threading enables a single processor to work as two logically different processors.
- A single code of execution is known as thread. It is a part of a program that executes independently of other parts and concurrently with other parts of the program.

The Pentium 4 is available with Hyper-Threading (HT) technology. This ensures that the program executes faster. This edition is targeted for gamers because 3D games are complex programs and require a lot of processing

Intel Celeron

- Cheaper and economical
- Used for running applications that do not require a lot of processing
- Smaller cache size, clock speed and bus speed is also less
- Celeron D processor has 256 KB L2 cache, 533 MHz FSB and uses LGA775 socket

Intel Xeon

- Heavy-duty microprocessors
- Used to power servers and workstations on a network
- Supports multiprocessors

Intel Itanium

- Used to power network servers and workstations
- Can execute three instructions at a time
- Is a Reduced Instruction Set Computing (RISC) based microprocessor
- Cost is more than Xeon processors
- Uses in database and e-mail servers

Advanced Micro Devices (AMD)

- Created in the year 1969
- Developed
  - Duron
  - Athlon
- Cheaper than Pentium processors
- Uses Slot A to connect the AMD microprocessor to the motherboard

Dual Core

- Two cores on a single die comprise a dual core CPU
- Each of the cores has their own cache, can process independently and provide better performance
- To make use of dual core technology, the process must use multiple threads
- Well suited for multitasking environment
- Intel and AMD provide dual core processors for various segments

Install Microprocessor in ZIF socket and heat sink

1. Check voltage requirements
2. Wear an anti-static wristband
3. Place motherboard on work desk
4. Take microprocessor out from anti-static bag
5. Check that all pins on underside of microprocessor are straight
6. Locate socket where microprocessor must be installed
7. Find lever located besides the socket for microprocessor
8. Raise lever so that it is at right angle with motherboard
9. Align notch on microprocessor with alignment notch on motherboard socket
10. Gently, place microprocessor in the socket
11. Push lever back down such that it is parallel to motherboard and locked in place

Heat Sink

A component that is used to lower the temperature of an electronic device. Which absorbs heat from the electronic device and distributes it to surrounding environment.

Two types of heat sinks available namely:

Passive Heat Sink – The passive heat sink is a metal plate with fins attached to surface of the processor. The plane of the heat sink absorbs the heat of processor and fins streams the air to cool it.

Active Heat Sink – An active heat sink is an expansion of passive heat sink with a fan attached on top of the plane metal surface. This facilitates direct cooling of the processor.

Overclocking

- Overclocking increases the speed of the microprocessor
- You can overclock the microprocessor by changing jumper settings on motherboard or by changing appropriate BIOS settings
- Additional cooling devices such as CPU fan must be installed to cool down the processor
- Must be done with a great care by increasing clock speed as little as possible every time
- Must check documentation of the microprocessor and motherboard before overclocking
- Overclocking a processor beyond its maximum capacity can permanently damage the microprocessor

Upgrading the Microprocessor

- Improves the speed and performance of the system and to keep the system up to date
- To upgrade
  - Replace old microprocessor with new and better microprocessor
  - Replace old processor card on the slot with a new card

New processor should be compatible with existing motherboard otherwise you have to replace both processor and motherboard

END OF CHAPTER – 2

CHAPTER 3: Memory

There are two kinds of computer memory: *primary* and *secondary*. Primary memory is accessible directly by the processing unit. RAM is an example of primary memory. As soon as the computer is switched off the contents of the primary memory is lost. You can store and retrieve data much faster with primary memory compared to secondary memory. Secondary memory such as floppy disks, magnetic disk, etc., is located outside the computer. Primary memory is more expensive than secondary memory. Because of this the size of primary memory is less than that of secondary memory. We will discuss about secondary memory later on.

Computer memory is used to store two things:

i) Instructions to execute a program and data.
ii) When the computer is doing any job, the data that have to be processed are stored in the primary memory. This data may come from an input device like keyboard or from a secondary storage device like a floppy disk

The following terms related to memory of a computer are discussed below:

1. **Random Access Memory (RAM):** The primary storage is referred to as random access memory (RAM) because it is possible to randomly select and use any location of the memory directly store and retrieve data. It takes same time to any address of the memory as the first address. It is also called read/write memory. The storage of data and instructions inside the primary storage is temporary. It disappears from RAM as soon as the power to the computer is switched off. The memories, which lose their content on failure of power supply, are known as **volatile** memories .So now we can say that RAM is volatile memory.

2. **Read Only Memory (ROM):** There is another memory in computer, which is called Read Only Memory (ROM). Again it is the ICs inside the PC that form the ROM. The storage of program and data in the ROM is permanent. The ROM stores some standard processing programs supplied by the manufacturers to operate the personal computer. The ROM can only be read by the CPU but it cannot be changed. The basic input/output program is stored in the ROM that examines and initializes various equipments attached to the PC when the switch is made ON. The memories, which do not lose their content on failure of power supply, are known as **non-volatile** memories. ROM is non-volatile memory.

3. **PROM** There is another type of primary memory in computer, which is called Programmable Read Only Memory (PROM). You know that it is not possible to modify or erase programs stored in ROM, but it is possible for you to store your program in PROM chip. Once the programmes are written it cannot be changed and remain intact even if power is switched off. Therefore programs or instructions written in PROM or ROM cannot be erased or changed.

4. **EPROM:** This stands for Erasable Programmable Read Only Memory, which overcome the problem of PROM & ROM. EPROM chip can be programmed time and again by erasing the information stored earlier in it. Information stored in EPROM exposing the chip for some time ultraviolet light and it erases chip is reprogrammed using a special programming facility. When the EPROM is in use information can only be read.

5. **Cache Memory:** The speed of CPU is extremely high compared to the access time of main memory. Therefore the performance of CPU decreases due to the slow speed of main memory. To decrease the mismatch in operating speed, a small memory chip is attached between CPU and Main memory whose access time is very close to the processing speed of CPU. It is called CACHE memory. CACHE memories are accessed much faster than conventional RAM. It is used to store programs or

data currently being executed or temporary data frequently used by the CPU. So each memory makes main memory to be faster and larger than it really is. It is also very expensive to have bigger size of cache memory and its size is normally kept small.

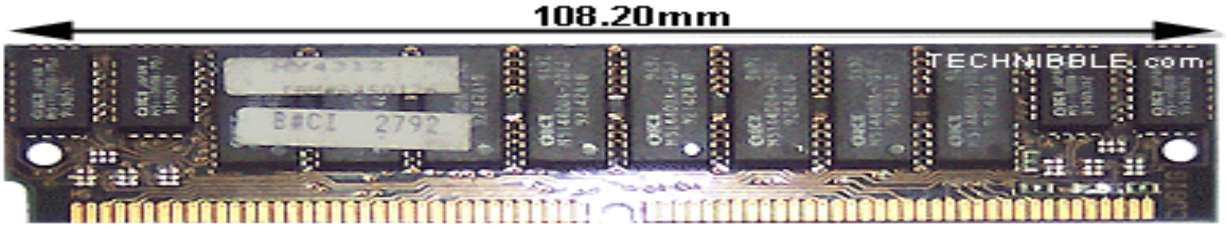
6. **Registers:** The CPU processes data and instructions with high speed, there is also movement of data between various units of computer. It is necessary to transfer the processed data with high speed. So the computer uses a number of special memory units called *registers.* They are not part of the main memory but they store data or information temporarily and pass it on as directed by the control unit.

Types of RAM: How to Identify and their Specifications:

There are many different types of RAM which have appeared over the years and it is often difficult knowing the difference between them both performance wise and visually identifying them. This article tells a little about each RAM type, what it looks like and how it performs.

EDO RAM

EDO RAM, which came out in 1995 as a new type of memory available for Pentium based systems. EDO is a modified form of FPM RAM. Extended Data Out refers to fact that the data output drivers on the memory module are not switched off when the memory controller removes the column address to begin the next cycle, unlike FPM RAM. Most early Pentium based systems use EDO.



EDO RAM

SDRAM

SDRAM, which is short for Synchronous DRAM, is a type of DRAM that runs in synchronization with the memory bus. Beginning in 1996 most Intel based chipsets began to support SDRAM which made it a popular choice for new systems in 2001.

SDRAM is capable of running at 133MHz which is about three times faster than FPM RAM and twice as fast as EDO RAM. Most Pentium or Celeron systems purchased in 1999 have SDRAM.

SD RAM