Introduction to Computers
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A World of Computers

- Computers can take many different forms and their capabilities are constantly expanding.

- The gap between computer technology and other allied electronics is narrowing with each passing day but there are basic characteristics that an electronic devise must possess to become a computer.
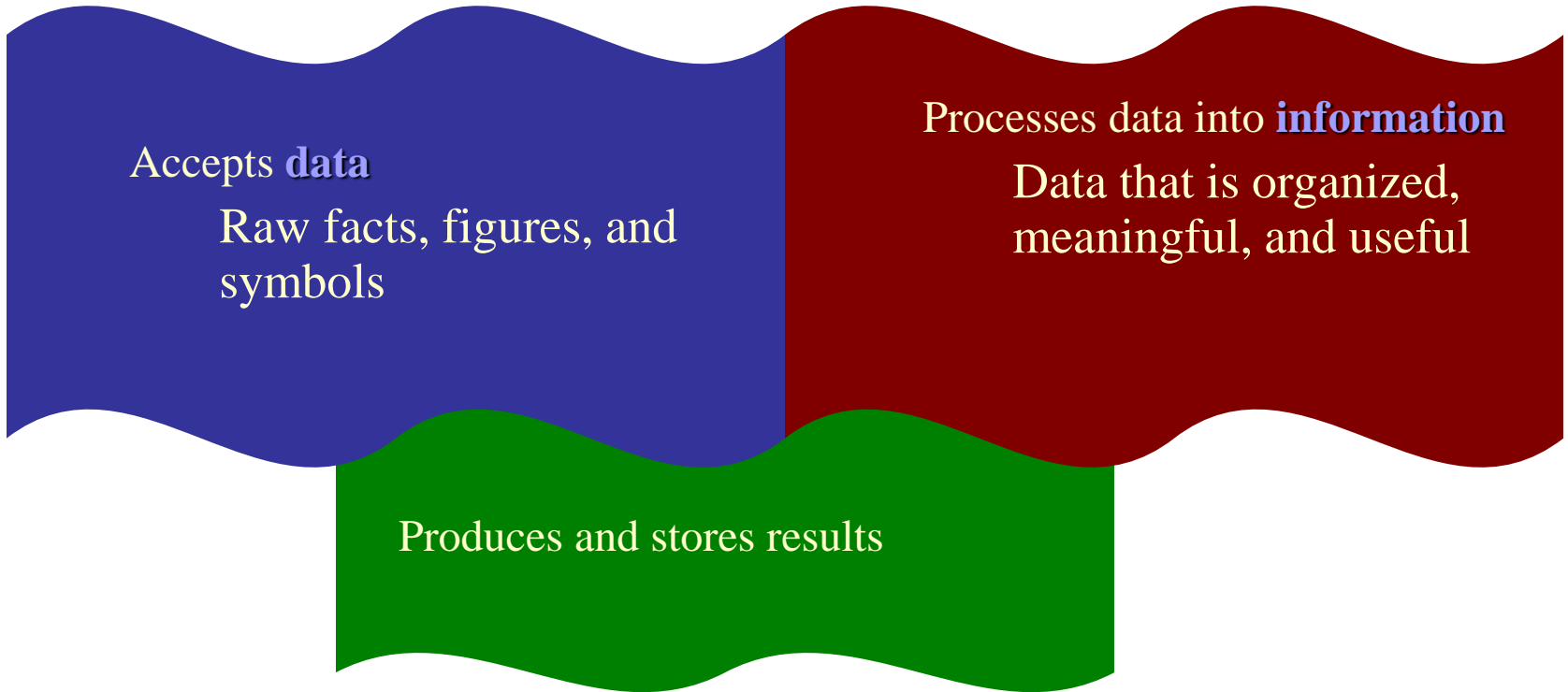
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Computer

- A computer is an electronic device that manipulates information or "data." It has the ability to store, retrieve, and process data.
- We may therefore define a computer as an *electronic device that is programmable to perform specialized tasks and equipped with an*
  - ❖ *input device*
  - ❖ *output device*
  - ❖ *Central Processing Unit (CPU)*
  - ❖ *Storage device.*

What Is a Computer?

- Again, A computer may also be defined as:

  ➤ **Any electronic device operating under the control of instructions stored in its own memory**

Accepts **data**
Raw facts, figures, and symbols

Processes data into **information**
Data that is organized, meaningful, and useful

Produces and stores results

Next ▶

Generation of Computers

- First Generation(1946 – 1954)
  - Main material used was vacuum tubes(electronic valves)

First Generation(1946 – 1954)

- Each computer was made of hundreds of such tubes

- As a result of the vacuum tubes, this generation of computers was huge in physical size. For example, ENIAC - the Electronic Numerical Integrator and Computer - which was developed in 1946 measured 18 feet by 80 feet and weighed 30 tons

- The Computers during this generation were very slow in terms of processing speed.

- The use of vacuum tubes made them to generate a lot of heat and had to be used in air-conditioned rooms

First Generation(1946 – 1954)

- The heat generated actually affected the life span of the computers and also created air conditioning problems

- The computers at this time were very expensive and therefore by the end of 1958 only about 2,500 first generation computers were installed world-wide.

Second Generation of Computers (1954-1962)

- The manufacturers replaced the vacuum tubes used in the first generation computers with transistors

- These transistors were much smaller in size and more reliable as compared to the vacuum tubes

- The second generation of computers was much **smaller** in physical size as compared to the first generation computers

- **Faster** in terms of processing speed, **less expensive** and also generated **less heat**.

- Second generation computers started showing the characteristics of modern day computers as they came with utilities such as printers, disk storage and operating systems
- Also, the instructions (program) could be stored inside the computer's memory. High-level languages such as COBOL (Common Business-Oriented Language) and FORTRAN (Formula Translator) were used.

Second Generation of Computers (1954-1962)

Third generation of Computers (1963 – 1972)

- The transistors were replaced with Integrated Circuits (ICs, semiconductor devices with several transistors built into one physical component).
- This brought a huge gain in computational power
- The first ICs were based on small-scale integration (SSI) circuits, which had around 10 devices per circuit
- This generation of Computers were cheaper, smaller in size, faster in data processing and generated less heat.

Third generation of Computers (1963 – 1972)

Third Generation Computers (1963-1972)

Fourth generation of Computers
(1972 – 1984)

- Technically speaking these are the modern day computers.

- The fourth generation of Computers were made of Very Large Integrated Circuits (VLICs)

- The VLICs (100,000 devices per chip) ensured that millions of components could be fit into a small chip

- These computers were cheaper, smaller in size, faster in data processing and generated less heat

Fifth Generation (Present and Beyond) Artificial Intelligence

- Fifth generation computing devices, based on artificial intelligence, are still in development, though there are some applications, such as voice recognition, that are being used today.

- The use of parallel processing and superconductors is helping to make artificial intelligence a reality. Quantum computation and molecular and nanotechnology will radically change the face of computers in years to come.

- The goal of fifth-generation computing is to develop devices that respond to natural language input and are capable of learning and self-organization.

Classification of Computer

Basically, there are three ways of classifying Computers and these are

- Classification by Data Representation

- Classification by Purpose

- Classification by processing speed and storage capacity

Classification by Data Representation

- Computers represent data in different forms. Some represent data in continuous form while others represent data in discrete form. Under classification by data representation, there are three types of Computers and these are

1. Digital,
2. Analogue
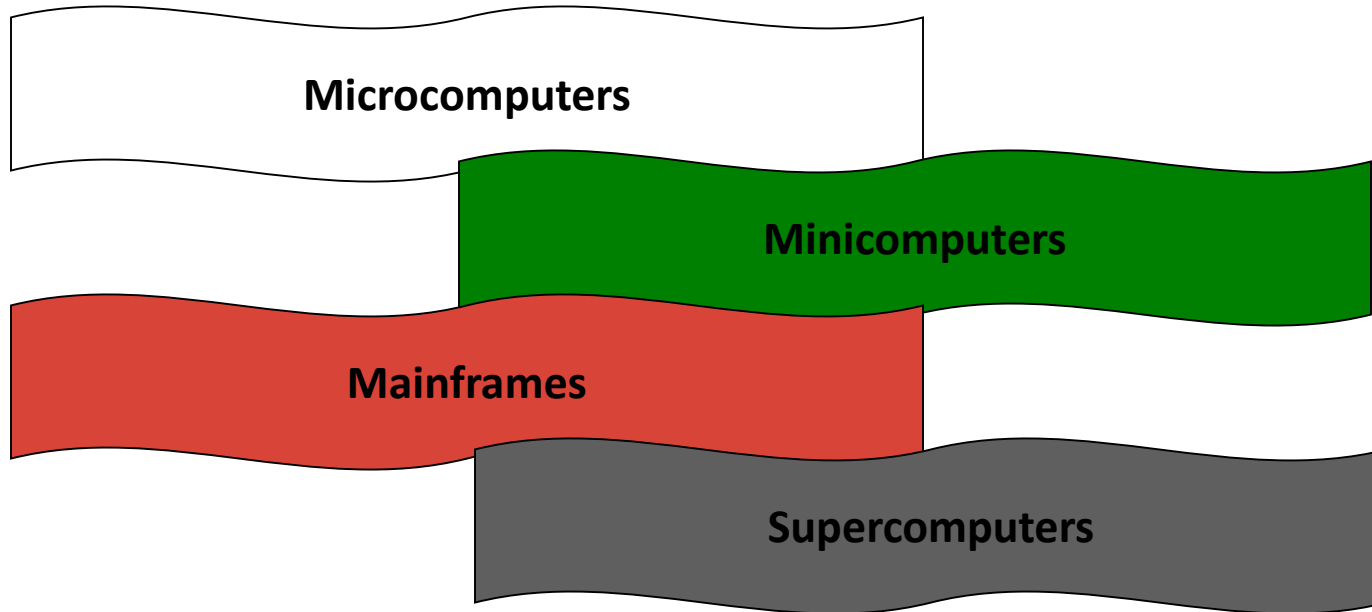3. Hybrid

Classification by Data Representation

- A digital computer represents data in discrete form (using 0s and 1s)

- Analogue computer represents data in a continuous form (uses continuously variable voltages rather than limiting itself to 0 and 1). Analogue computers are measuring devices for measuring quantities such as temperature, pressure, speed and voltages.

- The hybrid computer on the other hand can represent data in both continuous and discrete forms.

Classification by Purpose

- Depending on the flexibility in operations, a Computer can be classified as being either a special or a general computer.
- Special computers are computers that have been designed for a specific purpose. Apart from this purpose the Computer cannot be used for anything else
- General computers on the other hand are computers that are multi-purpose. For example a typical desktop computer can be used for all manner of tasks.

Classification by processing speed and storage capacity

- Computers come in variety of types and with a variety of processing and storage capabilities. We may classify computers as follows:

Microcomputers

Minicomputers

Mainframes

Supercomputers

Microcomputers

- Also known as personal computers (PCs) are small computers that can only be used by one person at a time. Microcomputers come in various sizes and shapes.

- They can be categorized as desktops, towers, laptops and palmtops

- The term desktop actually refers to the casing, or the tower. Once you add a monitor, mouse, and a keyboard, you have what is typically known as a desktop computer.

A Typical desktop computer

Figure 1.5   A Typical desktop computer

- The second type of computer that you may be familiar with is a laptop computer or laptops as they are often referred to. Laptops are battery or AC-powered personal computers that can be easily carried and used in a variety of locations

- A quick glance at the size of a laptop and you might guess that it would be difficult to expand or upgrade.

A Typical laptop computer

Figure 1.6 A Typical laptop computer

Minicomputers

- These were the main type of computers available in the late 1950s. Unlike PCs, minicomputers or minis – as they are often called – are multi-user and multi-tasks computers

- Multi-user - in the sense that they can accommodate more than one user at the same time and multi-task - as they can be made to be executing more than one task simultaneously

Mainframes

- Mainframes are an improvement on minis. Very fast medium-to-large size, large-capacity computers introduced in the late 1960s

- Their size varies depending on how many people or concurrent users they serve – from few hundred to thousands of people

- Because they have larger operational range, they are used in Wide Area Network connecting locations across cities and even countries.

A Mainframe Computer

Figure 1.7 A Mainframe Computer

Supercomputers

- A large computer or collection of computers that act as one large computer capable of processing enormous amounts of data.

- Supercomputers are used for very complex jobs such as nuclear research or collecting and calculating weather patterns.

Supercomputers

- These types of computers were first developed in the 1970s.

- Supercomputers are the fastest and the highest capacity computers.

- Their cost ranges from hundreds of thousands to millions of dollars.

- Among their uses are worldwide weather forecasting, oil explorations, aircraft design, evaluations of aging nuclear weapon systems and complex calculations in mathematical research.
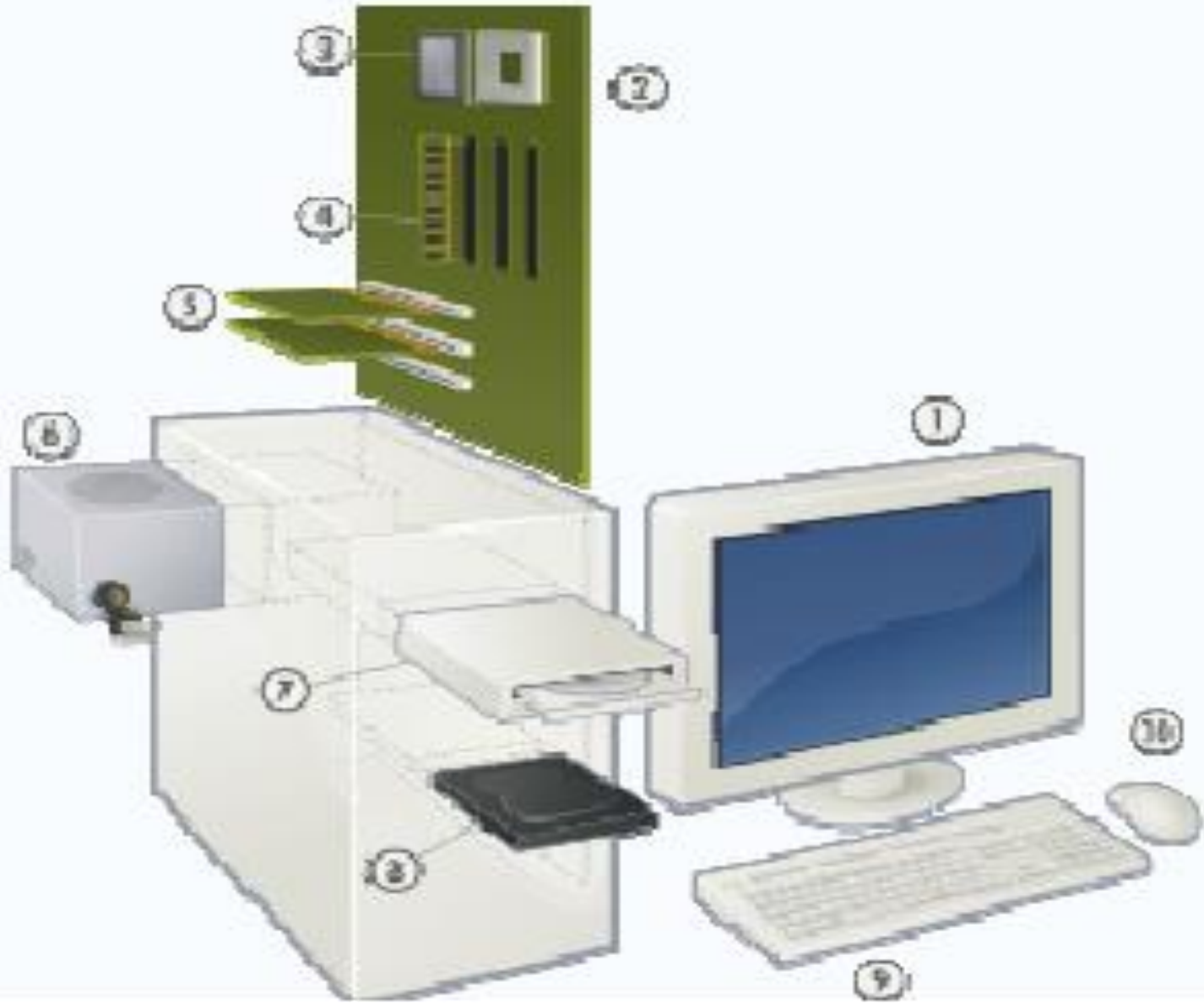
Supercomputers

- Supercomputers have hundreds to thousands of processors. One supercomputer Option Red fills about 85 locker-size cabinet of about 1600 square feet at Sandia   in Albuquerque, New Mexico in the U.S.A.

Supercomputers

- Because microcomputers are generally versatile, increasingly powerful, and more affordable than the other types of computers, they are practical tools for organizations to improve their productivity

- Whatever their size, speed, and capacity, all computers operate according to similar principles.

Parts of a Computer

Components of a Computer

- Every Computer has two major components namely the HARDWARE and the SOFTWARE

- The HARDWARE refers to the physical components, that is the components that one can see and touch.

- The SOFTWARE are the application programmes and the other operating information required by the Computer.

HARDWARE COMPONENTS

Input Devices

These are the components of the Computer used in providing inputs (be it in text, sound, graphics or images, etc) into the Computer. Most common input devices are as follows:

- Keyboard if the inputs are to be typed

- Microphone if the input is audio or sound

- Scanner, Camera if the input is graphics

More about Input Devices

- Input devices include keyboards, pointing devices, and source-data entry devices like scanners and digital cameras as well as voice and audio/video input devices like microphones and video cameras.

- The most common input device and the one you will probably have to learn how to use is the keyboard.

- The computer keyboard unlike the ordinary typewriter keyboard converts letters, numbers, and other characters into electrical signals in machine language and can be processed by the computer processor.

Input Devices

- Other devices that are commonly used in conjunction with the keyboard are pointing devices like the mouse. These devices control the position of the cursor – pointer on the screen. Pointing devices include:
- Mice, trackballs, and joysticks
- Light pens
- Digitizing tablets
- Pen-based systems

Input Devices

- Data-entry devices that do not require keyboard for inputting data include the following:
- Scanners
- Voice-recognition devices
- Audio input devices
- Video input devices
- Digital cameras
- Often times we find keyboard, pointing device and other source-data entry devices like scanners combined in a single computer systems.

Keyboard

- The keyboard is the commonest input device. It is usually connected to the system unit of the computer through a serial port with a cable.
- The keys on the keyboard can be divided into four groups namely:
- Standard keys
- Cursor-movement keys
- Numeric keys
- Function keys
-

Keyboard

Keyboard

- The *Standard typing keys* are similar to that of the typewriter with the familiar QWERTY arrangement of letter, number, and punctuation keys.

- QWERTY refers to the alphabets in the top left row on the standard typewriter keyboard.

- On the computer keyboard, it can be found on the third row.

- The Caps Lock, Shift, and Tab keys and also the Space bar work the same way as they do on a typewriter keyboard.

- The Caps Lock key is a toggle key

Keyboard

- The Enter key that works like the return key on a typewriter – and even often referred to as the Return key – is used to send commands to the computer, in addition to beginning a new paragraph in a word processing environment.

Keyboard

- *Cursor-movement keys* – sometimes called the arrow keys – are use to move the cursor around the text on the screen.

- The cursor is the blinking vertical bar on the screen that indicates insertion point or where data may be entered next.

- The cursor-movement keys move the cursor left, right, up, or down.

- Keys labeled Page Up and Page Down move the cursor the equivalent of one screen (page) up (backward) and down (forward) at a time respectively

Keyboard

- *Numeric keys* are laid out separately on the *numeric keypad* – a separate set of keys, 0 through 9 like those on a calculator – on the standard 101-key keyboard previously known as the AT-style keyboard

- The numeric keypad serves two purposes.

- With the Num Lock key off, the numeric keys duplicate as arrow keys for the movement of cursor and perform other functions such as Page Up and Page Down.

- And when the Num Lock is on, the keys may be used for entering numbers, as on a calculator.

- The Num Lock key is also a toggle key

Keyboard

- However, to maintain keyboard standard the numeric keys can also be found on the second row of keys with other special characters just like the typewriter keyboard.

- *Function keys* are the keys labelled F1, F2 through F12.

- These keys are not used for typing but rather for issuing commands.

- Desktops normally have 12 function keys while some portables like notebooks have only 10.

- The function that each of these keys perform are however software-specific.

Audio Input Devices

- An audio input device records or plays analogue sound and translates it for digital storage and processing.

- Voice-recognition devices are only one kind of audio input device which can translate music as well as other sounds.

Pointing Devices

- The principal pointing tools used with microcomputers are the mouse, the trackball, the joystick, and the touchpad.

- A mouse is a device that is rolled about on a desktop to direct a pointer on the monitor.

- The mouse pointer is the symbol that indicates the position of the mouse on the display screen.

- It may be an arrow, a rectangle, or even a representation of a person's pointing finger.

- It may change to an I-beam to indicate that it is a cursor identifying the place where text or other data may be entered.

Mouse

- The mouse is usually connected to the system unit by plugging it into a port or socket at the back of the unit using a cable.

- A ball under the mouse translates the mouse movement into digital signals and on top of the mouse are one to four buttons depending on the variation of the mouse.
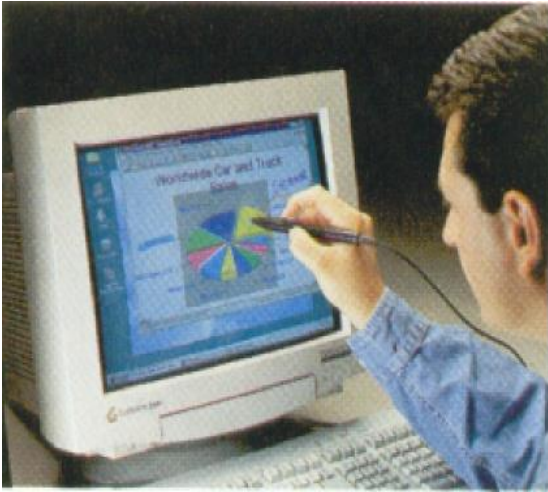
Trackball

- A trackball is a movable ball, on top of a stationary device, that is rotated with the fingers or palm of the hand.

- It looks like the mouse turn upside down; instead of moving the mouse around, you move the trackball with the tips of your fingers.

- Trackballs are specially suited for portable computers like laptops which are often used in confined working environments such as airline tray tables.

Joystick

- A joystick is a pointing device that consists of a vertical handle like a gearshift lever mounted on a base with one or two buttons.

- Joysticks are principally used in some computer-aided (CAD) systems, computerized robot systems, and in video games.

- Mostly found on laptops, touch pads are flat-top rectangular devices that let you control the cursor/pointer by rubbing your finger on the surface of the pad.

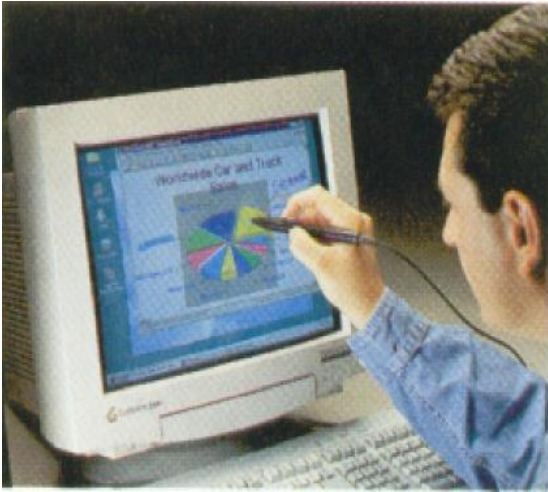- A click action is accomplished by tapping on the pad's surface

Light pen

A light pen in use

- The light pen is a light-sensitive device that is connected to the computer terminal.

- The user points to a desire location on the monitor and presses the pen which then sends the signal corresponding to the location to the computer.

- Light pens are used by graphic designers, engineers, and architects.

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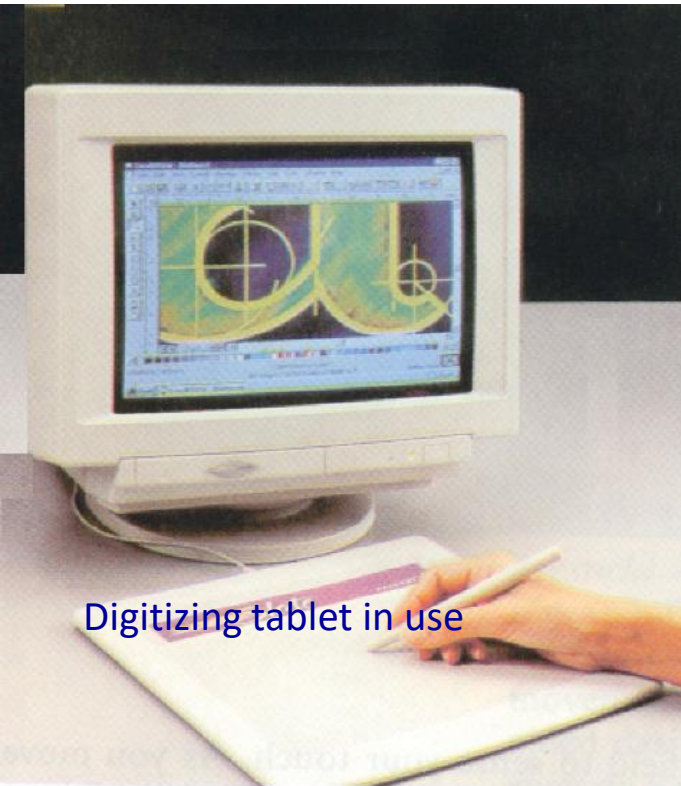- Light pens are used by graphic designers, engineers, and architects.

Digitizing Tablets

Digitizing tablet in use

- A digitizing device consists of a digital tablet that is connected to a stylus or a puck.

- A stylus is pen-like device that is used to sketch images in digitized form.

- A puck is a copying device that the user uses to copy or trace an image.

Digitizing Tablets

- A digitizing tablet used with a stylus enables the user to paint "naturally" and achieve effects similar to what an artist will achieve using pen, pencil, or charcoal.

- Alternatively, a digitized copy of a painting can be traced and stored into the computer by laying the painting or drawing on the tablet.

- Digitizing devices are used primarily by artists and graphic designers.

Scanning Devices

- Hardcopies of graphic images such as drawings and photos are translated into digital form by scanners using laser beams and reflected light.

- The images can be processed by a computer, displayed on a monitor, stored on a storage device, or communicated to another computer.

- Types of scanners include Bar-code readers, Mark- and character-recognition devices, Fax machines, and Imaging systems.

Digital Cameras

- Unlike analog video cameras which convert light intensities into infinitely variable signals, digital cameras convert light intensities into discrete 0s and 1s.

- Digital cameras have enjoyed wide popularity in industrial photography and journalism because the images are instantly available, can be deleted to make storage available for more photos, and can be transmitted over telephone lines.

Output Devices

- Monitor:- Produces soft copies. The two main types are cathode ray tube (CRT) and liquid crystal display (LCD) monitors.

The CRT monitor is big, like a tube television, and takes up a lot of desk space; however, it is the least expensive monitor option.

The LCD monitor is thin and saves energy, but costs more. Over the years you can expect to see fewer CRT monitors if not completely eliminated as LCD monitors become the standard

Types of monitors

An LCD Monitor

A CRT Monitor

Figure 1.10a An LCD Monitor

Figure 1.10b A CRT Monitor

- Printer for hardcopies

There are two types namely impact and non-impact.

Impact printers (e.g Dot Matrix) are very cheap and getting out of the market while the non-impact (laser, bubble jet, etc) are expensive and produce quality output

- Speaker for sound or audio output
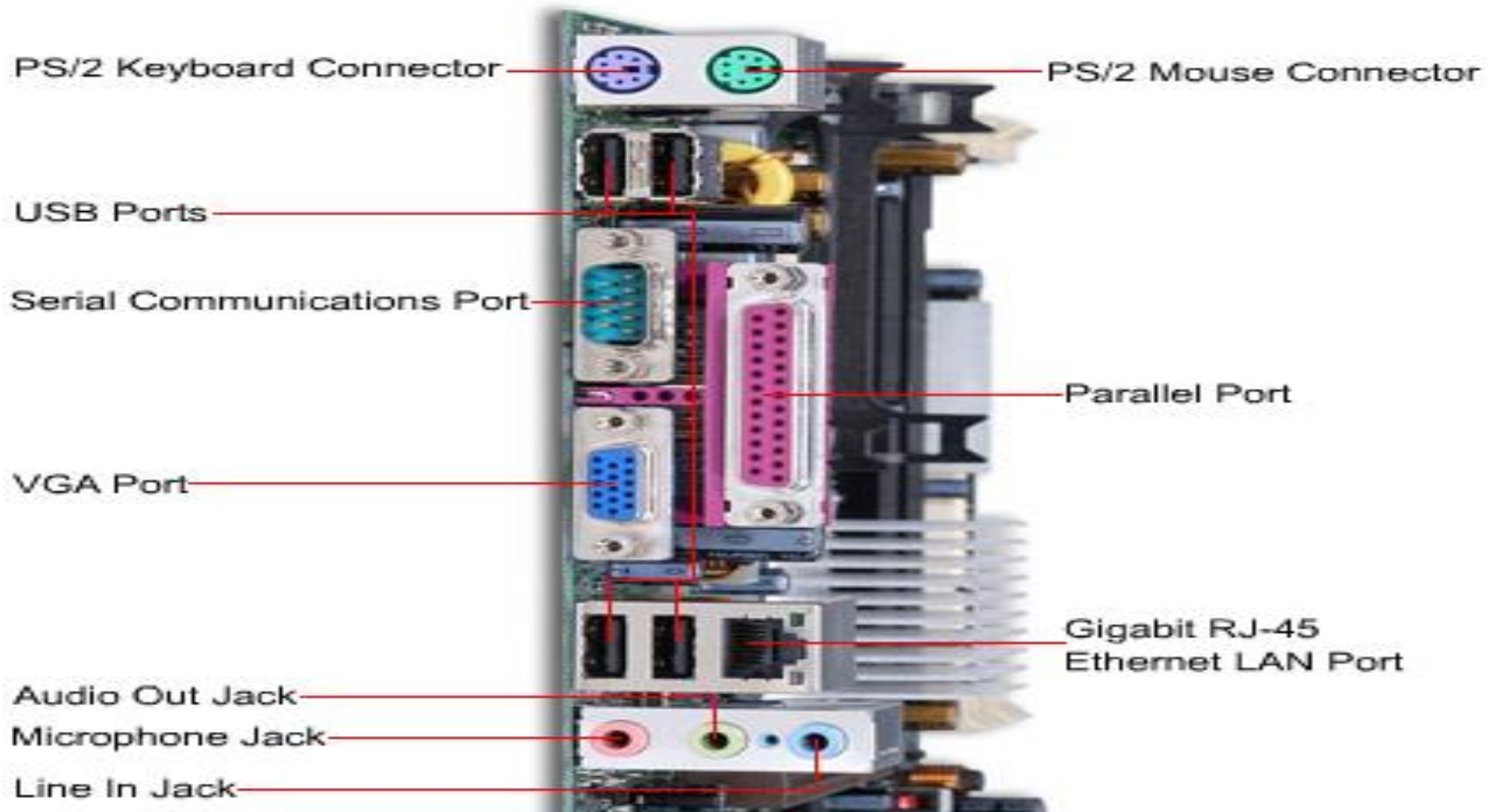- Plotter, similar to printer

Ports

Figure 1.15 Labeled Back View of Computer Case

- **SCSI ports**: SCSI is an acronym for Small Computer System Interface and it is pronounced "scuzzy".
  - In a *daisy chain* – linked SCSI-compatible devices that may include external hard disk drives, magnetic tape, back-up units, scanners, or CD-ROM drives – transfer of data at high speed rate for up to fifteen SCSI-compatible devices is made possible by the SCSI port providing an interface.

- **Games ports**: Game ports enable the attachment of game-playing devices like the joystick to the system unit.

- **Infrared ports**: These are wireless, data-transfer ports on some state-of-the-art computers and hardware peripherals such as printers.

- **FireWire Port**: It is the standard port used with digital video cameras and high-resolution scanners. FireWire replaced the Parallel SCSI, but it is not on every computer; however, you can buy an adapter card to add FireWire ports to your computer.

Inside The Microcomputer

- The box that contains the microcomputer's processing hardware and other components is called the system unit.

- Components that are inside the system unit includes the power supply, the motherboard, the microprocessor, specialized processor chips, RAM chips, ROM chips, other forms of memory – cache, VRAM, flash – expansion slots and boards, ports, bus lines, PC slots and cards.

- The hard disk drive, a diskette drive, and a CD-ROM drive among components are also found inside the system unit.

Inside The Microcomputer cont'd

- For now let us concern ourselves with the following parts of the system unit:

- Power supply

- Motherboard

- Microprocessor

- RAM chips

- ROM chips

- Other forms of memory - cache, VRAM, flash

- Expansion slots and boards

- Buses, PC slots and cards

Power supply

- The power supply is the device that converts power from AC to DC to run the computer.

- The electricity available from a standard wall outlet is an alternating current (AC) but microcomputers run on direct current (DC).

- The on/off switch in the computer turns on or shut off the electricity to the power supply.

Figure 1.20 A Power Supply

Power supply cont'd

- As electricity generates lots of heat, a fan is provided to cool the components and prevent them from getting too hot.

- For precaution sake, it is advisable to connect your computer to an uninterrupted power supply (UPS) or surge protectors instead of connecting it directly to the electricity power outlet

The Motherboard

A Typical Motherboard

- Also known as the system board, the motherboard is the main circuit board in the system unit.

- It's a thin plate that holds the CPU (Central Processing Unit), RAM, ROM chips and other forms of memory, connectors for the hard drive and optical drives.

The Motherboard

- It also houses the expansion cards to control the video and audio, as well as various external ports and peripherals.

- The motherboard connects directly or indirectly to every part of the computer.

The Microprocessor (CPU/Processor)

Figure 1.22 A Typical Memory Chip

- The Central Processing Unit (CPU), also called a processor, is located inside the computer case on the motherboard.

- It is often called the brain of the computer, or the computer's engine.

The Microprocessor (CPU/Processor) cont'd

- Its main function is to interpret the various instructions in a given program.

- The processor has three main components namely the Arithmetic-Logic Unit (ALU), the control Unit (CU) and registers.

- The ALU is the component that performs all the arithmetic and the logical operations, that is, operations such as addition, subtraction, multiplication, division and comparison of two or more items are all done by the ALU.

The Microprocessor (CPU/Processor) cont'd

- The CU is the unit that fetches the next instruction to be executed from the main memory.

It decodes the fetched instruction and issues appropriate command to the ALU, the memory or the input/output controllers for the execution of the instruction.

- The registers are on-chip memories

- There are many processor manufacturers for personal computers including Intel, Cyrix, VIA, and AMD.

- Today, the clock speed of a processor is measured in giga Hertz (GHz).

- The processor with the higher clock speed will execute instructions faster than the one with a lower clock speed.

Processor Speed

- Processor speed is measured in three ways with respect
  - to the frequency of its system clock (in megahertz),
  - the number of instructions processed per second and
  - floating-point operation per second.
- Every computer contains an internal timing device that is switched on when the power of the computer is turned on.
- This device is called the system clock. The system clock controls the pace at which all operations take place.
- The faster the clock, the faster the processing.

- Microcomputer processing speeds are often measured in megahertz (MHz), with 1 MHz equal to 1 million machine cycle or beats per second.

- Processing speed of Workstations and Mainframes are often measured in number of instructions processed per second (IPS) which currently runs into millions.

- Thus, MIPS (million of instruction per second) is a measure of computer processing speed.

- For Supercomputers, processing speed is often measured in flops – floating-point operation per second.

- Floating-point operation is a special kind of mathematical calculations.

- This measure is often expressed in megaflops (millions of floating-point operations per second), gigaflops (billions of floating-point operations per second) and teraflops (trillions of floating-point operations per second).
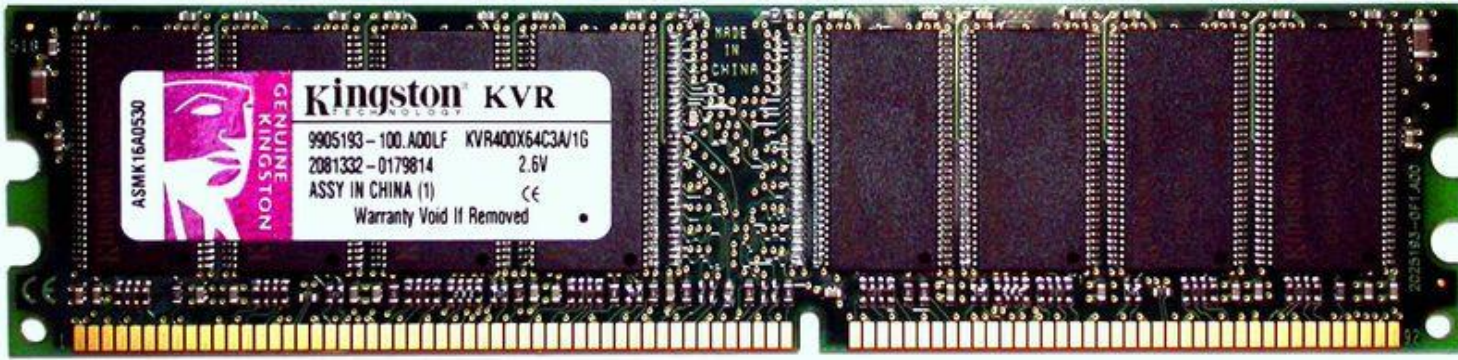
RAM CHIPS

Figure 1.13 A Typical Memory Chip

- The main memory or the RAM (random access memory), is the temporary work space for the processor.

- It is a temporal or versatile memory

RAM CHIPS

- It temporary holds data and instructions that will be needed shortly by the processor.

- Data is temporarily stored here until you save your work to the hard disk.

- This short-term memory disappears when the computer is turned off, so always save your file before turning off the machine.

- The capacity of the RAM therefore determines how large the software that can be run on any computer and how fast it can run.

ROM Chips

- The Read Only Memory (ROM) chips also called firmware, cannot be written on or erased by the computer – as the name suggests, its content can only be read.

- Firmware is the term that is used for software permanently stored on a chip – microprogrammed.

- If we say that RAM chips temporarily remembers (information supplied by the user or software), then ROM chips can be said to permanently remember (information supplied by the manufacturer).

ROM Chips

- ROM chips contain instructions that need to be available at all times for the computer to "get up and run".

- One of these is the bootstrap – instructions that tell the computer what to do when it is switched on or booted.

- To get the computer going, a ROM also performs a "power-on-self-test" (POST).

- There are three variations of ROM chips that are used in special situations. The three variations are PROM, EPROM, and EEPROM.

ROM Chips cont';d

- *PROM*: Programmable Read - Only Memories are blank chips on which instructions or programs are written using special equipment. Once the program is written, it cannot be erased.

- *EPROM*: Erasable Programmable Read Only Memories are like PROM chips except that the contents can be erased, using special equipment and new data or instructions can be written. A special device that uses ultraviolet light is used to erase its content.

EEPROM Chips

- *EEPROM*: Electronic Erasable Programmable Read-Only Memory can be reprogrammed using special electrical impulses. The advantage of EEPROM chips is that they need not be removed from the computer to be reprogrammed.

Computer Memory Capacity

- How much data – in other words, how many 0s and 1s – a computer memory or a storage device can hold is very important for its operation.

- As we already mentioned, a 0 or 1 occupies one bit of memory space.

- A character consists of eight bits thus occupies eight bits of memory space.

- As data are keyed into the computer in characters, bits are grouped into eight bits – 1 byte.

- A Byte is used to hold a letter, number, or a special character (such as *, &, $, etc).

- The kilobyte is the common unit of measure for internal memory of microcomputers. 1024 bytes 2^{10} bytes

- A Megabyte (MB) is about 1 million bytes. Precisely (1,048,576 bytes). 2^{20} bytes. A floppy diskette for example has a capacity of 2 MB.

- A Gigabyte (GB) is about 1 billion bytes.
- Precisely 1,073,741,824 bytes or ? MB.
- This measure is often used to measure the capacity of hard disks of microcomputers or PCs, CD-ROMs and main memory capacity of mainframes and supercomputers.
- A Terabyte (TB) represents 1 trillion bytes or 240 bytes or precisely 1,009,511,627,776 bytes.
- Supercomputers main memory capacities are expressed in terabytes.

Other Types of Memories

- RAM is divided into two sections with one section relatively large and called the main RAM.

- The other section called the cache memory being tiny and containing few but more expensive chips.

- Cache memory is a special high-speed memory area that the processor can access quickly.

- It serves as a buffer (or bridge) between the processor and the main RAM.

- Another form of memory is the flash RAM cards that consist of circuitry on a credit-card-size plate or card.

- Flash RAM cards are derived from EEPROM and are non-volatile.

- They are used to simulate main memory and also to back up or supplement the hard disk drives.

RAM Capacity, Word Size and Processing Speed

- The power of supercomputers, mainframes, minicomputers, workstations and microcomputer, is measured according to three main parameters: RAM capacity, wordsize capability, and processor speed.

- There are other deciding factors, though these three are the most important.

WordSize

- The next deciding factor of the power of a computer is its *wordsize* – the number of bits its register can hold and process at one time and can be transferred to and from memory, output / input devices and remote sites through its internal bus – electronic highway.

- A 32-bit processor will process data and instructions in 32-bit chunk and a 64-bit processor in 64-bit chunk thereby being twice faster.

- It should be noted that expansion bus capacity (also measured in word size), the capacity of the bus that connects the processor, RAM, and registers to the peripherals of the computer also plays a major role.

An Expansion Board

Expansion Slots

- These are places/sockets used to expansion cards (such as sound card, video, graphics, Ethernet or memory)

Communication Devices

Communication devices make it possible for computers to communicate with each other and share information and other resources in a network environment.
When the radius of the network is within a short range, the network is called a Local Area Network (LAN) and if the radius spans over long distances like cities and even countries, it is called a Wide Area Network (WAN).

Communication Devices

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Network Card for Communication

Network card

The network card allows your computer to communicate over a network **1.18 A network card**

Communication Devices

- Computer communication is accomplished in two ways. We have wired connection and wireless connection.

- Wired connection is implemented with the use of telephone lines and cables

- Wireless connection with the use of microwaves and radio waves

Communication Devices

- In the transmission of information from one computer to another, particularly wired connection which is most predominant, a piece of hardware known as MODEM (modulator-demodulator modem) is needed for conversion of signals from digital form into analog form and vice-versa as transmission over telephone lines is in analog form while computer data to be transferred are usually in digital form.

Communication Devices

- Other forms of channels are the cables. In this category, we have the coaxial cable and the fiber- optic cable.

- Coaxial cable commonly called "co-ax", consists of insulated copper wire wrapped in a solid or braided metal shield, then in an external cover. Co-ax is mostly used for cable television and to connect parts of a LAN over a long range.

INTERNAL DATA REPRESENTATION

• The two common binary coding schemes normally used in data representation are the ASCII – and EBCDIC – codes.

- ASCII, which is an acronym for *American Standard Code for Information Interchange* was later extended to accommodate more special characters and the latter version was referred to as extended ASCII or ASCII-8.

- The latest of the versions is the ASCII-16 coding scheme which uses 16 bits. ASCII is the most widely coding scheme used in microcomputers.

\- Unicode or ASCII-16 which is a version of ASCII uses 2 bytes (16 bits) to represent a character, instead of 1 byte (8 bits) and therefore can handle 65,536 characters rather than just 256

- EBCDIC stands for *Extended Binary Coded Decimal Interchange Code* is the most widely used scheme in mainframe computers. Table 1.1 shows the codes for the uppercase alphabetic letters and numerical digits, 0 to 9. (See Table 1.1)

Table 1.1

Character	ASCII	EBCDIC	Character	ASCII	EBCDIC
A	0100 0001	1100 0001	N	0100 1110	1101 0101
B	0100 0010	1100 0010	O	0100 1111	1101 0110
C	0100 0011	1100 0011	P	0101 0000	1101 0111
D	0100 0100	1100 0100	Q	0101 0001	1101 1000
E	0100 0101	1100 0101	R	0101 0010	1101 1001
F	0100 0110	1100 0110	S	0101 0011	1110 0010
G	0100 0111	1100 0111	T	0101 0100	1110 0011
H	0100 1000	1100 1000	U	0101 0101	1110 0100
I	0100 1001	1100 1001	V	0101 0110	1110 0101
J	0100 1010	1101 0001	W	0101 0111	1110 0110
K	0100 1011	1101 0010	X	0101 1000	1110 0111
L	0100 1100	1101 0011	Y	0101 1001	1110 1000
M	0100 1101	1101 0100	Z	0101 1010	1110 1001
0	0011 0000	1111 0000	5	0011 0101	1111 0101
1	0011 0001	1111 0001	6	0011 0110	1111 0110
2	0011 0010	1111 0010	7	0011 0111	1111 0111
3	0011 0011	1111 0011	8	0011 1000	1111 1000
4	0011 0100	1111 0100	9	0011 1001	1111 1001

Machine language

- Machine language – the language that the computer "speaks and understands" – is the binary programming codes which can be processed directly.

- Instructions in machine language consist of series of 0s and 1s which could be quite tedious to read and write to humans.

- Machine language is machine dependant due to differences in instruction sets.

Machine language cont'd

- Thus each model or family of processors has a unique machine language.

- To circumvent this problem, programmers write in special programming languages – high level languages – that more closely resemble human languages.

- Codes in these high level languages such as BASIC or C++ are then translated by system software programs called language translators (Assemblers, Interpreters and compilers) into the machine language that the particular type of processor can "understand".

INPUT/ OUTPUT AND STORAGE DEVICES

Learning Objectives

After reading this unit you should be able to:

- Identify the various hardware devices

- Explain how data is represented internally by the computer

- Distinguish between the different types of file

STORAGE DEVICES

- Storage devices are media for storing data. Often referred to as secondary storage, storage devices can range from

- Computer software or programs in additions to data must be stored in a computer-usable form.

  Software instructions must be retrieved from a permanent storage device and placed into RAM for any processing to take place.

- Generally, a secondary storage can be likened to a file cabinet in which files (data) are stored until they are needed.

- Then you open the drawer, take out the appropriate folder or file, and place it on top of your desk (in primary storage, or RAM), where you work on it – either to write some few things on it or to remove and throw some few pages away.

- However, in the case of electronic documents, you are actually taking out a copy of the desired file and putting it on the desktop.

- The original file remains in the file cabinet (secondary storage) while the copy of the original is being edited or updated on the desktop (in the RAM).

- After working on the file, you take it off the desktop (out of primary storage) and return it to the cabinet (secondary storage). Thus the updated file replaces the original file.

- Storage devices can be said to consist of two physical parts namely the storage medium on which information and software are stored, and the device that reads and write the storage medium.

- When listening to a tape or a CD, the storage medium is the cassette or CD and your cassette or CD player is the device that reads from the cassette or CD.

- Storage devices can be categorized in two ways. One is by their method of storage the other is by method of access.

- Method of storage implies the technology used for storing or writing information onto the storage medium.
- Most popular types of technology include magnetic, optical and magneto-optical.
- Method of storage can be likened to the method you use to record information on paper – writing with a pen or pencil or typing.
- Method of access implies the order in which information is written to and read from the storage medium.

- Basically, we have two main types of access methods - sequential and direct.

- To understand access methods, think about the difference between cassette tapes and CDs.

- Cassettes use sequential method; music tracks are stored sequentially on them.

- On the other hand, CDs use direct access as such you can play any track by going directly to it without having to fast forward or rewind to the track as with tapes.

- Storage devices fall into families of cassettes or CDs – tape or disk. Tape storage devices use sequential access method and magnetic storage method while disk devices use direct access method and magnetic, optical or magneto-optical storage methods.

Tape Storage Devices

- Magnetic tapes – simply called tape drives – used to be a common secondary storage medium for large computer systems.

- However, these days magnetic tape is used mainly on large systems for backup and archiving – maintaining historical records – and on some microcomputers for backup.

- Tape storage devices use a magnetic method of storage and a sequential method of access to read and write information to and from a magnetic tape. These are similar to cassette tapes.
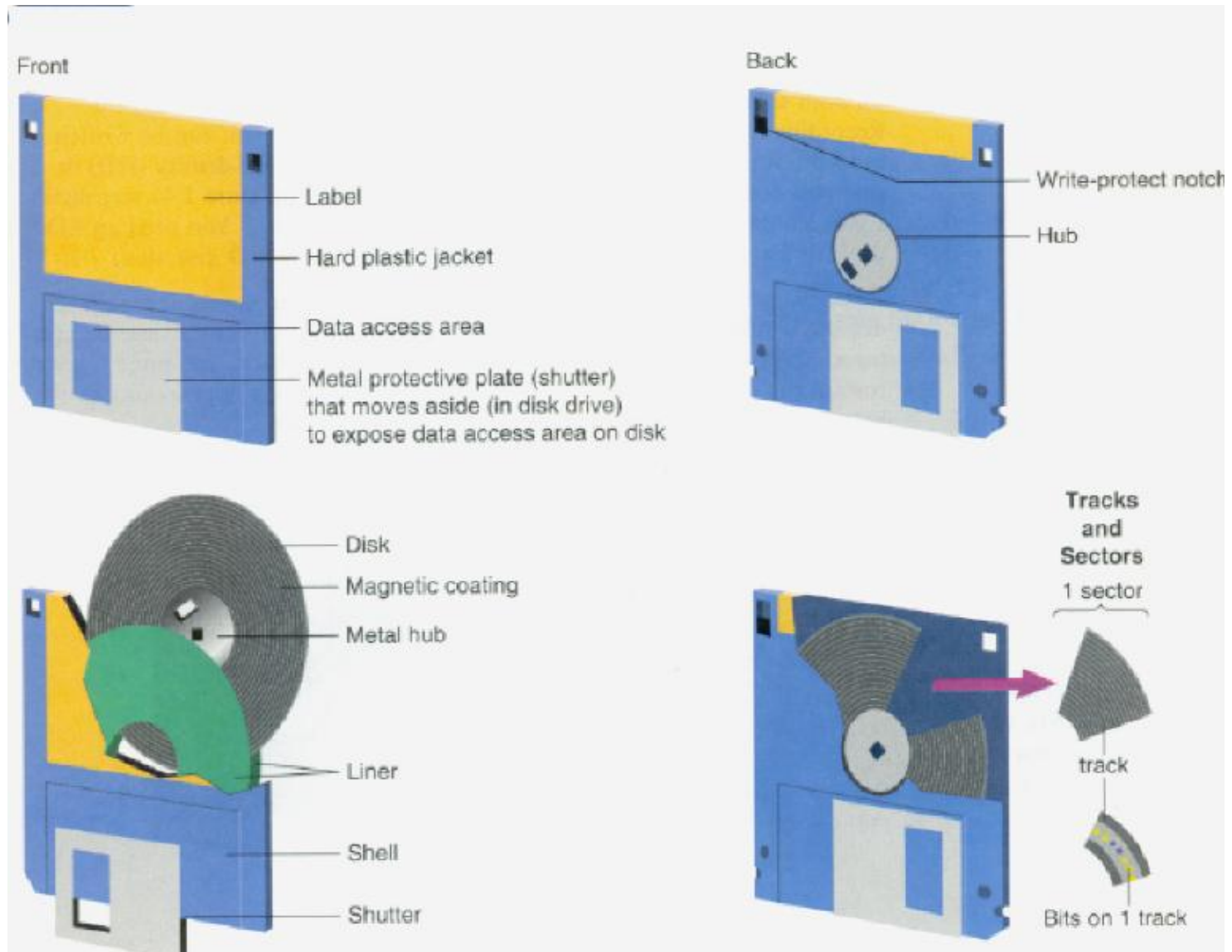
- Disk storage devices are the most common storage device in use today.

- These types of devices are so named because of the shape of their storage medium. The storage medium is called a disk – round platter on which information is written on tracks in the form of concentric circles.

- The storage capacity of disk storage devices is measured in the same way as the internal memory – kilobytes (KB), megabytes (MB), and gigabytes (GB).

- The storage capacity of magnetic disks ranges from few megabytes to several gigabytes – billions of characters.

- Variations of magnetic disks include the floppy disks, internal hard disks and compact disks.

Floppy Disk

- Floppy disk, popularly known as diskette is a removable, round, flat piece of circular plastic that is placed inside a hard jacket – a squared plastic case – to protect it from being touched.
- Diskettes are often called floppy because of their fragile nature.
- The disk is rotated within the jacket while inside the disk drive. Floppy disks come in 5.25" and 3.5" sizes.
- However, the smaller 3.5" disks have replaced the 5.25" as the predominant floppies in microcomputers and workstations.

Floppy Disk (3.5")

- A typical 3.5" floppy disk can store up to 1.44 MB of data.

- Advantages of these diskettes are that they are smaller and therefore easier to carry and since they are contained in hard plastic jackets, they are less susceptible to physical damage.

- The use of diskettes is however fast fading out due to the availability of more reliable, high capacity, robust, portable and yet cheap storage devices such as the Pen drive.

Characteristics of Diskettes

Floppy diskettes have the following characteristics:

- Tracks and sectors: Data is recorded on diskettes in concentric rings called tracks.

- Each track is divided into sectors. Sectors, like tracks are invisible and are wedge shaped used by the computer for storage reference purposes.

- Each sector typically holds 512 bytes of data. However, the number of sectors per tract varies according to the recording density.

- Unformatted vrs Formatted diskette: Most diskettes today come of the factory formatted.

- For a diskette to be ready for use, it has to be formatted.

- Formatting – or initializing as it known in Macintosh environment – means that you must prepare the disk for use so that the computer operating system can read and write information on it.

- Unformatted diskettes are without tracks and sectors on it. By formatting the diskette you define the tracks and sectors on it as well as setting up the file allocation table (FAT) for the diskette.

Optical Disks

- Optical disks are removable disks on which data is written and read using laser technology – These disks store much more data than floppies. A single optical disk of type called CD-ROM can hold up to 700 MB of data.

Optical Disks

- The main types of optical technology used with computers are:
- CD-ROM disks
- CD-R disks
- CD-RW disks
- DVD/DVD-ROM

CD-ROM Disks

- One of the most popular of optical disks is the CD-ROM – compact disk-read-only memory.

- This type is used only to hold software programs and data.

- CD-ROM is much like the music CD; it is a read-only storage medium.

- Read-only means once data or information – which may include visuals and sound – is written on the disk from the factory, it cannot be overwritten or erased by the user.

CD-ROM Disks `

- Most microcomputers have built-in CD-ROM drives.

- The faster the drive spins, the more quickly it can deliver data to the processor.

- Typical PC CD-ROM drive is used with only one disk; however, there are multi-disk drives that can handle up to 100 disks. Such drives are called jukeboxes, or CD changers.

CD-R Disks

- CD-R, which stands for compact disk-recordable, is a CD format that allows users with CD-R drives to write data, only once, onto a specially manufactured disk that can then be read by a standard CD-ROM drive.

CD-R Disks

- CD-R are now becoming the industry standard for backing up files on the hard disk and for coping large volume of software programs and data including audio visuals.

- A typical CD-R has a capacity 700 megabytes

CD-RW Disks

- CD-RW stands for compact disk rewritable. It is sometime referred to as erasable CD.
- CD-RW allows users to erase data so that the disk can be used over and over again just like the pen drive.

DVD-ROM Disks

- The letters used to be interpreted as "digital video disk" and later, when its diverse possibilities became obvious, for "digital versatile disk".

- DVD is a silvery, 5-inch optically readable digital disk that looks like an audio compact disk but can store up to 40 gigabytes.

- The computer version of DVD is called the DVD-ROM disk.

- It represents a new generation of high-density CD-ROM disks.

Hard Disk

- A hard disk cartridge is a disk storage device in which the disk drive is separate from the hard disk storage medium.

- This type provides increased storage capacity of hard disks and ability to change disk media, as with floppy disks.

- Hard card, often referred to as memory cards, this is a type of hard disk that can be added to your system by inserting it into an expansion slot.

- Hard disks have the advantage of capacity and speed.

- Seek time – the time it takes for read-write heads to move to the correct track – measured in milliseconds (1000th of a second).

- Seek time for microcomputers hard disks ranges from 1 to 3ms.

- After the head reaches the desired data, it must wait for the disk to rotate so the head is positioned over the correct sector; this rotation time is called latency, which may be about 1 to 2 ms for a hard drive.

- Access time is the sum of seek time and latency.
- Main disadvantage of hard disk remains the possibility of head crash.
- A head crash happens when the surface of the read-write head or particles on its surface come into contact with the disk surface, causing the loss of some or all of the data on the disk.
- A head crash can also be caused by jarring or even power outage when the hard disk is in use.

- Hard disk crash can be disastrous particularly if the data on it has not been back up, so care has to be taken to backup your data at all times.

- It is also strongly recommended that your system be always connected to an uninterrupted power supply (UPS).

Pen Drives (Flash Drives)

- Pen drive is a portable USB flash memory device that can be used to quickly transfer audio, video and data files from the hard drive of one computer to another. It is physically small in size

- USB flash drives are typically removable and rewritable, much smaller than a floppy disk, and most USB flash drives weigh less than an ounce (30 g)

- Most flash drives use a standard type - USB interface - connection allowing plugging into a port on a personal computer, but drives for other interfaces also exist.

Types of Files

- A file is a collection of related data or information that is identified by a unique name and treated as a unit by the computer.

- Not all files however, can be used by all software.

- The format in which a file is saved must be compatible with the particular software for the software to be able to use or process the file.

Types of Files

- Each file is given a unique named and a — "tag" (PC-based) or extension names added after a period such as .DOC added onto the name of a Microsoft word-processed document file (MYFILE.DOC).

- Normally, the applications software automatically adds an extension to file names.

Types of Files

- The following are some common types of files:

    Program files:

    - These are files containing software instructions. Source program files contain high-level computer instructions in their original form, written in a programming language by computer programmers.

    - Files that contain the machine language instructions are called executable files (or binary files).

    - These files can be identified as having the extension as .COM or .EXE

Data Files:

- Data files contain data, not programs – that is, they contain user-created text documents.

- Such documents are often created using application software programs.

- These files are given extension names by the software that was used to create them.

- Example is spreadsheet files created with Excel having .xls extensions or documents created using word-processing software, such as Microsoft Word having .doc extensions.

ASCII Files:

- Also referred to as text files, these are plain text-only files. They contain no formatting such as boldface or italics, and no graphics. The characters are in ASCII code.

- This file format is used to transfer documents between incompatible platforms, such as IBM and Macintosh. ASCII or Text file usually have .txt extensions.

Image Files:

- These file types hold digitized graphics. They often have many different extensions, depending on the software used to create them.

- Some examples are .JPG (still images compressed according to standards of the Joint Photographic Experts Group), .GIF (graphics interchange format), and .BMP (bitmap) files that use standard Windows graphics format.

Audio Files:

- Audio files contain digitized sound. Common extensions are .WAV and .MID

Video Files:

- Video files contain digitized video images. Common extensions are .MPG (Moving Pictures Expert Groups) and also .AVI.