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INFORMATION COMMUNICATION TECHNOLOGY

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INFORMATI0N COMMUNICATION TECHNOLOGY MANUAL

PREFACE

Today, many managers are using computers, business databases and models to help make decisive decisions. This is a positive change in behavior and some evidence indicates the use of computers to support management decision-making is entering a new and more sophisticated stage. The novelty of managers using computers is "wearing off" and more importantly the capabilities of our support systems are beginning to match the expectations of managers. Information Systems are now both a business necessity and an opportunity to gain competitive advantage. This manual tries to build on these positive changes and provide an updated exploration of computerized information systems.

Information Communication Technology is only one part of an innovative educational and knowledge resource for people interested in learning more about data processing facilities which come in hand when making decisions for their businesses. The idea was to develop a book that was strong on concepts and theory with timely and up-to-date application examples.

This manual has been written at a college reading level, anticipating that it might be read by technical and non-technical readers, and by practicing managers and undergraduate and graduate students. My presumption was that readers would have only an introductory-level background in Computing or Business Information Systems.

Any comment or constructive opinion will be highly appreciated.

TABLE OF CONTENT

CHAPTER 1

1.0 INTRODUCTION TO INFORMATION SYSTEMS

Objective

By the end of this topic the learner should be able to explain the evolution of computers, their use, advantages and disadvantages.

Summary of the subtopics

- Basic elements of a computer.
- Features of computers.
- History of computers
- Uses of computer.
- Classifications of computers.

1.1 Basic Elements of a Computer

a. Input; It is necessary to present data in a way that provide easy conversation into its own electronic pulse-based form. This is achieved by keying in data using a keyboard that changes it into machine sensible form.
b. Storage; Data and instructions enter the main storage, and are held until needed to be worked on.
c. Control; the processor controls the operation of the computer. It fetches instructions from main storage, interprets them and issues the necessary signals to the components making up the system.
d. Processing; Instructions are obeyed and the necessary arithmetic operations are carried out on the data.
e. Output; Results are taken from the main storage and fed on a output device. This may be a printer which changes information in a printed form called Hard copy.

Advantages of Using Computers

a. Computers are fast.eg in manipulating figures b.
Have large storage capacities
c. Occupies a small area in the office (working area) .
d. Computers are always accurate.
e. Computers can work for a long time without getting tired or bored. f.
Computer storage to neat offices (paperless offices).

Disadvantages of using Computers

a. Computers are expensive to purchase
b. One must be trained so as to use computer c.
Leads to unemployment
d. Laziness in working out simple activities e.g. simple calculations e.
Requires power to operate

1.2 Features of computers

1. **Speed-**the speed of a computer can be specified in terms of the processing speed or the access time that is, the time taken to find particular information. This speed is measured in fractions of seconds.
2. **Accuracy-** a computer never makes errors however, error may occur and some modern computers have features for detecting and correcting such errors. Usually errors are committed by the users feeding data to the computer hence the saying GIGO (Garbage in Garbage out).
3. **Storage-** a computer is capable of storing large amounts of data and it can produce this data again and again on demand. A human brain can never do that.
4. **Diligence-** a computer never gets tired or bored if it has to do the same job again and again. Even if it has to do a million calculations, it will do the last one with the same speed and accuracy as the first one.
5. **Automation-** once the instructions have been given, a computer can carry on its job automatically till it is complete.
6. **Versatile-** a computer is capable of performing a large number of different jobs depending on the instructions fed to it and the hardware characteristics.

1.3 Uses of the computer (role of computer in our society)

a. Education and research; Computers are widely used in education as teaching aids and in research institutions. In aviation, computers are used to train pilots. Scientists use computers to analyze experimental data. Engineers and architects use computers to design, test and re-design.

b. Health Care; Medical records on patients are today stored and retrieved from computer for patients management purpose. Computers also today allow for access to otherwise inaccessible or prohibitively. Expensive foreign expertise or labour and make it possible for hospitals in one country to use consultants or even surgeons in another thereby reducing traveling for patients, businessmen and professionals.

c. Industry and Commerce; Almost every industry or service providers use computers in day- to-day operations. It's known impossible to manage a large organization without the help of the computer. Apart from track of orders and bills, computers play a strategic role in business by defining new products and services, maintaining

   Competitive edge and providing new opportunities for management control. Leading companies are using computing technologies as competitive tool to develop new products and services, forge new relationships with the suppliers and edge competitors.

d. Offices; in modern offices, computers are now routinely used for general office automation including text production, accounting services, clients information, desk-top publishing, stock control, point-of-sale terminals.

e. Process Control; Computers are widely being used in the production environment to control chemical and mechanical processes. These are specialized applications and each computer system has to be constructed to do a specific job.

f. Communication industry; in the telecommunication industry, every telephone exchange today relies on computers to switch incoming and outgoing calls. Railway corporations rely on computers to co-ordinate the movement of their wagons and goods. In the air-line industry, computers are heavily used in air traffic control and surveillance of air space using radar equipment as well as for reservation purposes.

g. Police & Defense; Computers are nowadays used to fight crime. Police keeps database of fingerprints which are automatically analyzed by computers. In defense computers are used in electronic news gathering, efficient communication, detection and tracking of targets, radar systems, warning systems and military laser and guided missile s

1.4 Historical development of computing.

Generations of computers

First Generation: 1946-1956

The first generation of computers relied on **vacuum tubes** to store and process information. The tubes consumed a lot of power, were short-lived and generated a lot of heat.

Second Generation: 1957-1963

This generation of computers relied on **transistor technology** (invented in 1947 at Bell laboratories) and magnetic core memories. Transistors were more stable and reliable than vacuum tubes.

Third Generation: 1964-1979

This generation of computers used **integrated circuits** (ICs) which were made by combining several transistors together (3 to 15 transistors).magnetic disk was developed during this period for storage purposes.

Fourth Generation: 1979-1989

Computers in this generation used **large scale integration** (LSI which combined hundreds of transistors) and **very large scale integration** (VLSI) circuits. Memories used include3d magnetic disks, bubble memories and optical disks.

Fifth Generation: 1990-Present

The major thrust of the fifth generation of computers is distributed computing systems and the merging of telecommunications and computing technology. The technologies currently used and under research during this generation, include parallel architectures, three dimensional circuit design and super conducting materials

1.5 CLASSIFICATIONS OF COMPUTERS.

Computers may be classified in various ways which may include the following:

1. ACCORDING TO PHYSICAL SIZE.

a) **Supercomputers-** These are the largest and most powerful computers .complex scientific applications like weather forecasting requires a large amount of data to be manipulated within a very short time. Large supercomputers with faster processing using multiple processors and superior technology are used for complex tasks requiring a lot of computational power. Supercomputers use "Von Neumann designs"(the design in which a single controller is handling data and instructions in a single stream) multiprocessor systems with simultaneous or parallel processing. With multiple processors, a single task is split among the processors for faster execution. All the processors are controlled by a single central processor. Examples of supercomputers are CRAY T3D and NEC-500.

b) **Mainframe** –These are the second largest computers. They can process large amounts of data very quickly and therefore used by big companies, banks and government departments as network servers. They are usually kept in an air- conditioned environment in a special room. They act as nodes of large national and international communication networks such as the internet. Examples of mainframes are the IBM4381, ICL 39 series and the CDC Cyber series.

c) **Minicomputers-** they are physically smaller than the mainframe. They also support a number of concurrent users but are usually slower than mainframes. They are easier to manufacture and maintain hence cheaper. Minicomputers can be used in business and commerce and can be used for applications such as payroll, invoicing and stock control. They are mainly used as corporate servers in large organisations and the government or by medium sized organizations. The first really minicomputer was the PDP-8 launched in 1965.

d) **Microcomputers-** they are smaller than the minicomputers. The 'heart' of the microcomputer system is the microprocessor. The new microprocessor is not only cheaper, it is also faster, smaller, more energy efficient, more reliable and more modular. Computing power came onto the desktop and the low cost of microcomputers led to the explosive proliferation of computers into virtually every

area of business activity. Individuals are now using computers more and more i n their own offices and homes.

e) **Portable computers**-they have got the same capability like the microcomputer .the difference is that they are small enough to be carried around unlike the microcomputers. They are basically used by travelling professionals like doctors.

f) **Pocket computers**-this is the smallest form factor .they have got less features compared to portable computers. They are small enough to fit in ones pocket. They include the personal digital assistants (PDA).

2. ACCORDING TO DATA HANDLING.

a. **Analogue computers**-they are used to process data which is in a continuous form like temperature
b. **Digital computers**-these are computers uses to represent data on a wave with constant values to represent either a 0 or a 1 depending on the encoding technique being used.
c. **Hybrid computers**-these computers combine both features for analogue computers and for digital computers.

3. ACCORDING TO PURPOSE.

a. **General purpose computers**-these are computers designed to be used in many application areas e.g. graphics design, architectural design, computer gaming etc.
b. **Special purpose computer**-these computer scan be use in many application areas but they are dedicated to doing only one special task.
c. **Dedicated computers**-these computers are designed to do only one task.

1.6 Review Questions

a. What is the difference between data and information
b. Discuss application of computers in schools, government, defense and management.
c. List and explain the types of computers as categorized under the cost and size parameters.
d. Explain the advantages and disadvantages of computers.
e. Discuss the generation of computers.

Chapter 2

2.0 COMPONENTS OF A COMPUTER SYSTEM.

Objective.

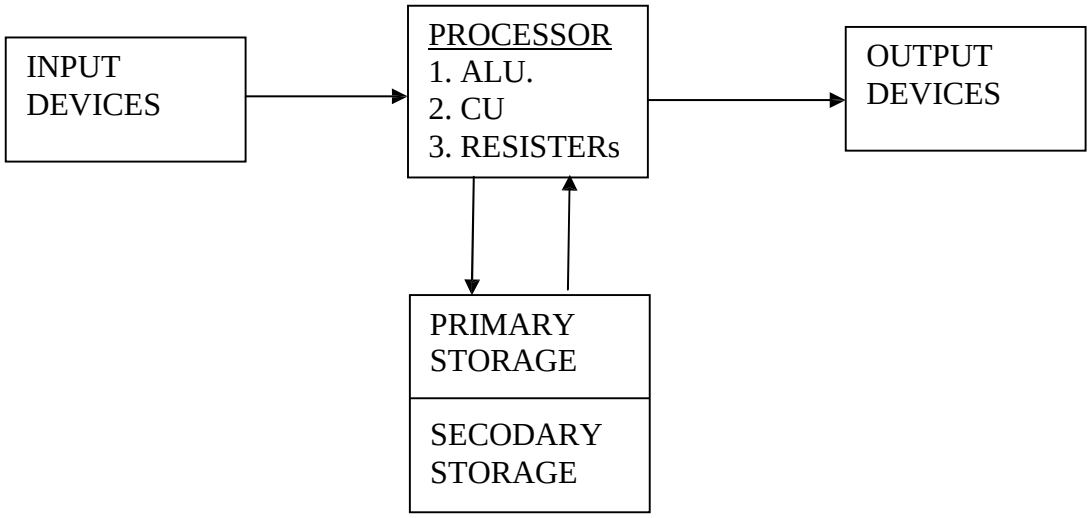
By the end of the chapter, the learner should be able to identify various computer components which include input devices, processing, storage devices and output devices.

Summary of the subtopics

- Hardware components
- Software components

2.1Hardware Components

COMPUTER HARDWARE STRUCTURE.



2.1.0. COMPUTER INPUT DEVICES.

An **Input device** is any piece of computer hardware equipment used to provide data and control signals to an information processing system (such as a computer). Input and output devices make up the hardware interface between a computer and the user or external world. The following are the various types of input devices:

a. **Keyboard**- a **keyboard** is a peripheral partially modeled after the typewriter keyboard. Physically, a keyboard is an arrangement of buttons, or keys. A keyboard typically has characters engraved or printed on the keys; in most cases, each press of a key corresponds to a single written symbol. However, to produce some symbols requires pressing and holding several keys simultaneously or in sequence; other keys do not produce any symbol, but instead affect the operation of the computer or the keyboard itself.

b. **Mouse-** The **mouse** is used to control the movement of a pointer on the screen when it is moved horizontally over a flat surface. A ball under the mouse rotates when it is moved and turns two rods, one for left/right and one for up/down. Buttons on the mouse let you select options from menus and drag objects around the screen etc. Some models are now wireless.

c. **Digitizers-** A video digitizer is used to convert analogue signals from a video camera or video cassette recorder into a digital format. The **digitized** video data can then be saved as a file and played on a monitor. Software will allow the video to be edited and special effects added, as well as individual still images to be captured and saved. Digital video cameras digitize the image inside the camera and save the video frames in a digital format. This data can then be transferred directly to the computer via a fast transfer cable and interface such as Firmware.

d. **Speech Synthesizers**- The speech synthesizer is the piece of equipment that produces sound from text in the form of a synthetic voice. This is either an external synthesizer - a box that plugs into the rear of the computer, a 'software synthesizer' which operates through the PCs soundcard, or a card that plugs into the PCMCIA slot on a laptop PC.

e. OPTICAL CHARACTER RECOGNITION

Optical character recognition (OCR) is a technology that involves reading typewritten,-printed, or handwritten characters from-ordinary documents and translating the images into a form that the computer can understand. Most OCR devices include a small optical scanner for reading characters

and sophisticated software for analyzing what is read.

f. Optical Mark Recognition (OMR)

Optical mark recognition (OMR) devices read hand-drawn marks such as small circles or rectangles. A person places these marks on a form, such as test, survey, or questionnaire answer sheet (Figure 3-3). The OMR device first reads a master document, such as an answer key sheet for a test, to record correct answers based on patterns of light; the remaining documents then are passed through the OMR device and patterns of light are matched against the master document. **Magnetic**

g. Ink Character Recognition Reader

Magnetic-ink character recognition (MICR) reader is used to read text printed with magnetized ink. MICR is used almost exclusively by the banking industry for check processing. Each check in your checkbook has pre-coded MICR characters on the lower-left edge; these characters represent the bank number, your account number, and the check number.

h. LIGHT PEN

A light pen is a handheld input device that contains a light source or can detect light. Some light pens require a specially designed monitor, while others work with a standard monitor. Instead of touching the screen with your finger to interact with the computer, you press the light pen against the surface of the screen or point the light pen at the screen and then press a button on the pen. Light pens are used in applications where desktop space is limited such as in the health-care field or when a wide variety of people use the application, such as electronic voting.

i. Touch Screen.

A monitor that has a touch-sensitive panel on the screen is called a touch screen. You interact with the computer by touching areas of the screen with your finger, which acts as an input device. Because they require a lot of arm movements, touch screens are not used to enter large amounts of data. Instead you touch words, pictures, numbers, or locations identified on the scre en. Touch screens often are used in kiosks located in stores, hotels, airports, and museums. Customers at Hallmark stores, for example, can use a kiosk to create personalized greeting cards. Some laptop computers even have a touch screen.

j. Joystick

Users running game software such as a driving or flight simulator may prefer to use a joystick as their

pointing device. A joystick is a vertical lever mounted on a base. You move the lever in different directions to control the actions of a vehicle or player. The lever usually includes buttons called *triggers* that you can press to activate certain events. Some joysticks also have additional buttons that you can set to perform other actions.

k. Touchpad

A touchpad or trackpad is a small, flat, rectangular pointing device that is sensitive to pressure and motion. To move the pointer using a touchpad, you slide your fingertip across the surface of the pad. Some touchpad have one or more buttons around the edge of the pad that work like mouse buttons; on others, you tap the pad's surface to simulate mouse operations such as clicking. Although you can attach a stand-alone touchpad to any personal computer, touchpad are found more often on laptop computers.

2.1.1. THE CENTRAL PROCESSING UNIT.

Central Processing Unit (**CPU**), or sometimes just called **processor**, is a description of a class of logic machines that can execute computer programs. This broad definition can easily be applied to many early computers that existed long before the term "CPU" ever came into widespread usage. The form, design and implementation of CPUs have changed dramatically since the earliest examples, but their fundamental operation has remained much the same. The CPU is divided into two, i.e. the Arithmetic Logic Unit (ALU) and Control Unit (CU).

ALU- An arithmetic-logic unit (ALU) is the part of a computer processor (CPU) that carries out arithmetic and logic operations on the operands in computer instruction words. In some processors, the ALU is divided into two units, an arithmetic unit (AU) and a logic unit (LU). Some processors contain more than one AU - for example, one for *fixed-point* operations and another for *floating-point* operations. (In personal computers floating point operations are sometimes done by a floating point unit on a separate chip called a numeric coprocessor.)

Control Unit (CU) - The control unit is the circuitry that controls the flow of information through the processor, and coordinates the activities of the other units within it. In a way, it is the "brain within the brain", as it controls what happens inside the processor, which in turn controls the rest of the PC.is summary the CU performs the following duties.

a. Fetching data and instructions from the main memory.
b. Decoding the instructions fetched from the main memory.
c. Instructing the ALU on what arithmetic and logic operations to carry through. d.

Coordinating the timing of events within the computer system.

Registers- Registers are fast temporary memory units within the processor that store data and instructions awaiting to be processed and also the results of the ALU (Data that has been processed).:

- (***IR)*** **Instruction Register**.-Stores the next instruction to be executed by the CPU.
- ***(Pc) program counter****-stores the address of the next instruction to be fetched from the main memory.*
- **Address Register. -**This register contains the address of the place the CPU wants to work within the main memory. It is directly connected to the RAM chips on the motherboard.
- ***(MBR)*** **Memory Buffer Register**-This register contains the data awaiting to be processed by the CPU.
- ***Accumulator****-this register stores the results of ALU (data that has been processed).*

2.1.2. COMPUTER STORAGE

Computer storage is divided into two categories which include:

a. Primary storage (main memory).
b. Secondary storage (backing storage, auxilially storage).

PRIMARY STORAGE.

Primary storage or the main memory is used to store programs currently being used by the computer also the pc firmware like the BIOS (basic input output system)
The main memory is also categories which include:

RAM

RAM (random access memory) is a memory chip that the processor can read from and write to. RAM is volatile **memory**, meaning that its contents are lost when the computer's power is turned off. Multiple programs can be loaded into RAM simultaneously, provided you have enough RAM to accommodate all the programs. The program with which you are working currently displays on the screen.

There are two basic types of RAM which include

a. **Dynamic RAM** –This type of memory as the name suggests(dynamic),it require to be refreshed(recharge)in order to keep it contents. It is recharged because it consists of capacitors that loose charge. DRAM is slow due to the refreshing procedures. However, it is less expensive to produce hence is used for the computer working memory.

b. **Static RAM.** This type of memory as the name suggests (static) does not require to be refreshed like the DRAM. This is because it consists of transistors which store charge constantly until the memory is refreshed to store new contents.SRAM faster than the DRAM.However,they are expensive to produce hence the can only be used for mission critical memories like the computer cache memory.

ROM

ROM (read-only memory) is a memory chip that only can be read and used; that is, it cannot be modified. ROM is **nonvolatile memory**, meaning that its contents are not lost when the computer's power is turned off. Commonly used for storing program instructions that is not subjected to change. Generally provided by manufacturer, ROM chips that contain permanently written data, instruction, or information are called **firmware**. There are various types of ROM which include:

a. **PROM** (Programmable ROM)-This ROM chip is bought when empty can only be programmed once.

b. **EPROM** (Erasable PROM)-This type of ROM is bought when already programmed but can be erased and be reprogrammed again. This is done by exposing the chip to ultra –violet light (UV –light).

c. **EEPROM** (Electrically Erasable PROM)-This ROM, just like the EPROM is bought when already programmed but can be erased and be reprogrammed again. The only difference is that the EEPROM is erased by applying an electric charge on the chip.

SECONDARY STORAGE (BACKING STORAGE).

Secondary storage is where by data is stored and programs installed permanently for future use. Backing storage can be divided into two main categories:

- **Magnetic media** which stores the binary data on a disk or tape coated with a material that can be magnetized differently, depending on whether a 0 or 1 is stored.
- **An optical medium which stores** the binary data in a surface that reflects laser light differently, depending on whether a 0 or 1 is stored.

Magnetic media - <u>Hard disks:</u>

Data is stored by magnetising the surface of flat, circular plates called **platters** which have a surface that can be magnetized. They constantly rotate at very high speed. A read/write head floats on a cushion of air a fraction of a millimeter above the surface of the disc. The drive is inside a sealed unit because even a speck of dust could cause the heads to crash.

Programs and data are held on the disc in blocks formed by **tracks** and **sectors**. These are created when the hard disc is first **formatted** and this must take place before the disc can be used. Disc are usually supplied pre-formatted.

For a drive to read data from a disc, the read/write head must move in or out to align with the correct track (*the time to do this is called the seek time*). It must wait then until the correct sector rotates round until it underneath the read/write head.

Uses:

- The hard disc is usually the **main backing storage media for a typical computer** or server. It is used to store:
  - The operating system (*e.g. Microsoft® Windows*)
  - Applications software (*e.g. word-processor, database, spreadsheet, etc.*)
  - Files such as documents, music, video etc.

Advantages:

- Very fast access to data. Data can be read directly from any part of the hard disc (**random access**). The access speed is about **1000 KB per second**.
- They are not susceptible to environmental conditions.
- They have got a long lifespan.
- They have got a large storage capacity.
- They not easily stolen because they are fixed within the computer.

Disadvantages:

- They are not removable.
- Once the fail, a lot of data is lost.
- Once they fail, the computer cannot start because that is where the operating system is installed.

Magnetic media - <u>Floppy disk:</u>

These can be found on most microcomputers and accept the usual 3.5 inch floppy discs. High density discs for a PC hold 1.44 MB of data (*enough to store about 350 pages of A4 text*). A floppy disc needs to be **formatted** before it can be used but most discs are now sold already formatted for PC's.

Uses:

- Floppy discs are useful for transferring data between computers
- For keeping a back-up of small files.
- Installing programs.

Advantages:

- They are very cheap to buy and floppy disc drives are very common.
- They are portable.
- They are removable.

Disadvantages:

- They are easily physically damaged if unprotected and magnetic fields can damage the data.
- They are relatively **slow** to access because floppy discs rotate far more slowly than hard discs, at only six revolutions per second, and only start spinning when requested. The access speed is about **36 KB per second**.
- They have got a very small storage capacity.(1.44mb).

Magnetic media - <u>Magnetic Tape:</u>

Just like the tape in a tape-recorder, the data is written to or read from the tape as it passes the magnetic heads.

Uses:

- Magnetic tapes are often used to make a copy of hard discs for back-up reasons.

Advantages:

- Magnetic tape is **relatively cheap** .
- Can **store very large quantities of data** (*typically 26 GB*).
- They are durable.

Disadvantage:

- **Accessing data is very slow** and you cannot go directly to an item of data on the tape as you can with a disc. It is necessary to start at the beginning of the tape and search for the data as the tape goes past the heads (**serial access**).

Optical Media - CD-Rom:

CD-ROM - means **C**ompact **D**isc - **R**ead **O**nly **M**emory. This means you can only read from the disc, not write or store data onto it.

They are also known as **optical discs** because the data is read by a laser beam reflecting or not reflecting from the disc surface.

Like a floppy disc, a CD-ROM only starts spinning when requested and it has to spin up to the correct speed each time it is accessed. It is much **faster to access than a floppy** but it is currently **slower than a hard disc**.

Uses:

- Most software programs are now sold on CD-Rom.
- Distribution of audio music.
- Storing of data.

Advantages:

- CD-ROM's hold large quantities of data (*650 MB*).
- They are relatively tough as long as the surface does not get too scratched.
- They are cheap to buy.

Disadvantages:

- You cannot save files to a CD-Rom (*although CD-R and CD-RW discs now exist which can be written to*)

Optical media-DVD (Digital Versatile Disk).

DVDs where advancement of CDs which where developed basically for distribution of video movies. They have a large storage capacity than the CDs (4.7 gb).

2.1.4. COMPUTER OUTPUT DEVICES

What is Output?

Output is data that has been processed into a useful form called information. That is, a computer processes input into output. Computers generate several types of output, depending on the hardware and software being used and the requirements of the user. Each output can either be a **softcopy or hardcopy**. You may choose to display or view this output on a monitor, print it on a printer, or listen to it through speakers or a headset. Four common types of output are text, graphics, audio, and video.

Text consists of characters that are used to create words, sentences, and paragraphs. A character is a letter, number, punctuation mark, or any other symbol that requires one byte of computer storage space.

Graphics are digital representations of non-text information such as drawings, charts, and photographs. Graphics also can be animated, giving them the illusion of motion. Animation is created by displaying a series of still images in rapid sequence.

Many of today's software programs support graphics. For example, you can include a photograph in a word processing document or create a chart of data in a spreadsheet program.

Some software packages are designed specifically to create and edit graphics. Paint programs, for instance, allow you to create graphics that can be used in brochures, newsletters, and Web pages.

Image editing software allows you to alter graphics by including enhancements such as blended colors, animation, and other special effects.

Audio is music, speech, or any other sound. Recall that sound waves, such as the human voice or music, are analog. To store such sounds, a computer converts the sounds from a continuous analog signal into a digital format. Most output devices require that the computer convert the digital format back into analog signals.

Video consists of images that are played back at speeds that provide the appearance of full motion. Video often is captured with a video input device such as a video camera or VCR. Most video signals are analog; however, some video devices record the video images digitally.

A video capture card converts an analog video signal into a digital signal that a computer can understand. The digital signal then is stored on the computer's hard disk. Some output devices accept the digital signal, while others require that the computer convert the digital signals back into analog signals.

Examples of output devices include the following.

MONITOR (visual Display Unit).

A monitor **is** an output device that visually conveys text, graphics, and video information on a screen area.. Information shown on a display device often is called soft copy**,** because the information exists electronically and is displayed for a temporary period of time.

Monitor terminologies.

Pixel-is the smallest displayable element of a picture. Many pixels make a picture.

Resolution-this is the sharpness of an image displayed on the screen.

Monitor size-this is the diagonal distance across the screen.

Refresh rate-this is the number of time in a second the screen is being redrawn. The standard refresh rate is 70hz.monitors with low refresh rate lead to images with flickers which are harmful to your eyes.

Interlacing-this is a technique where by monitor use two passes inorder to display a complete image.

Non-interlacing-this is a technique where by monitors use only one pass to display a complete image.

There are two types of monitors which include:

CRT
Monitors

A CRT monitor, is a softcopy display device that consists of a screen housed in a plastic or metal case. Inside the monitor is a large glass tube called a cathode ray tube (CRT). The screen, which is the front of the tube, is coated with tiny dots of phosphor material that glow when electrically charged.

These dots glow in three different colors (red, blue, green) which mix to form millions of colors. Inside the CRT, an electron beam moves back and forth across the back of the screen, causing the dots to glow, which produces an image on the screen. Each dot, called a pixel (short for *picture* element), is a single point in an electronic image. Monitors consist of hundreds, thousands, or millions of pixels arranged in rows and columns that can be used to create images.

LCD
Monitors

LCD displays commonly are used in laptop computers, handheld computers, digital watches,' and calculators because they are thinner and more lightweight than CRT monitors.

Unlike a CRT monitor, an LCD monitors does not use a cathode ray tube (CRT) to create

images on the screen; it instead uses a liquid crystal display (LCD). A liquid crystal display (LCD) has special molecules (called liquid crystals) deposited between two conducting plates. One plate acts as the source of light while the other acts as a display area. The work of the liquid sandwiched in between them is to block the light passing through kit in a pattern. Absence of light or presence of light will be an image on the screen.

PRINTERS

A printer is the basis hardcopy output device that produces text and graphics on a physical medium such as paper or transparency film. Printed information is called hard copy because the information exists physically and is a more permanent form of output than that presented on a display device (soft copy).

Hard copy, also called a printout, can be printed in portrait or landscape orientation. A page with portrait orientation is taller than it is wide, with information printed across the shorter width of the paper; a page with landscape orientation is wider than it is tall, with information printed across the widest part of the paper. Letters, reports, and books typically are printed in portrait orientation; spreadsheets, slide shows, and graphics often are printed in landscape orientation.

CLASSIFICATIONS OF PRINTERS

Generally, printers can be classified in the following two ways

i. **Speed-**character printers, line printers and page printers
ii. **Printing mechanism**-impact printers and non-impact printers

CHARACTER PRINTERS.

This is low speed printer that as the name suggests (character) print one character at a time. An example of a character printer is the dot matrix.

DOT MATRIX PRINTER.

A dot-matrix printer is a character printer that produces printed images when tiny wire pins

on a print head mechanism strike an inked ribbon. When the ribbon presses against the paper, it creates dots that form characters and graphics. It was the first printer to be used in the computing industry. The first dot matrix printer had around 8pins while the last dot matrix printer had got around 40 pins. The more the number of pins, the better the output.

ADVANTAGES OF DOT MATRIX.

a. Can use both tractor feed paper and single sheet papers
b. Can be used to produce multiple copies when used with carbon.

DISADVANTAGES.

a. They are slow (they print one character at a time).
b. They are noisy and can not be used in some environments like hospitals.
c. They don't produce quality output.

LINE PRINTERS

As the name suggests, they print one line at a time. An example of a line printer is the ink - jet printer.

INKJET PRINTERS.

An ink-jet printer is a type of non-impact printer that forms characters and graphics by spraying tiny drops of liquid ink onto a piece of paper. Ink-jet printers usually use individual sheets of paper stored in a removable or stationary tray. These printers can produce letter-quality text and graphics in both black-and-white and color on various materials such as envelopes, labels, transparencies, and iron-on t-shirt transfers, as well as a variety of paper types. Some ink-jet printers can print photo-quality images on any type of paper, while other ink-jet printers require a heavier weight premium paper for better-looking color documents. Many ink-jet printers are sold with software for creating greeting cards, banners, business cards, letterheads, and transparencies.

The print head mechanism of an ink-jet printer contains ink-filled print cartridges, each

with fifty to several hundred small ink holes, or nozzles. Each nozzle in the print cartridge is similar to an individual pin on a dot-matrix printer. Just as any combination of dot-matrix pins can be activated, ink can be propelled by heat or pressure through any combination of the nozzles to form a character or image on the paper.

PAGE PRINTERS.

Page printers print a full page at a time. An example of a page printer is the laser jet.

LASER JET PRINTER.

A laser printer is a high-speed, high-quality non-impact printer. Laser printers for personal computers usually use individual sheets of paper stored in a removable tray that slides into the printer case. Some laser printers have trays that can accommodate different sizes of paper, while others require separate trays for letter- and legal-sized paper. Most laser printers have a manual feed slot where you can insert individual sheets and envelopes. You also can print transparencies on a laser printer.

Laser printers can print text and graphics in very high-quality resolutions, ranging from 600 dpi to 1,200 dpi. While laser printers typically cost more than ink-jet printers, they also are much faster, printing text at speeds of four to thirty pages per minute.

Operating in a manner similar to a copy machine, a laser printer creates images using a laser beam and powdered ink, **called toner**, which is packaged in a cartridge. The laser beam produces an image on a special drum inside the printer. The light of the laser alters the electrical charge on the drum wherever it hits. When this occurs, the toner sticks to the drum and then is transferred to the paper through a combination of pressure. When the toner runs out, you can replace the toner cartridge.

IMPACT Vs NON-IMPACT

PRINTERS Impact Printers

An impact printer forms characters and graphics on a piece of paper by **striking mechanism against an ink ribbon** that physically contacts the paper. Because of the striking activity, impact printers generally are noisy.

Many impact printers do not provide letter quality print. Letter quality (LQ) output is a quality of print acceptable for business letters. Many impact printers produce near letter quality (NLQ) print, which is slightly less clear than letter quality. NLQ impact printers are used for jobs that require only near letter quality, such as printing mailing labels, envelopes, or invoices.

Two commonly used types of impact printers are dot-matrix printers and daisy wheel printers.

Non-impact Printer

A non-impact printer forms characters and graphics on a piece of paper **without actually striking** the paper. Some spray ink, while others use heat and pressure to create images. Because these printers do not strike the paper, they are much quieter than the previously discussed impact printers.

Three commonly used types of non-impact printers are ink-jet printers, laser printers, and thermal printers.

2.2 Computer software

Computer software is a general term used to describe a collection of computer programs, procedures and documentation that perform some tasks on a computer system. "Software" is sometimes used in a broader context to mean anything which is not hardware but which is *used* with hardware.

Computer software is classified into three broad categories:

a. System software.
b. Application software.

2.2.0 System software

System software is any computer software which manages and controls computer hardware so that application software can perform a task.

System software are classified into two

System utilities-these are software that perform routine task within the computer. Example of these is the text editors. Currently, system utilities are part of the operating system.

Operating systems-these can be defined as a set of programs working together to ensure management of the computer system.

Functions of the operating system.

Starting the computer-after the initial self-testing of the computer (POST) the operating system starts the computer hardware.

Process management-all the various programs running within the computer system are managed by the OS.

Memory management-the allocation of the limited memory space among many programs is done by the OS.

Input output management-all the input and output procedures are controlled by the OS.

File management-all the operations on computer files like opening, closing, renaming and deleting are managed by the OS.

Task management-the allocation of the processor time among various programs is overseen the OS.

Error reporting-all the errors, both software and hardware errors are reported by the OS.

Event logging-all the activities performed in the computer are recorded by the OS.

Classifications of the operating system.

The OS can be classified in three ways.

a. According to purpose.
b. According to the number of users
c. According to task

A. According to purpose. (Dedicated purpose & general purpose)

Dedicated purpose OS-These operating systems are designed to used only for one purpose. They are permanently installed in a ROM by the manufacturer. They include the software used in elevators, petro pumps, automatic doors etc.

General purpose OS-These are designed to be used in many application areas. They can be used in word processing, graphics design, computer gaming, architectural design etc.they can include windows xp,MAC OS,linux etc.

B. According to number of users (single user OS & multi-user OS).

Single user-these are designed to be used by only one person at a time. They also referred to as desktop operating system. They include windows xp, windows vista, windows 7, linux, mac etc.

Multi-user-these are designed to support more than one computers at a time. They are referred to as server operating systems. Examples include windows server 2000, 2003, 2005, 200 8, novel, UNIX etc.

C. According to task (single tasking OS & multi-tasking OS)

Single tasking-single tasking operating systems are designed to support only one application at a time. Examples of these include Microsoft DOS.

Multi-tasking-these are designed to support many applications at the same time. an example of these include all Microsoft windows operating systems.

2.2.1 Application software.

Application software is a subclass of computer software that employs the capabilities of a computer directly and thoroughly to a task that the user wishes to perform. They are simply software designed to perform a specific task

There are two categories of application software which include:

Application packages-these are also known as vendor-off-the shelf. They are bought already packaged and they are designed for general user requirements. Examples of these include the Microsoft office suite, graphics software, CAD software etc.

Tailor made-these application software, as the name suggests (tailor) are designed to suite specific user requirement. Example of these includes college management systems.

2.3 Programming languages

A **programming language** is an artificial language that can be used to control the behavior of a machine, particularly a computer. Programming languages are used to facilitate communication about the task of organizing and manipulating information.

Programming languages have revolved from the very cumbersome machine language to user-friendly high-level languages. Various types of programming languages are explained below in the order in which they were developed.

Machine language-these is a language of 0s & 1s.it is also known as binary language. Machine language was cumbersome and tedious to code hence it took a very long time to develop a single program.

However, machine language is directly processed by the computer because there is no translation required hence they are fast in execution.

Assembly languages-these is also referred o as low level languages. it was an improvement from the machine language. Assembly language is however still not user friendly. Assembly language can not be executed directly by the computer but translation to machine language is required .this is done by a piece of software called the **assembler.**

High level languages-these languages use the normal English statements hence they are easy to learn, easy to understand and easy to develop.

High level languages cannot be executed directly by the computer. Just like the assembly language, translation to machine language is required. This is done a piece of software known as the **compiler or the interpreter**.

A compiler converts a block of high level instruction at the same time while the i**nterpreter** converts one at a time.

Examples of high level languages include:

BASIC (beginners all purpose symbolic language)-it very easy to learn and hence suitable for beginners in programming.
COBOL (common business-oriented language)-suitable for business application.

FORTRAN (formula translation)-suitable for engineering and mathematical applications.

PASCAL-is a general-purpose language which was named to honor a French scientist blaise Pascal.

VISUAL BASIC to allow writing windows programs

DELPHI visual form of PASCAL for windows applications

Others include C & C++.

NB/4th generation languages and 5th generation languages are more user-oriented languages.

2.4 Review Questions

a. With an aid of a diagram, explain the computer hardware structure.

b. Discuss ten input devices.

c. Discuss the central processing unit.

d. Explain five input devices.

e. Explain three classification of computer software.

f. Explain the functions of operating system.

g. Explain the work of the assembler, compiler ad the interpreter.

CHAPTER 3.

3.0. COMPUTER NETWORKS.

A *computer network* is a connection of two or more computers using transmission media that can either be wired or wireless with a major purpose of sharing resources

Purpose of networking

a. To share computer hardware resources like the hardisk,printer and the processor b.
To share files and folders.
c. To share application programs
d. For electronic communication like sending of emails and fax.
e. For electronic meeting systems e.g. tele conferencing and video conferencing. f.
For electronic commuting (working from home).
g. For eliminating sneaker nets which are the major cause of virus spread.

3.1 Types of networks:

Below is a list of the most common types of computer networks in order of size.

Personal Area Network (PAN)

A personal area network (PAN) is a computer network used for communication among computer devices close to one another. Some examples of devices that may be used in a PAN are printers, fax machines, telephones, PDAs or scanners. The reach of a PAN is typically within about 20-30 feet (approximately 6-9 meters).

Local Area Network (LAN)

A network covering **a small geographical** area, like a home, office, or building. Current LANs are most likely to be based on Ethernet technology.

Campus Area Network (CAN)

This is a network connecting computers in an institution where by the buildings are scattered e.g. hospital, a university, a research center etc**.**

Metropolitan Area Network (MAN)

A Metropolitan Area Network is a network that connects computers in a relatively large geographical area e.g. town or a city.

Wide Area Network (WAN)

A WAN is a data communications network covers a large geographical area like a country or a region.

Global Area Network (GAN)

Global area networks (GAN) is a network connecting computers in an extremely large geographical area e.g. The whole globe.

3.2. Types of network configuration.

There are two types of network configurations which include:

1. **Peer to peer networks**

A peer-to-peer network is a small network around 10-20 computers where by all the computers are equal in terms of specification and capability. There is no a dedicated server machine that is each computer can act as a server or as a client.

Advantages of peer to peer

a. They are cheap in terms of both hardware and software. b.
They are easy to install and implement.
c. No network administrator required because each user manages his or her own machine. d.
They don't have a single failure point.

Disadvantages of peer to peer.

a. Security is poor because not all users will implement passwords.
b. Performance is low because of the overhead of acting both as a server as well as a client. c.
They are not reliable.

d. They are not expandable.

2. Client/server networks

A client server network is a network where by at least one computer should be playing the role of a server.

Advantages of client/server networks

a. Security is good because all the users should provide their user name and passwords.
b. Performance is high because there is no the overhead of acting as a server or as a client. c. They are easy to manage because the computers are managed from a central point.
d. They can be expanded to accommodate more computers.

Disadvantages of client server network.

a. They are expensive in terms of both hardware and software.
b. They are complex to install. An extra cost is incurred in employing a network administrator. c. They have a common failure point (server).

3.3. NETWORK COMPOMENTS (HARDWARE).

The following devices are required in setting up a network.

a. **Clients**-these are the computers accessing shared resources in a given network.
b. **Servers**-this are the computers providing the shared resources to clients in a network.
c. **NIC (**Network interface card)-this is a device that enables network devices connect to network media.
d. **HUB**-This is a device that connects various computers together to share resources in a network. the HUB sent data by broadcasting.
e. **Switch**-just like the HUB, the switch connects computers together but it does not broadcast. It sends data to the exact computer.
f. **Repeater**-this is a device that regenerates weak signal due the process of attenuation. (Attenuation is the process by which signals looses its original strength and require to be boosted again).
g. **Bridge**-this is a device that connects various network segments together to for a single network.

h. **Router**-this is a device used to connect a given local area network to other remote networks.

i. **Brouter**-this is a device that combines both features of a bridge and router.

j. **Multiplexer**-this is a device that combines many input singles together to move a single composite signal at the sender.

k. **Demultiplexer**-this is a device that splits the signals combined by the multiplexer back to their original form at the receiver.

l. **Gateway**-this is an application that facilitates communication between different network environments e.g. windows and novel Netware environment.

3.4. NETWORK SOFTWARE.

In order to run a network, the following software are required:

a. **Client operating system (COS**)-This is the software that runs on a network client.

b. **Network Operating system (NOS**)-This is the software that runs on network server.

c. **Network drivers**-this is a piece of software that facilitates communication between the OS and the NIC.

d. **Browser**-is a software that facilitates accessing of web pages (internet) e.g. Mozilla, internet explorer, opera.

e. **Protocols**-these are set of rules which explain how communication should occur in a network.

3.5. Network cables.

There are three basic types of cable that are used in networking. they include the following:

1. **Twisted-Pair Cable**

A twisted consist of two conductors (usually copper), each with its own-colored plastic insulation twisted on each other as the name suggests.

Twisted cable comes in two forms: unshielded and shielded**.**

Unshielded Twisted (UTP) cable

UTP consists of a number of twisted pairs with simple plastic casing. UTP is commonly used in telephone system.

Shielded Twisted (STP)

STP includes shielding to reduce cross talk as well as to limit the effects of external interference

Advantages of twisted pair cables.

a. They are cheap to buy.
b. They are easy to install.
c. They are already installed in many buildings

Disadvantages.

a. They are susceptible to EMI and eaves dropping.
b. They suffer high attenuation levels.

2. **Coaxial Cable**

Coaxial cable, commonly called coax, has two conductors that share the same axis. A solid copper wire runs down the centre of the cable, and this wire is surrounded by plastic foam insulation. The foam is surrounded by a second conductor, wire mesh tube, metallic foil, or both. The wire mesh protects the wire from EMI. It is often called the

shield. A tough plastic jacket forms the cover of the cable, providing protection and insulation. There are two forms of coaxial cables

Thinnet-is a thin form factor the name suggests with less capabilities compared to the thick net in terms of bandwidth and attenuation levels.

Thicknet-is a thick form factor with more capabilities than the thinnet in terms of bandwidth and attenuation levels

Advantages of coaxial cables

a. Thinnet is cheap to buy.
b. Thicknet does not suffer high attenuation levels. c.

Thicknet has got a relatively high speed.

Disadvantages.

a. Thinnet suffers high attenuation levels but not as twisted pair.
b. Both forms are susceptible to EMI eavesdropping but not are twisted pair.

3. **Fiber Optic Cable**

Fiber optic cable transmits light signals rather than electrical signals. It is enormously more efficient than the other network transmission media. It consists of a glass core used for the transmission of data.

Advantages of Fiber Optic

a. It's immune to EMI and eavesdropping.
b. Suffers low attenuation levels.
c. Has got very high bandwidth.

Disadvantages of Fiber Optic

a. Is most expensive among all the cables.
b. It is complex to install and maintain.

c. It is fragile.

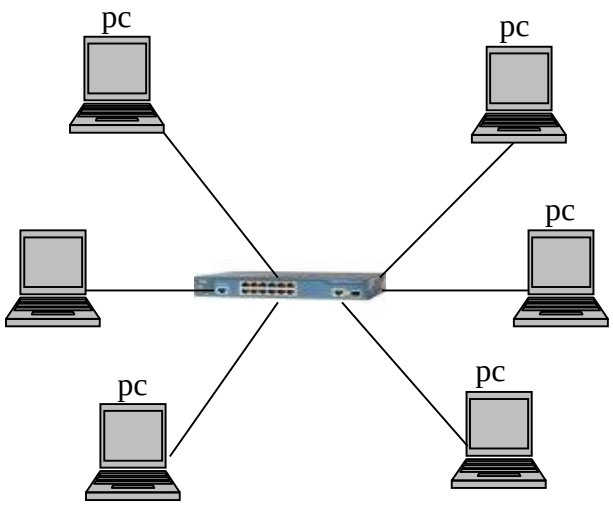
3.5. Network topologies

A network topology defines the physical arrangement and connection of computers in a given network.

There are four basic types of topologies which include:

1. **Star topology.**

This is a physical setup where by all the computers connect to a central point which can either be a HUB or a switch.



Advantages

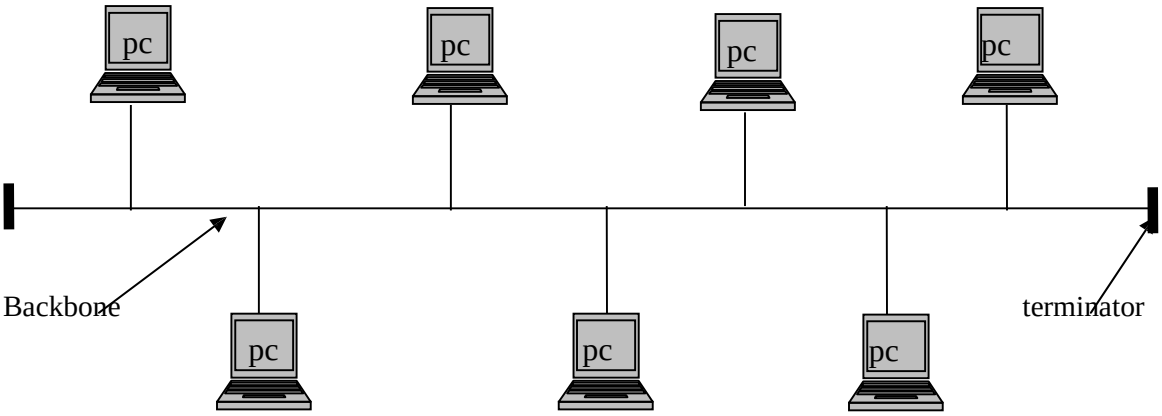
a. If is easy to install and configure.
b. It is easy to troubleshoot.
c. Failure of one computer does not affect the others.

Disadvantages.

a. Failure of the central point leads to failure of the entire network. b.
Require many cables.

2. Bus topology

This is a physical setup where by all the computers connect to single linear cable known as the backbone. A terminator is fitted at both ends of the bus to avoid signal bounce.



Advantages

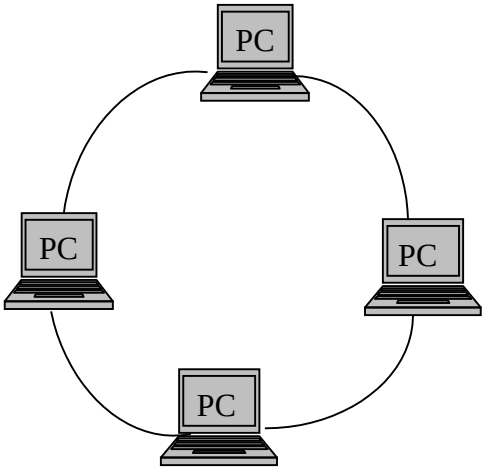
a. It is easy to install
b. It requires less cables
c. Failure of one computer does not affect the others.

Disadvantages.

a. It is difficult to configure.
b. They are difficult to troubleshoot.
c. Limitations are imposed on the maximum number of devices.

3. **Ring topology.**

This is a physical setup where all the computers are connected in a closed loop. Each computer is responsible for regenerating data around the network.



Advantages.

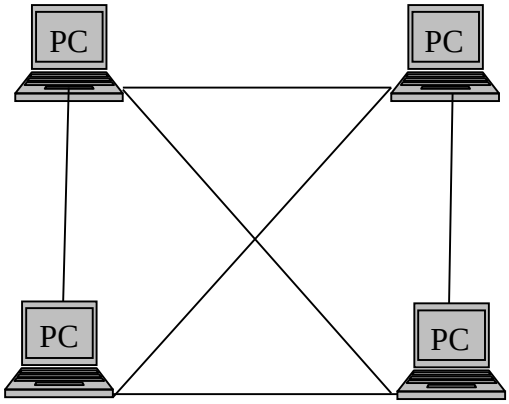
a. They use a small amount of cable.
b. They are easy to install.
c. Two ring systems can be used for fault tolerance.

Disadvantages

a. They are difficult to configure.
b. Failure of on computer can affect the others. c.
They are difficult to troubleshoot.

4. Mesh topology

This is a physical setup where by each computer has got more than one connectio n to the others. There is usually no failure point thou this topology is practically not applicable.



Advantages.

a. It offers the best fault tolerance.
b. Failure of one computer does not disrupt the network.

Disadvantages.

a. Much cable is required.
b. It required each computer to have more than one NIC.

2.6 Review Questions

- Explain the various categories of networks according to physical size.
- Explain the two types of network configurations.
- Explain the four basic topologies clearly stating the failure.
- Discuss the three basis cables.

Chapter 4

4.0 ORGANIZATION AND PROCESSING OF COMPUTER

FILES OBJECTIVE.

By the end of the topic the student should correctly define a computer file, explain various file access methods and organization.

Summary of the subtopics

- Meaning of computer file
- Elements of computer files.
- Types of computer files
- File organization methods.
- Factors that influence file organization selection.

4.1. Definition of computer file

A **computer file** is a block of arbitrary information, or resource for storing information, which can be permanently stored in the secondary storage. is. Computer files can be considered as the modern counterpart of paper documents which traditionally were kept in offices' and libraries' .

4.2. Elements of computer files.

The following are the elements of computer files defined hierarchically from the smallest to the largest.

Bit-it is the smallest element of data storage in a physical file which can either be a 1 or a 0.

Character-it is a combination of several bits depending on the character coding scheme being used e.g. BCD uses 4bits while ASCII uses 8bits to represent a single character.

Field-it is a combination of several characters that define a single data item.

Record -is a collection of related fields.

File- is an organized collection of related records.

Database-is a collection of related files.

4.3 Types of Computer File

Master file

A collection of records pertaining to one of the main subjects of an information system, such as customers, employees, products and vendors. Master files contain descriptive data, such as name and address, as well as summary information, such as amount due and year-to-date sales.

Following are the kinds of fields that make up a typical master record in a business information system. There can be many more fields depending on the organization. The "key" fields below are the ones that are generally indexed for matching against the transaction records as well as fast retrieval for queries. The account number is usually the primary key, but name may also be primary. There can be secondary indexes; for example, in an inverted file structure, almost all the fields could be indexed.

Transaction file

File that contains all the additions, deletions, and amendments required during file updating to produce a new version of a master file.

The data in transaction files is used to update the master files, which contain the data about the subjects of the organization (customers, employees, vendors, etc.). Transaction files also serve as audit trails and history for the organization. Where before they were transferred to offline storage after some period of time, they are increasingly being kept online for routine analyses. Following are the kinds of fields that make up a typical transaction record in a business information system. There can be many more fields depending on the organization. The "key" fields below are the ones that are generally indexed for fast matching against the master record. The account number is usually the primary key, but name may also be used as a primary key.

Report file

These are a file that gives summary of other files basically for printing purposes.

Sort file

Is a file which is retrieved by altering the sequence of other files. A

file that contains the sorted information

Back-up file.

This is a duplicate copy of the original file which is meant to be used in the event of a disaster. When the original file cant file used by any reasons like theft, corruption etc.

Reference file

As the name suggest, it is meant for reference whenever required e.g. price list.

4.4 File organization methods

The available methods include:

- Serial;
- Sequential;
- Indexed sequential;
- Random.

Serial Organization

Serial files are stored in chronological order that is as each record is received it is stored in the next available storage position. In general it is only used on a serial medium such as magnetic tape. This type of file organization means that the records are in no particular order and therefore to ret rieve a single record the whole file needs to be read from the begging to end. Serial organization is usually the method used for creating Transaction files (unsorted), Work and Dump files.

Sequential Organization

Sequential files are serial files whose records are sorted and stored in an ascending or descending on a particular key field. The physical order of the records on the disk is not necessarily sequential, as most manufacturers support an organization where certain records (inserted after the file has been set up) are held in a logical sequence but are physically placed into an overflow area. They are

no longer physically contiguous with the preceding and following logical records, but they can be retrieved in sequence.

Indexed Sequential Organization

Indexed Sequential file organization is logically the same as sequential organization, but an index is built indicating the block containing the record with a given value for the Key field.

This method combines the advantages of a sequential file with the possibility of direct access using the Primary Key (the primary Key is the field that is used to control the sequence of the records). These days, manufacturers providing Indexed Sequential Software allow for the building of indexes using fields other than the primary Key. These additional fields on which indexes are built are called Secondary Keys.

There are three major types of indexes used:

Basic Index: This provides a location for each record (key) that exists in the System.

Implicit Index: This type of index gives a location of all possible records (keys) Whether they exist or not.

Limit Index: This index groups the records (keys) and only provides the location of the highest key in the group. Generally they form a hierarchical index.

Data records are blocked before being written to disk. An index may consist of the highest key in each block, (or on each track).

Random (or Direct)

A randomly organized file contains records arranged physically without regard to the Sequence of the primary key. Records are loaded to disk by establishing a direct relationship between the Key of the record and its address on the file, normally by use of a formula (or algorithm) that converts the primary Key to a physical disk address. This relationship is also used for retrieval.

- Fast response is required.

4.5 Factors to consider when selecting a file organization method

- **Frequency of update**- you should determine how often the file is going to require update and the timing of such update. Periodic update e.g. monthly, quarterly, for a payroll system

all the transactions are used to update the master files in one run. For the non-periodic systems, the transactions may be applied onto the system any time as required.

- **File activity**- the type of file organization should be based on the expected number of records to be hit in particular run.

- **File access method**- in this case the computer shall be transferring the contents of the file from the storage media into the computer.

- **Nature of the system**- considerations should be made on whether the system will be one which runs periodically or it is event-driven system. Periodically run systems are essentially batch processing systems whose transactions relating to particular business are accumulated over a period of time after which they are applied to relevant master files in single run. Such systems produce periodic reports from the maintained files. Event driven systems allow enquiries and instant update so long as the transactions are available for the production of instant information from the maintained master files.

- **The master file's medium**- the type of file organization adopted influences the choice of the medium to be used in storing the computer file. A serial access medium e.g. the magnetic tape can not be used to store a random file or indexed-sequential files because for such medium searching for a particular record of interest proceeds serially despite the file organization adopted.

4.6 Review questions

- State and describe three file organization techniques
- Explain the following computer files:
  - o Master file
  - o Sort file
  - o Transaction file
  - o Reference file.
  - o Back up files
- Discuss the elements of computer files.
- What are the factors to consider when selecting a file organization method?

Chapter 5

5.0 DATABASE MANAGEMENT SYSTEMS

OBJECTIVE.
By the end of the topic, the leaner should be able differentiate traditional method of record keeping and the modern methods of record keeping.

Summary of the subtopics

- Basic concepts
- Data modeling

Overview

Databases play a great role in businesses and organizations today. They enable the storage of records in well organized and secure manner. They also enable many users to access and use data or information simultaneously.

5.1 Basic concepts

A *Database Management System* (DBMS) is a software program that enables the creation and management of databases. Generally, these databases will be more complex than the text file/spreadsheet example in the previous lesson. In fact, most of today's database systems are referred to as a *Relational Database Management System (RDBMS)*, because of their ability to store related data across multiple tables.

Some of the more popular relational database management systems include:

- Microsoft Access
- Filemaker
- Microsoft SQL Server
- MySQL
- Oracle

Database models

A **database model** is a theory or specification describing how a database is structured and used. Several such models have been suggested.

Common models include:

- Hierarchical model
- Network model
- Relational model
- Entity-relationship
- Object-Relational model

Hierarchical model

In a **hierarchical data model**, data is organized into a tree-like structure. The structure allows repeating information using parent/child relationships: each parent can have many children but each child only has one parent. All attributes of a specific record are listed under an entity type. In a database, an entity type is the equivalent of a table; each individual record is represented as a row and an attribute as a column. Entity types are related to each other using *1: N* mapping, also known as one-to-many relationships. The most recognized example of hierarchical model database is an IMS designed by IBM.

Network model

The network model is a database model conceived as a flexible way of representing objects and their relationships. It was developed into a standard specification published in 1969 by the CODASYL Consortium. Where the hierarchical model structures data as a tree of records, with each record having one parent record and many children, the network model allows each record to have multiple parent and child records, forming a lattice structure.

Relational model

Its core idea is to describe a database as a collection of predicates over a finite set of predicate variables, describing constraints on the possible values and combinations of values. The content of the database at any given time is a finite model (logic) of the database, i.e. a set of relations, one per predicate variable, such that all predicates are satisfied. A request for information from the database (a database query) is also a predicate.

The purpose of the relational model is to provide a declarative method for specifying data and queries: we directly state what information the database contains and what information we want from it, and let the database management system software take care of describing data structures for storing the data and retrieval procedures for getting queries answered.

Entity-relationship

An entity-relationship model/diagram (or ERD) is an abstract conceptual representation of structured data. Entity-relationship modeling is a relational schema database modeling method, used in software engineering to produce a type of conceptual data model (or semantic data model) of a system, often a relational database, and its requirements in a top-down fashion. Diagrams created using this process are called entity-relationship diagrams, or ER diagrams for short.

Object-Relational model

An object-relational database (ORD) or object-relational database management system (ORDBMS) is a database management system similar to a relational database, but with an object-oriented database model: objects, classes and inheritance are directly supported in database schemas and in the query language. In addition, it supports extension of the data model with custom data-types and methods.

One aim for this type of system is to bridge the gap between conceptual data modeling techniques such as ERD and ORM, which often use classes and inheritance, and relational databases, which do not directly support them.

Object model

In computing, **object model** has two related but distinct meanings:

1. The properties of objects in general, in a specific computer programming language, technology, notation or methodology that uses them. For example, the *Java object model*, the *COM object model*, or *the object model of OMT*. Such object models are usually defined using concepts such as class, message, inheritance, polymorphism, and encapsulation. There is an extensive literature on formalized object models as a subset of the formal semantics of programming languages.
2. A collection of objects or classes through which a program can examine and manipulate some specific parts of its world. In other words, the object-oriented interface to some service or system. Such an interface is said to be the *object model of* the represented service or system. For example, the HTodel (DOM) is a collection of objects that represent a page in a web browser, used by script programs to examine and dynamically change the page. There is a Microsoft Excel object model for controlling Microsoft Excel from another program, and the ASCOM Telescope Driver is an object model for controlling an astronomical telescope.

Logically structuring data

Once the relationships and dependencies amongst the various pieces of information have been determined, it is possible to arrange the data into a logical structure which can then be mapped into the storage objects supported by the database management system. In the case of relational databases the storage objects are tables which store data in rows and columns.

Each table may represent an implementation of either a logical object or a relationship joining one or more instances of one or more logical objects. Relationships between tables may then be stored as links connecting child tables with parents. Since complex logical relationships are themselves tables they will probably have links to more than one parent.

In an Object database the storage objects correspond directly to the objects used by the Object- oriented programming language used to write the applications that will manage and access the data. The relationships may be defined as attributes of the object classes involved or as methods that operate on the object classes.

Physical database design

The physical design of the database specifies the physical configuration of the database on the storage media. This includes detailed specification of data elements, data types, indexing options, and other parameters residing in the DBMS data dictionary.

5.2 Data modeling

Entity relationship- An entity-relationship model/diagram (or ERD) is an abstract conceptual representation of structured data. **Entity-relationship modeling** is a relational schema database modeling method, used in software engineering to produce a type of conceptual data model (or semantic data model) of a system, often a relational database, and its requirements in a top-down fashion. Diagrams created using this process are called *entity-relationship diagrams*, or *ER diagrams* for short

5.3 Review questions

- Discuss the five common database models
- Define the following terms as used in database management;
  - o Data redundancy
  - o Entity relationship
- A database is independent of the application that uses it. Discuss
- List and briefly describe three advantages of using the database approach in data storage as compared to the file based approach.
- List and explain two features to be found in a typical database management system.

Chapter 6

6.0DATA PROCESSING

Objective.

By the end of the topic, the leaner should explain how data is processed within a computer system using various software and hardware implementations.

Overview

Data processing is any computer process that converts data into information or knowledge. The processing is usually assumed to be automated and running on a computer. Because data are most useful when well-presented and actually *informative*, data-processing systems are often referred to as information systems to emphasize their practicality. Nevertheless, both terms are roughly synonymous, performing similar conversions; data-processing systems typically manipulate raw data into information, and likewise information systems typically take raw data as input to produce information as output.

Summary of the subtopics

- Methods of data processing
- Data processing modes
- Advantages and disadvantages of data processing modes.

6.1 Methods of data processing

- **Mechanical-** these are systems whose activities are carried out by human operated keyboard devices such as accounting machines, cash registers, calculators etc. data is input by the machine operator, manipulated by the machine and the output is obtained in the form of printed documents or in the other form such as the displayed results through the calculator display unit.
- **Manual-** In this system, activities are carried out manually by the human clerks whose efforts may be aided by some calculating tools such as slide rule, logarithms, etc.

- **Electromechanical –** this is where by the system consist of features of both electronic and mechanical systems. It lies somewhere between the pure mechanized and pure electronic systems.
- **Electronic Data Processing (EDP**) can refer to the use of automated methods to process commercial data. Typically, this uses relatively simple, repetitive activities to process large volumes of similar information. For example: stock updates applied to an inventory, banking transactions applied to account and customer master files, booking and ticketing transactions to an airline's reservation system, billing for utility services.

6.2 Data processing modes

Batch processing (offline processing)

In this mode transactions are accumulated over a period of time and then processed at a pre - specified time to produce a batch of output. Data collection is usually done off-line in isolation of the CPU, on special machines known as data entry terminals. The data collected is input after a fixed time period, processed and the result obtained. A typical application of this type is the payroll preparation. The operating system that co-ordinates and monitors the batch processing environment is described as the batch operating system.

Advantages

- It is simple to develop
- Timing of the report (information) is not necessary.
- The unit cost of processing is

low. Disadvantages

- The time lag between origination of the transactions and the information availability.
- Late information is not suitable in situations where instant decisions are required.
- It is difficult to provide the desired priority scheduling.

On-line processing

In this mode of processing, the result of data processing transaction is made available immediately. All computer peripherals and other equipments e.g. communication equipment are under direct influence of the central processor. Once the input transactions are available they can be processed to produce the information sought for.

The user/operator can interact with the system at any time/point of processing using the I/O facilities that are under direct influence of the processor. The files are also held online and hence enquiries or file interrogation is possible at any time. the transactions can be input and master files be directly updated on the spot.

Advantages

- Files are maintained up to date
- Information is readily available for current decisions
- File enquiries are possible through the terminals(work-stations)

Disadvantages

- These systems are complex to develop
- They are costly in terms of the hardware, software, storage media, operating system, communication facilities, etc.

Time sharing processing

This is a processing mode in which case the central processor serves two or more users with different processing requirements (tasks). The central computer is therefore available to a variety of users, connected to it via communication links, who may wish to process their data and receive information or test their programs. The computer works upon the user request and the results are communicated back to the work station via the communication links.

The processor time is normally divided out appropriately among the user tasks into time slices which is the time during which an active job has got the sole access to the processor's resources. Control is switched from one job to another under the influence of the operating system, in turn; hence the processor idle time is removed. The central computer checks if there is any request from a particular terminal which requires service, if yes it is served and control proceeds to the next terminal, the sequence of events are described as polling or round robin.

Advantages

- It offers better services to the users since information output is fast
- The problem of the processor idle time is solved or removed.
- Files are held on-line hence enquiries or file interrogation is possible.
- Man-computer dialogues are often in use through terminals connected to the host computer.
- It is helpful to small companies which can not afford purchasing the computer and the related facilities thus served at a fee through time sharing processing mode.
- It avoids software duplication
- The user of the system can avail there facility of computer through remote terminals.

Disadvantages

- The users have got no control over the central computer
- The response time is high (slow) when there are many tasks.
- It is not reliable as regards the security of data.

Real time processing

It refers to a data processing system in which the time interval required to process and respond to inputs is so small that the response itself is useful for controlling the physical activity of a process. Real time processing provides immediate transaction input capability from all input-originating stations. Many remote stations may be connected directly by appropriate communications equipment into the central processor, files may be updated currently and enquiries may be answered by immediate access to up-to-now records.

Advantages

- Information is readily available for instant decision
- Provides better service to users
- It is a fast and reliable mode of data processing

Disadvantages

- They are complex systems that use complex operating systems hence very expensive.
- The systems are not easy to develop.
- Real time systems usually use two or more computers, sharing up the work load, the concept described as multi-processing which is expensive.
- They require large communication equipment e.g. Front End Processor(FEP)

Distributing Processing

This system consists of various geographically dispensed computers linked by communication lines and all the computers linked belong to the same organization. This implies that the computers are located at various departments or business sites for the individual department or the business site to be served individually by its own computer resources.

A typical application of this system is in the banks where all the braches have intelligent terminals linked to a big computer at the head office. Data from the branches is sent to the master where it is processed.

Advantages

- There is a reduction of the load on the host computer.
- There is minimization of cost in data processing due to the use of low cost mini computers.
- There is reduction of delays in data processing
- It offers better services to the customers
- There is less risk of system breakdown
- Less complexity of the system design and implementation due to decentralization.

- The level of expertise required is

less. Disadvantages

- Expensive because extra cost on communication equipment
- Data duplication is very common
- Programming problems occur with micro and mini computers
- More training needed for the users involved.

Multi-programming

It is the concept of having more than one program resident in the computer memory and are being processed or executed apparently at the same time. Scheduling the job for run or execution is done automatically by the processor under the influence of the control program, the operating system which in this case is described as multi-programming or multi-tasking operating system.

Advantages

- It increases productivity of a computer
- Reduces the CPU idle time.
- It reduces the incidence of the peripheral bound operations

Disadvantages

- It requires more expensive C.P.U
- The operating system is complex and difficult to operate.
- It requires more expensive input/output facilities.

Interactive Processing

These systems are characterized by data storage in direct access, easily accessible media and by processing that can take place immediately as transactions occur. In the interactive approach to hardware system design the data is processed individually and continuously as transactions take place and output is generated instantly. Since processing interactive system takes place in order as events occur or information is needed, data storage must be in on-line, direct access form. Disks are

the most widely used on-line direct access storage and most interactive systems are built around this media.

Factors to consider in selecting data processing mode

- The suitability of accumulating data into batches for processing
- The need for direct information retrieval and file interrogations.
- The optimization of the processing time.
- The time factor of the information for decision making by the managers.
- The cost of acquiring the relevant hardware, software, media, etc and the cost of maintenance.
- The ease of development, use and subsequent maintenance.
- The control over the resources e.g. files, I/O devices, etc.
- The necessity of data communication equipment and facilities and the involved costs and convenience.
- The need for the shared resources among several users who may afford purchasing their own facilities as in time sharing configuration/systems.

6.3 Review questions

- Define data processing modes. Explain various types of data processing modes.
- Explain batch processing and describe its application, advantages and disadvantages.
- Write short notes on the following:
  - o Time sharing
  - o Real time processing
  - o Distributed processing
- Explain the concept of multi-programming.
- What are the factors to consider in selecting a data processing mode.

Chapter 7

7.0 COMPUTER SECURITY.

Objective.
By the end of the topic the learner should be able to explain the importance of computer security and various ways for implementing computer security.

Overview

It is a vitally important for an organization to the responsibility of protecting their computer systems and their data from unauthorized access and loss. This chapter highlights some of the measures that need to be put in place to ensure computer and data security.

Summary of the subtopics

- Data Protection Act
- Types of computer security.
- Network security.

7.1 Data Protection Act

The Data Protection Act is concerned with information about individuals (personal data) which is processed automatically, i.e. in computer systems, with those that undertake the processing (Data users); and with the individuals to whom the data relates (data subjects)

The Data Protection Act works in two main ways

- giving individuals certain rights e.g. access to information held about themselves
- requiring those who record and use personal information on computer to be open about that use and to follow sound and proper practices

7.2 Type of computer security.

Computer security can be categorized into three classes:

a. Physical security
b. Data and software security
c. Procedural security

Physical security (environmental)

This involves physical damage and sabotage which may be caused by the following: to buildings, hardware, software, data, and documentation, of personnel. Accidental threats include fire, flood, building collapse and failure of essential services. Deliberate threats include sabotage and vandalism.

Fire

Fire is one of the most common causes of serious environmental computer disaster. A frequent cause of damage is fire in the air conditioning system. It is important to understand that most damage is caused by the corrosive effect of smoke, rather than by the fire itself.

Flood

Floods are more likely to be caused by dripping tapes and burst pipes that by rivers breaking their banks.

Building Collapse

Earthquakes and subsidence of land could make a building unsafe. Partial or total collapse can be caused by impact from falling aircraft or road accident. Also, the threat of terrorist bomb attacks cannot be ignored!

Theft:

The theft of large pieces of computer equipment is unusual, but personal and laptop computers, floppy discs and software. The theft of hardware, software or data not only causes unavailability but may also result in loss of confidentiality.

Methods for implementing physical security.

- Use smoke detector.
- Using key and lock method.
- Employing security guards.
- Proper storage of media devices
- Use non liquid fire extinguisher
- Avoid locating the resources/offices near to main road
- Using UPS on all the machines
- Avoid having water pipe line in the computer rooms of office.

Data and software security (logical security).

Logical threats are those affects access to and the integrity of data and software. Accidental threats include software fault (bug), communication errors and inaccurate input. Deliberate threats include unauthorized access to computer program and data (hacking) and malicious or fraudulent a alteration of software and data (including the introducing of computer viruses).

Unauthorized Access

Unauthorized access to a computer system by outsiders will usually be achieved by hacking into dial-up communication links or by tapping into private leased lines. Members of staff may also use these means to access unauthorized information. Such activities can cause a loss of confidentiality of data.

Virus:

A virus is a program of piece of coding which is originally deliberately introduced into a computer system with the intention of corrupting software and/or data. The effect of virus can vary from the mere annoyance of message appearing on the screen to the

destruction of software and data file. A deliberate introduction of a virus is a serious criminal offence under computer misuse act, 1990.

Data and software security is put in place to ensure the following:

Confidentiality

Data held on magnetic media is easily accessible; therefore, media containing confidential information should be protected from access in the same way as confidential paper files.

Copyright

Application programs, clip art, music and other data of this kind are created by other people. They may own the copyright. This type of data must **not** be copied without the permission of the originator.

Methods for implementing logical security.

- Use security guard stop/check unauthorized personnel
- Use video camera.
- Lock the room after office hours
- All user should observe password principles which include:

    - Passwords must be at least six characters long.
    - Passwords must be changed at least monthly.
    - Passwords must be changed immediately if there is suspicion that some has figured out your password.
    - Password must not be easy enough to guess.
    - It must not be written down.
    - There must be limited entries to try the password (no more that three).

- Use anti-virus software in all the workstations.
- Install a firewall in the company network.
- Install intruder detection systems.

Procedural security.

Procedural threats arise from personnel failing to obey the rules. Accidental threats can arise from ignorance of the correct procedures. Deliberate threats arise from personnel failing to follow known procedures because they either find them too troublesome. **Methods of implementing procedural security.**

- Provide regular training to the staff about security threats and it's prevention methods
- Do periodic checking of equipment.
- Do periodic data and software audit.

7.3 Network Security Technique.

It is important to understand the primary function of access control techniques. First and foremost, their purpose is to permit only authorized parties to us particular facilities. Some access control techniques are discussed below

a. Password

A password is familiar to people who work with or use IT. In general, these are string characters. Primary advantage of using a password-based access control system is that it is easily understood by those having to use it. Furthermore, they are easy to implement.

b. Dial back.

In remote access applications the dial back modem has become a familiar tool. The principle behind this technique is straightforward. A user wishing to access must first leave a *message* which indicates who they are,

c. Biometric Techniques

Biometrics characteristics are unique feature of an individual. Such as fingerprints, voice patterns retinal image and DNA typing. Biometrics are an extremely accurate way of providing access control. It is also a very easily manages system. The difficulty arises because there has to be some way in which these biological or subliminally habitual characteristics can be represented in electronic form. As can be imagined, the equipment required to produce a quantitative version of, say, retinal scan, is quite complex and expensive. This means that in general, use of biometric techniques well beyond the reach of most security practitioners.

d. Encryption Techniques

Encryption means that the sender transforms the original information to another form and sends the resulting unintelligible message out over the network. Decryption reverses the encryption process in order to transform the message back to its original form.

To carry sensitive information, such as military or financial data, a system must be able to assure privacy. Microwave, satellite, and other wireless media, however, cannot be protected from the unauthorized reception (or interception) of transmission. Even cable system cannot always prevent unauthorized access.

7.4 Review questions

- Describe the following terms as used in data security:
    i. Data corruption
    ii. Confidentiality
    iii. Copyright

- Describe the two main ways in which Data Protection Act works.

- Describe the terms; computer and data security.

- Explain various way of protecting your computer from physical threats.