

قسم نظم المعلوماتية

Introduction to Information Technology

Introduction

1. Information Technology

1.1 Information Technology (IT) this is a general term which relates to the use of computers as an aid to creating and maintaining data, i.e. information. IT is related to all aspects of managing and processing information, especially within a large organization.

Information technology plays a major role in reengineering business processes, the speed, information processing power, and ease-of-use of modern computer hardware, software, and networks can dramatically increase the efficiency of business processes, and communications among its people.

Information technologies and business systems that use IT allow us to work more intelligently, they also often change how we structure and manage our organization and processes-that is, how we work and how interact. IT is a facilitator of organization activities and processes. Therefore it is very important for every manager and professional staff member to learn about IT from the stand point of his or her specialized field.

Every manager and staff member should know how to build, use, and Manage successful systems based on IT.

In sales and Marketing, managers use IT to:

1. develop new goods and services (product analysis)
2. -determine the best Location for production and distribution facilities (site analysis).
3. determine the best advertising and sales total revenues promotion analysis.
4. Set product prices to get the highest total revenues (price analysis).
5. Marketing managers also use IT to manage customer relationship.

IT: are the individuals components that are typically organized into computer –based information systems (IS). The two terms IT & IS are not precisely synonymous, but are used interchangeably in common practice.

A **computer** is programmable, multiuse that accepts data- raw facts and figures and processes, or manipulates, it into information that can use, such as summaries or totals. Its purpose is to speed up problem solving and increase productivity.

Communications or telecommunications, technology consists of electromagnetic devices and systems for communicating over long distances.

Computers may seem like incredibly complicated devices, but their underlying principle is simple. When you open up a personal computer, what you see is mainly electronic circuitry. And what is the most basic statement that can be made about electricity. It can be either turned on or turned off, or switched between high voltage and low voltage. Because computers are based on /off or other two state conditions, they use binary system, which consists of two digits 0 and 1.

1.2 Information System

Information systems (IS) collects, processes, stores, analyzes, and disseminates information for a specific purposes, like any other system ,**an information system include inputs(data, instructions)and outputs(reports, calculations).**

It processes the inputs and produces outputs that are sent to the user or other system.

It is important to note the differences between data, information.

Data: are raw facts or elementary descriptions of things, events, activities, and transactions that are captured, recorded, stored, and classified but not organized to convey any specific meaning.

Examples of data would include grade point averages, bank balances, or the number of hours employees worked in a pay period.

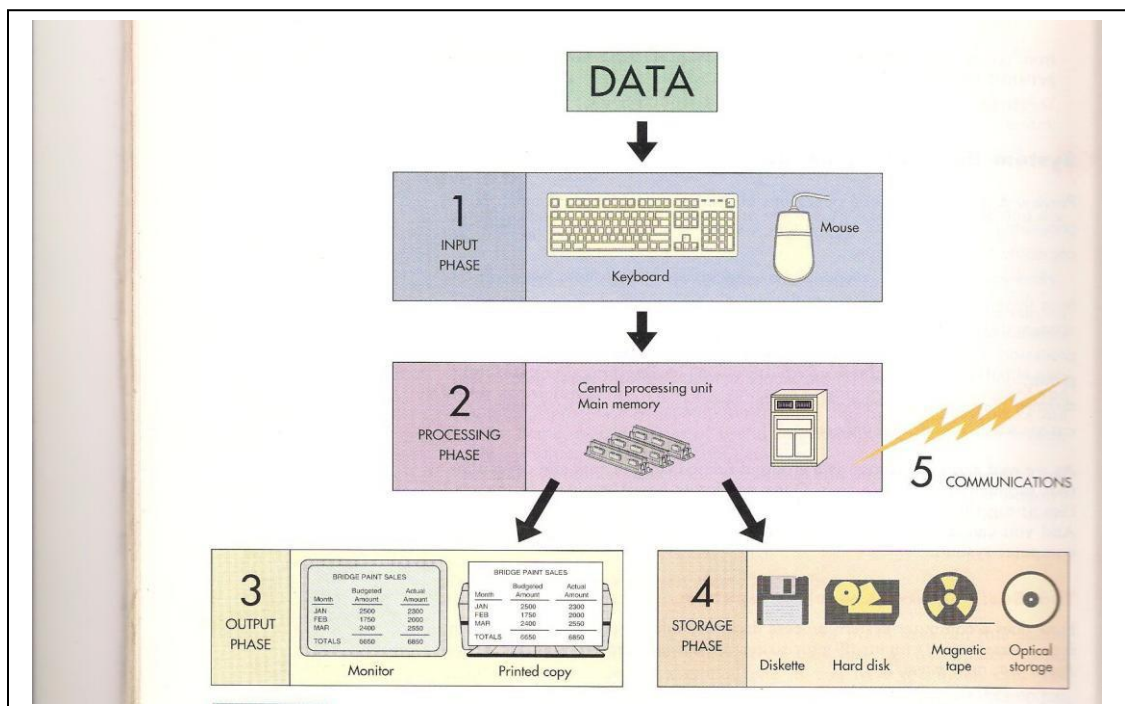
Information: is collection of facts (data) organized in some manner so that they are meaningful to a recipient, for example, if we include student name with grade point

averages, customer names with bank balances, and employees' wages with hours worked, we would have useful information.

-A computer goes through four operations when it process data into information.

1- Input, 2- processing, 3- output and 4- storage.

- 1- Input operation: data is entered or otherwise captured electronically and is converted to a form that can be processed by the computer. The means for capturing data (raw, unsorted facts) is input hardware, such as keyboard.
- 2- Processing operation: the data is manipulated to process or transform it into information for example numbers may be added or subtracted.
- 3- Output operation: the information which has been processed from the data is produced in form usable by people. Examples of output are printed text, sound, and charts and graphs displayed on computer screen.
- 4- Secondary storage operation: the information and programs are stored in computer -processable form.



1.3 Computer –Based Information System

Computer –based information system (SBIS) is an information system that uses computer and often telecommunications technology to perform some or all of its intended tasks.

An information technology is a particular component of a system, like a personal computer, printer, or network.

The basic components of information systems are the following:

1-**hardware**: a set of devices such as processor, monitor, keyboard, and Printer that accepts data and information processes them and displays them. 2-**software**: a set of computer programs that enables the hardware to process data.

3-**database**: an organized collections of related files, records, etc, that stores data and the associations among them

4-**network**: a connecting system that permits the sharing of resources among different computers.

5-**procedures**: the strategies, policies, methods, and rules for using the information systems.

6-**people**: the most important element in IS: include those persons who work with the information system or use its output.

2. Computer Organization and Information technology

2.1 Introduction to Computer Architecture

- Most computers have similar architectures that combine software and hardware.

Hardware

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

Software

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

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

Input devices

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

Output devices

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

Peripheral device

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

2.2 Main Parts of a Personal Computer

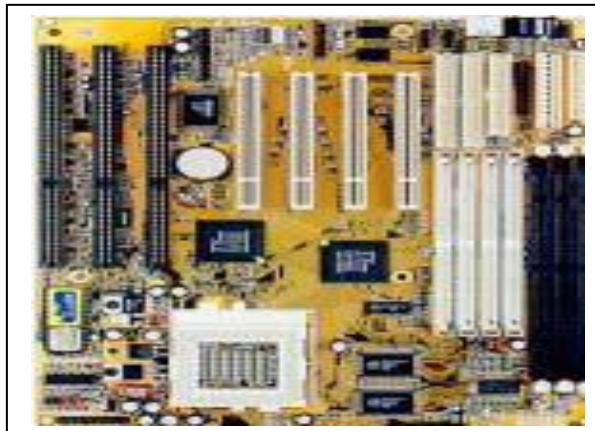
The System Unit

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



The System (Mother) Board

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



The CPU

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

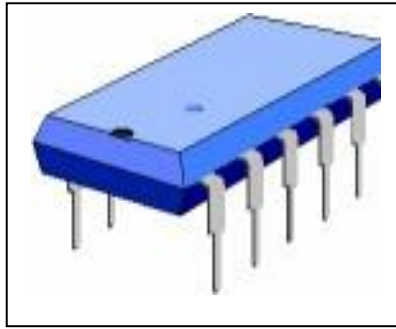
Memory (RAM)

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



ROM-BIOS

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



Serial Port

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



Parallel Port

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

Universal Serial Bus (USB)

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



2.3 Computer hardware

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

It consists of the following:

- Central processing unit (CPU)
- Memory (primary and secondary storage)
- Input technology
- Output technology
- Communication technology

2.3.1-The Central Processing Unit

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

The microprocessor has different portions which perform different functions:

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

Control unit

-Direct and coordinates all units of the computer to execute program steps.

-Direct and coordinate all operation of the computer systems. These operations include;

- 1- Control to the input and output devices.
- 2- Entry and retrieval of information from memory.
- 3- Routing of information between the memory, arithmetic and logic unit.
- 4- Control unit automatically coordinates the operation of the entire computer system, although the control unit does not perform any actual processing on the data, it acts as a central nervous system used to send control signals to other units.

Arithmetic and Logic Unit (ALU)

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

2.3.2 Computer Memory

There are two basic categories of memory:

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

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

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

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

Memory Capacity

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

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

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

- 1- **Byte:** A byte consists of eight bits.
- 2- **Kilobyte:** A kilobyte (KB) consists of 1024 bytes.
- 3- **Megabyte:** A megabyte (MB) consists of 1024 kilobytes, (1024*1024) byte or 1,048,576 byte) approximately 1,000,000 bytes.
- 4- **Gigabyte:** A gigabyte (GB) consists of 1024 megabytes, (1024*1024*1024 byte) or (1,073,741,824 byte), approximately 1,000,000,000 bytes.
- 5- **Terabyte:** A terabyte (TB) consists of approximately 1,000,000,000,000 bytes.

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

1-Random Access Memory (RAM): it stores more information than registers and is farther away from the CPU, but it stores less than secondary storage and is much closer to the CPU than is the secondary storage. When you start most software programs on your computer, the entire program is brought from secondary storage into RAM. As you use the program, small parts of the programs instructions and data are sent into the instructions as close to the CPU.

2-Read Only Memory (ROM)

Read-only-memory (ROM) is the place (a type of chip) where certain critical instructions are safe guarded. ROM is nonvolatile and retains these instructions when the power to the computer is turned off.

B) Secondary Storage (Backing Storage)

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

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

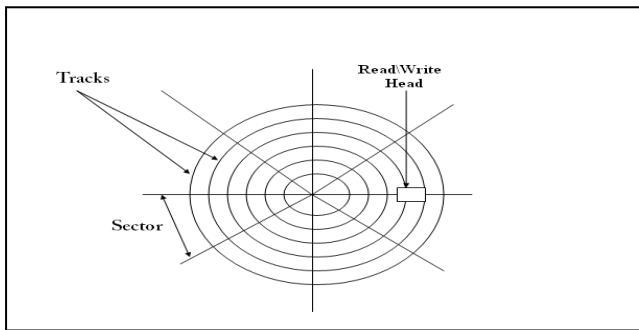
- a) **Magnetic tape**
- b) **Magnetic disc**
- c) **Magnetic diskette (floppy disc)**
- d) **Optical discs**

B-Features of magnetic disks (hard disks)

1. disks are randomly accessed
2. disks are of size and shape similar to a long-playing record
3. The surfaces of each disk are of magnetic material.
4. Each disk surface is divided into a number of concentric tracks (typically 200).
5. Disks are placed on pack and each pack may have 6 or 11 disks and is used as a single unit.
6. The latest models of disk packs can store many hundreds of megabytes of data (i.e. hundreds of millions of characters).

Hard Disk Performance: Several basic parameters determine the performance of a given hard disk drive. A seek operation is the movement of the read/write head to the desired track.

- 1- Seek Time: A seeks time is the movement of the read\write head to the desired track, hard disk drives have an average seek time of several milliseconds, depending on the particular drive.
- 2- Latency Time: The latency period is the time takes for the desired sector to spin under the head once the head is positioned over the desired track.Latency time depend on the constant rotational speed of the disk.



Hard Disk

The Difference between Internal and External hard disks: Internal hard disks are located inside your main computer unit, while external hard disks are joined to the main computer unit via a lead which you plug into the back of your computer unit. Some external hard disks will plug into the USB port (connector) located at the back of your computer. Other external hard disks require the installation of a special card within your computer which allows the connection of the external hard disk to the computer unit.

C- Features of optical disks

- 1- this is a random access device.
- 2- Data is written into the disk by burning a permanent pattern into the surface of the disk by means of high precision laser beam.
- 3- data is read by using the laser at lower intensity and detecting the pattern reflected from its beam by the surface of the disk.

There are many types of optical disks:

1- compact disk read-only memory (CD-ROM) storing devices feature high capacity, low cost.

It has become popular for recorded music as well as information (such as books) a variant is the digital video disk (DVD), used for movies.

- 2- Write once, read many (WORM) disk can be written.
- 3- rewritable CD is a less common technology that allows the disk to be written upon and written up to 1.000 times.

PRIMARY STORAGE

Primary storage has much less capacity than secondary storage, and is faster and more expensive per byte stored, primary storage is located much closer to the CPU than is secondary storage. Sequential _access secondary storage media such as magnetic tape is much slower and less expensive than direct access media (e.g. hard drives, optical media)

Computer Software

There are two major types of software: **system software & application software**

System Software:

Is a set of instructions that serves primarily as an intermediary between computer hardware and application programs. System software provides important self regulatory functions for computer system, such as loading itself when the computer is first turned on, managing hardware resources such as secondary storage for all applications, and providing commonly used sets of instructions for all applications to use.

Application software

Is a set of computer instructions that provide more functionality to a user such as word processing and payroll programs. System software can be grouped into two major functional categories:

System control programs and system support programs.

System Control Programs

System control programs control the use of the hardware, software, and data resources of a computer system. The main system control program is the operating system.

Operating System

Supervise the overall operation of the computer, including monitoring the computer's status and scheduling operations, which include input and output processes. In addition, the operating system allocates CPU time and main memory to programs running on the computer, and is also provides an interface between the user and the hardware. The operating system provides services that include process management, virtual memory, file management, security, fault tolerance, and the user interface.

Chapter 2

Computer Software

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between the user and the hardware.

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A-Process management

Means managing the program or programs (also called jobs) running on the processor at a given time, in the simplest case (a desktop operating system), the operating system loads a program into main memory and execute it.

-Multitasking:

Multitasking or multiprogramming is the management if two or more tasks, or programs running on the computer system at the same time.

Multithreading:

Is a form of multitasking that focuses on running multiple tasks within single application simultaneously, For example, a word processing application may edit one document while another document is being spell checked.

Time-sharing:

Is an extension of multiprogramming in this mode, a number of users operate online with the same CPU, but each uses a different input/output terminal. The programs of these users are placed into partitions in primary storage, execution of these programs rotates among all users, occurring so rapidly.

B- Virtual memory

Simulates more main memory than actually exists in the computer system. it allows a program to behave access to the full storage capacity of a computer, rather than just access to the amount of primary storage installed in the computer. In effect, primary storage is extended into a secondary storage device. This enlarged capability boosts the speed of the computer.

C-File management and security

The operating system is responsible for file management and security, managing the arrangement of, and access of, files held in secondary storage. The operating system creates and manages a directory structure that allows files to be created and retrieved by name. And it also may control access to those files based on permission and access controls. The operating system provides other forms of user's authority and security permissions.

-Common Operating System Tasks

- 1-monitoring performance
- 2-correcting errors
- 3-providing the user interface
- 4-starting 'booting' the computer
- 5- reading the program into memory
- 6- managing memory allocation to those programs
- 7- placing files and programs in secondary storage
- 8-creating and maintaining directories.
- 9- formatting disks
- 10- controlling the computer monitor
- 11-sending jobs to printers
- 12-maintaining security and limiting access
- 13-locating files
- 14-detecting viruses
- 15-compressing data

1-2- System support programs

The second major category as system software, system support program, that support the operations, management and users of a computer system by providing a variety of support services, system utility programs, performance monitors, and security monitors are examples of system support programs.

A- System Performance Monitors

Are programs that monitor the processing of jobs on a computer system performance and produce reports containing detailed statistics relating to the use of system resources, such as processor time, memory space, input/output devices, and system and application programs.

B- System Security Monitors

Are programs that monitor the use of a computer system to protect it and its resources from the unauthorized use, fraud, or destruction such programs provide the computer security needs to allow only authorized users access to the system. Security monitors also control use of the hardware, software, and data resources of a computer system.

2-Application software

Application software consists of instructions that direct a computer system to perform specific information processing activities and that provide functionality for users. this type of software consists of many widely used packages:

1) **Spreadsheets:** computer spread sheets software transforms a computer screen into a ledger sheet, of coded rows and columns. Users can enter numeric or textual data into each grid location, called a cell.

Computer spread sheets packages can be used for financial information, such as statements or cash flow analysis.

Microsoft excels is example of spreadsheet packages.

2) **Data management:** data management software supports the storage, retrieval, and manipulation of related data.

Microsoft's access is an example of popular database management software.

3) **Word processing:** word processing software allows the user to manipulate text rather than just numbers. a typical word processing software package consists of an integrated set of programs including an editor program, a formatting program, a print program, a dictionary program, charting.

4) **Multimedia:** multimedia software combines at least two media for input or output of data. These media include audio (sound), voice, animation, video, graphics, and images.

Programming languages

Programming languages provide the basic building blocks for all systems and application software. Programming languages allow people to tell computers what to do and are the means by which software systems are developed, we will describe the five generations-levels-of programming languages:

1) Machine language

Is the lowest-level computer language, consisting of the internal representation of the instructions and data. This machine code-the actual instructions understood and directly executable by the CPU is composed of binary digits. Machine language is the only programming language that the machine actually understands, CPU is capable of executing only machine language programs.

These user oriented languages make it much easier for people to program. But they are impossible for the computer to execute without first translating the program into machine language.

-The set of instructions written in a user _oriented language is called asource program.

-The set of instructions produced after translation into machine language is called the object program.

2) Assembly language

Assembly languages are considered second-generation languages, it is more user-friendly because it represent machine language instructions and data locations in primary storage, which people can more easily use. Compared to machine language, assembly language eases the job of the programmers.

Translating an assembly language program into machine language is

accomplished by system software program called an assembler.

3) **Procedural language**

- Called third-generation language
- Procedural language are much closer to natural language (the way we talk) and therefore, are easier to write, read.
- Procedural language use common words rather than abbreviated mnemonics.
- There are three examples of procedural languages FORTRAN, COBOL, and C.

4) **Nonprocedural languages**

- Called fourth-generation language.
- They can be used by non technical users to carry out specific functional tasks.
- These languages simplify the programming process as well as reduce the number of coding errors.
- They are common in database applications as query languages, report generators.

5) **Natural languages**

- Are called fifth –generation languages or" intelligent language"
- They are use mnemonics and tables.
- Most of these languages are still experimental because the programs that are translate natural language into machine – readable form are extremely complex and require a large amount of computer resources.

There are a handful of newer programming languages:

1) Visual programming languages

- Are used within graphical environment
- Are using a mouse, icons, and symbols on screen.
- Visual basic and visual C++ are examples of visual programming languages.

2) Hypertext markup language (HTML)

- Is an approach to data management in which data are stored in a network of nodes connected by links (called hyperlinks) • Users can access data through an interactive browsing system.
- The combination of nodes, links, and supporting indexes for any particular topic is a hypertext document
- A hypertext document may contain text, images, and other types of information such as data files, audio, and video.
- World Wide Web (www) uses HTML for creating and recognizing hypertext document.

3) object-oriented programming languages

- object-oriented programming (OOP) languages are based on the idea of taking a small amount of data and instructions about what to do with that data and putting both of them together into what is called an **object**
- C++ and JAVA are examples of OOP languages.

Chapter 3

Managing Organizational Data and information

Introduction

Our previous chapters gave us an introduction to information system and organizational topics, as well as insights into how IT hardware and software function. These technologies and systems support organizations through their ability to handle-acquire, store, access, analyze, and transmit electronic data. Properly managed these data become information.

The Data Hierarchy

A computer system organizes data in a hierarchy that begins with bits, and proceeds to bytes, fields, records, files, and databases, a bit represents the smallest unit of data a computer can process (0 or 1).and a group of eight bits, a byte ,represent a single character, which can be a letter, number, or a symbol. A logical grouping of characters into a word, small group of words or a complete number is called a field.

A logical grouping of related fields, comprise a record, logical grouping of records is called a file, and logical grouping of related files would constitute a database.

Storing and Accessing Records

records are stored in different ways on secondary storage media, and the arrangement determines the manner in which they can be accessed ,as we learned in previous lectures with sequential access ,data records must be retrieved in the same physical sequence in which they are stored.

A - Problems with a File Approach

1) Data Redundancy

As application and their data files were created by different programmers over a period of time the same piece of information could be duplicated in several places. In the university example, each data file will contain records about students, many of whom will be represented in other data files; therefore, student's files in the aggregate will contain some amount of duplicate data.

2) Data Inconsistency تضارب البيانات

data redundancy leads to the potential for data inconsistency, which means that the various copies of the data no longer agree, for example, if a student changes his or her address, the new address must be changed across all applications in the university that require the address.

3) Data Isolation عزل البيانات

file organization also leads to difficulty in accessing data from different applications, for example, in a university, an administrator who wanted to know which student taking advanced courses were also starting players on the football team would most likely not be able to get answer from the computer –based file system. The administrator would probably have to manually compare printed output data from the two data files. This manual process would take a great deal of time.

B - Database: The modern approach

A database which is a logical group of related files, can eliminate many of the problems associated with the traditional file environment, with the database approach, all the data are typically contained in the same storage location, rather than residing in many different files across the organization, unlike the traditional approach, in which different programs access the different data files, -the database is arranged so that one set of software programs the database management system provides access to all data. **Therefore data redundancy, data isolation and data inconsistency are minimized, and data can be shared among all users of the data, an addition, security and data integrity are increased.**

Locating Data in Database

A database is collection of related files, and where those related files are located can greatly affect user accessibility, query response times, data entry, and security and cost in general, **database files can be centralized or distributed.**

1-Centralized Database

Centralized database has all the related files in one physical location, centralized database files on large mainframe computers were the main database platform for decades.

2-Distributed database

Distributed database has complete copies of a database, or portions of a database. In more than one location, which is usually close to the user.

- **Database Management System (DBMS)**

The software program (or group of programs) that provides access to a database is known as a database management system (DBMS). the DBMS permits an organization to store data in one location, from which it can be updated and retrieved. And it provides access to the stored data by various application programs. DBMS also provide mechanisms for maintaining the integrity of the stored information ,managing security and user access,recovering information when the system fails. The DBMS provides userswith tools to add, delete, maintain, display, print, search, select, sort, andupgrade data.

Database management systems provide many advantages to the organization:-

- 1-improved strategic use of corporate data
- 2-reduced complexity of the organization's information system environment
- 3-reduced data redundancy and inconsistency
- 4-enhanced data integrity
- 5-application –data independence
- 6-improved security
- 7-reduced application development and maintenance costs
- 8-improved flexibility of information system
- 9-increased access and availability of data and information

-Logical data models

The three most common data models are hierarchical, network, and relational:

1) Hierarchical database model

The hierarchical database model rigidly structures data into an inverted "tree" in which each record contains two elements, the first is a single root or master field, often called a key, which identifies the type location or ordering of the records, the second is a variable number of fields, which define the rest of data within a record.

The hierarchical model was developed simply because hierarchical relationships are commonly found in many traditional business organizations and processes.

The strongest advantage of the hierarchical is the speed and efficiency with which it can be searched for the data.

2) Network database model

the network database model creates relationships among data through a linked list structure in which subroutines records (called members, not children) can be linked to more than one data element (called an owner) similar to the hierarchical model, the network model uses explicit links called pointers, to link members and owners. With the network approach, a member record can be linked to an owner record and, at the same time, can itself be an owner record linked to other sets of members

3) Relational database model

While most business organizations have been organized in a hierarchical fashion, most business data---especially accounting and financial data---have traditionally been organized into simple tables of columns and rows. tables allows quick comparisons by row or column, and items are easy to retrieve by finding the point of intersections of a particular row and column.

Managing the Database

- Database management systems perform functions that most users never see
- The infrastructure is needed so that the database can be maintained and modified and also to assure its efficient operation Resources
- The **performance statistics processor** component of the DBMS maintains information that identifies what data is being used, who is using it, when it is being used, and so forth
- As the database management system runs, it keeps a **transaction log** that notes every database action taken as well as the exact time the action was taken
- A **backup** copy of the database is also made periodically Database Personnel
- The **database administrator (DBA)** has both technical and managerial responsibilities over the database resource.
- **Database programmers** create the database applications required by firms for their corporate use
- The **database end-user**, by virtue of the decisions made and the amount of data retrieved, also has a major impact on database design, use, and efficiency.