1 Information Technology in Business Environment

Information Technologies are woven into complex systems:

- Interrelating with other systems
- Permeating every business process
- Enabling tremendous gains in knowledge, productivity, and profitability
- A great variety of information can now be gathered at each part of each business process, and information can be distributed throughout the organization, giving knowledge and insight for competitive decision-making and advantage.

1.1 Business in Information Age: Pressures

1. Global competition for Market and Labor
2. Need for real time operations
3. Changing workforce
4. Customer Orientation
5. Technological innovation and obsolescence
6. Information overload
7. Social responsibility
8. Government Regulation and Deregulation
9. Ethical Issues

1.2 Organizational Responses to Business Pressures

1. Strategic system
2. Customer Focus and Customer Service
3. Continuous Improvement Efforts
   Just-in-time(JIT)
   Total quality management(TQM)
4. Business Process Reengineering
5. Empowering Employees and Fostering Collaborative work

6. Business Alliances

   Supply Chain Management (SCM)
   Enterprise Resource Planning(ERP)

7. Electronic Commerce

Refer pg. 3-12 of the textbook

2 Why You Need to Learn About IT

- T is interesting
- IT facilitates work in organizatons
- IT offers career opportunities
- IT is used by all departments

3 Information System

IS collects, processes, stores, analyzes, and disseminates information for a specific purpose. An information system includes input(data,instructions) and outputs (reports, calculations). It process the inputs and produces outputs that are sent to the user or to other systems. A feedback mechanism that controls the operation may be included.
Information system is an integrated set of components for collecting, storing, and processing data and for providing information, knowledge, and digital products.
A combination of hardware, software, infrastructure and trained personnel organized to facilitate planning, control, coordination, and decision making in an organization.

- Data items. An elementary description of things, events, activities, and transactions that are recorded , classified, and stored, but are not organized to convey any specific meaning. Eg. Bank balances, grade point average etc.
- Information. Data that have been organized to that they have meaning and value to the recipient. Information comes from data that have been processed. Eg. Customer names with bank balance, student names with their respective grade etc.
- Knowledge. Data and/ or information that have been organized and processed to convey understanding, experience, accumulated learning, and expertise as apply to a current problem or activity.

3.1 Computer Based Information System (CBIS)

A computer-based information system (CBIS) 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, a printer, or a network. But few information technologies are used alone. Rather, they are most effective combined into information systems. The basic components of information systems are the following:

- Hardware
- Software
- Database
- Network
- Procedure
- People

3.2 Capabilities of CBIS

1. Provide Fast and Accurate Transaction
2. Provide Large Capacity, Fast Access Storage
3. Provide Fast Communications
4. Reduce Information Overload
5. Span Boundaries
6. Provide Support for Decision Making
7. Provide a Competitive Weapon

Refer pg.18 of the textbook

4 Information Technology Architecture

A high-level map or plan of the information assets in an organization, which guides current operations and is a blueprint for future directions. In preparing the IT architecture, the designer needs similar information, which can be divided into two part:

1. The business needs for information
   The existing and planned IT infrastructure and applications of the organization

2. IT Infrastructure
   The physical facilities, IT components, IT services, and IT management that support an entire organization.

   - IT components are the computer hardware, software and communications technologies that are used by IT personnel to produce IT services.
   - IT services include data management systems development , and security concerns . IT infrastructure include these resources as well as their integration, operation, documentation, maintenance and management

5 Evolution of Information System

5.1 Transaction Processing System (TPS)

The first business application of computers(in the mid- 1950s) performed repetitive high-volume, transaction-computing tasks. The computers crunched numbers summarizing and organizing transactions and data in the accounting, finance, and human resources areas. Such systems are generally called transaction-processing systems (TPSs)

5.2 Management Information Systems (MIS)

These systems access, organize, summarize and display information for supporting routine decision making in the functional areas

5.3 Support System or Office Automation Systems (OAS)

Systems that are developed to support office and clerical workers such as word processing system. Computer Aided Design (CAD) is another example of support system. .

5.4 Decision Support System (DSS)

Decision Support Systems were developed to provide computer based support for complex, non-routine decision. DSS expanded into two direction i) Executive Information System ii) Group Support system. The various commercial software products that support people working in groups is called Groupware

5.5 End-user Computing

The use or development of information systems by the principal users of the systems? outputs, such as analysts, managers, and other professionals is called End-user computing system

5.6 Intelligent System (IS)

Managerial applications of artificial intelligence is called IS. It include Expert System (ES) which is an advisory systems that provide the stored knowledge of experts to non experts. There are new type of IS with machine learning capabilities that can learn from historical cases.

5.7 Knowledge Management System

It supports the creating, gathering, organizing, integrating and disseminating of organization knowledge.

5.8 Data Warehousing

A data warehouse is a database designed to support DSS, ESS and other analytical and end-user activities.

5.9 Mobile computing

Information systems that support employee who are working with customers or business partners outside the physical boundaries of their companies; can be done over wire line or wireless networks.

6 Classification of Information Systems

The two most common classifications are:

1. Classification by breath of support
2. Classification by organizational level .

6.1 Classification by breadth of support

Typical information systems that follow the hierarchical organization structure are functional (departmental) enterprise-wide and inter-organizational

- Functional information systems are organized around the traditional departments.
- Enterprise information systems serve several departments or the entire enterprise.
- Inter-organizational systems connect two or more organizations.
- An organization?s supply chain describes the flow of materials, information money and service from raw material suppliers through factories and warehouses to the end customers.

- IT provide two major types of software solution for managing supply chain activities; First enterprise resource planning (ERP), Second Supply Chain Management (SCM)

6.2 Classification by Organizational Levels

The typical enterprise is organized hierarchically, from the clerical and office worker layer, to the operational layer, the managerial layer, the knowledge worker layer and finally the strategic layer.

1. **Clerical Level** Clerical workers constitute a large class of employee who support managers at all levels of the company. Among clerical workers, those who use, manipulate, or disseminate information are referred to as data workers. These employee include bookkeepers, secretaries who work with word processors, electronic file clerks, and insurance claim processors.

2. **Operational Level** Operational, or first-line managers deal with the day-to day operations of the organization, making routine decision, which deal in general with activities such as short- term planning, organizing, and control.

3. **The Knowledge-Work Level** They act as advisors and assistants to both top and middle management and are often subject-area experts. Many of these professional workers are classified as knowledge workers, people who create information and knowledge as part of their work and integrate it into the business

4. **The Strategic Level** Top-level or strategic managers (the executive) make decision that deal with situation that may significantly change the manner in which business is done

5. **Computing Environment** It is the way in which an organization?s information technologies (hardware, software, and communications technology) are organized and integrated for optimal efficiency and effectiveness.

6. **Legacy System** Older systems, typically those that process an organization?s high-volume transactions that are central to the operations of a business.

7. **Distributed Computing** Computing architecture that divides the processing work between two or more computers, using a network for connection, also called distributed processing. Distributed computing can be further divided into following:

   - **Client/Server Architecture**
     (a) A type of distributed architecture that divides distributed computing units into two major categories, clients and servers, connected by a network .
     (b) Client: A computer (such as a PC attached to a network) that is used to access shared network resources.

(c) Server: A computer that is attached to a client/server network and provides clients with variety of services.

- **Enterprise wide computing** Computing environment in which each client/ server architecture is used throughout an organization.
- **Peer-to-Peer (P2P)** A distribute computing network in which each client/ server computer shares files or computer resources directory with others but not through a central service (as in traditional client/ server architecture).
- **Web Based System**
  (a) Web based systems:
  Applications or service that are resident on a server that is accessible using a web browser and is therefore accessible from anywhere via the internet.
  (b) Internet:
  a worldwide system of computer ? a network of networks; a public, cooperative and self- sustaining facility accessible to hundreds of millions of people worldwide.
  (c) Information Superhighway.
  A national fiber-optic- based network and wireless infrastructure that will connect all internet users in a country.
  (d) World Wide Web
  An application that uses the transport functions of the Internet; has universally accepted standards for storing, retrieving formatting, and displaying information via a client/server architecture.
  (e) Intranet
  A private network, usually within one enterprise that uses web technologies such as browsers and Internet protocols separated from the Internet by a security gateway such as a firewall.
  (f) Extranet
  A secured network that connects several intranets via the Internet; allows two or more enterprise to communicate and collaborate in a controlled fashion

Hardware refers to the physical equipment used for the input, processing, output, and storage activities of a computer system. Computer hardware is the physical parts or components of a computer, such as the monitor, mouse, keyboard, computer data storage, hard disk drive (HDD), graphic cards, sound cards, memory (RAM), motherboard, and so on, all of which are physical objects that are tangible. It consists of following:

- Central processing unit (CPU)
- Memory

- Input technologies
- Output Technologies
- Communication Technologies

7 Central Processing Unit (CPU)

A central processing unit (CPU) is the hardware within a computer that carries out the instructions of a computer program by performing the basic arithmetical, logical, and input/output operations of the system. It is a microprocessor made up of millions of microscopic transistors embedded in a circuit on a silicon wafer or chip. *Eg. Pentium, Alpha, Athlon etc.*

7.1 How CPU Works

- The inputs are data and brief instructions about what to do with the data. These instructions come from software in other parts of the computer. The inputs are stored in registers until they are sent to the next step in the processing.
- Data and instruction travel in chip via electrical pathways called buses. The size of the bus determines how much information can flow at any time.
- The control unit directs the flow of data and instructions within the chip.
- The arithmetic-logic unit (ALU) receives data and instructions from the registers and makes the desired computation. These data and instructions have been translated into binary form. The CPU can process only binary data.
- The data in their original form and the instructions are sent to storage registers and then are sent back to a storage place outside the chip, such as computer?s hard drive. Meanwhile, the transformed data go to another register and then on to other parts of computer.

The cycle of processing, known as **machine instruction cycle**, occurs millions of times per second or more. It is faster or slower, depending on the following factors:

- Machine instruction cycle:
  The cycle of computer processing, whose speed is measured in terms of the number of instructions a chip processes per second.
- Clock speed:
  The preset speed of the computer clock that times all chip activities, measured in megahertz and gigahertz.

- Word length:
  The number of bits (0s and 1s) that can be processed by the CPU at any one time.
- Bus width:
  The size of the physical paths down which the data and instructions travel as electrical impulses on a computer chip.
- Line width:
  The distance between transistors; the smaller the line width, the faster the chip.

Moore's Law Microprocessor complexity would double every two years as a result of the following changes:

- Increasing miniaturization of transistors.
- Making the physical layout of the chip?s components as compact and efficient as possible.
- Using materials for the chip that improve the conductivity (flow) of electricity. Targeting the amount of basic instructions programmed into the chip.

Microcontroller:
Computer chips, embedded in products and technologies that usually cost less and work in less-demanding applications than microprocessors.

8 Computer Memory

8.1 Memory Capacity

Bits : 0s and 1s Byte = 8 bit string Kilobyte = 1024 bytes Megabyte = 1024 Kilobyte Gigabyte = 1024 Megabyte Terabyte = 1 trillion bytes

There are two types of computer memory : **Primary memory Secondary memory**

9 Primary Memory

Small amounts of data and information that will be immediately used by the CPU are stored in primary memory or primary storage. It is also known as main memory. It stores data to be processed by the CPU, instructions for the CPU as to how to process data, and operating system programs that manage various aspects of computer?s operation for a short period of time. Primary storage takes place in chips mounted on the motherboard and are located as close as physically possible to the CPU. There

are four min types of primary storage: Register, Random Access Memory (RAM), Cache Memory and Read Only Memory (ROM).

9.1 Register

- Registers are part of the CPU
- Have least capacity
- Stores extremely limited amounts of instructions and data only immediately before and after process

9.2 RAM

- stores more information than registers
- stores less than secondary storage
- RAM is temporary and volatile memory
- software program and small amounts of data are stored in RAM when they are brought from secondary storage
- two main types of RAM are dynamic RAM (DRAM) and static RAM (SRAM)
- DRAM offers the greatest capacities and the lowest cost per bit but it is relatively slower
- SRAM costs more than DRAM but has higher level performance

9.3 Cache Memory

-also known as CPU memory t is a type of high speed memory that a processor can access more rapidly than RAM. it is faster than RAM because it is located closer to the CPU the basic purpose of cache memory is to store program instructions that are frequently re-referenced by software during operation when a microcontroller processes data, it looks first in cache memory there are mainly 2 types of cache memory : **L1 (Level 1) L2 (Level 2)** L1 is smaller and faster than L2 and is located in the processor L2 is located on the motherboard but not in the processor nowdays chips are designed with L1 and L2 in the processor and another one called L3 cache on the motherboard

9.4 ROM

- critical instructions are stored in ROM
- it is non-volatile

- instruction in ROM can only be read by the computer and can not be changed by the user.
- other forms of ROM are Programmable ROM (PROM) and Erasable and Programmable ROM (EPROM)

10 Secondary Storag

- designed to store very large volume of data
- it is non volatile
- it is generally electromechanical in nature
- it is slower than primary storage
- it is much more cost effective than primary memory
- it can take place in variety of media

Magnetic tape

- A secondary storage medium on a large open reel or in a smaller cartridge or cassette.
- it is the cheapest storage medium
- can store very large amount of data
- it is a sequential access memory thus data retrieval is very slow
- Data access in which the compute system must run through data in sequence in order to locate a particular piece is called sequential access **Sequential access**
  - Data are stored in binary format
  - it stores information by giving tiny particles of iron oxide embedded on the tape either a negative or positive polarization

10.1 Magnetic disks

- A form of secondary storage on a magnetized disk divided into tracks and sectors that provide addresses for various pieces of data; also called hard disks.
- used for mass storage
- data can be accessed in non-sequential manner; uses direct access
- in direct access method data can be located using data?s address
- data access is very fast
- but they are susceptible to mechanical failure

10.2 Magnetic Diskette

- also known as floppy disks
- they are made up of flexible Mylar
- slower than hard drives
- less storage capacity
- highly portable

10.3 Optical Storage Device

- A form of secondary storage in which a laser reads the surface of a reflective plastic platter.
- pinpoint laser beam is used to burn tiny holes into the surface of the reflective plastic platter
- when information is to be read another laser shines on the surface; and if the light is reflected it is read as 1 and if the light shines on one of the holes resulting in lack of reflection then it is read as 0 -
- types of optical storage : **Compact-disk Read Only Memory (CD-ROM), Digital Video Disk (DVD), Fluorescent Multilayer Disk (FMD-ROM)**
- Compact disk, read-only memory (CD-ROM)
  A form of secondary storage that can be only read and not written on.
- Digital video disk (DVD):
  An optical storage device used to store digital video or computer data.
- Fluorescent multilayer disk (FMD-ROM):
  An optical storage device with much greater storage capacity than DVDs. It uses multiple layers on an optical disk to store data. All layers of an FMD can be read in parallel, thus it has a high data rate

10.4 Memory cards

Credit-card-size storage devices that can be installed in an adapter or slot in many personal computers.

10.5 Expandable storage devices

Removable disk cartridges used as backup storage for internal hard drives of PCs.

11 Enterprise Storage System

It is an independent, external system with intelligence that includes two or more storage devices. There are three major types of enterprise storage systems: RAID, SAN and NAS.

11.1 Redundant Array of Independent Disks (RAID)

RAID (redundant array of independent disks; originally redundant array of inexpensive disks) provides a way of storing the same data in different places (thus, redundantly) on multiple hard disks (though not all RAID levels provide redundancy). By placing data on multiple disks, input/output (I/O) operations can overlap in a balanced way, improving performance. Since multiple disks increase the mean time between failures (MTBF), storing data redundantly also increases fault tolerance.

11.2 Storage Area Network (SAN)

A storage-area network (SAN) is a dedicated high-speed network (or subnetwork) that interconnects and presents shared pools of storage devices to multiple servers. A SAN moves storage resources off the common user network and reorganizes them into an independent, high-performance network. This allows each server to access shared storage as if it were a drive directly attached to the server. When a host wants to access a storage device on the SAN, it sends out a block-based access request for the storage device.

11.3 Network Attached Storage (NAS)

Network-attached storage (NAS) is a file-level computer data storage server connected to a computer network providing data access to a heterogeneous group of clients. NAS is specialized for serving files either by its hardware, software, or configuration

12 Output devices

An output device is an electromechanical, which accepts data from a computer and translates them into a form which is suitable for use by the outside world. Monitor, printer, plotter, speaker and scanner are some of the examples of output devices. These output devices convert the input data into the internal codes used by the computer and also converts internal codes into human readable form while supplying the output. They are connected to the computer system through I/O ports.

Output devices generate a computer output:

- Soft-copy: output: it cannot be touched but is easily editable. Output displayed on a terminal screen is soft-copy output.
- Hard-copy: A hard-copy can be touched but is not easily editable. Output generated by printer is hard-copy output.

12.1 Monitor

Computer monitors are similar to television screen. Virtually everything in a monitor is electronically controlled. The absence of mechanical complexity greatly reduces the likelihood of failure. Video Display Terminal: Output and input devices attached together.

The two basic types of monitors are **Cathode Ray Tube (CRT) Flat panel.** In order to connect a monitor to computer, you must have a graphics adapter card (also known as a video card). The graphics card is plugs into an expansion slot in motherboard inside the computer and the monitor plugs into the graphics adapter card.

12.2 Printer

Printer is prints text or any other information on paper. Types of printers:

(a) Daisy wheel printer
Daisy wheel printer has a plastic or metal wheel on the shape of each character stands out. A hammer presses the wheel against a ribbon, which in turn makes an ink stain in the shape of the character on the paper. These printers are noisy and slow. Daisy wheel printers are impact printers since they print by hammering the wheel against ribbon.

Dot-Matrix Printer
Dot matrix printer produces characters by striking pins against an ink ribbon. Print head is a part of these printers which consists of a matrix of tiny needles, typically seven rows with nine needles in each which hammers out characters in the form of patterns of tiny dots. They can print multi-page forms (that is, carbon copies). Dot matrix printers are impact printers.

(b) Ink-jet Printer
Ink jet print characters by spraying small drops of ink at a sheet of paper. The ink is different from normal ink having a high iron content. There are magnetized plates in the ink?s path which direct the ink onto the paper in the desired shapes. Ink-jet printers are capable of producing high quality print

approaching that produced by laser print. They can not produce multiple copies of a document in a single printing.

Ink-jet is slower than laser printer and ink-jet printers require a special type of ink. Ink-jet printers are non-impact printers because they print by spraying ink on the page. Hence they are quite in operation.

(c) Laser printer
Laser printer uses a beam to produce an image on a drum. Laser printers produce very high-quality print and are capable of printing an almost unlimited variety of fonts .

(d) LCD and LED Printer
These printers are similar to a laser printer. Instead of using a laser to create an image on the drum as in the laser printer. These printers shines a light through a liquid crystal panel. Individual pixels in the panel let the light pass or block the light, thereby creating an image composed of dots on the drum. Liquid crystal shutter printers produce print quality equivalent to that of laser printers.

(e) Line printers
Line printers are very fast printers which can print in the range of 300 to 2500 lines per minute. The disadvantage of line printers is that they can?t print graphics, the print quality is low, and they are very noisy.

(f) Thermal printe
r Thermal printer uses heat to transfer an impression onto paper. These printers produce images by pushing electrically heated pins against special heat sensitive paper. They are inexpensive and are used in many fax machines. They produce low quality print, and the paper tends to curl and fade.

12.3 Plotter

Plotter is an output device for translating information from a computer into pictorial or graphical form on paper or a similar medium. A Device that draws pictures on paper based on commands from a computer. Plotters differ from printers in that they draw lines using a pen. As a result, they can produce continuous lines, whereas printers can only simulate lines by printing a closely spaced series of dots. Plotters are expensive than printers. They are used in engineering applications where precision is mandatory.

12.4 Sound cards and Speakers

Sound card is an output device which is related with the production of sound in the computer system. Sound cards are necessary for nearly all CD-ROMs.

Sound cards enable the computer to output sound through speakers connected to the board, to record sound input from a microphone connected to the computer, and manipulate sound stored on a disk. There are two basic methods which are used by Sound cards to translate digital data into analog sounds: FM synthesis: This method mimics different musical instruments according to built-in formulas. Wavetable synthesis: This method relies on recordings of actual instruments to produce sound. Wavetable synthesis produces more accurate sound, but is also more expensive.

Working of Sound Card

The sound card records audio by converting analog into digital data using on analog-to-digital converter chip. These digital signals are sent to a digital signal processor (DSP) chip that can be considered as the heart of the sound card. This chip frees the computer?s processor by taking over tasks relating to processing of the digital sound signals. This processed data is then stored in files on the hard disk or other media in the prescribed format, typically WAV (full form) or MIDI (full form). Playing back these sound files involves sending the data in these files to the DSP chip, that in turn process it and sends it to a digital-to-analog converter chip. This chip converts the digital signals into an electrical current that is amplified by the speakers to produce sound. Sound card interfaces should include a line input, line output, microphone and speaker connectors.

12.5 3D Audio

3D audio is a technique in which more depth is given to traditional stereo sound.

12.6 Voice Output

It uses sophisticated synthesizer software to construct the sonic equivalent of textual words.

13 Input Technologies

An input device is a peripheral (piece of computer hardware equipment) used to provide data and control signals to an information processing system such as a computer or information appliance. Examples of input devices include keyboards, mouse, scanners, digital cameras and joysticks.
Input technologies can be broadly classified into :

i. Human Data-Entry Devices
ii. Source Data Automation

13.1 Human Data-Entry Devices

It allows people to communicate with the computer.

- Keyboards
  Most common input device (for text and numerical data).
- Mouse
  Handheld device used to point cursor at point on screen, such as an icon; user clicks button on mouse instructing computer to take some action.
- Optical mouse
  Mouse is not connected to computer by a cable; mouse uses camera chip to take images of surface it passes over, comparing successive images to determine its position.
- Trackball
  User rotates a ball built into top of device to move cursor (rather than moving entire device such as a mouse).
- Touchpad
  User moves cursor by sliding finger across a sensitized pad and then can tap pad when cursor is in desired position to instruct computer to take action (also called glide-and-tap pad).
- Joystick
  Joystick moves cursor to desired place on screen; commonly used in workstations that display dynamic graphics and in video games.
- Touchscreen
  Users instruct computer to take some action by touching a particular part of the screen; commonly used in information kiosks such as ATM machines.
- Stylus
  Pen-style device that allows user either to touch parts of a predetermined menu of options or to handwrite information into the computer (as with some PDAs); works with touchsensitive screens.
- Voice-recognition
  Converts voice wave sounds into digital input for computer; critical technology for physically challenged people who cannot use other input devices.

13.2 Source Data Automation

It allows to input data with minimal human intervention; this technology speeds up data collection, reduce errors, and gather data at the source of transaction or other events.

- Automated teller machines

Interactive devices that enable people to make bank transactions from remote locations.

- Point-of-sale terminals
  Computerized cash registers that also may incorporate touch screen technology and barcode scanners to input data such as item sold, price, etc.
- Barcode scanners
  Devices scan black-and-white barcode lines printed on merchandise labels.
- Optical mark reader
  Scanner for detecting presence of dark marks on predetermined grid, such as multiplechoice test answer sheets.
- Magnetic ink character reader
  Read magnetic ink printed on checks which identify the bank, checking account, and check number.
- Optical character recognition
  Software that converts text into digital form for input into computer. Sensors Collect data directly from the environment and input data directly into computer;
- Cameras Digital
  cameras capture images and convert them into digital files
- Retinal scanning
  displays Projects an image, pixel by pixel, directly onto a viewer?s retina; used with mobile devices;

14 Software

Software is a general term for the various kinds of programs used to operate computers and related devices.Software can be thought of as the variable part of a computer and hardware the invariable part. Software is often divided into **application software** (programs that do work users are directly interested in) and **system software** (which includes operating systems and any program that supports application software). The term *middleware* is sometimes used to describe programming that mediates between application and system software or between two different kinds of application software (for example, sending a remote work request from an application in a computer that has one kind of operating system to an application in a computer with a different operating system).
When the first applications of computers in business were introduced in the early 1950s, software was less important (and less costly) in computer systems. Today, software comprises a much larger percentage of the cost of modern computer systems

14.1 Software Crisis

- no software applications fast enough to keep up with rapidly changing business conditions and rapidly evolving technologies
- not only must new applications be developed quickly, but existing software must also be maintained
- increasing complexity, leads to the increased potential for "bugs"
- testing and "debugging" software is expensive and time-consuming

14.2 Software Fundamentals

- **computer programs**
  sequences of instructions for the computer
- **programming**
  process of writing (or coding) programs
- **programmers**
  individuals who perform programming
- **stored program concept**
  in this concept stored programs are accessed and their instructions are executed in the computer's CPU

15 Types of Software

Software can be generally divided into two categories :

i. **System Software**
ii. **Application Software**

15.1 System Software

- the class of programs that control and support the computer system and its information processing activities
- facilitates the programming, testing, and debugging of computer programs
- usually independent of any specific type of application
- support application software by directing the basic functions of the computer

Sytem Software can be grouped into two major functional categories : **System Control Program and System Support Program**

i. **System Control Program**
   It control the use of the hardware, software and data resources of a computer

system. The main system system control program is the **Operating System**. The OS supervises the overall operation of the computer, including monitoring the computer's status and scheduling operations. It allocates CPU time and main memory to programs running on the computer, and also provides an interface between the user and the hardware

Service Provided by the Operating System

- **Process management**
  managing the program or programs running on the processor at a given time
- **Multitasking (or multiprogramming)**
  managing two or more tasks, programs, running on the computer system at the same time
- **Time-sharing**
  a number of users operate on-line with the same CPU, but each uses a different input/output terminal
- **Multithreading**
  a form of multitasking that focuses on running multiple tasks within a single application simultaneously
- **Multiprocessing**
  a computer system with two or more processors that can run more than one program or thread at a given time by assigning them to different processors
- **Virtual memory**
  simulates more main memory than actually exists in the computer system
- **File Management and Security**
  managing the arrangement of, and access to, files held in secondary storage
- **Fault Tolerance**
  the ability of a system to produce correct results and continue to operate even in the presence of faults or errors
- **Graphical User Interface (GUI)**
  allows users to have direct control of visible objects and actions that

Types of OS

- Mobile Device Operating Systems
- Desktop and Notebook Computer Operating System
- Departmental Server Operating System
- Enterprise Server Operating System
- Supercomputer Operating System

(refer page 99/100of the textbook)

ii. **System Support Programs**
System support programs support the operations, management, and users of a computer system by providing a variety of support services. Example of system support programs are :

- **System utility programs**
accomplish common tasks such as sorting records, checking the integrity of diskettes, creating directories and subdirectories, restoring accidentally erased files, locating files within the directory structure, managing memory usage, and redirecting output
- **System performance monitors**
monitor the processing of jobs on a computer system and produce reports containing detailed statistics concerning the use of system resources
- **System security monitors**
monitor the use of a computer system to protect it and its resources from unauthorized use, fraud, or destruction

15.2 Application Software

Instructions that direct a computer system to perform specific information processing activities and provide functionality for users are called Application Software.
Application software, or simply applications, are often called productivity programs or end-user programs because they enable the user to complete tasks such as creating documents, spreadsheets, databases, and publications, doing online research, sending email, designing graphics, running businesses, and even playing games. Application software is specific to the task it is designed for and can be as simple as a calculator application or as complex as a word processing application.
Types of Application Software

- **Proprietary application software**
addresses a specific or unique business need for a company
- **Off-the-shelf application software**
developed programs sold to many organizations
may be customizable or may be standard package
- **Personal Application Software**
one of the off-the-shelf application programs that are not linked to any specific business function, but instead support general types of processing

it is designed to help individual users increase their productivity
various types of personal application software are listed below :

- Spreadsheets
- Data Management
- Word processing
- Desktop Publishing
- Graphics
- Multimedia
- Communications
- Speech recognition software
- Groupware

(refer to pg 101-105)

15.3 Software Suites

- collections of application software packages that integrate the functions of the packages
- examples : Microsoft Office, Novell Perfect Office, and Lotus SmartSuite
- generally include : a spreadsheet program, word processor, database program, and graphics package with the ability to move document, data and diagrams among them.

15.4 Software Issues

i. **Software Selection**
Factors to be considered while selecting a software are:
   - size and location of the current and future user base
   - system administration tools
   - initial and subsequent costs
   - current and future system capabilities
   - existing computing environment
   - in-house technical skills

ii. **Software Evaluation**
Quality of a software can be evaluated on the basis of following points:
   - ease of use in development
   - maintenance
   - data handling
   - graphic presentation

- environments and hardware
- vendor support
- security
- documentation
- output option
- learning

iii. **Software Licensing**

copyright - exclusive legal right to reproduce, publish, and sell the software
licenses - permission granted under the law to engage in an activity otherwise unlawful

iv. **Software Upgrades**
-revised software may offer valuable enhancements but may offer little in terms of additional capabilities
-revised software may contain bugs

v. **Shareware, Freeware, and Cheapware**
Shareware - low price software
Freeware - free copyrighted software
Cheapware - free public-domain software

vi. **Open Systems**
a paradigm of computing products that work together
use the same operating system with compatible software on all the different computers in a system

16 Programming Language

A programming language is a formal constructed language designed to communicate instructions to a machine, particularly a computer. Programming languages can be used to create programs to control the behaviour of a machine or to express algorithms.
Types of Programming Language

- **Machine Language**
  Machine code or machine language is a set of instructions executed directly by a computer's central processing unit (CPU). Each instruction performs a very specific task, such as a load, a jump, or an ALU operation on a unit of data in a CPU register or memory. It is considered as

the first-generation language, it is the lowest-level computer language consisting of the internal representation of instruction and data.

- **Assembly Language**
  An assembly (or assembler) language, often abbreviated asm, is a low-level programming language for a computer, or other programmable device, in which there is a very strong (generally one-to-one) correspondence between the language and the architecture's machine code instructions. It represents machine language instructions and data locations in primary storage by using *mnemonics*.It is the next level up from machine language but is still considered a lower-level language. It is user-friendly compared to machine language . Translating an assembly language program into machine language is accomplished by a system software program called an **assembler**.
- **Procedural Language**
  Procedural language is a type of computer programming language that specifies a series of well-structured steps and procedures within its programming context to compose a program. It contains a systematic order of statements, functions and commands to complete a computational task or program. It is also called "third-generation language" and considered as the first level of higher-level programming language.
  Procedural language require the programmer to specify, step by step, exactly how the computer must accomplish a task. Because computers understands only machine language, higher level language must be translated into machine language prior to execution. This task is accomplished by systems software called language translators. A language translator convert the hight-level program called **source code** into machine language code called **object code**.
  The translation of a high level language program to object code is done by a software called **complier**. It translates the entire program at once. On contrary, as **interpreter** is a compiler that translates and execute one source program statement at a time.
  Examples of procedural language : *GO, FORTRAN, Pascal, BASIC.*
- **Non Procedural Language**
  A computer language that does not require writing traditional programming logic. Also known as a "declarative language", users concentrate on defining the input and output rather than the program steps. It is also called fourth-generation language(4GLs). It allows users to specify the desired result without having to specify the detailed procedures needed to achieve the result.
  The languages simplify and accelerate the programming process, as well

as reduce the number of coding errors. It also enables non-technical users to carry out specific functional tasks. It is commnly used in database applications as query languages, report generators and data manipulators. Eg. *SQL: Structured Query Language*

- **Natural Programming Languages**
  They are known as fifth generation- language or intelligent languages. Natural Language Programming (NLP) is an ontology-assisted way of programming in terms of natural language sentences. A structured document with content, sections and subsections for explanations of sentences forms a NLP document, which is actually a computer program.
- **VisuaL Programming Languages**
  A visual programming language (VPL) is any programming language that lets users create programs by manipulating program elements graphically rather than by specifying them textually. It uses mouse, icons, symbols , pull-down menu etc. to make programming easier. Eg. *Visual Basic, Visual C++*

- **Hypertext Markup Language**
- **Extensible Markup Language**
- **Componentware**
- **VRML**
- **Object Oriented Programming Language**
- **UML**

[*Refer pg 112 - 115*]

17 Computer Network

A computer network is a group of computer systems and other computing hardware devices that are linked together through communication channels to facilitate communication and resource-sharing among a wide range of users.

Advantages of Network

- Facilitate communication via email, video conferencing, instant messaging, etc.
- Enable multiple users to share a single hardware device like a printer or scanner
- Enable file sharing across the network

- Allow for the sharing of software or operating programs on remote systems
- Make information easier to access and maintain among network users

Disadvantages

- Data and information maybe stolen by computer hackers.
- If any computer in the network get affected by the virus, there is high chance of spreading computer virus.
- Computers on the network have to depend on the server.

18 Communication Media/Channel

Communication media refers to the means of delivering and receiving data or information. In telecommunication, these means are transmission and storage tools or channels for data storage and transmission.
There are two main types of communication channels:

A. Guided or Bounded or Wired Communication Media
B. Unbounded or Unguided or Wireless Communication Media

18.1 Guided Media

- A transmission media where data signals are transmitted along a specific path through cable is known as Guided Transmission Media.
- It transfer data from one place to another with the help of wire.
- There are three types of cables used for wired network.
  - Twisted Pair Cable
  - Co-axial cable
  - Fiber optic cable

Twisted Pair Wire

- it is used for almost all business telephone wiring
- it consists of strands of copper wire twisted in pair
- it is inexpensive, easy to work and it can be made relatively unobtrusive by running it inside walls, floors or ceilings
- it is relatively slow for data transmission
- it is susceptible to interference from other electrical sources
- it can be easily tapped for gaining unauthorized acess

Co-axial Cable

- it is commonly used to carry high-speed data traffic and tv signals

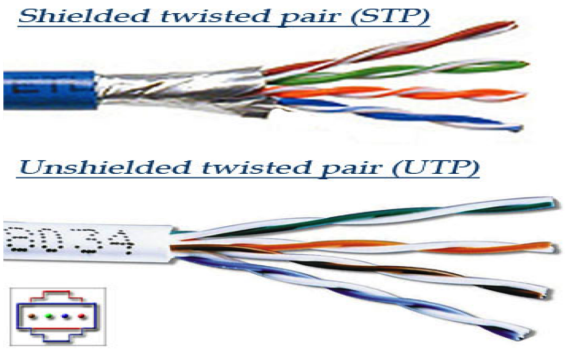

Figure 1: Twisted Pair Wire

- it consists of insulated copper wire
- it is less susceptible to electrical interferences
- it more expensive and less flexible than twisted pair
- data transmission over coaxial cable is divided in to two basic types :
  Baseband: transmission is analog and each wire carries only one signal at a time
  Broadband: transmission is digital and each wire carries multiple signal at time

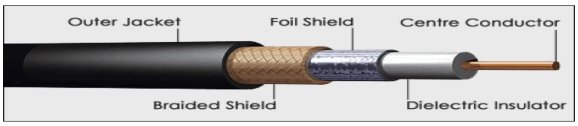

Figure 2: Coaxial cable

Fiber Optic Cable

- Fiber optic cables are made up of plastic or glass fibers and gives high quality transmission of signal at a very high speed.
- It transmits light rather than electronic signals.
- Fiber optic cable transmission are not affected by electromagnetic interference.
- These can be used to communicate either analog or digital signals.
- These are most commonly used for point to point one way communication.
- It can transmit data at much higher rate than twisted pair and coaxial cable.
- It can carry more data at very high speed and to long distances.

- No significant loss of intensity of light, so repeaters need not be placed so closer together as in coaxial cable.
- Transmissions are not affected by electrical and magnetic interferences.
- Smaller in size and lighter in weight than others.
- Provides security as it is difficult to tap optical signals.
- Optical fibers are fragile and can?t be bend.
- Joining two optical fiber cables is not simple and easy

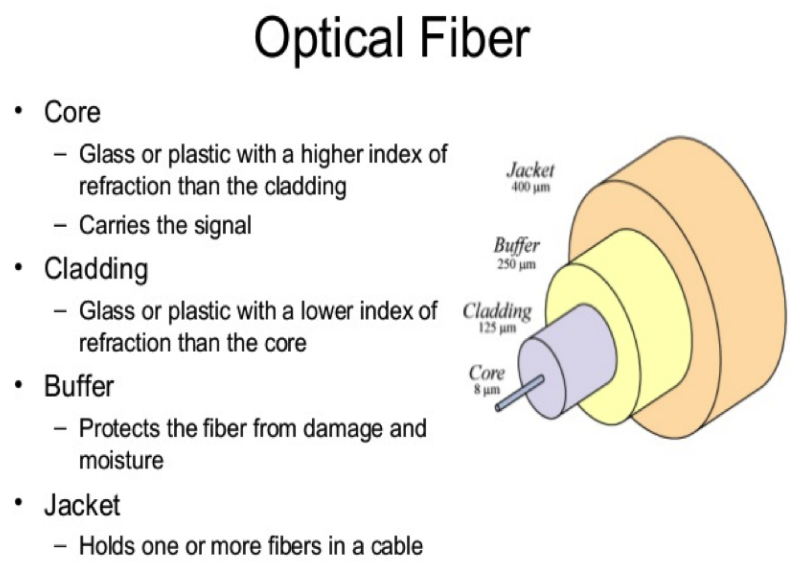

Figure 3: Fibre Optic cable

18.2 Unguided Media/Wireless Channel

- The way to transfer data without the help of wire is called Unguided media.
- The type of Communication media in which communication devices sends and receives data signals through air or space is called Unguided media.
- The data is communicated in the form of wave.
- Unguided media provides means to transmit data signals but does not guide them along a specific path.

- The data signals are not bounded to a cabling media.
- Therefore, unguided media is also called Unbounded media.
- The type of Communication media in which communication devices sends and receives data signals through air or space is called Unguided media.
- The data is communicated in the form of wave.
- Unguided media provides means to transmit data signals but does not guide them along a specific path.
- The data signals are not bounded to a cabling media.
- Therefore, unguided media is also called Unbounded media.

Types of unguided media are as follows:

Microwave

- In microwave transmission, data is transmitted through air or space, instead of through cables or wires.
- Microwaves are high frequency radio waves.
- Microwave uses line-of-sight transmission through space.
- Microwave works in LOS (Line of Sight)
- The line-of-sight means that data signals (or waves) can only travel in straight lines and cannot bend.
- The data is transmitted and received through a microwave station.
- A microwave station is also called relay station or booster.
- A microwave station contains an antenna, transmitter, receiver, and other equipments that are required for microwave transmission.
- Microwave antennas are placed on the high towers or buildings.
- These are placed within 20 to 30 miles of each other. there may be many microwave stations between the sender and receiver.
- data is transmitted from one microwave station to another.
- Each microwave station receives signals from previous microwave station and transmits to next station.

Satellite

- Satellite communication system consists of a satellite and several earth stations.
- The communication satellite is a space station.
- Each earth station consists of large dish antenna. It can send and receive data signals.
- A satellite receives microwave signals (or messages) from earth station.
- It amplifies the signals and sends them to another earth station.

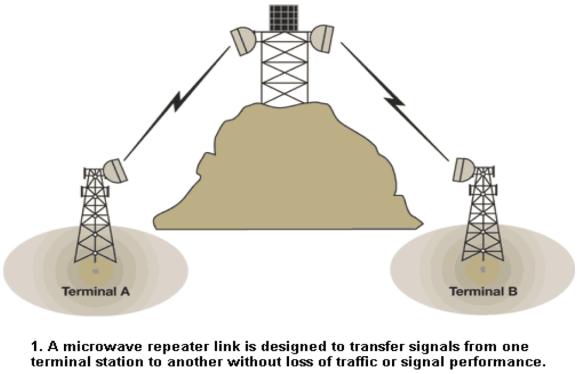

Figure 4: Microwave Communication

- Data transmission speed of satellite is fast.
- There are generally three types of satellite : *GEO (GeoStatonary Orbit), MEO (Medium Earth Orbit), LEO (Lower Earth Orbit)*
- *Advantage*: The main advantage of satellite communication system is that a large amount of data can be communicated from one country to another.
- *Disadvantage:* The disadvantage of satellite communication is that bad weather can affect the quality of satellite transmission.

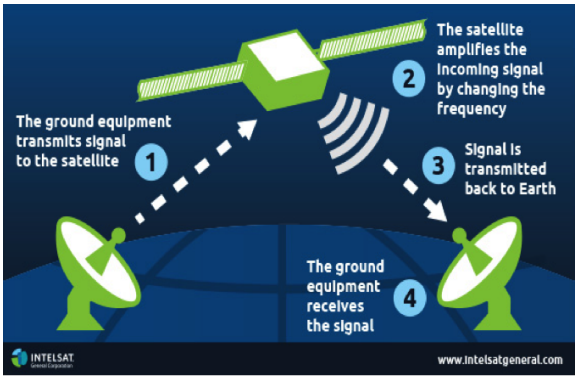

Figure 5: Satellite Communication

Global Positioning System

- The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense.
- GPS was originally intended for military applications

- in the 1980s, the government made the system available for civilian use.
- GPS works in any weather conditions, anywhere in the world, 24 hours a day.
- There are no subscription fees or setup charges to use GPS.

How GPS Works GPS satellites circle the earth twice a day in a very precise orbit and transmit signal information to earth. GPS receivers take this information and use trilateration to calculate the user's exact location. Essentially, the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. The time difference tells the GPS receiver how far away the satellite is. Now, with distance measurements from a few more satellites, the receiver can determine the user's position and display it on the unit's electronic map.

A GPS receiver must be locked on to the signal of at least 3 satellites to calculate a 2-D position (latitude and longitude) and track movement. With four or more satellites in view, the receiver can determine the user's 3-D position (latitude, longitude and altitude). Once the user's position has been determined, the GPS unit can calculate other information, such as speed, bearing, track, trip distance, distance to destination, sunrise and sunset time and more.

Radiowave A very low frequency electromagnetic wave (from roughly 30 kilohertz to 100 gigahertz). Radio waves are used for the transmission of radio and television signals; the microwaves used in radar and microwave ovens are also radio waves. Many celestial objects, such as pulsars, emit radio waves.

19 Types of Network

A. Local Area Network (LAN)
B. MAN (Metropolitan Area Network)
C. WAN (Wide Area Network)

19.1 LAN

- A local area network (LAN) is a group of computers and associated devices that share a common communications line or wireless link to a server.
- Typically, a LAN encompasses computers and peripherals connected to a server within a small geographic area such as an office building or home.

- Computers and other mobile devices can share resources such as a printer or network storage.
- A local-area network (LAN) is a computer network that spans a relatively small area (about 2000 ft)
- Most often, a LAN is confined to a single room, building or group of buildings, however, one LAN can be connected to other LANs over any distance via telephone lines and radio waves.
- LANs are capable of transmitting data at very fast rates, much faster than data can be transmitted over a telephone line; but the distances are limited and there is also a limit on the number of computers that can be attached to a single LAN.
- Types of LAN are :
  - WLAN : A wireless local area network (WLAN) is a wireless computer network that links two or more devices using a wireless distribution method (often spread-spectrum or OFDM radio) within a limited area such as a home, school, computer laboratory, or office building.
  - Bluetooth Network: Bluetooth personal area network (PAN) is a technology that allows you to create an Ethernet network with wireless links between laptops, mobile phones, and handheld devices.
  - **PBX**: PBX stands for Private Branch Exchange, which is a private telephone network used within a company. Users of the PBX phone system share a number of outside lines for making external phone calls.

19.2 MAN

- A metropolitan area network (MAN) is a network that interconnects users with computer resources in a geographic area or region larger than that covered by even a large local area network (LAN) but smaller than the area covered by a wide area network (WAN).
- The term is applied to the interconnection of networks in a city into a single larger network (which may then also offer efficient connection to a wide area network).
- It is also used to mean the interconnection of several local area networks by bridging them with backbone lines.
- The latter usage is also sometimes referred to as a campus network.

19.3 WAN

- A computer network that spans a relatively large geographical area.

- Typically, a WAN consists of two or more local-area networks (LANs).
- Computers connected to a wide-area network are often connected through public networks, such as the telephone system.
- They can also be connected through leased lines or satellites.
- The largest WAN in existence is the Internet.
- Types of WAN :
  - Value Added Netwrok
    A value-added network (VAN) is a hosted service offering that acts as an intermediary between business partners sharing standards based or proprietary data via shared business processes.
  - VPN (Virtual Pvt Network)
    VPN is a network that is constructed by using public wires ? usually the Internet ? to connect to a private network, such as a company's internal network. There are a number of systems that enable you to create networks using the Internet as the medium for transporting data.

20 Network Topology

Network Topology is the schematic description of a network arrangement, connecting various nodes(sender and receiver) through lines of connection. Some basic types of N/w topologies are : Bus Topology

- Bus topology is a network type in where every computer and network device is connected to single cable.
- It transmits data only in one direction.
- Every device is connected to a single cable
- It is cost effective.
- Cable required is least compared to other network topology.
- Used in small networks.
- t is easy to understand.
- Easy to expand joining two cables together.
- Cables fails then whole network fails.
- If network traffic is heavy or nodes are more the performance of the network decreases.
- Cable has a limited length.
- It is slower than the ring topology

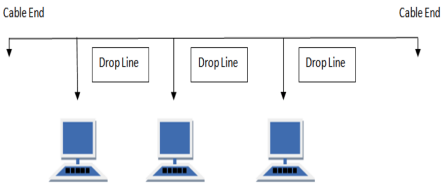

Figure 6: Bus Topology

20.1 Ring Topology

- It is called ring topology because it forms a ring as each computer is connected to another computer, with the last one connected to the first. Exactly two neighbours for each device.
- A number of repeaters are used and the transmission is unidirectional.
- Date is transferred in a sequential manner that is bit by bit.
- Transmitting network is not affected by high traffic or by adding more nodes, as only the nodes having tokens can transmit data.
- Cheap to install and expand
- Troubleshooting is difficult in ring topology.
- Adding or deleting the computers disturbs the network activity.
- Failure of one computer disturbs the whole network.

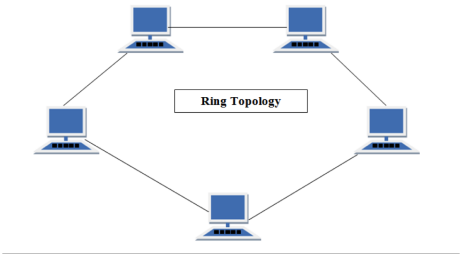

Figure 7: RingTopology

20.2 Star Topolgy

- In this type of topology all the computers are connected to a single hub through a cable.
- This hub is the central node and all others nodes are connected to the central node.
- Every node has its own dedicated connection to the hub.

- Acts as a repeater for data flow.
- Can be used with twisted pair, Optical Fibre or coaxial cable.
- Fast performance with few nodes and low network traffic.
- Hub can be upgraded easily.
- Easy to troubleshoot.
- Easy to setup and modify.
- Only that node is affected which has failed rest of the nodes can work smoothly.
- Cost of installation is high.
- Expensive to use.
- If the hub is affected then the whole network is stopped because all the nodes depend on the hub. Performance is based on the hub that is it depends on its capacity

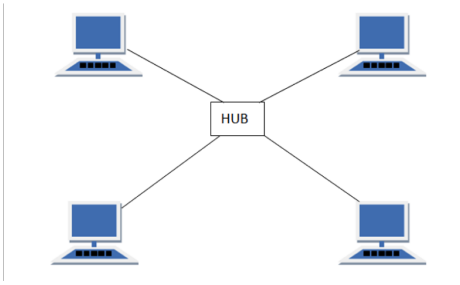

Figure 8: Star Topology

20.3 Mesh Topology

- It is a point-to-point connection to other nodes or devices. is carried only between two devices or nodes to which it is connected.
- Types of Mesh Topology
  Partial Mesh Topology : In this topology some of the systems are connected in the same fashion as mesh topology but some devices are only connected to two or three devices.
  Full Mesh Topology : Each and every nodes or devices are connected to each other.
- Features of Mesh Topology
  -Fully connected.
  -Robust.
  -Not flexible.

- Advantages of Mesh Topology
  -Each connection can carry its own data load.
  -It is robust.
  Fault is diagnosed easily.
  Provides security and privacy.

- Disadvantages of Mesh Topology
  Installation and configuration is difficult.
  Cabling cost is more.
  Bulk wiring is required

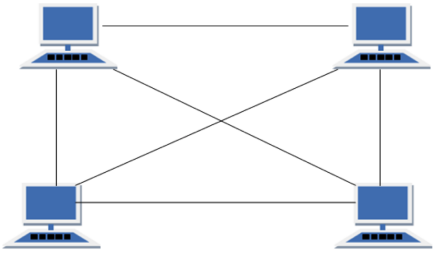

Figure 9: Mesh Topology

20.4 Hybrid Topology

- It is two different types of topologies which is a mixture of two or more topologies.
- For example if in an office in one department ring topology is used and in another star topology is used, connecting these topologies will result in Hybrid Topology (ring topology and star topology).
- Features of Hybrid Topology
  It is a combination of two or topologies
  Inherits the advantages and disadvantages of the topologies included

- Advantages of Hybrid Topology
  Reliable as Error detecting and trouble shooting is easy.
  Effective.
  Scalable as size can be increased easily.
  Flexible.

- Disadvantages of Hybrid Topology
  Complex in design.
  Costly.

21 OSI Layer

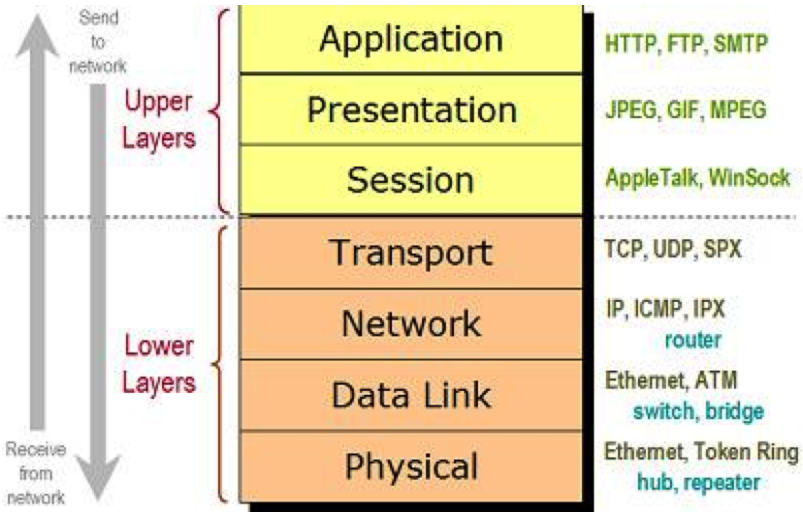

Figure 10: OSI Layer

21.1 Physical (Layer 1)

OSI Model, Layer 1 conveys the bit stream - electrical impulse, light or radio signal ? through the network at the electrical and mechanical level. It provides the hardware means of sending and receiving data on a carrier, including defining cables, cards and physical aspects. Fast Ethernet, RS232, and ATM are protocols with physical layer components.
Layer 1 Physical examples include Ethernet, FDDI, B8ZS, V.35, V.24, RJ45.

21.2 Data Link (Layer 2)

At OSI Model, Layer 2, data packets are encoded and decoded into bits. It furnishes transmission protocol knowledge and management and handles errors in the physical layer, flow control and frame synchronization. The data link layer is divided into two sub layers: The Media Access Control (MAC) layer and the Logical Link Control (LLC) layer. The MAC sub

layer controls how a computer on the network gains access to the data and permission to transmit it. The LLC layer controls frame synchronization, flow control and error checking.
Layer 2 Data Link examples include PPP, FDDI, ATM, IEEE 802.5/ 802.2, IEEE 802.3/802.2, HDLC, Frame Relay.

21.3 Network (Layer 3)

Layer 3 provides switching and routing technologies, creating logical paths, known as virtual circuits, for transmitting data from node to node. Routing and forwarding are functions of this layer, as well as addressing, internetworking, error handling, congestion control and packet sequencing.
Layer 3 Network examples include AppleTalk DDP, IP, IPX.

21.4 Transport (Layer 4)

OSI Model, Layer 4, provides transparent transfer of data between end systems, or hosts, and is responsible for end-to-end error recovery and flow control. It ensures complete data transfer.
Layer 4 Transport examples include SPX, TCP, UDP.

21.5 Session (Layer 5)

This layer establishes, manages and terminates connections between applications. The session layer sets up, coordinates, and terminates conversations, exchanges, and dialogues between the applications at each end. It deals with session and connection coordination.
Layer 5 Session examples include NFS, NetBios names, RPC, SQL.

21.6 Presentation (Layer 6)

This layer provides independence from differences in data representation (e.g., encryption) by translating from application to network format, and vice versa. The presentation layer works to transform data into the form that the application layer can accept. This layer formats and encrypts data to be sent across a network, providing freedom from compatibility problems. It is sometimes called the syntax layer.
Layer 6 Presentation examples include encryption, ASCII, EBCDIC, TIFF, GIF, PICT, JPEG, MPEG, MIDI.

21.7 Application (Layer 7)

OSI Model, Layer 7, supports application and end-user processes. Communication partners are identified, quality of service is identified, user authentication and privacy are considered, and any constraints on data syntax are identified. Everything at this layer is application-specific. This layer provides application services for file transfers, e-mail, and other network software services. Telnet and FTP are applications that exist entirely in the application level. Tiered application architectures are part of this layer. Layer 7 Application examples include WWW browsers, NFS, SNMP, Telnet, HTTP, FTP

21.8 Network Communications Software

Network Operating System:
A network operating system (**nos**) is a system software that controls the hardware devices, software, and communications media and channels across a network. It allows various devices to communicate with each other. Eg: *Windows NT, Netware*

Protocols
The set of rules and procedures governing transmission across a network is called Protocol. The principal functions of protocols in a network are *line access* and *collision avoidance*. Line access concerns how the sending device gains access to the network to send a message. Collision avoidance refers to managing message transmission so two message do not collide with each other on the network.

- **Ethernet protocol**
  The most common protocol is Ethernet 10BaseT. The 10BaseT means that the network has a speed of 10 Mbps. Fast Ethernet is 100BaseT which means that the network has a speed of 100 Mbps. The most common protocol in large corporation is the Gigabit Ethernet which provides network data transmission speed of one billion bits per second.

- **TCP/IP**
  The Transmission Control Protocol/Internet Protocol is a file transfer protocol that can sen d large files of information across networks with assurance that the data will arrive in uncorrupted form. It allows reasonable and error-free transmission between different systems and is the protocol of internet. TCP/IP is has four layers

Types of Data Transmission

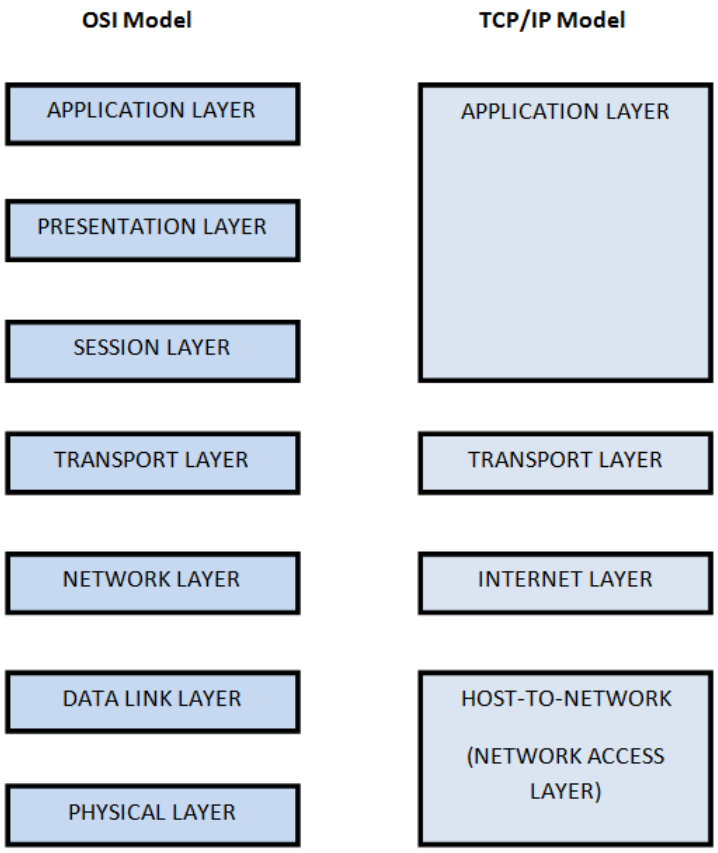

Figure 11: Comparison between OSI and TCP/IP

- **Packet Switching**
  Packet switching is a digital networking communications method that groups all transmitted data into suitably sized blocks, called packets, which are transmitted via a medium that may be shared by multiple simultaneous communication sessions.
- **Circuit Switching** Circuit switching is a methodology of implementing a telecommunications network in which two network nodes establish a dedicated communications channel (circuit) through the network before the nodes may communicate.
- **Frame Relay**
  Frame relay is a faster and less expensive version of packet switching. Frame relay is a shared network services that package data into frames

that are similar to packet. It does not perform error correction. it can communicate at transmission speeds of 1.544 Mbps.

- **Fiber Distributed Data Interface (FDDI)**
  FDDI passes data around a ring with a bandwidth of 100 Mbps. It is based on the high-speed, high-capacity capabilities of fibre optics. Implementing FDDI in a LAN is 10 times more expensive.
- **Aysnchronous Transfer Mode (ATM)**
  Asynchronous transfer mode (ATM) is a switching technique used by telecommunication networks that uses asynchronous time-division multiplexing to encode data into small, fixed-sized cells. This is different from Ethernet or Internet, which use variable packet sizes for data or frames. ATM networks are packet -switched, dividing data into uniform cells, each with 53 groups of 8 bytes, eliminating the need for protocol conversion. It provides support for data, video and voice transmission on one communication line. It requires fibre-optic cable and can transmit data upto 2.5 Gigabits per second but it us more expensive than ISDN and DSL.
- **Switched Hub Technologies**
  Switched Hub Technologies are often used to boost local area networks. A switched hub can turn many small LANs into one big LAN.
- **Synchronous Optical Network (SONET)**
  SONET is an interface standard for transporting digital signals over fibre optic links that allows the integration of transmission from multiple vendors
- **T-Carrie System**
  It is a digital transmission system that defines circuits that operate at different rates, all of which are multiples of basic 64 Kbps used to transmit single voice call.

Applications of Telecommunications

- Electonic Mail
- Videoconferencing
- Electronic Data Interchange
- Electronic Fund Transfer
- Fascimiles
- Telecommuting
- Distance Learning
- Telematics

(*refer pg. 190-192*)

22 Database

A computer system organizes data in a hierarchy that begins with bits, and proceeds to bytes, fields, records, files and databases. *bit :* smallest unit of data a computer can process (0s and 1s)
byte : a group of 8 bits
Fields : a logical grouping of characters into a word, a small group of words, or a complete number is called Field
Records: a logical grouping of related fields
Files : grouping of related records
Database:
A database is a collection of information that is organized so that it can easily be accessed, managed, and updated.

Advantages of Database

A. Reduce data redundancy
B. Avoid inconsistency
C. Data sharing
D. Standards can be enforced
E. Security restrictions can be applied
F. Integrity or accuracy can be maintained

Characteristics of Database

A. Should be able to store all kinds of data that exists in this real world
B. Should be able to relate the entities / tables in the database by means of a relation.
C. Data and application should be isolated. Because database is a system which gives the platform to store the data, and the data is the one which allows the database to work. Hence there should be clear differentiation between them.
D. No Data Redundancy :There should not be any duplication of data in the database. Data should be stored in such a way that it should not be repeated in multiple tables
E. DBMS has a strong query language. Once the database is designed, this helps the user to retrieve and manipulate the data.
F. Database must be 'Shared' i.e Multiple users should be able to access the same database, without affecting the other user
G. Database should also provide security, i.e.; when there are multiple users are accessing the database, each user will have their own levels of rights to see the database.

H. Database should also support ACID property. i.e.; while performing any transactions like insert, update and delete, database makes sure that the real purpose of the data is not lost.

22.1 Storing and Accessing Records

- **Indexed Sequential Access Method (ISAM)**
  ISAM uses an index of key fields to locate individual records. An index to a file lists the key field of each record and where that record is physically located in storage. Records are stored on disks in their key sequence. A *track-index* shows the highest value of the key field that can be found on a specific track. To locate a specific record, the track index is searched to locate the cylinder and the track containing the record. The track is then sequentially read to find the record
- Direct File Access Method
  It uses the key field to locate the physical address of a record. It is most appropriate when individual records must be located directly and rapidly for immediate processing.

22.2 DBMS vs Traditional File Approach

- A database management system coordinates both the physical and the logical access to the data, whereas a file-processing system coordinates only the physical access.
- A database management system is designed to allow flexible access to data (i.e. queries), whereas a file-processing system is designed to allow predetermined access to data (i.e. compiled programs).
- A database management system is designed to coordinate multiple users accessing the same data at the same time. A file-processing system is usually designed to allow one or more programs to access different data files at the same time. In a file-processing system, a file can be accessed by two programs concurrently only if both programs have read-only access to the file.
- Redundancy is control in DBMS, but not in file system.
- Unauthorized access is restricted in DBMS but not in the file system.
- DBMS provide back up and recovery whereas data lost in file system can't be recovered.
- DBMS provide multiple user interfaces. Data is isolated in file system.

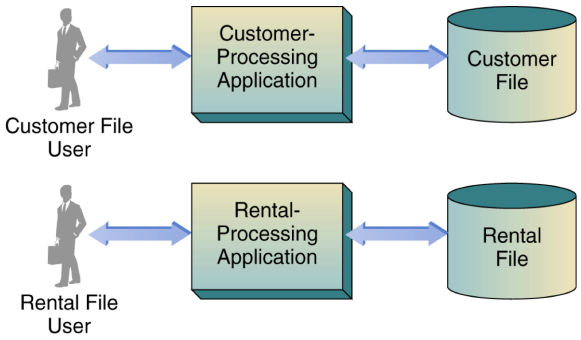

Figure 12: File Approach

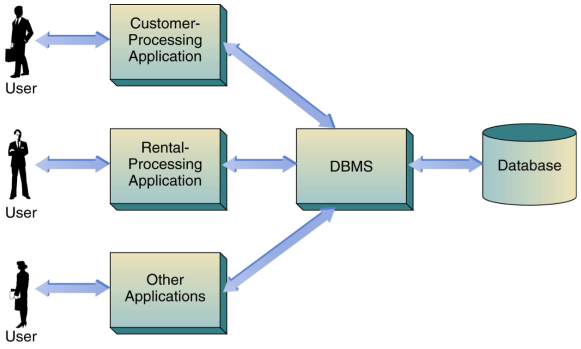

Figure 13: DBMS

22.3 Advantages of DBMS

A. Data Mapping and Access: - DBMS defines the way to map any two related tables by means of primary key ?foreign key relationship

B. Data Redundancy: - By the introduction of primary key in the table, data redundancy problem is reduced to great extent. As we saw, primary key is the unique column for each record, when there is a re-entry of same record, it does not allow saving such records.
DBMS has strong designing techniques like normalization which makes sure the same copy of data is not stored in same table or in multiple tables. It makes sure all the informations are stored only once in the database tables.

C. Data Independence and Consistency: - DBMS defines a standard to represent the data in the form of rows and columns. It also stores the information about the tables, columns, keys, storage space, used space, available space etc separately from the logical data. Hence they totally

independent of the way they are stored and the data being stored. Any changes to the physical storage (like disks, tapes etc) or structure, does not harm the data being stored. Since DBMS defines each columns and rows at the beginning itself and controls the way data being entered, there is no affect on the programs or any other tables or data. Hence the consistency of the data also maintained.

D. Security: - DBMS allows different levels of access to different users based on their roles, it prevents data overwriting and deletion by unauthorised users.

E. Integrity: - DBMS allows having restrictions on individual columns. It would be defined while designing the table itself, which means chances of entering wrong values in a table is greatly reduced.

F. Atomicity: - DBMS makes sure either the transaction is fully complete or it is rolled back to the previous committed state. It does not allow the system to be in a partially committed state.

G. Concurrent Access: - DBMS provide access to multiple users to access the database at the same time. It has its own mechanism to have concurrency accesses and hence avoid any incorrect data in the system.

Entity Relationship Modeling

The entity-relationship model (or ER model) is a way of graphically representing the logical relationships of entities (or objects) in order to create a database. It uses ER diagram to document the conceptual data model. ER diagram consists of entities, attributes, and relationships and cardinalities.

- Entity
  An entity can be a real-world object, either animate or inanimate, that can be easily identifiable. For example, in a school database, students, teachers, classes, and courses offered can be considered as entities. All these entities have some attributes or properties that give them their identity.
- Attributes
  Entities are represented by means of their properties, called attributes. All attributes have values. For example, a student entity may have name, class, and age as attributes.
- Relationship
  The association among entities is called a relationship. For example, an employee "works at" a department, a student "enrolls" in a course. Here, "Works at" and "Enrolls" are called relationships.
- Cardinalities
  Cardinality defines the number of entities in one entity set, which can

be associated with the number of entities of other set via relationship set.

Database Normalization Database Normalisation is a technique of organizing the data in the database. Normalization is a systematic approach of decomposing tables to eliminate data redundancy and undesirable characteristics like Insertion, Update and Deletion anomalies. It is a multi-step process that puts data into tabular form by removing duplicated data from the relation tables.

Normalization is used for mainly two purpose,

A. Eliminating reduntant(useless) data.
B. Ensuring data dependencies make sense i.e data is logically stored.

Normalization rule are divided into following normal form.

A. First Normal Form
B. Second Normal Form
C. Third Normal Form
D. BCNF

22.4 DBMS Components

There are four main components in DBMS

A. **Data Model**
   The data model defines the way data are conceptually structured. Example includes the hierarchical, network, relational, object-oriented, hypermedia and multidimensional models.
B. **Data Definition Language** DDLs are used to define the metadata of the database. i.e.; using this, we create schema, tables, constraints, indexes in the database. DDLs are also used to modify Schema, tables index etc. Basically, using DDL statements, we create skeleton of the database. It helps to store the metadata information like number of schemas and tables, their names, columns in each table, indexes, constraints etc in the database.
   Some of the DDL commands are Create, Rename etc.
C. **Data Manupulation Language (DML)** DML is used with third-generation, fourth-generation or object-oriented languages to query the contents of the database, store or update information in the database, and develop database application. When we have to insert records into table or get specific record from the table, or need to change some record, or delete some record or perform any other actions on records in the database, we need to have some media to perform it. DML helps to

handle user requests. It helps to insert, delete, update, and retrieve the data from the database. Select, Insert etc are the examples of DML.

D. **Data Dictionary** It stores definitions of data elements and data characteristics such as individuals, business functions, programs, and reports that use the data elements, as well as the physical representation, responsible parties in the organisation and security. Because the data dictionary provides standard definitions for all data elements, the potential for data inconsistency is reduced.

22.5 Data Models

A database model is a type of data model that determines the logical structure of a database and fundamentally determines in which manner data can be stored, organized, and manipulated. Different types:

A. Hierarchical model
B. Network model
C. Relational model
D. Object Oriented model

- **Hierarchical Data Model**
  - A hierarchical database is a design that uses a one-to-many relationship for data elements.
  - Hierarchical database models use a tree structure that links a number of disparate elements to one "owner",or "parent," primary record.
  - The data is stored as records which are connected to one another through links.
  - A record is a collection of fields, with each field containing only one value.
  - The entity type of a record defines which fields the record contains.
  - A record in the hierarchical database model corresponds to a row (or tuple) in the relational database model and an entity type corresponds to a table (or relation)
  - The hierarchical database model mandates that each child record has only one parent, whereas each parent record can have one or more child records.
  - In order to retrieve data from a hierarchical database the whole tree needs to be traversed starting from the root node.
  - This model is recognized as the first database model created by IBM in the 1960s

- **Advantages:**
  Speed of access is faster because of the predefined data paths.
  Disadvantages:
  Complex implementation
  Predefined tree structure reduces flexibility.
  Difficult to manage.

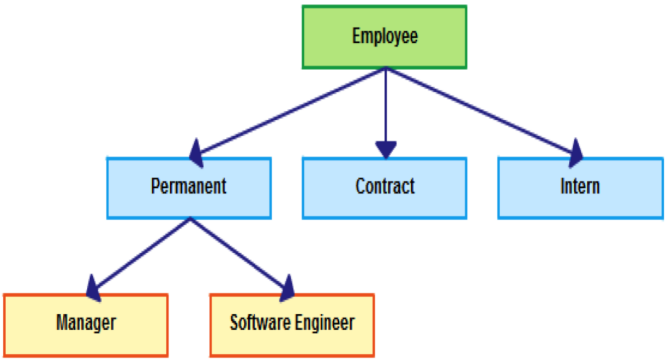

Figure 14: Hierarchical Database Model

- **Network Database Model**
  - A network database model is a database model that allows multiple records to be linked to the same owner file.
  - The model can be seen as an upside down tree where the branches are the member information linked to the owner, which is the bottom of the tree.
  - The multiple linkages which this information allows the network database model to be very flexible.
  - In addition, the relationship that the information has in the network database model is defined as many-to-many relationship because one owner file can be linked to many member files and vice versa.
  - **Advantages**
    Because it has the many-many relationship, network database model can easily be accessed in any table record in the database
    For more complex data, it is easier to use because of the multiple relationship founded among its data
    Easier to navigate and search for information because of its flexibility
    Disadvantage:
    Difficult for first time users

Difficulties with alterations of the database because when information entered can alter the entire database

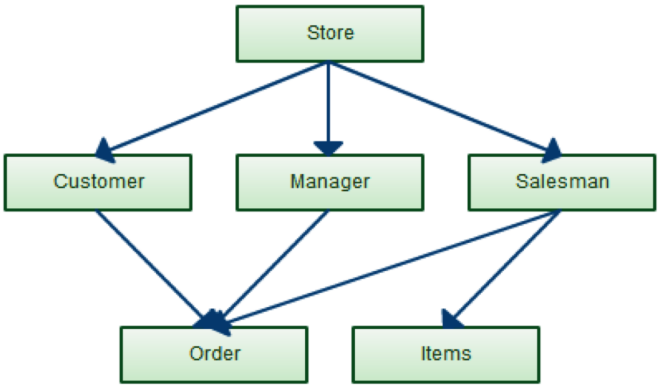

Figure 15: Hierarchical Database Model

- **Relational Database Model**
  - Data is stored in tables called relations.
  - Relations can be normalized.
  - In normalized relations, values saved are atomic values.
  - Each row in a relation contains a unique value.
  - Each column in a relation contains values from a same domain.
  - **Advantages:**
    Ease of use
    Flexibility:
    Precision:
    Security:
    Data Independence:
    Data Manipulation Language
  - **Disadvantages :**
    Performance
    Physical Storage Consumption

22.6 Data Warehouse

- A data warehouse is a relational or multidimensional database management system designed to support management decision making.

- Data warehouse is a repository of an organization's electronically stored data and are designed to facilitate reporting and analysis
- Also emphasizes on the means to retrieve and analyze data, to extract, transform and load data, and to manage the data dictionary.
- An expanded definition for data warehousing includes business intelligence tools, tools to extract, transform, and load data into the repository, and tools to manage and retrieve metadata (data about data).
- In contrast to data, warehouses are operational systems that perform day-to-day transaction processing.
- A data warehouse is a collection of computer-based information that is critical to successful execution of enterprise initiatives
- It provides a tool to satisfy the information needs of the employee?s at all organizational levels-not just for complex data queries but as a general facility for getting quick, accurate and often insightful information.
- It is designed so that its users can recognize the information they want and access that information using simple tools.
- One of the principal reasons for developing a Data Warehouse is to integrate operational data from various sources into a single and consistent architecture that supports analysis and decision making with the enterprise.
- The data in the "warehouse" are stored in a single, agreed upon format even when underlying operational applications store the data differently.
- Some of the applications data warehousing can be used for are:
  Credit card churn analysis
  Insurance fraud analysis
  Call record analysis
  Logistics management (part of Supply Chain Management that plans, implements, and controls the efficient, effective, forward, and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers? requirements)

Advantages of Data Warehouse

- More cost effective decision making: A data warehouse allows reduction of staff and computer resources required to support queries and reports against operational and production database. This typically offers significant savings.
- Better enterprise intelligence: Increased quality and flexibility of enterprise analysis arises from the multi-level data structure which guarantees data accuracy and reliability ensuring that a Data Warehouse contains only ?trusted? data.

- Enhanced customer service: An enterprise can maintain better customer relationships by correlating all customer data via a single Data Warehouse Architecture.
- Business reengineering: Allowing unlimited analysis of enterprise information often provides insights to enterprise processes that may yield breakthrough ideas for engineering those processes. Knowing what information is important to an enterprise will provide direction and priority for reengineering efforts.
- A data warehouse provides a common data model for all data of interest regardless of the data's source. This makes it easier to report and analyze information than it would be if multiple data models were used to retrieve information such as sales invoices, order receipts, general ledger charges, etc.
- Prior to loading data into the data warehouse, inconsistencies are identified and resolved. This greatly simplifies reporting and analysis.
- Information in the data warehouse is under the control of data warehouse users so that, even if the source system data is purged (washed out) over time, the information in the warehouse can be stored safely for extended periods of time.
- Because they are separate from operational systems, data warehouses provide retrieval of data without slowing down operational systems.
- Data warehouses facilitate decision support system applications such as trend reports, exception reports,and reports that show actual performance versus goals. ?

22.7 Components of Data Warehous

A. **Summarised Data**
   - Classified into two categories: lightly summarized and highly summarized
   - Lightly summarized data are the hallmark (trademark) of data warehouse as all enterprise elements do not have the same information requirement. They include less data than the total data stored in current detail.
   - Highly summarized data are primarily for enterprise executives. They come from either the lightly summarized data used by enterprise elements or from current detail. Data volume at this level is much less than other levels.

B. **Current Detail**
   It is the heart of the data warehouse where the whole bulk of data

resides. It comes directly from operational systems of records and may be stored as raw data or as aggregations of raw data

C. **Operational System of Record**
It is a source of the data that feeds the Data Warehouse.

D. **Integration/Transformation Programs**
As operational data items pass from their systems of record to a data warehouse, integration and transformation programs convert them from application-specific data into enterprise data.

E. **Archives**
Contains old data (normally over two years old) of significant, continuing interest and value to the enterprise.

F. **Metadata**
Metadata is "data about other data", of any sort in any media. It is definitional data that provides information about or documentation of other data managed within an application or environment.

22.8 Uses of Data Warehouse

A. **Standard Reports and Queries**
Many users of the data warehouse need to access a set of standard reports and queries and hence it is desirable to periodically produce a set of standard reports that are required by many different users. When these users need a particular report, they can just view the report that has already run the data warehouse system rather than running it themselves. This facility can be particularly useful for reports that take a long time to run.

B. **Queries Against Summarized Data**
The summary views in the data warehouse can be object of a large majority of analysis in a data warehouse. These views contain predefined standard business analysis.

C. **Data Mining** Data mining is the process of extracting hidden patterns from data. As more data are gathered, with the amount of data doubling every year, data mining is becoming an increasingly important tool to transform this data into information. It is commonly used in a wide range of profiling practices, such as marketing, fraud detection and scientific discovery. Data mining can be applied to data sets of any size.
Data mining has five main functions:

- *Classification* : infers the defining characteristics of a certain group

- *Clustering*: identifies groups of items that share a particular characteristics
- *Association*: identifies relationships between events that occur at one time
- *Sequencing*: similar to association, except that the relationship exists over a period of time
- *Forecastin*: estimates future values based on patterns within large sets of data

22.9 Data Mart

- Data Mart is a subset if an enterprise-wide Data Warehouse, which typically supports an enterprise element (department, region).
- As part of an iterative Data Warehouse development process, an enterprise builds a series of physical (or logical) data marts over time and links them via an enterprise-wide logical data warehouse or feeds them from a single physical warehouse.
- The data mart is directed at a partition of data (often called a subject area) that is created for the use of a dedicated group of users.
- A data mart might, in fact, be a set of denormalized, summarized, or aggregated data.
- In most instances, however, the data mart is a physically separate store of data and is resident on separate database server, often a local area network serving a dedicated user group.

23 Management Information System (MIS)

A management information system (MIS) is a computerized database of financial information organized and programmed in such a way that it produces regular reports on operations for every level of management in a company.
An MIS produces following reports

- *Routine/Scheduled Reports* :Routine periodic reports are produced at scheduled intervals, ranging from hourly quality control reports to reports on monthly absenteeism rates.
- *Ad-Hoc(Demand) Reports*: Managers frequently need special information, which is not included in the routine reports, or they need the same information that is included in the routine reports, but at different times. Such out-of-the routine reports are called **ad-hoc reports**. They also may include requests for **drill down reports**, which

show a greater level of detail; **key-indicator reports**, which summarize the performance of critical activities; and **comparative reports**,which compare performances of different departments.

- *Exception Reports* These kind of reports include only information that exceeds certain threshold standards.

refer pg. 238 for information flow diagram

24 Transaction Processing System

A transaction process system (TPS) is an information processing system for business transactions involving the collection, modification and retrieval of all transaction data. Characteristics of a TPS include performance, reliability and consistency.
TPS is also known as transaction processing or real-time processing.

24.1 Characteristics of a TPS

- Processes large amounts of data
- Needs high processing speed due to high volume
- Sources of data are mostly internal and the outputs is intended mainly for internal audience
- Processes information on a regular basis
- Requires large storage
- Monitors and collects data once generated
- Input and output data are structured and are formatted in a standard fashion
- High level of detail
- Requires high Processing reliability
- Ability to query files and database

24.2 The process of TPS

Batch Processing :
transactions are collected as they occur and are placed in groups or batches. The system then processes and prepares the batches periodically
Online processing
data are processed as soon as a transaction occurs
Hybrid system
combination of batch and online processing, it can collect data as they occur but process them at a specified interval

24.3 TPS Tasks

A. Order processing
B. The ledger
C. Accounts payable and receivable
D. Inventory Management
E. Payroll
F. Periodic reports and statements

25 Marketing and Sales

Marketing is a widely used term to describe the means of communication between the company and the consumer audience. Marketing is the adaptation of the commercial activities and use of institutions by the organizations with a purpose to induce behavioral change on a short-term or permanent basis.
Sales can be defined as a transaction between two parties where the buyer receives goods (tangible or intangible), services and/or assets in exchange for money or an agreement between a buyer and seller on the price of a security.
Marketing and Sales system activities can be organised into four groups

A. Customer Service
B. Telemarketing
C. Distribution Channels Management
D. Marketing Management

25.1 Customer Service

Customer service is the service provided to customers before, during and after purchasing and using goods and services. Good customer service provides an experience that meets customer expectations. Customer service can can be enhanced using IT by implementing following :
Customer profiles and preference analysis
creating customer database for both existing and potential customers.
Mass Customization
it refers to the production of large quantities of products in which each product is customized to the customer's wishes
Targeted advertising on the Web
Customer inquiry systems and automated help desk

25.2 Telemarketing

It is the process that uses telecommunications and information systems to execute a marketing program. A telemarketing process can be divided into five major activities:*advertising, order processing, customer service, sales support and account management*

25.3 Distribution Channel Management

A distribution channel is the network of individuals and organizations involved in getting a product or service from the producer to the customer. Distribution channels are also known as marketing channels or marketing distribution channels.
It includes following tasks

- Delivery management
- Improving sales at retail stores

25.4 Marketing Management

Marketing management is defined as the process of overseeing and planning new product development, advertising, promotions and sales. Marketing management activities are supported by computerised information systems by helping them in performing tasks:

- Pricing of products or services
- Salesperson productivity
- Product-customer profitability analysis
- Sales analysis and trends
- New products, services and market planning

26 Customer Relationship Management (CRM)

Customer relationship management (CRM) is a term that refers to practices, strategies and technologies that companies use to manage and analyze customer interactions and data throughout the customer lifecycle, with the goal of improving business relationships with customers, assisting in customer retention and driving sales growth. CRM systems are designed to compile information on customers across different channels or points of contact between the customer and the company which could include the company's website, telephone, live chat, direct mail, marketing materials and social media. CRM systems can also give customer-facing staff detailed information on customers' personal information, purchase history, buying

preferences and concerns.
There are five common steps in CRM

A. Make it easy for customers to do business with you
B. Focus on the end-customer for your products and services
C. Redesign your customer-facing business processes from the end-customer's point of view
D. Wire your company for profit
E. Foster customer loyalty

27 Production and Operations Management Systems (POM)

The POM function in an organization is responsible for the processes that transform inputs into useful outputs. The POM area is diversified in comparison to the other functional areas and so are its supporting information systems. For instance, manufacturing companies use different processes than service organizations and a hospital operates much differently from a university.

27.1 Logistics and Materials Management

This deals with ordering, purchasing, inbound and outbound shipping activities. Such activities are a good example of processes that cross several functional departments. For example, scanners and voice technologies can support inspection and robots can be used to perform distribution and materials handling.

27.2 Inventory Management

This determines how much inventory to keep. Once management has made decisions about how much to order and when, an information system can track the level of inventory for each item that needs to be controlled. When the inventory falls to a certain level (i.e. reorder point), inventory software can automatically generate a purchase order

27.3 Quality Control

Quality Control systems provide information about the quality of incoming material and parts, as well as the quality of in-process semi finished and finished products. Quality-control software can be a standalone system or part of a Total Quality Management (TQM) system.

28 Planning Production / Operations

Some major areas of planning and their computerized support are:

28.1 Materials Requirement Planning (MRP)

MRP is a production planning, scheduling and inventory control system used to manage manufacturing process. An MRP system is intended to simultaneously meet three objectives:

- Ensure materials are available for production and products are available for delivery to customers.
- Maintain the lowest possible material and product levels in store.
- Plan manufacturing activities, delivery schedules and purchasing activities.
- Manufacturing Resource Planning (MRP II)
  MRP II is an integrated computer system that connects the regular MRP to other functional areas, especially finance and human resources. It can also be defined as a method for the effective planning of all resources of a manufacturing company. Ideally, it addresses operational planning in units, financial planning, and has a simulation capability to answer "what-if" questions and extension of closed-loop MRP. It helps to determine the costs of parts and the cash flow needed to pay for parts. It also estimates cost of labor, tools, equipment repair and energy. Finally it provides a detailed computerized budget.
- Just-in-time systems

  Just in time (JIT) inventory is a management system in which materials or products are produced or acquired only as demand requires, thus minimizing waste of all kinds (space, labor, materials, energy and so on). It is a methodology that is aimed primarily at reducing flow times within production as well as response times from suppliers and to customers. Just-in-time (JIT) manufacturing is a production model in which items are created to meet demand, not created in surplus or in advance of need. The main purpose of JIT production is to avoid the waste associated with overproduction, waiting and excess inventory

- Project Management
  A project is usually a one-time effort composed of many interrelated activities, comprising of specific set of operations and designed to accomplish a singular goal. It costs a substantial amount of money, and lasts from weeks to years. The management of project is enhanced

by project management tools such as Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM).

- Short-term schedules
  Operation managers schedule jobs and employees on a daily or weekly basis with the support of information systems. For example, bar chart and Gantt charts can be used to show scheduled and actual production times. Also the complex scheduling situations can be supported by DSS or expert systems.

29 Automated Design Work and Manufacturing

29.1 Computer-aided design (CAD)

CAD is a system that enables drawings to be constructed on a computer screen and subsequently stored, manipulated and updated electronically. It helps to enhance the designer?s productivity, speeds up the design process, reduces design errors and reduces the number of designers needed to perform the same amount of work.

29.2 Computer-aided manufacturing (CAM)

CAM uses computer-aided techniques to plan and control a production facility. Computer-aided process planning, numerical control part programming, robotics programming etc are such techniques. When CAD feeds design and testing information to a CAM system, the combined system is referred to as CAD/CAM.

29.3 Computer-integrated manufacturing (CIM)

CIM is a concept about the implementation of various integrated computer systems in factory automation. It has following goals:

- Simplification of manufacturing technologies
- Automation of manufacturing processes by integration of information technologies.
- Integration and coordination via computer hardware and software of all aspects of design, manufacturing and related functions.

30 Human Resources Management Systems

Human Resource Management (HR) is an important task that starts with the hiring of an employee and ends with his or her retirement or departure.

It includes following tasks:

- Recruitment
- Position inventory
- Recruitment using Internet
- Employee selection
- Human Resources Maintenance and Development

Some of the activities supported by IT in human resource maintenance are as follows:

- Training and human resources development
- Performance evaluation
- Turnover, tardiness and absenteeism analyses
- Human Resources management and Planning

Information Technology can help in managing human resource in following fields:

- Personnel files and skills inventory
- Benefits administration
- Government reports
- Personnel planning
- Succession planning and implementation
- Labor-management negotiations

(refer pg 248)

31 Electronic Commerce (E-Commerce)

E-commerce (EC) is the buying, selling and exchanging of goods, services and information or the transmitting of funds or data, over an electronic network, primarily the Internet. It covers a range of different types of businesses, from consumer based retail sites, through auction or music sites, to business exchanges trading goods and services between corporations. It is currently one of the most important aspects of the Internet to emerge. Ecommerce allows consumers to electronically exchange goods and services with no barriers of time or distance. These business transactions occur business-to-business, business-to-consumer, consumer-to-consumer or consumer-to-business. The terms e-commerce and e-business are often used interchangeably.

31.1 Types of E-Commerce

- **Business-to-Business Commerce (B2B)**
  B2B refers to electronic commerce between businesses rather than between a business and a consumer. B2B businesses often deal with hundreds or even thousands of other businesses, either as customers or suppliers.
- **Collaborative Commerce (c-commerce)**
  In C-commerce, business partners collaborate electronically. Such collaboration frequently occurs between and among business partners along the supply chain.
- **Business-to-Consumer (B2C)**
  B2C is distinguished by the establishment of electronic business relationships between businesses and final consumers. It corresponds to the retail section of e-commerce, where traditional retail trade normally operates.
- **Consumers-to-Business (C2B)**
  In C2B there is a complete reversal of the traditional sense of exchanging goods. This type of e-commerce is very common in crowd sourcing based projects. A large number of individuals make their services or products available for purchase for companies seeking precisely these types of services or products.
- **Consumer-to-Consumer (C2C)**
  C2C e-commerce encompasses all electronic transactions of goods or services conducted between consumers. Generally, these transactions are conducted through a third party, which provides the online platform where the transactions are actually carried out.
- **Intra business (intra organizational) commerce**
  In such e-commerce an organization uses e-commerce internally to improve its operations. Business to its employees (B2E) is special case of such e-commerce.
- **Government-to-Citizens (G2C) and to others**
  In this e-commerce, the government provides services to its citizens via e-commerce technologies. Government can also do business with other governments (G2G) as well as with businesses (G2B).
- **Mobile Commerce (m-Commerce)**
  When e-commerce is done in a wireless environment, e.g. cell phones to access internet, such ecommerce are known as m-commerce.

32 Benefits of e-commerce

33 To organizations

- Expands company?s marketplace to national and international markets.
- Enables companies to procure material and services from other companies, rapidly and at less cost.
- Shortens marketing distribution channels, making products cheaper and vendors? profits higher.
- Decreases cost of creating, processing, distributing, storing and retrieving information by digitizing process.
- Lowers telecommunication costs
- Helps small businesses compete against large companies.

To customers

- Frequently provides less expensive products and services
- Gives more choices to consumers
- Enables customers to shop or make other transactions 24 hours a day, from almost any location.
- Delivers relevant and detailed information in seconds.
- Makes electronic auctions possible.
- Allows consumers to interact in electronic communities and to exchange ideas and compare experiences.

33.1 To society

- Enables individuals to work at home and do less travelling
- Increases standard of people?s living
- Enables people in developing countries and rural areas to enjoy products and services that are otherwise not available.
- Facilitates delivery of public services, reducing distribution cost and chance of fraud.

34 Limitations of e-commerce

34.1 Technical Limitations

- Lack of universally accepted standards for quality, security and reliability.
- Insufficient telecommunication bandwidth

- Still evolving software development tools
- Difficulties in integrating internet and e-commerce software with some existing applications and databases
- Need for special web servers in addition to network servers
- Expensive and inconvenient internet accessibility for many would-be users.

34.2 Non-technical Limitations

- Unresolved legal issues
- Lack of national and international government regulations and industry standards.
- Lack of mature methodologies for measuring benefits of and justifying e-commerce.
- Customer resistance to changing from a real to a virtual store. People do not yet sufficiently trust paperless, faceless transactions.
- Perception that e-commerce is expensive and unsecured.
- An insufficient number of sellers and buyers exist for profitable e-commerce operations.