



# Learner Guide: Module 6

---

**Manipulative Computer Programming**

**US: 115373, 115367, 115362**

**National Certificate: Information**

**Technology: Systems Development**

**SAQA 48872 - Level 5 - 131 Credits**

## Copyright

All rights reserved. The copyright of this document, its previous editions and any annexures thereto, is protected and expressly reserved. No part of this document may be reproduced, stored in a retrievable system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior permission.

Learner Information	
Name & Surname	
ID Number	
Tel/Cell	
Email Address	
Organisation	
Facilitator Name	

## Introduction

The purpose of this Learner Guide is to provide learners with the necessary knowledge and it provides a comprehensive overview of the module: Manipulative Computer Programming, and forms part of a series of modularised Learner Guides that have been developed for the qualification: National Certificate: Information Technology: Systems Development SAQA 48872 - Level 5 - 131 Credits.

**This Learner Guide has been designed to improve the skills and knowledge of learners, and thus enabling them to effectively and efficiently complete specific tasks.**

## Outcomes

At the end of this module, you will be able to:

- Explain the principles of computer networks
- Explain how data is stored on computers
- Describe information systems departments in business organisations

## Assessment

The only way to establish whether a learner is competent and has accomplished the Learning Outcomes is through an assessment process. Assessment involves collecting and interpreting evidence about the learner's ability to perform a task. This guide may include assessments in the form of activities, assignments, tasks or projects, as well as workplace practical tasks. Learners are required to perform tasks on the job to collect enough and appropriate evidence for their portfolio of evidence, proof signed by their supervisor that the tasks were performed successfully.

## Qualify

To qualify and receive credits towards the learning program, a registered assessor will conduct an evaluation and assessment of the learner's portfolio of evidence and competency.

## Learner Responsibility

Learners are required to attend the training workshops as a group or as specified by their organization. These workshops are presented in modules, and conducted by a qualified facilitator. The responsibility of learning rest with the learner, so:

- Be proactive and ask questions,
- Seek assistance and help from your facilitators, if required.

Learning Unit: 1	US: 115373, NQF Level 3 Worth 5 Credits Explain the principles of computer networks
Unit Standard Purpose	<p><b>This unit standard is intended:</b></p> <ul style="list-style-type: none"> <li>• to provide fundamental knowledge of the areas covered</li> <li>• for those working in, or entering the workplace in the area of Data Communication &amp; Networking</li> <li>• as additional knowledge for those wanting to understand the areas covered</li> </ul> <p><b>People credited with this unit standard are able to:</b></p> <ul style="list-style-type: none"> <li>• Describe data communication.</li> <li>• Demonstrate knowledge of main features of LAN's</li> <li>• Demonstrate knowledge of main features of WAN's.</li> <li>• The performance of all elements is to a standard that allows for further learning in this area.</li> </ul>
Prerequisites	<p><b>The credit value of this unit is based on a person having prior knowledge and skills to:</b></p> <ul style="list-style-type: none"> <li>• Demonstrate an understanding of fundamental mathematics (at least NQF level 3).</li> <li>• Demonstrate PC competency skills (End-User Computing unit Standards, at least up to NQF level 3.)</li> <li>• Demonstrate competence to resolve technical computer problems (SGB-ID=DC301/ 302).</li> <li>• Demonstrate an understanding of local and wide area networks, and their installation.</li> </ul>

## 1.1 Describe data communication

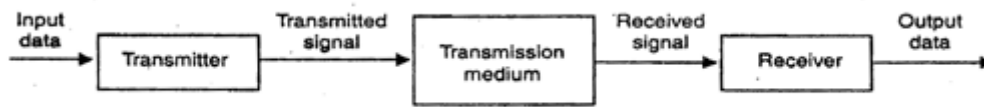
*Learning Outcomes:*

- *The description explains the roles of key elements in data communication.*
- *The description differentiates between LAN's and WAN's.*

**The description explains the roles of key elements in data communication.**

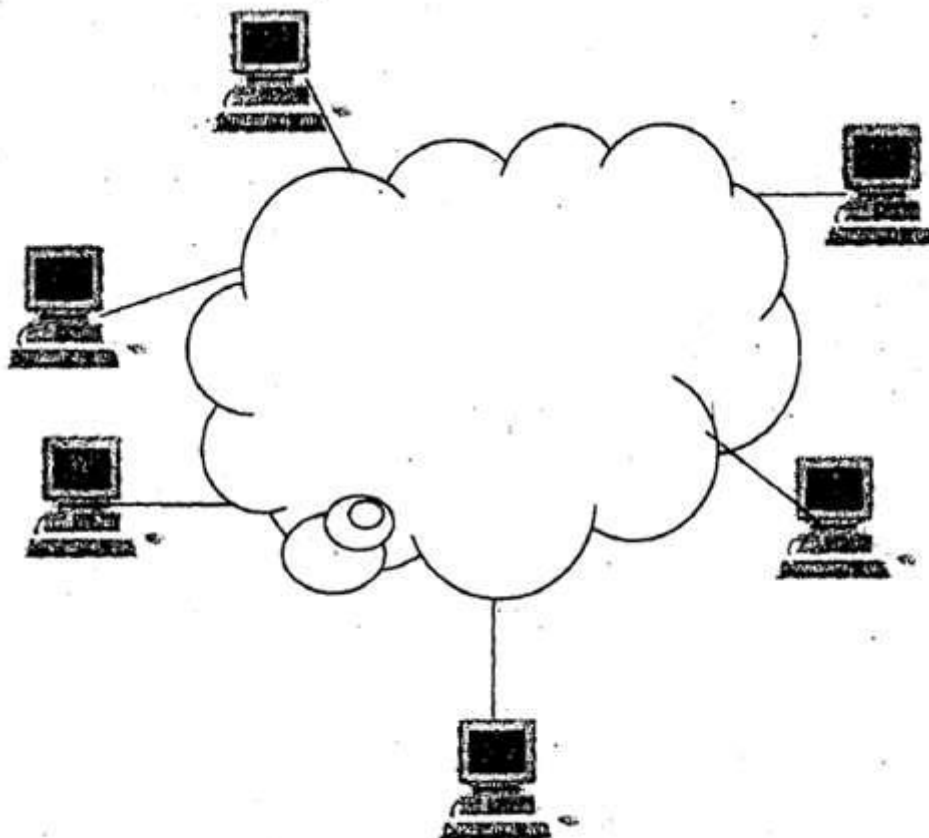
**Data communication** refers to the exchange of data between a source and a receiver. Data communication is said to be local if communicating devices are in the same building or a similarly restricted geographical area. The meanings of source and receiver are very simple. The device that transmits the data is known as source and the device that receives the transmitted data is known as receiver. Data communication aims at the transfer of data and maintenance of the data during the process but not the actual generation of the information at the source and receiver.

**Datum** mean the facts information statistics or the like derived by calculation or experimentation. The facts and information so gathered are processed in accordance with defined systems of procedure. Data can exist in a variety of forms such as numbers, text, bits and bytes. The Figure is an illustration of a simple data communication system.



*Simple Data Communication System*

A data communication system may collect data from remote locations through data transmission circuits, and then outputs processed results to remote locations. Figure provides a broader view of data communication networks. The different data communication techniques which are presently in widespread use evolved gradually either to improve the data communication techniques already existing or to replace the same with better options and features. Then, there are data communication jargons to contend with such as baud rate, modems, routers, LAN, WAN, TCP/IP, ISDN, during the selection of communication systems. Hence, it becomes necessary to review and understand these terms and gradual development of data communication methods.



*A Data Communication System using remote locations*

### Components of data communication system

A Communication system has following components:

1. **Message:** It is the information or data to be communicated. It can consist of text, numbers, pictures, sound or video or any combination of these.
2. **Sender:** It is the device/computer that generates and sends that message.

3. **Receiver:** It is the device or computer that receives the message. The location of receiver computer is generally different from the sender computer. The distance between sender and receiver depends upon the types of network used in between.

4. **Medium:** It is the channel or physical path through which the message is carried from sender to the receiver. The medium can be wired like twisted pair wire, coaxial cable, fiber-optic cable or wireless like laser, radio waves, and microwaves.

5. **Protocol:** It is a set of rules that govern the communication between the devices. Both sender and receiver follow same protocols to communicate with each other.

**A protocol performs the following functions:**

1. **Data sequencing.** It refers to breaking a long message into smaller packets of fixed size. Data sequencing rules define the method of numbering packets to detect loss or duplication of packets, and to correctly identify packets, which belong to same message.

2. **Data routing.** Data routing defines the most efficient path between the source and destination.

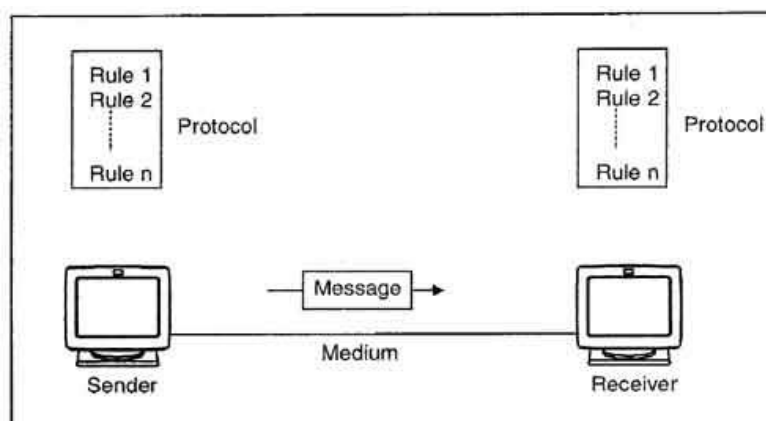
3. **Data formatting.** Data formatting rules define which group of bits or characters within packet constitute data, control, addressing, or other information.

4. **Flow control.** A communication protocol also prevents a fast sender from overwhelming a slow receiver. It ensures resource sharing and protection against traffic congestion by regulating the flow of data on communication lines.

5. **Error control.** These rules are designed to detect errors in messages and to ensure transmission of correct messages. The most common method is to retransmit erroneous message block. In such a case, a block having error is discarded by the receiver and is retransmitted by the sender.

6. **Precedence and order of transmission.** These rules ensure that all the nodes get a chance to use the communication lines and other resources of the network based on the priorities assigned to them.

7. **Connection establishment and termination.** These rules define how connections are established, maintained and terminated when two nodes of a network want to communicate with each other.



**8. Data security.** Providing data security and privacy is also built into most communication software packages. It prevents access of data by unauthorized users.

**9. Log information.** Several communication software are designed to develop log information, which consists of all jobs and data communications tasks that have taken place. Such information may be used for charging the users of the network based on their usage of the network resources.

**The description differentiates between LAN's and WAN's.**

### Types of Networks

There are many different types of networks. However, from an end user's point of view there are two basic types:

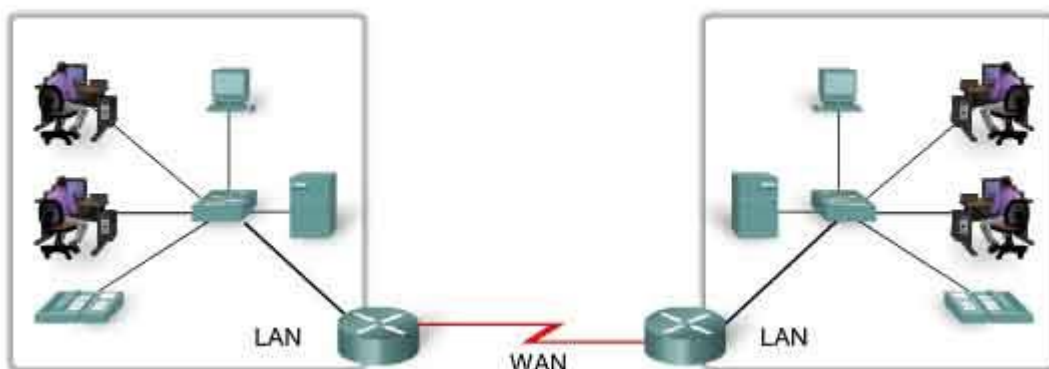
#### **Local-Area Networks (LANs)**

- The computers are geographically close together (that is, in the same building).

#### **Wide-Area Networks (WANs)**

- The computers are farther apart and are connected by telephone lines or radio waves

LANs separated by geographic distance are connected by a network known as a Wide Area Network (WAN).



## **1.2 Demonstrate knowledge of main features of LANs.**

*Learning Outcomes:*

- *The demonstration identifies the uses of LAN's with respect to current practice.*
- *The demonstration identifies the main types of LAN media.*
- *The demonstration describes the main LAN configurations.*
- *The demonstration describes LAN bandwidth.*
- *The demonstration describes LAN protocols.*

### **LANs - Local Area Networks**

**Definition - A LAN is a network that is limited to an area such as a building or school.**

In a LAN, computers and hardware such as printers can be connected by cable (*copper wiring*), fibre optic cabling (*glass fibres*) or using a wireless (*radio waves*) connection.

### **Protocol**

The protocol defines a common set of rules and signals that computers on the network use to communicate. One of the most popular protocols for LANs is called Ethernet. Another popular LAN protocol for PCs is the IBM token-ring network.

### **Architecture**

Networks can be broadly classified as using either peer-to-peer or client/server architecture. Computers on a network are sometimes called nodes. Computers and devices that allocate resources for a network are called servers.

### **Local Area Network (LAN)**

LAN is a computer network that spans a relatively small area. Most LANs are confined to a single building or group of buildings. However, one LAN can be connected to other LANs over any distance via telephone lines and radio waves. A system of LANs connected in this way is called a wide-area network (WAN).

Most LANs connect workstations and personal computers. Each node (individual computer) in a LAN has its own CPU with which it executes programs, but it is also able to access data and devices anywhere on the LAN. This means that many users can share expensive devices, such as laser printers, as well as data. Users can also use the LAN to communicate with each other, by sending e-mail or engaging in chat sessions.

There are many different types of LANs-token-ring networks, Ethernets, and ARC nets being the most common for PCs. LANs are capable of transmitting data at very fast rates, much faster than data can be transmitted over a telephone line; but the distance is limited, and there is also a limit on the number of computers that can be attached to a single LAN.

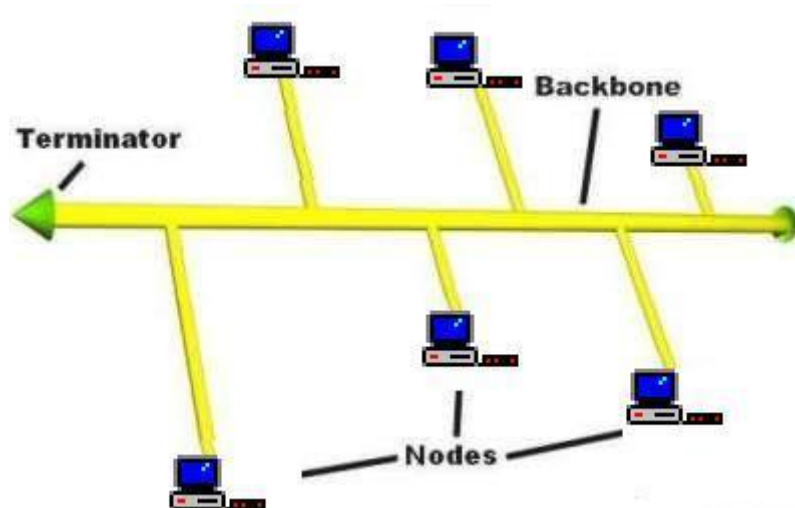
## **BASIC LAN CONFIGURATIONS**

Typical LAN configurations are star, ring and bus networks.

### **4BUS NETWORK**

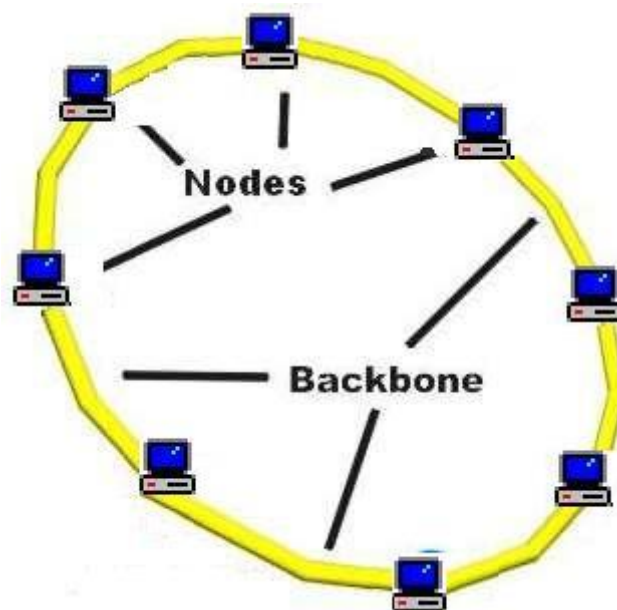
A bus network is made up of a cable called a bus that is shared by all the workstations or network nodes. All the nodes receive transmitted data, but the node to which they are addressed only accepts the data. Bus networks are easily and cheaply installed. An example of a bus network is Ethernet, the most popular network.





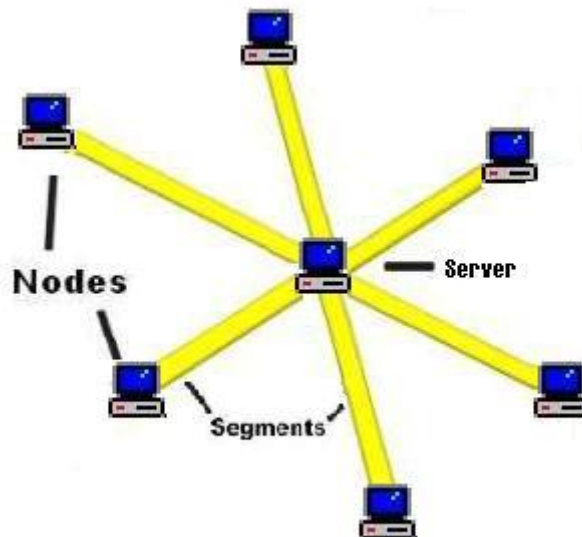
### **RING NETWORK**

A ring topology is where workstations are connected in a ring pattern. Signals in the ring are sent in one direction from the source node, around the ring from node to node, until they reach the destination. A ring network can be designed so that a malfunctioning terminal will not cause problems for the other terminals. IBM's Token Ring is an example of a ring network.



### **STAR NETWORK**

A star network is where each workstation is connected to a central workstation called the network server. The cable is not shared in a star network. So, if the server ceases to function it can cause total loss of communication on the entire network. If anyone workstation is not working properly, it will not affect any other workstation. StarLAN from AT&T is an example of a star network.



### **Advantages of LANs:**

- Hardware such as printers can be shared so individual workstations do not need their own printer. When they print, the data is stored in a queue on a server. The data is then passed to the printer.
- All the users work can be stored in a central place (the dedicated file server) so a user can access their work through any computer on the network.
- Software can be shared, software packages are stored on the server and downloaded to workstations as requested. Note that a license still has to be bought for each copy of the software needed.
- Data can be shared because database files stored in the server are available to users around the network; data from CD-ROMs can also be shared across the network.
- Central back-up can take place automatically at regular intervals. A user will usually be able to retrieve work that has been deleted by mistake.
- Messages can be sent to people working at other computers on the network which can save time and paper.
- It is possible to set up a local intranet such as that on the KLB school network. The web pages of information can be accessed only over the LAN. An intranet is free because it does not involve phone links.



- There is control over users' access rights to programs and data.
- Disadvantages of LANs:
- Printing can be slow. Where a lot of workstations are served by only one or two printers, long print queues may develop.
- A virus can spread more easily. If a virus gets into one computer, it is likely to spread quickly across the network because it will get into the central backing store.
- As data is shared there is a greater need for security. Users of the network have to have authentication techniques such as user ids and passwords. Unique user ID's control access to the files and settings on the network while passwords prevent unauthorized users from logging onto the network. Data may also have to be encrypted so that it is meaningless if intercepted.
- If the server fails, all the workstations are affected. Work stored on shared hard disk drives will not be accessible and it will not be possible to use network printers either.
- The cost of installing the equipment is greater. Cabling can be expensive to buy and to install.
- Damage to cables can isolate computers. Some sections of the network can become isolated and will not be able to communicate with the rest of the network.
- Because networks can be complicated to maintain, a network manager may be need to be employed to run the system.

### **LAN media**

**LAN media** define how you access the network physically. Three common LAN media are

- Copper UTP cables (commonly referred to as Ethernet patch cables), it's the cheapest way of connecting a device to the LAN. Very commonly used for normal connections up to 1 GBit/s.
- Optical Fiber, rather expensive but allows for very high bandwidths. Thus, it's usually used as backbone cabling rather than normal connections between devices.
- Wireless LAN, which uses radio waves transmitted through the air. Slower than wired LAN but allows for greater mobility of the hosts. Security may be a bit shaky, thus it's usually not used in security sensitive environments.

### **LAN Bandwidth Management**

A LAN (Local Area Network) usually covers a small area such as a certain office, a few buildings, or perhaps just a home. Unlike WANs (Wide Area Networks), LANs have no need for leased telecommunication lines, and tend to have very high data transfer rates. In order for a LAN to run smoothly, the network manager needs to keep a close eye on the bandwidth usage. By monitoring it carefully and being aware of which applications use up the most bandwidth, problems such as performance bottlenecks can be avoided. PRTG Network Monitor is the ideal solution for easy, reliable LAN bandwidth management. This bandwidth measurement software provides administrators with

live readings as well as long-term usage trends, all in clear, easy-to-read graphs and tables. With accurate information about network traffic and bandwidth usage, you can manage your LAN in a proactive way and steer clear of costly and time-consuming problems.

### 1.3 Demonstrate knowledge of main features of WANs.

*Learning Outcomes:*

- *The demonstration explains the uses of WAN's with respect to current practice.*
- *The demonstration explains the uses, hardware requirements and advantages of WAN's.*

#### WANs - Wide Area Networks

A **WAN** is 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

**Definition - a Wide Area Network is not confined to one building. The computers and terminals forming part of the network can be spread around the world.**

External communication links such as **satellites**, **microwaves**, **telecommunication links** and **optical fibre** will be used to connect the parts of a WAN. The connection must normally be paid for because the links are external. The **Internet** is a **worldwide WAN** and a LAN can be connected to it using a router.

#### Advantages of WANs:

- These are similar to those of LAN's except the scale of sharing etc. becomes far greater and can be world-wide.

#### Disadvantages of WANs:

- Again, these are similar to those of LAN's except that issues such as security become even more important as potential hackers could break into a computer system from anywhere in the world rather than having to physically be in a building.
- Encryption of secure data such as financial transactions is necessary because it is even easier to intercept data.

#### Revision points - you should be able to do the following:

- Explain what is meant by a **network** and know the benefits of networking computers
- Define a **LAN** (Local Area Network) and a **WAN** (Wide Area Network) and discuss the advantages and disadvantages of each

#### Questions:

What is a network?

1. Explain what a Wide Area Network is.
2. State one advantage and one disadvantage of a WAN.
3. When using a LAN, why is it necessary to have a password?
4. Describe the software that makes up a network.
5. Describe the devices that make up a typical network.

### **Important terms used in Networking**

#### **(a) Internet**

The newest type of network to be used within an organisation is an internet or internet web. Such networks enable computers (or network) of any type to communicate easily. The hardware and software needs are the same as for the internet, specifically TCP/IP, server and browser software used for the World Wide Web. Because most organisations have a need for more dynamic ways to link people and information, the internet market is expanding day by day. Moreover, there is no need to adjust the network when a new user joins in. With the help of Internet, all computers of an organisation can work as stand-alone systems, connected to a mainframe, or part of a LAN or WAN.

#### **(b) E-Mail**

E-mail stands for electronic mail. This is one of the most widely used features of Internet. Mails are regularly used today where without the help of postage stamp; we can transfer mails anywhere in the world. With electronic mail the service is similar. But here data is transmitted through Internet and therefore within minutes the message reaches the destination may it be anywhere in the world. Therefore, the mailing system through e-mail is excessively fast and is being used widely for mail transfer.

#### **(c) Voice Messaging**

It is a new communication approach which is similar to electronic mail except that it is audio message rather than text messages that are processed. A sender speaks into a telephone rather than typing, giving the name of the recipient and the message. That sender's voice signal is then digitised and stored. The system can then either deliver the message at a specified time in future or it can be retrieved from a database by the recipient. The message is reconverted back into its analogue format when it is delivered or retrieved so that the recipient hears it as the original sender's voice on a telephone. Voice messaging requires a computer with an ability to store the audio messages in digital form and then convert them back in an audio form upon verification. Each user has a voice mailbox in secondary storage and special equipment converts the audio message to and from the digital form. The main advantage of voice mail over electronic mail is that the sender does not have to type. Voice mail also makes it easy to include people in the firm's environment in a communication network.

#### (d) E-Commerce

Electronic commerce or e-commerce as it is popularly known refers to the paperless exchange of business information using Electronic Data Interchange, Electronic mail, Electronic Bulletin Boards, Electronic Fund Transfer and other network-based technologies. Electronic Commerce (EC) not only automates manual process and paper transactions, but it also helps organisations to move into a fully electronic environment and change the way they usually operate. Few organisations have recently started conducting EC over Internet, the network of networks. Internet has also helped EC to boost up because it is a low-cost alternative to the proprietary networks. EC standards are however under development. Electronic Data Interchange (EDI) is still the dominant part of EC. Information Technology has transformed the way people work. Electronic Commerce (EC) has unearthed yet another revolution which is changing the way business houses buy and sell products and services.

#### WAN Hardware

A **WAN - Wide Area Network** is a network with a much broader reach than LANs and MANs. They span across metropolitan areas and may well span across nations and language differences. The PSTN - Public Switched Telephone Network or POTS - Plain Old Telephone System is a WAN. The entire Internet is a WAN. A home user's connection to the Internet is very likely done through a WAN. While they interact with LANs, they are fundamentally different in form and functions.

The hardware required to implement a WAN link can be as simple and readily available as a modem and a telephone line. On the other hand, it can be complicated and expensive, such as satellites and transoceanic cabling. This webpage will survey some of the most frequently used hardware.

**Modems.** The word **modem** originally derived from **modulation/demodulation**. This needs to occur in order to take digital signals from/to computers and transmit/receive them over analog telephone lines. Currently, they take on an even larger variety of basic approaches to functioning.

They tend to come in two main varieties in terms of their relative position inside or outside the transmitting/receiving device. Modems can be categorized as **internal** or **external**.

One of the main advantages of an **internal modem** is compactness. They are circuit boards that fit into one of two places inside a computer.

- ISA - Industry Standard Architecture slot
- PCI - Peripheral Component Interconnect slot

Since they are inside you do not need to find extra space on the desktop, nor do you need an extra serial cable.

Unfortunately, internal modems are traditionally more difficult to configure than external ones. Several things need to be set in order to ensure there aren't conflicts with other internal components.

- **IRQ - Interrupt Request**
  - this is an assigned location where the system expects the device, in this case a modem, to interrupt it when the device sends a signal
  - signals that go to a processor on the same line would interrupt each other
- **Input/Output Address**
  - this is the memory location where data from the device is stored in order to be processed by the CPU
  - again, if multiple devices try to use the same I/O address it will inevitably result in conflicts
- **Virtual Com Port**
  - this is a logical port number by which the operating system identifies a serial port
  - you must set each serial device to use a different com port

All modern operating systems provide a means by which you can view how resources are being used. Modifying these settings depends on the modem. The following list gives three typical ways these settings can be changed.

- Dip switches - these are small switches directly on the circuit board that can be moved
- Jumpers - pairs of metal pins built into the circuit board that represent an electrical contact point
  - configured so that a small plug is placed on the pins to complete a circuit
- Software - a software program is used to change the configuration

Many modems support **PNP - Plug and Play** technology which enables the operating system to

- detect the device
- install the necessary software drivers
- detect what resources are available on the computer
- assign particular resources to the device automatically

Little or no intervention is required from the user. Unfortunately, these sorts of devices require your computer's operating system to have features that are compatible.

**External modems** have a couple advantages over internal ones.

- most provide status lights
  - power is on
  - connected

- transferring data
- usually easier to configure and install than internal ones

A couple disadvantages of external modems are

- they require a power cord to plug into an electrical outlet, rather than running off the computer's power like an internal modem
- they require a serial cable to run from the modem to one of the serial ports on the back of the computer

To use an external modem, you need to have an available serial port. Most computers have two built in serial ports, COM 1 and COM 2, with connectors on the back of the computer. It is important to remember that many other devices such as scanners, digital cameras and serial printing devices also use serial ports.

If your computer doesn't have a serial port then you have a few options.

- use an internal modem
- install an expansion card in your computer
- if you have a USB you can chain several serial devices off a single port

Serial ports make use of a **UART - Universal Asynchronous Receiver/Transmitter** chip to handle serial communications. This chip comes in different types and the type used determines how fast data can be transferred over the serial port.

Drivers are software programs that act as liaisons between hardware devices and the operating system. Some modems require a modem driver that either comes with the modem or can be downloaded from the manufacturer's website.

A computer may also be configured as a **dial-up server** or **remote access server** to allow other computers to dial into it and connect over the phone lines. Computers running particular server software can support many remote access connections simultaneously. In order to do this the server needs to have a **modem bank**. The modem bank allows the server to make use of a group of modems simultaneously.

**ISDN and DSL Adapters.** The device used to connect a computer to an **ISDN - Integrated Services Digital Network** or **DSL - Digital Subscriber Line** is often referred to as a modem. It is more accurate to call it a **terminal adapter**. It doesn't really modulate and/or demodulate signals because the lines are digital.

**ISDN adapters** also come in both internal and external varieties. They are configured similarly to modems, but typical 128 Kbps ISDN service consists of two data channels each running at 64 Kbps. The two data channels usually have separate phone numbers.



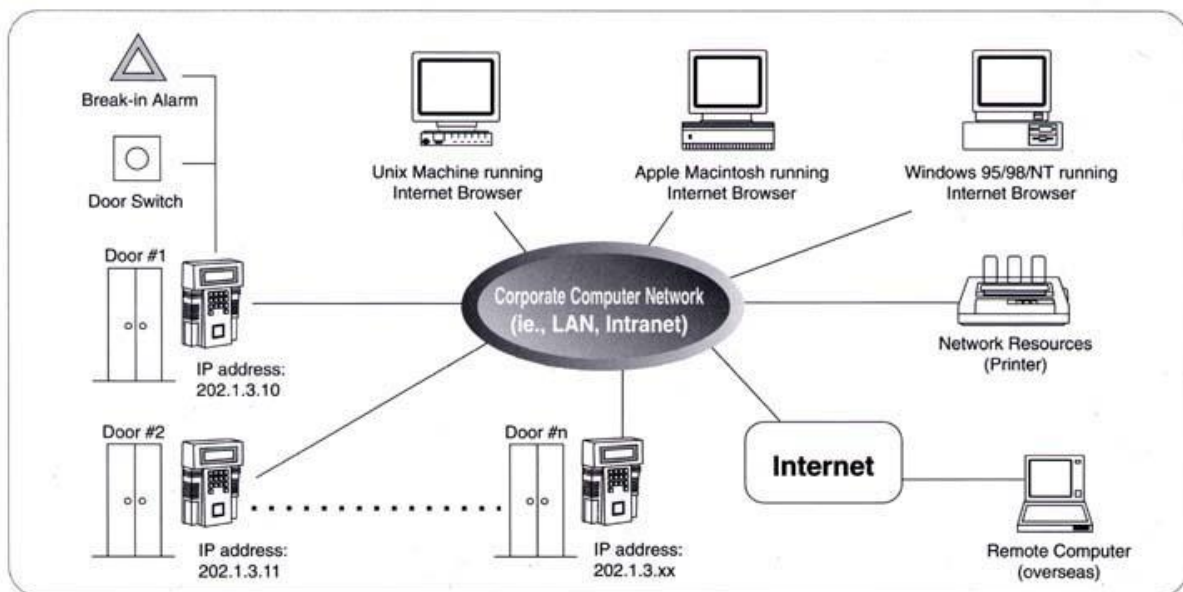
ISDN adapters are configured with information about the **SPID - Service Profile Identifier** for each channel. Each of these SPIDs consists of a telephone number, a two-digit sharing terminal identifier and a two-digit terminal identifier. Some more recent models support automated SPID selection and don't require the admin to enter the information.

**DSL adapters or endpoints** are required at both ends of a DSL connection. Sometimes these endpoints are external. Other times they are placed together with the NIC on the same card.

**Customer Premises Equipment.** CPE - Customer Premises Equipment is a general term that encompasses several different devices. These are used for processing transmissions on WAN links such as

- T-1 lines
- T-3 lines
- X.25 connections
- Frame Relay links

#### ● A Typical Connection Diagram



Learning Unit: 2	US: 115367, NQF Level 4 Worth 7 Credits Explain how data is stored on computers
Unit Standard Purpose	<p><b>This unit standard is intended:</b></p> <ul style="list-style-type: none"> <li>• to provide conceptual knowledge of the areas covered</li> <li>• for those working in, or entering the workplace in the area of Information Systems and Technology Management</li> <li>• as additional knowledge for those wanting to understand the areas covered</li> </ul> <p><b>People credited with this unit standard are able to:</b></p> <ul style="list-style-type: none"> <li>• Describe the roles of IS departments in organisations</li> <li>• Describe the structures of IS departments in organisations</li> <li>• The performance of all elements is to a standard that allows for further learning in this area.</li> </ul>
Prerequisites	<p><b>The credit value of this unit is based on a person having prior knowledge and skills to:</b></p> <ul style="list-style-type: none"> <li>• Demonstrate an understanding of fundamental mathematics (at least NQF level 3).</li> <li>• Demonstrate PC competency skills (End-User Computing unit Standards, at least up to NQF level 3).</li> </ul>

## 2.1 Demonstrate knowledge of main features of WANs.

*Learning Outcomes:*

- *The demonstration distinguishes between data types and includes examples.*
- *The description of the use of coding systems in a business environment distinguishes categories of coding systems and includes examples.*
- *The demonstration illustrates how data manipulation operations are performed on data types.*

### The demonstration distinguishes between data types and includes examples

A **data type** is a classification of the type of data that a variable or object can hold in computer programming. Data type is an important factor in virtually all computer programming languages, including visual basic, C#, C++ and JavaScript. When programmers create computer applications, both desktop and web-based, data types must be referenced and used correctly, to ensure the result of the application's functions is correct and error-free.

### PRIMITIVE DATA TYPE

#### - Boolean type

Boolean data type refers to those types of computer data which represent the values in two forms i.e. true and false. All the values are represented as true and false or yes and no. these are also known as logical data. In some software, it has been interpreted in the form of numbers which indicates either its true or false, 0 is considered as false while other digit is referred as true.

### **- Numeric type**

Numeric data is one of the very common types of computer data which simply means numbers. Numbers can be many forms including, integers, real numbers, currency calculation, percentage, binary numbers etc. some software use different language for such numeric type of data which includes, single, double or float.

1. **Integers:** It is consisting of whole numbers and can be represented in negative as well as positive. It doesn't have any decimal values.
2. **Real numbers:** It contains decimal and fractional values as well and can be represented in negative and positive.
3. **Currency:** It contains a specific symbol which refers to a particular country. This type of numeric value is recorded till two decimal digits.
4. **Percentage:** Percentage values are recorded in a way that it is calculated out of 100 and can be denoted in a whole number as well as in decimal values. It has a specific percentage symbol (%) which is used to indicate percentage value.

### **COMPOSITE DATA TYPE**

Composite data type is a combination of primitive data type; they combine to form composite data type which is also known as data structure. There are different types of composite data, which serves different purposes like, array, union, record, sets, objects and tagged union.

### **ALPHANUMERIC DATA TYPE:**

Alphanumeric data simply means one of the types of computer data that contains alphabets as well as numbers. It is very common type of data storage system, which allows different type of computer data to store in one place. It contains alphabets, numbers, symbols, space and punctuation marks. It records every bit of details you want to store in your computer. It is also referred as text data.

### **ABSTRACT DATA TYPE:**

Abstract data type is one of the rare types of computer data; it doesn't have any representation and implementation. It is just a vague term or language used which don't have any purpose. Array and records contain such types of computer data, they are considered as concrete as they specify the elements present in a memory.

Data Type	Size (bits)	Initial Value	Min Value	Max Value
boolean	1	false	false	true
byte	8	0	-128 ( $-2^7$ )	127 ( $2^7 - 1$ )
short	16	0	$-2^{15}$	$2^{15} - 1$
char	16	'\u0000'	'\u0000' (0)	'\uFFFF' ( $2^{16} - 1$ )
int	32	0	$-2^{31}$	$2^{31} - 1$
long	64	0L	$-2^{63}$	$2^{63} - 1$
float	32	0.0F	1.4E-45	3.4028235E38
double	64	0.0	4.9E-324	1.7976931348623157E308

**The description of the use of coding systems in a business environment distinguishes categories of coding systems and includes examples:**

#### **COMPUTER CODING SYSTEMS**

To represent numeric, alphabetic, and special characters in a computer's internal storage and on magnetic media, we must use some sort of coding system. In computers, the code is made up of fixed size groups of binary positions. Each binary position in a group is assigned a specific value; for example 8, 4, 2, or 1. In this way, every character can be represented by a combination of bits that is different from any other combination. In this section you will learn how the selected coding systems are used to represent data. The coding systems included are Extended Binary Coded Decimal Interchange Code (**EBCDIC**), and American Standard Code for Information Interchange (**ASCII**).

#### **EXTENDED BINARY CODED DECIMAL INTERCHANGE CODE (EBCDIC)**

Using an 8-bit code, it is possible to represent 256 different characters or bit combinations. This provides a unique code for each decimal value 0 through 9 (for a total of 10), each **uppercase** and **lowercase** letter (for a total of 52), and for a variety of special characters. In addition to four numeric bits, **four** zone bit positions are used in 8-bit code as illustrated. Each group of the eight bits makes up one alphabetic, numeric, or special character and is called a byte.

Figure 1. - Format for EBCDIC and ASCII codes.

ZONE BITS				NUMERIC BITS			
Z/ 8	Z/ 4	Z/ 2	Z/ 1	8	4	2	1

When you look at figure 1, you will notice that the four rightmost bits in EBCDIC are assigned values of 8, 4, 2, and 1. The next four bits to the left are called the zone bits. The EBCDIC coding chart for uppercase and lowercase alphabetic characters and for the numeric digits 0 through 9 is shown in figure 2, with their hexadecimal equivalents. Hexadecimal is a number system used with some computer systems. It has a base of 16 (0-9 and A-F). A represents 10; B represents 11; C represents 12; D represents 13; E represents 14; and F represents 15. In EBCDIC, the bit pattern 1100 is the zone combination used for the alphabetic characters A through I, 1101 is used for the characters J through R, and 1110 is the zone combination used for characters S through Z. The bit pattern 1111 is the zone combination used when representing decimal digits. For example, the code 11000001 is equivalent to the letter **A**; the code 11110001 is equivalent to the decimal digit 1. Other zone combinations are used when forming special characters. Not all of the 256 combinations of 8-bit code have been assigned characters. characters DP-3 are represented using EBCDIC.

Figure 2. - Eight-bit EBCDIC coding chart (including hexadecimal equivalents).

ALPHABETIC CHARACTERS					
UPPERCASE			LOWERCASE		
PRINTS AS	EBCDIC		PRINTS AS	EBCDIC	
	IN BINARY	IN HEXA- DECIMAL		IN BINARY	IN HEXA- DECIMAL
	1111 1000	F 0		1111 1001	F 1
A	1100 0001	C 1	a	1000 0001	8 1
B	1100 0010	C 2	b	1000 0010	8 2
C	1100 0011	C 3	c	1000 0011	8 3
D	1100 0100	C 4	d	1000 0100	8 4
E	1100 0101	C 5	e	1000 0101	8 5
F	1100 0110	C 6	f	1000 0110	8 6
G	1100 0111	C 7	g	1000 0111	8 7
H	1100 1000	C 8	h	1000 1000	8 8
I	1100 1001	C 9	i	1000 1001	8 9
J	1101 0001	D 1	j	1001 0001	9 1
K	1101 0010	D 2	k	1001 0010	9 2
L	1101 0011	D 3	l	1001 0011	9 3
M	1101 0100	D 4	m	1001 0100	9 4
N	1101 0101	D 5	n	1001 0101	9 5
O	1101 0110	D 6	o	1001 0110	9 6
P	1101 0111	D 7	p	1001 0111	9 7
Q	1101 1000	D 8	q	1001 1000	9 8
R	1101 1001	D 9	r	1001 1001	9 9
S	1110 0010	E 2	s	1010 0010	A 2
T	1110 0011	E 3	t	1010 0011	A 3
U	1110 0100	E 4	u	1010 0100	A 4
V	1110 0101	E 5	v	1010 0101	A 5
W	1110 0110	E 6	w	1010 0110	A 6
X	1110 0111	E 7	x	1010 0111	A 7
Y	1110 1000	E 8	y	1010 1000	A 8
Z	1110 1001	E 9	z	1010 1001	A 9
NUMERIC CHARACTERS					
0	1111 0000	F 0	5	1111 0101	F 5
1	1111 0001	F 1	6	1111 0110	F 6
2	1111 0010	F 2	7	1111 0111	F 7
3	1111 0011	F 3	8	1111 1000	F 8
4	1111 0100	F 4	9	1111 1001	F 9

Since one numeric character can be represented and stored using only four bits (8-4-2-1), using an 8-bit code allows the representation of two numeric characters (decimal digits) as illustrated. Representing two numeric characters in one byte (eight bits) is referred to as **packing** or **packed data**. By packing data (numeric characters only) in this way, it allows us to conserve the amount of storage space required, and at the same time, increases processing speed.

**Figure 4. - Packed data.**

DECIMAL VALUE	92	73
EBCDIC	10010010	01110011
BIT PLACE VALUES	84218421	8421
8421	BYTE 1	BYTE 2

#### AMERICAN STANDARD CODE FOR INFORMATION INTERCHANGE (ASCII)

Another 8-bit code, known as the American Standard Code for Information Interchange (**ASCII**) (pronounced ASS-KEY), was originally designed as a 7-bit code. Several computer manufacturers cooperated to develop this code for **transmitting** and processing data. The purpose was to **standardize** a binary code to give the computer user the capability of using several machines to

process data regardless of the manufacturer: **IBM, HONEYWELL, UNIVAC, BURROUGHS**, and so on. However, since most computers are designed to handle (store and manipulate) 8-bit code, an 8-bit version of ASCII was developed. ASCII is commonly used in the transmission of data through data communications and is used almost exclusively to represent data internally in microcomputers. The concepts and advantages of ASCII are **identical** to those of EBCDIC. The important difference between the two coding systems lies in the 8-bit combinations assigned to represent the various alphabetic, numeric, and special characters. When using ASCII 8-bit code, you will notice the selection of bit patterns used in the positions differs from those used in EBCDIC. For example, let's look at the characters **DP3** in both EBCDIC and ASCII to see how they compare.

Character	D	P	3
EBCDIC	1100 0100	1101 0111	1111 0011
ASCII	0100 0100	0101 0000	0011 0011

In ASCII, rather than breaking letters into three groups, uppercase letters are assigned codes beginning with hexadecimal value **41** and continuing sequentially through hexadecimal value **5A**. Similarly, lowercase letters are assigned hexadecimal values of **61** through **7A**. The decimal values **1** through **9** are assigned the zone code 0011 in ASCII rather than 1111 as in EBCDIC. Figure 4-7 is the ASCII coding chart showing uppercase and lowercase alphabetic characters and numeric digits 0 through 9.

### Eight-bit ASCII coding chart (including hexadecimal equivalents).

ALPHABETIC CHARACTERS					
UPPERCASE			LOWERCASE		
PRINTS AS	ASCII CODE		PRINTS AS	ASCII CODE	
	IN BINARY	IN HEXA-DECIMAL		IN BINARY	IN HEXA-DECIMAL
	8421 8421			8421 8421	
A	0100 0001	4 1	a	0110 0001	6 1
B	0100 0010	4 2	b	0110 0010	6 2
C	0100 0011	4 3	c	0110 0011	6 3
D	0100 0100	4 4	d	0110 0100	6 4
E	0100 0101	4 5	e	0110 0101	6 5
F	0100 0110	4 6	f	0110 0110	6 6
G	0100 0111	4 7	g	0110 0111	6 7
H	0100 1000	4 8	h	0110 1000	6 8
I	0100 1001	4 9	i	0110 1001	6 9
J	0100 1010	4 A	j	0110 1010	6 A
K	0100 1011	4 B	k	0110 1011	6 B
L	0100 1100	4 C	l	0110 1100	6 C
M	0100 1101	4 D	m	0110 1101	6 D
N	0100 1110	4 E	n	0110 1110	6 E
O	0100 1111	4 F	o	0110 1111	6 F
P	0101 0000	5 0	p	0111 0000	7 0
Q	0101 0001	5 1	q	0111 0001	7 1
R	0101 0010	5 2	r	0111 0010	7 2
S	0101 0011	5 3	s	0111 0011	7 3
T	0101 0100	5 4	t	0111 0100	7 4
U	0101 0101	5 5	u	0111 0101	7 5
V	0101 0110	5 6	v	0111 0110	7 6
W	0101 0111	5 7	w	0111 0111	7 7
X	0101 1000	5 8	x	0111 1000	7 8
Y	0101 1001	5 9	y	0111 1001	7 9
Z	0101 1010	5 A	z	0111 1010	7 A
NUMERIC CHARACTERS					
0	0011 0000	3 0	6	0011 0101	3 6
1	0011 0001	3 1	7	0011 0110	3 7
2	0011 0010	3 2	8	0011 0111	3 8
3	0011 0011	3 3	9	0011 1000	3 9
4	0011 0100	3 4		0011 1001	3 9

At this point you should understand how coding systems are used to represent data in both EBCDIC and ASCII. Regardless of what coding system is used, each character will have an additional bit called a check bit or parity bit.

### PARITY BIT

This additional check or parity bit in each storage location is used to detect errors in the circuitry. Therefore, a computer that uses an 8-bit code, such as EBCDIC or ASCII, will have a ninth bit for parity checking. The parity bit (also called a check bit, the C position in a code) provides an internal means for checking the validity, the correctness, of code construction. That is, the total number of bits in a character, including the parity bit, must always be **odd** or **always** be **even**, depending upon whether the particular computer system or device you are using is odd or even parity. Therefore, the coding is said to be in either **odd** or **even** parity code, and the test for bit count is called a **parity check**.



Now, let's talk about bits and bytes, primary storage, and storage capacities; or, to put it another way, the capacity of a storage location. Sit back, keep your memory cycling, and we will explain the ways data may be stored and retrieved inside the computer.

Q.6 What does the acronym EBCDIC stand for? **Answer**

Q.7 By using an 8-bit code, how many characters or bit combinations can be represented? **Answer**

Q.8 What is the base of a hexadecimal number system? **Answer**

Q.9 What term is used for the representation of two numeric characters stored in eight bits?

Q.10 What does the acronym ASCII mean? **Answer**

Q.11 What was the purpose of several computer manufacturers cooperating to develop ASCII code for processing and transmitting data? **Answer**

Q.12 Are there any differences in the concepts and advantages of ASCII and EBCDIC? **Answer**

Q.13 How is the parity bit in each storage location used? **Answer**

Q.14 A computer or device that uses 8-bit ASCII or EBCDIC will use how many bits to store each character? **Answer**

A6. Extended Binary Coded Decimal Interchange Code.

A7. 256.

A8. 16.

A9. Packing or packed data.

A10. American Standard Code for Information Interchange.

A11. To standardize a binary code to give the computer user the capability of using several machines to process data regardless of the manufacturer.

A12. No, they are identical.

A13. To detect errors in the circuitry.

A14. Nine.

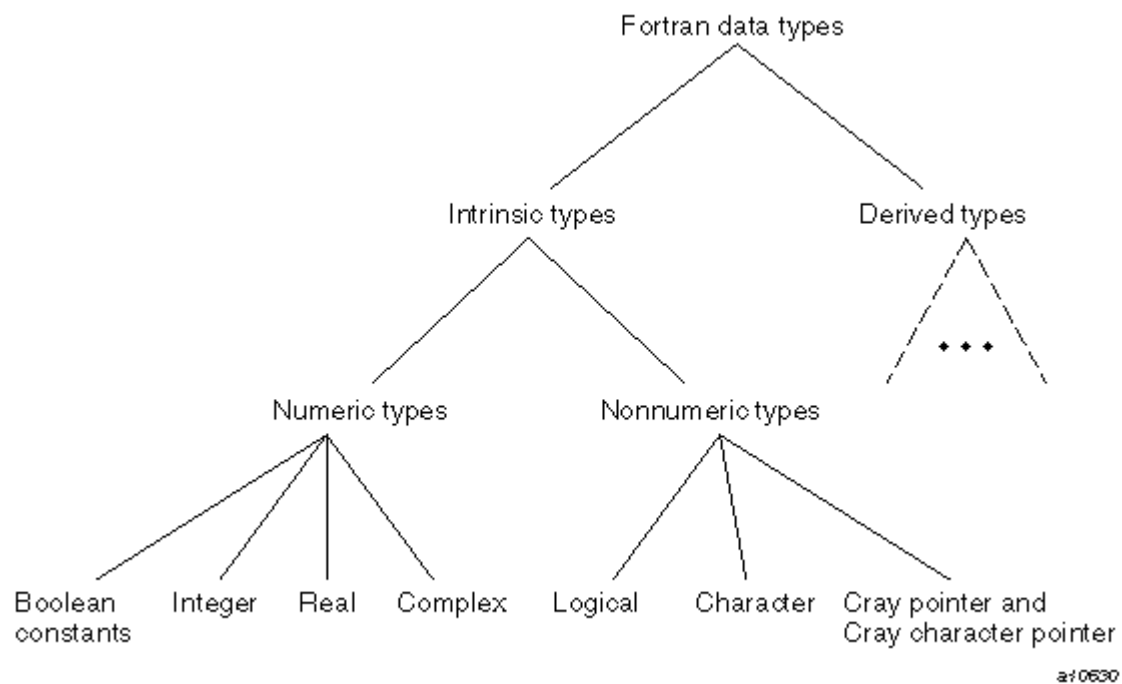
Data manipulation involves performing calculations on numbers and manipulating strings. Programs manipulate and use variables in many ways, often depending on the type of the data. Each data type has a number of operations - things that you can do to it. There are 3 major set of operators in most programming languages - Numeric or Arithmetic operators, Comparison operators and Logical operators. Let's know each set-in detail.

### Numeric or Arithmetic Operators

- + Addition
- Subtraction
- \* Multiplication
- / Division
- \ Integer division
- Mod Modulus arithmetic
- & String concatenation

Arithmetic operators for manipulating data include the familiar addition, subtraction, multiplication and division operators. There are some interesting variations such as the modulus (Mod) and integer division (\) available in visual basic.

### Fortran data types



As the following list shows, the type of the data determines the operations that can be performed on it:

Data Type	Operations
Real, complex, integer, Boolean	Addition, subtraction, multiplication, division, exponentiation, negation, comparison, masking expressions
Logical	Negation, conjunction, disjunction, and equivalence
Character	Concatenation, comparison

User defined	User defined
Cray pointer, Cray character pointer	Addition, subtraction, and LOC( ) function

The intrinsic types have the appropriate built-in (intrinsic) operations. You must define the operations performed on user-defined data types.

### **Bit manipulation in the C programming language**

C has direct support for bitwise operations that can be used for bit manipulation. In the following examples, *n* is the index of the bit to be manipulated within the variable *bit\_fld*, which is an unsigned char being used as a bit field. Bit indexing begins at 0, not 1. Bit 0 is the least significant bit.

#### **Set a bit**

```
bit_fld |= (1 << n)
```

#### **Clear a bit**

```
bit_fld &= ~(1 << n)
```

#### **Toggle a bit**

```
bit_fld ^= (1 << n)
```

#### **Test a bit**

```
bit_fld & (1 << n)
```

When using an array of bytes to represent set of bits, i.e., a bit array or bitset, the index of the byte in the array associated with a bit *n* can be calculated using division.

## 2.2 Describe computer data structures.

*Learning Outcomes:*

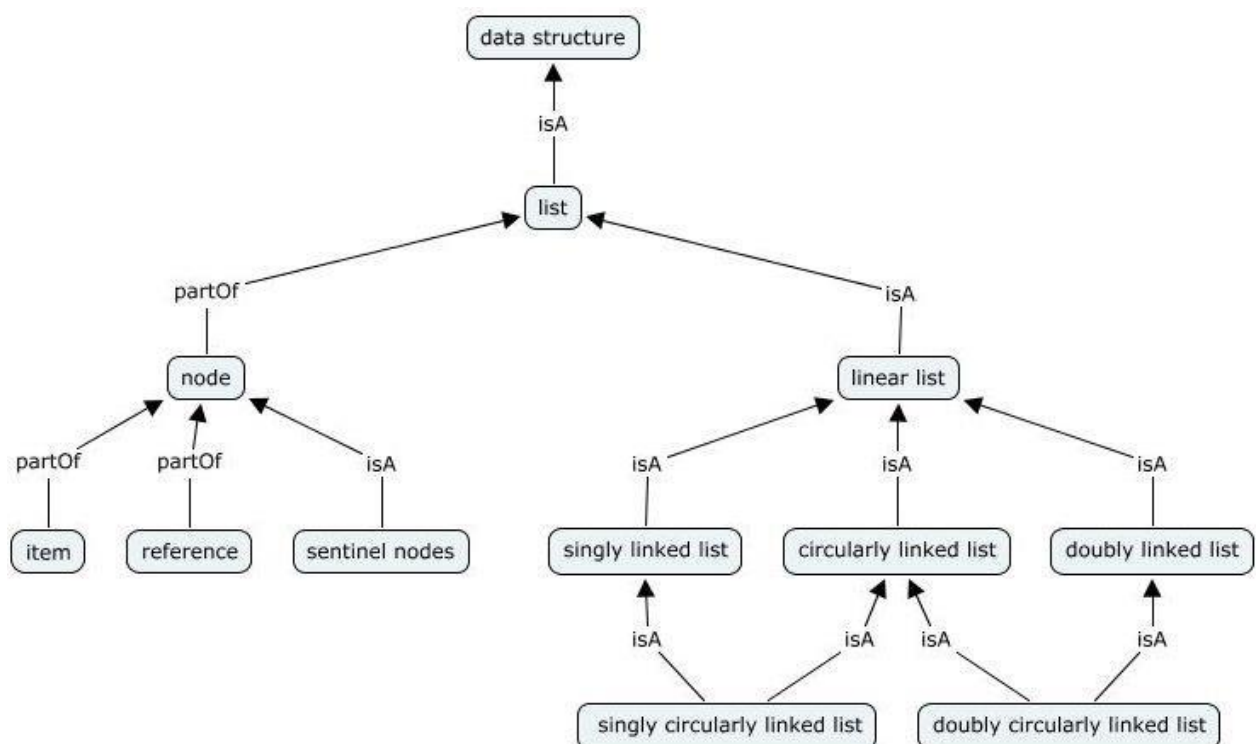
- *The description distinguishes types of computer data structures and identifies examples.*
- *The description distinguishes types of computer files and identifies examples.*
- *The description distinguishes types of computer databases and identifies examples.*

### **The description distinguishes types of computer data structures and identifies examples.**

In computer science, a data structure is a particular way of storing and organizing data in a computer so that it can be used efficiently. Different kinds of data structures are suited to different kinds of applications, and some are highly specialized to specific tasks. For example, B-trees are particularly well-suited for implementation of databases, while compiler implementations usually use hash tables to look up identifiers.

### Data structures

Whereas control structures organize algorithms, data structures organize information. In particular, data structures specify types of data, and thus which operations can be performed on them, while eliminating the need for a programmer to keep track of memory addresses. Simple data structures include integers, real numbers, Booleans (true/false), and characters or character strings. Compound data structures are formed by combining one or more data types. The most important compound data structures are the array, a homogeneous collection of data, and the record, a heterogeneous collection. An array may represent a vector of numbers, a list of strings, or



**Data structure**, Way in which data are stored for efficient search and retrieval. The simplest data structure is the one-dimensional (linear) array, in which stored elements are numbered with consecutive integers and contents are accessed by these numbers. Data items stored non consecutively in memory may be linked by pointers (memory addresses stored with items to indicate where the "next" item or items in the structure are located). Many algorithms have been developed for sorting data efficiently; these apply to structures residing in main memory and also to structures that constitute information systems and databases. **Bits, Bytes, Characters, Fields, Records, Files, and Databases are examples**

The description distinguishes types of computer files and identifies examples.

## FILES

- WORK FILE IS Temporary [file containing data](#), computations, [documents](#), [drafts](#), [records](#), [roughnotes](#), and sketches [employed](#) in the [analysis](#) or [preparation](#) of [plans](#), [projects](#), or other documents.

**Program Files** is a folder in Microsoft Windows operating systems where applications that are not part of the operating system are installed by default.

- A **text file** (sometimes spelled "textfile": an old alternate name is "flatfile") is a kind of [computer file](#) that is structured as a sequence of [lines](#) of [electronic text](#). A text file exists within a [computer file system](#). The end of a text file is often denoted by placing one or more special characters, known as an [end-of-file](#) marker, after the last line in a text file.
- "Text file" refers to a type of container, while [plain text](#) refers to a type of content. Text files can contain plain text, but they are not limited to such.
- At a generic level of description, there are two kinds of computer files: text files and [binary files](#)

# File Organization and Structure

- **Sequential Files**
- A sequential file is organized such that each record in the file except the first has a unique predecessor record and each record except the last has a unique successor record. These predecessor-successor relationships are established by the order in which the records are written when the file is created. Once established, the predecessor-successor relationships do not change except in the case where records are added to the end of the file.
- A file that is organized sequentially must be accessed sequentially.
- **Variable- or Fixed-Length Sequential Files**
- Sequential files may be recorded in variable-length or fixed-length record form. If a file consists of **variable-length records**, each logical record is preceded by control information that indicates the size of the logical record. The control information is recorded when the logical record is written, based on the size of the internal record specified in the WRITE statement, and is subsequently used by the input-output control system to determine the location of successive logical records. **If a file consists of fixed-length records**, the record size is established at the time the file is opened and is the same for every logical record on the file. Therefore, there is no need to record any control information with the logical record.
- .
- **Relative Files**
- A relative file, which must be allocated to random mass storage file space in the execution activity, is organized such that each record location is uniquely identified by an integer value greater than zero which specifies ordinal position on the file. In the RELATIVE KEY phrase of the SELECT clause, the source program specifies a numeric integer data item as the relative key item.
- **Indexed Files**
- An indexed file, which must be allocated in the execution activity to two or more random mass storage files (one for the index, and one or more for the data), is organized such that each record is uniquely identified by the value of a key within the record. In the RECORD KEY phrase of the SELECT clause, the source program specifies one of the data items within one of the records associated with the file as the record key data item. Each attempt to access a record based on the record key item causes a search of the index file for a key that matches the current contents of the record key data item in the file record area. The matching index record in turn points to the location of the associated data record.

# FILES

- File: A file is a collection of related data that is treated as a single unit on a peripheral device. for example text document in word processing.
- Types OF FILES:
- **Master file:** it contains records of permanent data types. master files are created at the time when you install your business. if you wish to convert your company into computerised one you need to create master file which can be created by using your manual file folder and keying data onto storage devices for example the name of customer, dob, gender etc these are permanent data types
- **Transaction file:** It contains data which is used to update the records of master file for example address of the customer etc. **transaction file**, A collection of transaction records. The data in transaction files is used to update the master files, which contain the data about the subjects of the organization (customers, employees, vendors, etc.). Transaction files also serve as audit trails and history for the organization. Where before they were transferred to offline storage after some period of time, they are increasingly being kept online for routine analyses. See [data warehouse](#), [transaction processing](#) and [information system](#).
- A **report** is a textual work (usually of writing, speech, television, or film) made with the specific intention of relaying information or recounting certain events in a widely [presentable form](#).
- Written reports are documents which present focused, salient content to a specific audience. Reports are often used to display the result of an experiment, investigation, or inquiry. The audience may be public or private, an individual or the public in general. Reports are used in government, business, education, science, and other fields.
- A report file is a **file** that describes how a **report** is printed.

**The description distinguishes types of computer databases and identifies examples.**

## Types of Database Management Systems

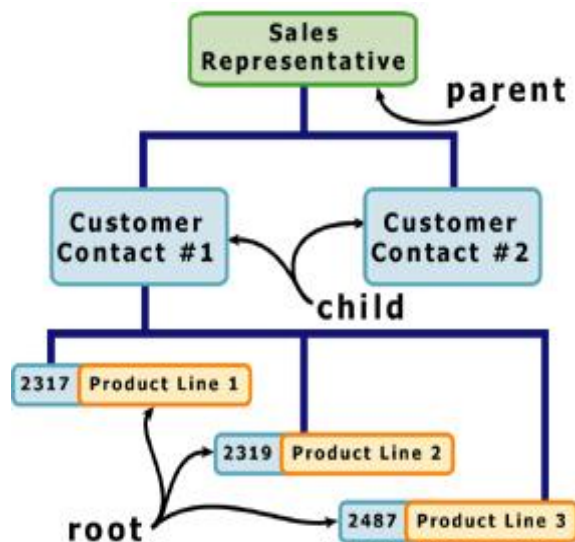
DBMSs come in many shapes and sizes. For a few hundred dollars, you can purchase a DBMS for your desktop computer. For larger computer systems, much more expensive DBMSs are required. Many mainframe-based DBMSs are leased by organizations. DBMSs of this scale are highly sophisticated and would be extremely expensive to develop from scratch. Therefore, it is cheaper for an organization to lease such a DBMS program than to develop it. Since there are a variety of DBMSs available, you should know some of the basic features, as well as strengths and weaknesses, of the major types.

After reading this lesson, you should be able to:

- Compare and contrast the structure of different database management systems.
- Define hierarchical databases.
- Define network databases.
- Define relational databases.
- Define object-oriented databases.

## Types of DBMS: Hierarchical Databases

There are four structural types of database management systems: hierarchical, network, relational, and object-oriented.



**Hierarchical Databases (DBMS)**, commonly used on mainframe computers, have been around for a long time. It is one of the oldest methods of organizing and storing data, and it is still used by some organizations for making travel reservations. A hierarchical database is organized in pyramid fashion, like the branches of a tree extending downwards. Related fields or records are grouped together so that there are higher-level records and lower-level records, just like the parents in a family tree sit above the subordinated children. Based on this analogy, the parent record at the top of the pyramid is called the **root record**. A child record always has only one parent record to which it is linked, just like in a normal family tree. In contrast, a parent record may have more than one child record linked to it. Hierarchical databases work by moving from the top down. A record search is conducted by starting at the top of the pyramid and working down through the tree from parent to child until the appropriate child record is found. Furthermore, each child can also be a parent with children underneath it.

The advantage of hierarchical databases is that they can be accessed and updated rapidly because the tree-like structure and the relationships between records are defined in advance. However, this feature is a two-edged sword. The disadvantage of this type of database structure is that each child in the tree may have only one parent, and relationships or linkages between children are not permitted, even if they make sense from a logical standpoint. Hierarchical databases are so rigid in their design that adding a new field or record requires that the entire database be redefined.

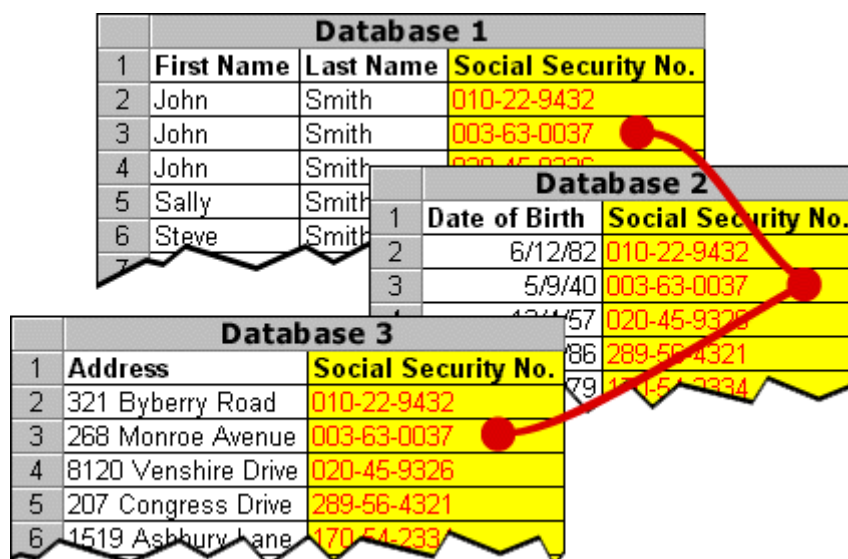
#### **Types of DBMS: Network Databases**





**Network databases** are similar to hierarchical databases by also having a hierarchical structure. There are a few key differences, however. Instead of looking like an upside-down tree, a network database looks more like a cobweb or interconnected network of records. In network databases, children are called **members** and parents are called **owners**. The most important difference is that each child or member can have more than one parent (or owner). Like hierarchical databases, network databases are principally used on mainframe computers. Since more connections can be made between different types of data, network databases are considered more flexible. However, two limitations must be considered when using this kind of database. Similar to hierarchical databases, network databases must be defined in advance. There is also a limit to the number of connections that can be made between records.

#### Types of DBMS: Relational Databases



In **relational databases**, the relationship between data files is relational, not hierarchical. Hierarchical and network databases require the user to pass down through a hierarchy in order to access needed

data. Relational databases connect data in different files by using common data elements or a key field. Data in relational databases is stored in different tables, each having a key field that uniquely identifies each row. Relational databases are more flexible than either the hierarchical or network database structures. In relational databases, tables or files filled with data are called **relations**, **tuples** designate a row or record, and columns are referred to as **attributes** or fields. Relational databases work on the principle that each table has a key field that uniquely identifies each row, and that these key fields can be used to connect one table of data to another. Thus, one table might have a row consisting of a customer account number as the key field along with address and telephone number. The customer account number in this table could be linked to another table of data that also includes customer account number (a key field), but in this case, contains information about product returns, including an item number (another key field). This key field can be linked to another table that contains item numbers and other product information such as production location, colour, quality control person, and other data. Therefore, using this database, customer information can be linked to specific product information.

The relational database has become quite popular for two major reasons. First, relational databases can be used with little or no training. Second, database entries can be modified without redefining the entire structure. The downside of using a relational database is that searching for data can take more time than if other methods are used.

#### **Types of DBMS: Object-oriented Databases (OODBMS)**

Able to handle many new data types, including graphics, photographs, audio, and video, **object-oriented databases** represent a significant advance over their other database cousins. Hierarchical and network databases are all designed to handle structured data; that is, data that fits nicely into fields, rows, and columns. They are useful for handling small snippets of information such as names, addresses, zip codes, product numbers, and any kind of statistic or number you can think of. On the other hand, an object-oriented database can be used to store data from a variety of media sources, such as photographs and text, and produce work, as output, in a multimedia format. Object-oriented databases use small, reusable chunks of software called objects. The objects themselves are stored in the object-oriented database. Each object consists of two elements: 1) a piece of data (e.g., sound, video, text, or graphics), and 2) the instructions, or software programs called methods, for what to do with the data. Part two of this definition requires a little more explanation. The instructions contained within the object are used to do something with the data in the object. For example, test scores would be within the object as would the instructions for calculating average test score. Object-oriented databases have two disadvantages. First, they are more costly to develop. Second, most organizations are reluctant to abandon or convert from those databases that they have already invested money in

developing and implementing. However, the benefits to object-oriented databases are compelling. The ability to mix and match reusable objects provides incredible multimedia capability. Healthcare organizations, for example, can store, track, and recall CAT scans, X-rays, electrocardiograms and many other forms of crucial data.

Now that you have completed this lesson, you should be able to:

- Compare and contrast the structure of different database management systems.
- Define hierarchical databases.
- Define network databases.
- Define relational databases.
- Define object-oriented databases.

Learning Unit: 3	US: 115362, NQF Level 4 Worth 3 Credits Describe information systems departments in business organisations
Unit Standard Purpose	<p>The learner achieving this unit standard will be able to implement a data collection plan in the agricultural sector. S/he will be able to effectively analyse, interpret and evaluate agricultural data and be able to communicate findings accurately. In addition to this, the learner will be able to recognize, interpret and report on a range of deviations in data collection processes.</p> <p>Learners will be well positioned to extend their learning and practice into other areas of information management and dissemination in the agricultural sector. Competent learners will understand the value of accurate data collection to the agricultural sector and be able to implement best practices in the area of information gathering.</p> <p>Learners will understand the importance of the application of business principles in agricultural production with specific reference to information systems and technology.</p> <p>They will be able to operate farming practices as businesses and will gain the knowledge and skills to move from a subsistence orientation to an economic orientation in agriculture. Farmers will gain the knowledge and skills to access mainstream agriculture through a business-oriented approach to agriculture.</p>
Prerequisites	<p><b>It is assumed that a learner attempting this unit standard will demonstrate competence against unit standard</b></p> <ul style="list-style-type: none"> <li>• NQF 3: Supervise the Collection of Agricultural Data.</li> </ul>

### 3.1 Describe the roles of IS departments in business organisations.

*Learning Outcomes:*

- *The description identifies the roles typically found in an IS department.*
- *The description identifies the purpose of each role and outlines their tasks.*
- *The description compares the tasks of each role.*

An information system (IS) is the study of complementary networks of hardware and software (see information technology) that people and organizations use to collect, filter, process, create, and distribute data.

The study bridges business and computer science using the theoretical foundations of information and computation to study various business models and related algorithmic processes within a computer science discipline. **Computer Information System(s) (CIS)** is a field studying computers and algorithmic processes, including their principles, their software and hardware designs, their applications, and their impact on society while IS emphasizes functionality over design.

Any specific **Information System** aims to support operations, management and decision making. In a broad sense, the term is used to refer not only to the information and communication technology (ICT) that an organization uses, but also to the way in which people interact with this technology in support of business processes.

Some authors make a clear distinction between information systems, computer systems, and business processes. Information systems typically include an ICT component but are not purely concerned with ICT, focusing instead on the end use of information technology. Information systems are also different from business processes. Information systems help to control the performance of business processes.

**Explain why information systems are so essential in business today.**

Information systems are a foundation for conducting business today. In many industries, survival and even existence is difficult without extensive use of information technology. Information systems have become essential for helping organizations operate in a global economy. Organizations are trying to become more competitive and efficient by transforming themselves into digital firms where nearly all core business processes and relationships with customers, suppliers, and employees are digitally enabled. Businesses today use information systems to achieve six major objectives: operational excellence; new products, services, and business models; customer/supplier intimacy; improved decision making; competitive advantage; and day-to-day survival.

**Define an information system from both a technical and a business perspective.**

From a technical perspective, an information system collects, stores, and disseminates information from an organization's environment and internal operations to support organizational functions and decision making, communication, coordination, control, analysis, and visualization. Information systems transform raw data into useful information through three basic activities: input, processing, and output. From a business perspective, an information system provides a solution to a problem or challenge facing a firm and provides real economic value to the business.

**Identify and describe the three dimensions of information systems.**

An information system represents a combination of management, organization, and technology elements. The management dimension of information systems involves leadership, strategy, and management behaviour. The technology dimensions consist of computer hardware, software, data management technology, and networking/telecommunications technology (including the Internet).

The organization dimension of information systems involves the organization's hierarchy, functional specialties, business processes, culture, and political interest groups.

### **Key terms in Information systems**

**Chief information officer (CIO)**—senior manager in charge of the information systems function in the firm.

**Customer relationship management (CRM)** systems— business and technology discipline that uses information systems to coordinate all of the business processes surrounding the firm's interactions with its customers in sales, marketing, and service.

**Decision-support systems (DSS)** — information systems at the organization's management level that combine data and sophisticated analytical models or data analysis tools to support semi structured and unstructured decision making.

**Electronic business (e-business)** — the use of the Internet and digital technology to execute all the business processes in the enterprise. Includes e-commerce as well as processes for the internal management of the firm and for coordination with suppliers and other business partners.

**Electronic commerce (e-commerce)**— the process of buying and selling goods and services electronically, involving transactions using the Internet, networks, and other digital technologies.

**End users** — representative of departments outside the information systems group for whom applications are developed.

**Enterprise applications**— a system that can coordinate activities, decisions, and knowledge across many different functions, levels, and business management systems, and knowledge management systems.

**Enterprise systems**— integrated enterprise-wide information systems that coordinate key internal processes of the firm. **Executive support systems (ESS)** — information systems at the organization's strategic level designed to address unstructured decision making through advanced graphics and communications.

**Finance and accounting information systems**— systems used to keep track of the firm's financial assets and fund flows.

**Human resources information systems**— systems that maintain employee records, track employee skills, job performance, and training; and support planning for employee compensation and career development.

**Information systems department** — the formal organizational unit that is responsible for the information systems function in the organization.

**Information systems managers** — leaders of the various specialists in the information systems department.

**Interorganizational system**— information systems that automate the flow of information across organizational boundaries and link a company to its customers, distributors, or suppliers.

**Knowledge management systems (KMS)** — systems that support the creation, capture, storage, and dissemination of firm expertise and knowledge.

**Management information systems (MIS)** — the study of information systems focusing on their use in business and management.

**Manufacturing and production information systems** — systems that deal with the planning, development, and production of products and services and with controlling the flow of production.

**Portal** —Web interface for presenting integrated personalized content from a variety of sources. Also refers to a Web site service that provides an initial point of entry to the Web.

**Programmers** — highly trained technical specialists who write computer software instructions.

**Sales and marketing information systems** — systems that help the firm identify customers for the firm's products or services, develop products and services to meet their needs, promote these products and services, sell the products and services, and provide ongoing customer support.

**Supply chain management (SCM) systems** — information systems that automate the flow of information between a firm and its suppliers to optimize the planning, sourcing, manufacturing, and delivery of products and services. Systems analysts— the analysis of a problem that the organization will try to solve with an information system.

**Transaction processing systems (TPS)** — computerized systems that perform and record the daily routine transactions necessary to conduct the business; they serve the organization's operational level.

## 3.2 Describe the structure of IS departments in business organisations.

*Learning Outcomes:*

- *The description identifies the position of an IS department via an organisation chart.*
- *The description outlines the purpose of systems and operations areas within an IS department, and their interaction.*
- *The description explains the interactions of systems and operations*

**Define and describe business processes and their relationship to information systems.**

A business process is a logically related set of activities that define how specific business tasks are performed, and a business can be viewed as a collection of business processes. Business processes are concrete workflows of material, information, and knowledge. They also represent unique ways in which organizations coordinate work, information, and knowledge, and the ways in which management chooses to coordinate work. Managers need to pay attention to business processes because they determine how well the organization can execute its business, and thus be a potential source of strategic success or failure. Although each of the major business functions has its own set of business processes, many other business processes are cross functional, such as order fulfillment.

Information systems can help organizations achieve greater efficiencies by automating parts of these processes or by helping organizations redesign and streamline them. Firms can become more flexible and efficient by coordinating their business processes closely, and, in some cases, integrating these processes so they are focused on efficient management of resources and customer service.

**Describe the information systems supporting the major business functions: sales and marketing, manufacturing and production, finance and accounting, and human resources.**

At each level of the organization, information systems support the major functional areas of the business. Sales and marketing systems help the firm identify customers for the firm's products or services, develop products and services to meet customers needs, promote the products and services, sell the products and services, and provide ongoing customer support. Manufacturing and production systems deal with the planning, development, and production of products or services, and control the flow of production. Finance and accounting systems keep track of the firm's financial assets and fund flows. Human resources systems maintain employee records; track employee skills, job performance, and training; and support planning for employee compensation and career development.

**Evaluate the role played by systems serving the various levels of management in a business and their relationship to each other.**

There are four major types of information systems in contemporary organizations serving operational, middle, and senior management. Systems serving operational management are transaction processing systems (TPS), such as payroll or order processing, that track the flow of the daily routine transactions necessary to conduct business. MIS and DSS provide middle management with reports and access to the organization's current performance and historical records. Most MIS reports condense information from TPS and are not highly analytical. DSS support management decisions when these decisions are unique, rapidly changing, and not specified easily in advance. They have



more advanced analytical models and data analysis capabilities than MIS and often draw on information from external as well as internal sources. ESS support senior management by providing data of greatest importance to senior management decision makers, often in the form of graphs and charts delivered via portals. They have limited analytical capabilities but can draw on sophisticated graphics software and many sources of internal and external information.

**Explain how enterprise applications and intranets promote business process integration and improve organizational performance**

Enterprise applications, such as enterprise systems, supply chain management systems, customer relationship management systems, and knowledge management systems are designed to support organization-wide process coordination and integration so that the organization can operate efficiently. They span multiple functions and business processes and may be tied to the business processes of other organizations. Enterprise systems integrate the key internal business processes of a firm into a single software system so that information can flow throughout the organization, improve coordination, efficiency, and decision making. Supply chain management systems help the firm manage its relationship with suppliers to optimize the planning, sourcing, manufacturing, and delivery of products and services.

Customer relationship management uses information systems to coordinate all of the business processes surrounding the firm's interactions with its customers to optimize firm revenue and customer satisfaction. Knowledge management systems enable firms to optimize the creation, sharing, and distribution of knowledge to improve business processes and management decisions.

Intranets and extranets use Internet technology and standards to assemble information from various systems and present it to the user in a Web page format. Extranets make portions of private corporate intranets available to outsiders.