

ELEMENTARY COMPUTER PROGRAMING.

Computer Programming

A program – is an organized list of statements (instructions) that when executed, cause the computer to behave in a pre-determined manner or carry out a defined task.

Programming – Refers to the process of developing computer (instructions) programs used to solve a particular task.

A computer program is designed using a particular programming language. Each language has a special sequence or order of writing characters usually referred to as **syntax**

Terms used in programming

Source program.

This refers to the program code that the programmer enters in the program editor window (html editor, Java editor, php(personal home page) editor) that is not yet translated into machine-readable form.

Object code

This refers to the program code that is in machine –readable i.e a source code that has been translated into machine language.

Translators

These are programming tools that translates /convert the source program into object code. E.g. Assemblers, compilers, interpreters etc.

Assembler

An assembler translates a program written in assembly language into machine language.

Interpreter

This translates the source programs line-by-line, allowing the CPU to execute one line before translating the next. The translated line is not stored in the computer memory, hence every time the program is executed, it has to be translated.

Compiler

This translates the entire source program into object code. The compiler translates each high level instruction into several machine code instructions in a process called COMPILATION and produces a complete independent program that can be run by the computer as often as required without the original source program being present.

Levels of programming languages



There are two major levels namely; -

- i) Low level languages
- ii) High- level languages.

1. Low-level languages.

- These languages are classified as low because they can be directly, or easily understood by the computer with little effort to translate into computer understandable form.
- These languages are hardware oriented and therefore they are not portable. I.e. a program written for one computer cannot be installed and used on other.

Types of low level languages

A . Machine language: First generation (languages)

- In this language, instructions are written using binary logic. Given that data and instructions are in binary form, many lines of codes are needed to accomplish even a simple task like adding two numbers i.e. program written in this language look like this.

```
111000110 0000011 10000001
0001111 10001101
10001111 1111111 1000011
```

The program code is hard for humans to understand but it's easily understood by computers.

B. Assembly languages (second generation languages)

- This language is close to the machines vocabulary rather than the human beings vocabulary. It was developed in order to overcome the difficulties of understanding and using machine language. This language helps the programmers to write programs as a set of symbolic operation codes called mnemonics. Mnemonics are basically shortened two or three letter words. A sample program written in Assembly language.

```
Mov AX, 15      (move 15 to register AX)
SUB Ax, 10      (subtract 10 from the value Ax.)
```

Programs written in this language require an assembler to convert them into machine language.

2. High-level languages.

These languages are very close to the human language (English -like) and they can be read and understood even by people who are not experts in programming. These languages are machine independent. This means that a programmer concentrates on problem solving during a programming session rather than how a machine operates.

Classes of high-level languages

i) Third generation languages (3 GLS)



This generation language is also called structured or procedural languages. A procedural language makes it possible to break a program into components called modules. Each performing a particular task. Structured programming has advantages because it's flexible, easier to read and modify.

Examples of third generation programming language.

Pascal – Was developed to help in teaching and learning of structured programming.

Fortran – Was developed for mathematics , scientists and engineers. It enables writing of programs with mathematical expressions.

Cobol – Was designed for developing programs that solve business programs.

Basic – Developed to enable students to easily learn programming.

c- Used for developing system software e.g the operating systems. Its very powerful high level language because of its ability to provide programmer with powerful aspects / features of low level.

Ada – This language is suitable for developing military, industrial and real time systems.

ii) Forth generation languages (4 GLs)

This generation make programming an even easier task than the third generation language because they present the programmer with more programming tools. Examples of such tools are command buttons, forms etc. the 4 GLs are easy to learn and understand because they are user based. The languages syntax (grammar) is natural , near English language and use menus to prompts to guide a non-specialist or retrieve data with ease.

Examples of 4GLs

- a) Visual Basic
- b) Delphi Pascal
- c) Visual cobol
- d) C + +

iii) Fifth generation languages (5 G's)

These languages are designed around the concept of solving problems by enabling the computer to depict human like intelligence. These programs are designed to make the computer solve the problem programmer rather than programmer spending a lot of time to come up with the solution.

Examples of 5GL's

- a) PROLOG
- b) MERCURY
- c) LISP
- d) OCCAM.

iv) Object oriented programming languages. (OOP)

The concept behind OOP languages is to look at a program as having various objects instructing to make up a whole. Each object has a specific data



values that are unique to it (called state) and a set of the things it can accomplish called (functions or behavior). This process of having data and functions that operate on the data within an object is called **Encapsulation**. Several objects can then be linked together to form a complete program OOP has greatly contributed to development of **Graphical user interface operating systems and application programs**.

Examples of OOP

- a) Java
- b) Simula
- c) Small talk.
- d) Python
- e) C++
- f) Visual basic.net
- g) Sea sharp.

v) Web scripting languages.

These languages are used to develop or add functionalities on web pages. Web pages are hypertext documents created in a language called **Hypertext markup languages (HTML)** .the language consists of markup tags that tell the internet browser that the file contains HTML- code information and is distinguished by a file extension of HTML . the markup tags define the various components of a world wide Web document such as heading , tables , paragraphs , lists etc. HTML does not have the declaration part and control structures , hence its not considered as a true programming language. Due to its simplist, it has many limitations and can not be used alone when developing functional websites. Some special blocks of codes called Scripts may be inserted in HTML pages using scripting languages like JavaScript, VBScript etc in order to add functionality to HTML PAGES.

Advantages of Low-level languages.

1. The CPU understands machine language directly without translation.
2. They are suitable and hardly crash or breakdown once written
3. Running a program is fast, no compilation is needed.
4. They are economical in terms of the amount of memory they use.

Disadvantages Low-level languages

1. They are difficult and cumbersome to use and learn
2. Requires highly trained experts to both develop and maintain programs.
3. Debugging programs is difficult
4. They are machine dependant the programs are long.

Advantages of high-level languages



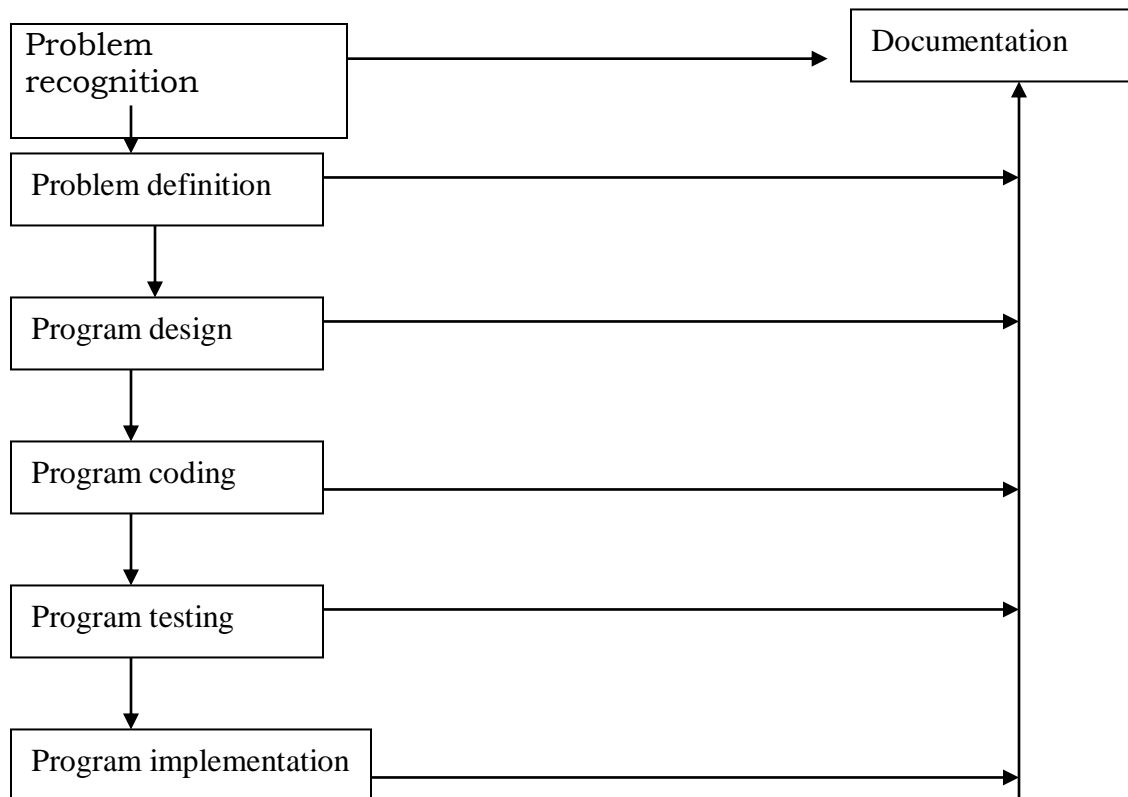
1. The programs are portable (not machine dependant)
2. They are user friendly and easy to use and learn.
3. They are more flexible
1. They provide better documentation
2. They are easy to debug
3. Require less time to code.

Disadvantages of high-level languages

- i) Program executed more slowly.
- ii) Require larger CPU storage capacity for compilation.
- iii) They have to be translated to machine-readable form before the computer can execute them.

Program development

There are six stages of program development. They include



i) Program recognition

This refers to the understanding and interpretation of a particular problem. To understand a problem one has to look for key words such as computer, evaluate, compare etc. a programmer identifies problems in the environment



and seeks to solve them by writing computer program that would provide the solution.

Circumstances that can cause the programmer to identify a problem.

1. Opportunity to improve the current program .
2. Anew directive given by the management requiring a change in the status quo.
3. Problems of undesirable solutions that prevent an individual or organization from achieving their purpose.

Example:- Problem is Finding the area of a circle.

Programmer to develop program used to calculate area of circle.

The equation for calculating the area of circle $A=\pi r^2$

ii) Problem definition.

At this stage the programmer tries to determine or define the likely input, processing and expected output using the key words outlined at the problem recognition stage. The boundaries of the expected program are established and if several methods to solve the same problem are identified the best alternatives should be chosen. At the end of the stage requirement documentation for the new program is written.

iii) Problem design

This is the actual development of the program's processing or problem solving logic called algorithm. (A limited number of logical steps that a program follows in order to solve a problem) the programmer comes up with an algorithm after analyzing the requirements specifications.

Some of the problems are made up of large block code. Ie they are Monolithic while others are made of several units called modules, which work together to form the whole program.

In modular programming each module performs a specific task. This approach makes a program flexible, easier to read and debug. This phase enable the programmer to come up with models of the expected program. The model shows the flow of events and data throughout the entire program from input of a program.

iv) Program coding

This is the actual process of converting a design model into its equivalent program. This is done by creating the program using a particular programming language. The end result of this stage is source programs that can be translated into machine-readable form for the computer to execute and solve the target problem.

v) Program Testing and Debugging.

After coding the program has to be tested and the errors detected and corrected. Debugging refers to detection and correction of errors that may



exist in the program. Program testing involves creating test data designed to produce predictable output.

There are two types of errors (bugs) that can be encountered when testing

- i) **Syntax errors** – They occur as a result of improper use of language rules. e.g. grammar mistakes , punctuation , improper naming of the variables etc. These errors are detectable by translator and must be corrected before the program runs.
- ii) Logical errors- They are not detectable by the translator. The program rules but gives wrong output or halts during execution.

Methods of error detection

- i) Desk checking / dry-run

It involves going through the program while still on a paper before entering it in the program editor.

- ii) Using Debugging Utilities.

In the program editor, you can run the debugging utilities during translation to detect syntax errors.

- iii) Using Test Data

The programmer carries out trial runs of the new program .At each run he enters various data variation and extremes including data with errors to test whether the system will grid to a halt. A good program should not crash due to incorrect data entry but should inform the user about the anomaly.

- vi) Implementation and maintenance Implementation.

This is the actual delivery and installation of the new program ready for use, creating data files and train people to use the system. The new system will change the way things are done hence it should be reviewed and maintained.

- vii) Review and maintenance

This stage is important because of the errors that may be encountered after implementation. A program may fail due to poor use, hence proper training and post implementation support of users will reduce chances of having them entering invalid data that crash the program.

- viii) Program documentation

This is writing of support materials explaining how the program can be used by users, installed by operators or modified by other programmers. All stages of development should be documented in order to help during future modification of the program.

Types of documentation

- i) User oriented documentation

These type enables the user to learn how to use the program as quickly as possible and with little help from grammar.

- ii) Operator oriented documentation



Meant for computer operators. E.g Technician. it helps them to install and maintain the program.

Development of algorithms.

Algorithms – Refers to a limited number of logical steps that a program follows in order to solve a problem.

Pseudo code – Refers to a set of statements written in a readable language (English – like) but expressing the processing logic of program.

Guidelines for designing a good pseudo code.

1. The statements must be short, clear and readable.
2. Pseudo code lines should be clearly outlined and indented clearly.
3. It should show clearly the start and stop of executable statements and control structures.
4. Statements must not have more than one meaning.

Examples of Pseudo code.

Write a pseudo code that can be used to prompt the user to enter two numbers, calculate the sum and average of the two numbers and then display the output on the screen.

Solution

START

Print “Enter two numbers”

Input x,y

Sum – $x+y$

Average = $\text{sum} / 2$

PRINT sum

PRINT Average

STOP

Program flowcharts.

A flowchart is a diagrammatic representation of a program in algorithms. It uses statements and symbols that have specific meaning. The symbols are of different standard shapes linked to show the order of processing. Each shape contains note stating what the operation is.

Guidelines for drawing a flowchart

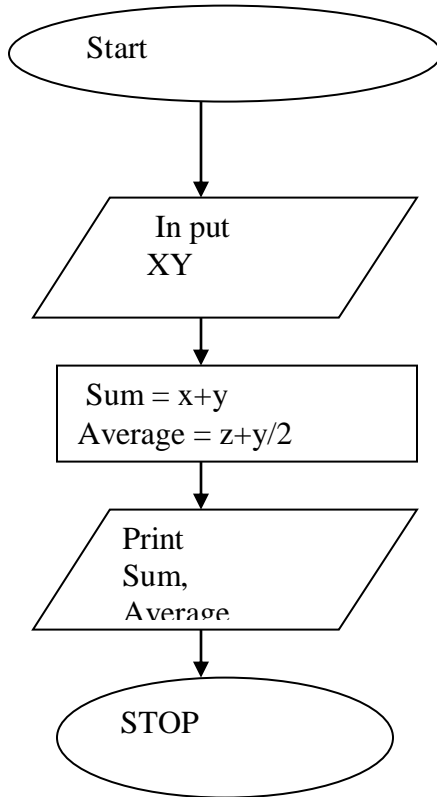
1. There should be only one entry and one exit point of a program algorithm.
2. Use correct symbol at each stage in the flowchart.
3. Avoid a crossd flow lines.
4. Be as neat and tidy in drawing as possible.
5. General direction of flow in any flowchart is from top to bottom , left to right.

Examples of flowchart

Draw a flowchart for a program used to prompt the user to enter two number s. the



program should find the sum, and average then display the output



Types of flowchart

System flowchart

It's a chart that depicts the systems as a whole with only subsystems or a major elements shown.

Program flowchart

This chart shows the sequence of operations as carried out by a computer program.

Advantages of flowchart.

1. Gives programmer good visual reference of what the program will do.
2. Serves as program or system documentation.
3. Its easy to trace through from the start to find the action resulting from a set of condition .
4. Allows programmer to test alternative solutions to a problem without over coding the program.

Disadvantages.

1. There are so many different ways to draw them.
2. Its difficult to remain neat and uncluttered if the logic is complex.

1. Constructing a flowchart is time consuming.
2. They take up considerable space.
3. They are difficult to amend without redrawing

Program control structure

They are blocks of statements that determine how statements are to be executed.

There are 3 control structures namely.

i) Sequence

In this control structure, the computer reads instructions from a program file starting from the first top line and proceeding downwards one by one to the end. Hence sequential program execution enables the computer to perform tasks that are arranged consecutively one after another in the code.

Examples of how a sequential program execute

<pre>Begin {procedure name} Action 1 Action 2 Action n End {procedure name}</pre>	}	<p>the program file reader reads sequentially statements by statements to the end of the file.</p>
-----------------------------------------------------------------------------------------------	---	----------------------------------------------------------------------------------------------------

ii) Selection/decision

This structure is used to branch, depending on whether the condition returns a value of True or False (yes or no)

For example

```
If < condition >
    Then Action 1
    Else Action 2
Endif.
```

There are 4 types of selection controls used in high-level programming

1. IF.....THEN

This is used if only one option is available. All other options are ignored. For example if a school wants to reward only the students who have mean mark of 80 and above, it will be reward only those students who have attained 80% and above and ignore the rest.

General format

```
If < condition > Then
Statements :
Endif
```

```
If mark >80 then
Print "Reward"
Endif
```



IF.....THEN.....ELSE

Used when there are two available options for example in a football match a player is given a RED CARD if he does a very serious mistake otherwise he is given Yellow Card.

General Format

```
If < condition >THEN
    Statements 1,
ELSE
    Statement 2
ENDIF
```

The algorithm will be;-

```
If fault = serious THEN
    Print "RED CARD"
ELSE
    Print " yellow card"
EndIf.
```

3. Nested IF

This is used where two or more options have to be considered to make a selection. For example, to award grade according to the marks as follows

- a) 80 marks Grade A
- b) 60 marks Grade B
- c) 50 marks Grade C
- d) 40 marks Grade D

General format

```
If < conditions >Then
    Statement
ELSE
If < condition >Then
    Statement
ELSE
If < condition >Then
    Statement
ELSE
    Statement
    EndIf
    EndIf
    End
```

CASE SELECTION

Its an alternative to the nested IF. This selection is preferred to the Nested if in order to reduce the many lines of codes . case selection can only be expressed using integers and alphabetic characters only. The Boolean expression should be CASE interger OF or CASE char OF.



General format

CASE x of

Label 1: statement 1
Label 2: statement 2
:
label n: statement n-1
ELSE
Statement n
End case

Example

CASE average OF
80...100: Grade = "A"
70-79 Grade= "B"
60-69 Grade = "C"
40-49 Grade = "E"
ELSE
Grade = "F"

End case.

iii) Iteration (coping) repetition

This is designed to execute the same block of code again and again until a certain condition is fulfilled . Iteration is important in situations where the same operation has to be carried out on a set of data many times.

There are three main looping controls.

i) THE – WHILE-DO LOOP

This repetitive structure tests the condition first before executing the successful code if and only if the Boolean expression returns a true value.

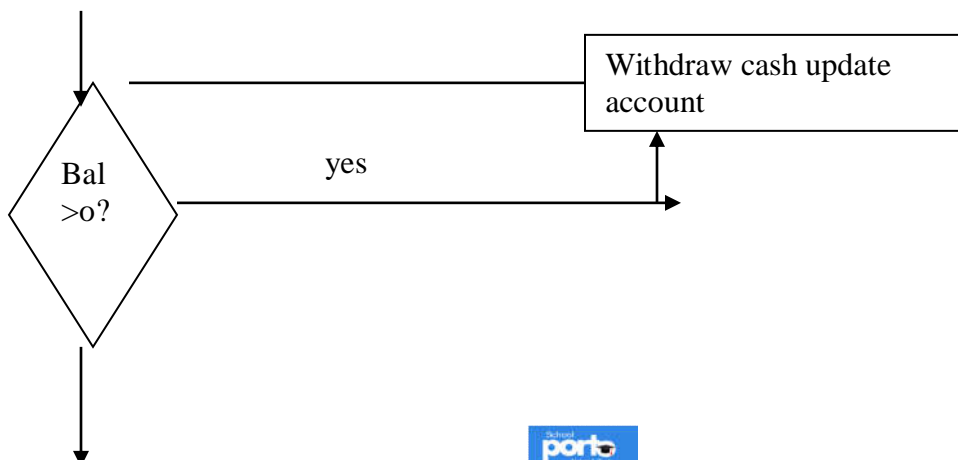
Example

To withdraw money using an ATM a customer must have a balance in his/her account.

General format

While <condition >Do
Statement
End while.

Flowchart



End loop
no

Pseudo code segment
While balance >0 do
 Withdraw cash
 Update account
End while

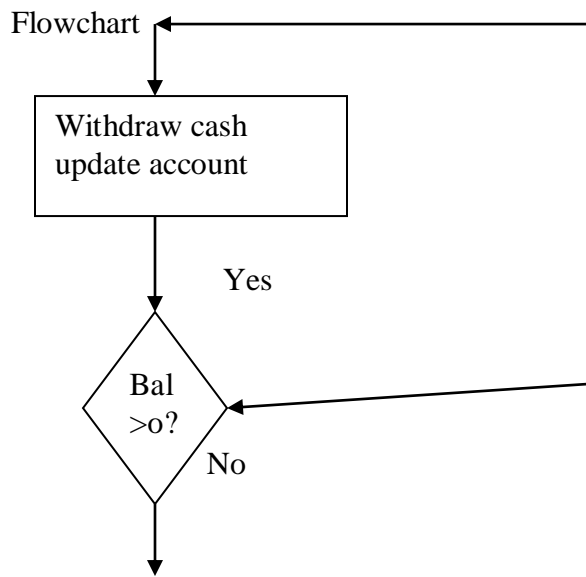
Example
Pseudo code segment
REPEAT
Withdraw cash
Update account
Until balance ≤0:

General format

REPEAT
Statement
UNTIL <condition>

iii) REPEAT.....UNTIL LOOP

In this structure the code is executed before testing the condition. The repeat loop stops when the Boolean statement returns a value. For example in the case of ATM of discussed above the client can withdraw money until balance is zero.



Exit loop
iii) The FOR LOOP



This structure is used where execution of the chosen statements has to be repeated a predetermined number of times. For example if a program is to calculate the sum of ten numbers provided by the user. The FOR LOOP can be used to prompt the user to enter the 10 numbers at most ten times. Once the numbers are entered the program calculates and displays the sum.

Pseudo code

```
FOR count = 1 to 10 Do
  Writeln "Enter a number (N)"
  Readln N
  Sum = sum +N
End FOR.
```

Display sum

The counter has to be set to a start value and sometimes to an end value.

General format of the loop

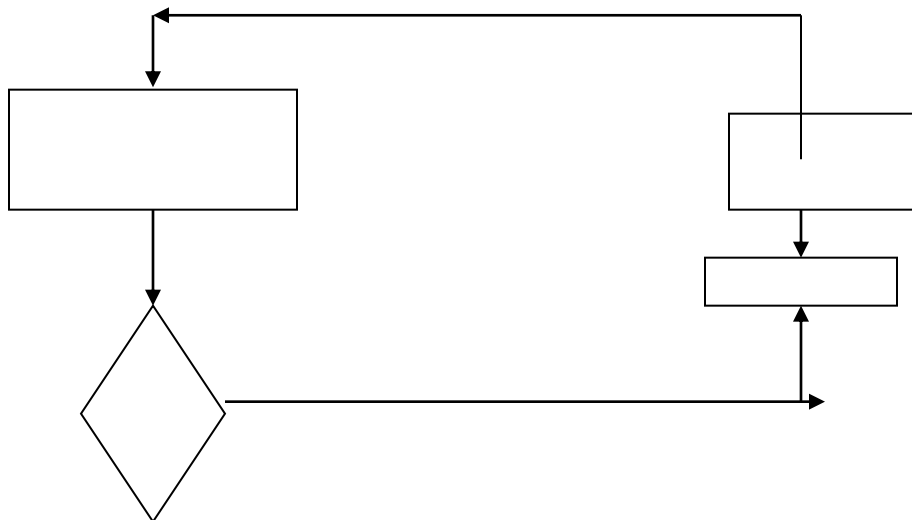
1. Format for the FOR loop that counts from lower limit.

```
For loop variables = lower limit To upper limit Do
  Statements
Endfor
```

2. Format for the "for" loop that counts from upper limit down to lower limit .

```
for loop variable = Upper limit Down To lower Limit Do
  Statements
Endfor
```

Flowchart for a forloop that counts upwards.



Flowchart for a FORLOOP that counts downwards

Diagram

Examples of complex pseudo codes.

1. Unshirika society pays 5% interest on shares exceeding 10,000 Ksh and 3% on share that do not meet their target. However no interests is paid on deposits in the members bank. Account . Design a pseudo code for a program that would:

- a) Prompt the user for shares and deposits of a particular member.
- b) Calculate the interest and total savings.
- c) Display the interest and total savings on the screen for a particular member.

Pseudo code

Start

Input Name, share, Deposit

If share > 10000 THEN

Interest = 0.05 x shares

ELSE

Interest = 0.03 x shares

EndIf

Total savings = Deposit Interest + shares

Print Name., Totalsaving, Interest

Stop

Flowchart

Diagram

2. Botswana has a population of 3,000,000 but this is falling by 4% each year. The island of Reunion has a population of 95,000 but this is increasing by 95 each year.

a) Draw a flowchart that predicts the year in which the population of Reunion will be greater than that of Botswana if the trend continues.

Solution

Pseudo code

Start

Bts: 3,000

IR: = 95,000

Year := 0

REPEAT

Bts = Bts - (Bts * (4/100))

IR = IR + (IR (9/100))

Year = year + 1

UNTIL IR > Bts

Print year

Stop

3. Write a program that will allow the input of name of student marks obtained in 5 subjects (Math, English, Computer, Biology).

The program should calculate the total and average marks for each student and assign the grades depending on the average marks obtained as follows.

80- 100 A

70- 79 B

60- 69 C

50-59 D

Below 50 -E

The program should then display each student's name, total marks and average.



Pseudo code
 START
 REPEAT
 Print “ Enter name and subject marks”
 Input Name, maths,English , Kiswahil , Computer , Biology
 Sum = maths,English , Kiswahil , Computer , Biology
 AVG = sum/5
 If (AVG \geq 80) AND (AVG \leq 100) THEN
 Grade = “A”
 If (AVG \geq 70) AND (AVG \leq 79) THEN
 Grade = “B”
 If (AVG \geq 60) AND (AVG \leq 69) THEN
 Grade = “c”
 If (AVG \geq 50) AND (AVG \leq 59) THEN
 Grade = “D”
 ELSE
 Grade = “E”
 Endif
 Endif
 Endif
 Endif
 Print name, sum, AVG, Grade
 Until count = Number of students.
 Stop
 Flowchart

PAST KCSE QUESTIONS ON THE TOPIC

1. 2002

State two types of documentation in program development and give the purpose of each .
 (4 marks)

2. state any three activities that occur in a program compilation process (3 marks)

3. The following can be used to list the add numbers between 0 and 100

1. Diagram

a) write a program segment for the flowchart using a high language (7 marks)

b) What would be the output from the flowchart if the statement in the decision box is changed to
 (3 marks)

i) odd = 100 ii) odd <100 iii) odd >100

2003

1 a) Distinguish between Machine and Assembly language (2 marks)

b) State the type of translator necessary for a program written in

i) High level language

ii) Assembly language

2. Briefly explain the purpose of the following types of a program documentation (2marks)



- i) User manual
 - ii) Reference guide
3. State any two features of user-friendly program (2 marks)
2. Study the flowchart below and the question that follow.
- a) Write a high level language program for the above flowchart (7 marks)
 - b) List the outputs of the flow chart above (5 marks)

KCSE 2004

- 1. Distinguish between a compiler and an interpreter (2 marks)
- 2. What is meant by the term DRY Running as used in program development (2 marks)
- 3. Differentiate between source program and object program (2 marks)
- 4. Bidii wholesaler has two categories of customers for order processing. Category “A” obtains 10% discount on all orders up to Ksh 10,000. Otherwise the discount is 20% on the entire order. Category “B” obtains 30% discount on all orders if the debt repayment is “good” otherwise the discount is 15% . Draw a flowchart for the order processing (15 marks)

KCSE 2005

1. Distinguish between Real, Integer and character data types a used in programming (3 marks)
Diagram

- 2. a) Name the control structure depicted by the flowchart above (1 mark)
- b) Explain the following terms as used in program implementation (2 marks)
 - i) Parallel running
 - ii) Direct changeover
- 3. a) State the stages of program development in which (2 marks)
 - i) A flowchart would be drawn
 - ii) The program would check whether the program does as required.
 - iii) The user guide would be written
 - iv) The requirements specification would be written

- b) State the output of the following segment.

Diagram

- c) Draw a flowchart to computer the combined resistance ® of two resitors R1 and R2 in parallel using the formula: (5 marks)

$$R = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$

KCSE 2006

- 1. a) List two examples of
 - i) Third generation language
 - ii) Object oriented languages.

2. 2007

- Write al algorithm to compute the area of a triangle (2 marks)

PRACTICE QUESTIONS ON THE TOPIC

- 1. Distinguish between the following
 - a) Compiler and interpreter.



- b) Object code and source code.
2. State 3 advantages of high level languages over low level language.
 3. Outline the stages of program development in their respective order
 2. State two advantages of modula programming.
 3. distinguish between pseudo code and Algorithm.
 4. explain three types of control structures used in programming
 5. write a pseudo code that will inform the user of what to waer depending on the weather . if its raining “wear rain coat” if not “wear overcoat”
 6. draw a flowchart for a program to display the name of a suspect to a crime who is aged between 20 and 35 year and between 66 and 70 inches tall.
 7. draw a flowchart to compute and print the grades for an examination. The input Data is Roll. No and marks for six subjects out of 100 . grades are allocated on the following basis
- | | |
|---------------------|---|
| % marks | |
| grades | |
| 75 and above | A |
| 60 and less than 75 | B |
| Less than 60 | C |

PREDICTION QUESTIONS ON THE TOPIC

1. a) What is meant by structured programming (1 mark)
- b) State 3 advantages of using modules in program development (2 marks)
2. Give a reason why its necessary to have a program design (1 mark)
2. Distinguish between user documentation and operator documentation (2 marks)
3. state two advantages and two disadvantages of using flowchart in program design (4 marks)
4. using a simple sketch , illustrate the
 - i) REPEAT.....UNTIL control structure (3 marks)
 - ii) WHILEDO control structure
 - iii) CASE control structure
5. Give an advantage of compiling a program rather than interpreting it (1 mark)

CHAPTER FOUR

SYSTEM DEVELOPMENT

A system

Is a set of items linked together to carry out a given task in order to achieve one or more objectives . a system is described as being either soft or hard.

i) Soft system

Human activity are said to be soft systems. They are said to be soft because:

- a) Their boundaries may be fluid or keep on changing
- b) Their goals and objectives conflict.
- c) Its difficult to precise define exact measures of performance for them.

ii) Hard systems

These are systems whose goals and objectives are clearly defined and the outcomes from the systems processes are predictable and can be modeled accurately.

Systems classification

i) Deterministic system



These are systems whose outputs are known precisely by their input e.g a computer.

ii) Probabilistic systems

These are systems whose output can only be predicted but not known precisely. e.g Business and economic system organization

iii) Cybernetic systems.

These are self-controlling systems, which adapt to the environment and regulate their own behavior by accessing the feedback. They access their output and adjust the input e.g. Human beings, plants systems.

Characteristic of systems

1. Holistic thinking

In this, a system is considered as a whole. A combination of various components that makes up a system creates a complex whole whose overall goals are more sophisticated than those of the individual components.

2. Sub systems.

A system is made up of different components (subsystem) . Therefore a system does not exist in solitude but it may be a component of large system.

3. Processor

This is an element of a system that does the actual transformation of input into output.

4. Objectives / purposes

Objectives of the system may be real or stated. An organisation should state objective and operate to achieve another user must know the major objective of a system.

5. Environment

The environment is the system within an organization operates. Environment provides a reason for the existence of the system.

6. Boundaries

System boundaries are external element whose changes in attitudes, behavior and property affect their state and are affected respectively. It's the limit of system.

7. Independence

For a system to be effective and efficient, its components or subsystems must be co-ordinate and linked together.

8. Feedback

A feedback is a check within a system to see whether predetermined goals are being met. The checks are conducted on a system to determine deviation.

9. Control

This is the process by which the system adapts to changes in the environment in order to give the expected level.

10. System Entropy

Entropy means decay. System decay naturally over time, hence it slowly becomes useless to the user either due to improvement in technology, new management or change in user requirements. Therefore it must be reviewed in order to improve it or develop a new one.

11. Inputs and outputs

A system communicates with its environment by receiving inputs and giving outputs.

12. Open and closed system



An open system receives input from and gives output to the environment while a closed system does not interact with the environment so that good quality reports are produced for easy understandings.

b) Input specification.

The input to the system is necessary because the content of their input are used to maintain the master files. The following should be considered in input specification .

- i) The contents and volume of input
- ii) The mode and devices of input selected.
- iii) Layout and sequence of input.

c) File / data stores

File requirement involves making an informed decision on file required to store data and information in the system. The analyst should identify the number of files that will be needed by the system and determine the structure of each file.

d) Hardware and software requirements.

System analyst should specify all hardware and software requirements for the new system.

He/she should consider; -

- a) Economic factors e.g price
- b) Operational factors e.g reliability
- c) User friendliness.

4. System design

This involves detailing the physical design of the system, it's the how of the process. Once the logical design is outlined during the system analysis , the analyst determines the physical design, which describes the hardware, software and operating procedures required to make a system operational. Several tools are used for designing an information system. . Examples are flowchart, data flow diagram, structured charts. Etc.

5. System construction.

This refers to coding, installation and testing of the molecules and their components such as outputs, inputs and files. The purpose of the construction is to develop and test a functional system that fulfils the business and design requirements.

Testing the system

The system is tested be entering some test data to find out whether its output are as expected.

The system is tested using the requirements specifications and the design specification to find out whether it meets all requirements specified.

6. System implementation

This involves installing the system in the user's computers. Testing the installed system, converting from old system to the new one and training the users.

System implementation involves;-

- i) File creation and conversion
- ii) Chang eover
- iii) Staff training.

- i) File creation and conversion



This involves setting up of the master files that are to be used in the support of the new system. The setting can be either from scratch or just to convert the files that were employed in old system.

ii) Training staff .

The training aim at ;-

- a) Convincing the staff of the user department on the effectiveness of the new system.
- b) Remove fear of change from them.
- c) Enabling the staff to cope with processing task of the new system.

Methods of Training

- ✓ Demonstration
- ✓ Manual reference
- ✓ Group discussion
- ✓ Visits

iii) Changeover

This is the process of changing over from old system to the new system.

Types of changeover

a) Direct changeover

In this approach the new system commence live operation and immediately the old system is abandoned.

Advantages of Direct changeover

- ✓ It's a cheap method

Disadvantages of Direct changeover

- ✓ Extremely risky
- ✓ Places an organization in a do or die situation.

b) Parallel changeover

In this changeover the operation of the old system and the new system run alongside each other.

Advantages

- ✓ Provides a method of training in the new system
- ✓ Personnel become familiar with the new system prior to actual changeover.

Disadvantages

- ✓ Costly to run two systems
- ✓ Cross checking is difficult
- ✓ Requires more staff hence more training required for additional staff.

c) Phase changeover.

In this approach implementation is done only one part of the new system at one time or a step by step.

Advantages

- ✓ Allow the system to be implemented quickly
- ✓ Less costly
- ✓ Failure of the system are limited



✓ Causes minimal disruption.

Disadvantages

✓ Problem on ensuring that the first phase is implemented and converted.

7. System review and maintenance.

System maintenance is the adjustment and enhancement or correction of errors after the system has been implemented. The reviewing involves going through the specification and testing the system after implementation to find out whether it still meets the original specification.

8. System documentation

This is written graphical record of the steps taken during the system development process.

System documentation consists of

i) Report of fact-finding which outlines methods used to collect data, weakness of the current system and recommendation of the current system.

ii) Requirements specification, which entails the output requirements, input, hardware and software required for the new system.

iii) System flowchart, which shows the overall functionality of the proposed information system.

iv) Tables or file structures depending on the approach used in system construction.

v) Sample test data to test whether the new computerized information system is working as expected.

vi) User manual, which helps the user work with the new system minimal guidance . The manual contains information like.

✓ How to install, start the system

✓ The interface of the system

✓ How to carry out various tasks

✓ Error collection and how to get help.



SYSTEMS THEORY and DEVELOPMENT

A System:

A system is a set of *inter-relate* components/Elements set together to perform a given task.

Information Systems (IS):

These are interrelated elements (hardware, software, users, data and information) working together to collect, process, store, and disseminate information for:

- Decision making
- Coordination
- Control
- Analysis
- And visualization (conceptualization/seeing complex subjects for org'nal survival.

Types of Information systems.

Can be classified basing on;

- Behavior of the system
- Nature of work done by the system

Therefore information systems can be;

- **Deterministic system:** - Is a system where given the input the output can be determined.
- **Probabilistic/stochastic system.** Is a system where given the input the output cannot be successfully determined.
- **Self-organizing/Adaptive/Cybernetic systems.**
Systems which are highly complex. i.e. system which continuous adapt to changes in the environment.
- Computer based information systems (CBIS): these rely on computer HW and SW
- Formal systems: These are systems that rest on clearly fixed and accepted data and procedures with predefined rules.
- **Management Information System (MIS):**

Focuses on computer based information systems aimed at organizational management provide reports and on-line access to the orgn's records

Are system that convert data from internal and external source into information to be used by managers if effective decision making for planning, Directing and control of original activities.

They include:

Executive information system (EIS) or Executive Support system ESS.

Systems used at the strategic level of management to facilitate non-routine decision making through illustrations and communication. They are at highest levels of control.

EIS/ESS usually provides summarized reports.



Decision support Systems (DSS)

MISs at the organization's mgt level combining data and complex models or tools to facilitate decision making. Used to help manager in effective decision-making where data is unstructured.

Unstructured data is one with very high level of uncertainty and difficulty to making the right decision using it.

Expert System:

Systems designed to provide specialized information/data for specialized areas or fields. E.g.

Accounting/Finance expert system.

Marketing expert system.

Human resource expert system.

Health applications

Systems can also be classified as;

- Data processing systems.
- Transaction system.
- Knowledge based system

Data processing systems (DPS):

These are systems that automate many of the routine clerical and administrative procedures in organisation. For document processing, order mgt, Stock control, and Routine billing of clients.

Management can not base on them for tactical and strategic decisions.

On-line Analytical Processing Systems (OLAPS):

These are real-time Interactive systems with direct connectivity between the data source and the users.

Transaction Processing System (TPS):

Support the operation of organizations by processing transactions as they and keeping them in master files. They work as the interface between the organization and its customers.

Other Systems include;

Neural Network System

Artificial intelligence systems.

Fuzzy logic systems

Open systems

Closed Systems

Information system literacy:

Involves a broad based understanding of information systems given the behavioural knowledge of orgns, individuals benefiting and using the IS, and technical knowledge about ICTs/Computers

Benefits of ISs

- Making organisational structures flatter.



- Separation of work from location is minimised. eliminated the physical distance
- Slowly doing away with manual work procedures as workflows get reorganised
- Orgns are becoming increasing flexibility as they can now easily sense and respond to challenges and changes in the work and market place.
- Redefinition of org'nal boundaries: as businesses get conducted across boundaries.
- Managers can now coordinate, plan, supervise and control organisational functions better on implementation of MIS



SYSTEM DEVELOPMENT

This (SD) defines the activities an organization should go through to come up with a properly functioning information system. The most common approaches to SD are;

- **System life cycle methodology**
- **Application software packages**
- **Prototyping approach**

1. System life cycle: This is an approach that **parcels** the SD process into formal stages that must be followed sequentially.

Logical stages:

- **System/situational analysis**
 - **System project definition**
 - **Feasibility study**
 - Needs assessment or problem identify and definition.
 - Specify solution
 - Establishment of information system requirements
 - **System study.** Looks at the problems of the existing system, defines the objectives the new system is to attain, and evaluates the various alternative solutions. Writes a system proposal report
- **System design** – Details how the new system is going to meet the information requirements of the organization. It creates design specifications for the system solution. Designs include inputs, outputs, user interface, databases, electronic processing and manual procedures designs.
- **Programming** – usually done by a technical/professional programmer who translates design specifications into program codes
- **Testing:** Is a thorough and exhaustive process aimed at determining as to whether the system gives the desired results. It involves **unit testing, system testing, and acceptance testing.** It also involves drawing conscious **test plans.**
- **Installation and documentation:** involves actual installation, re-testing, training of users and writing of user's manuals. Documentation involves a descriptive write-up about how the new system works. It is both technical and end-user oriented
- **Conversion stage: Involves switching from the old IS to the new one.**
 - **Parallel conversion strategy**
 - **Direct cutover**
 - **Pilot study strategy. Where the new system is introduce to a limited area**
 - **Phased approach.** Introduce in stages either by function or unit.
- **Production:** The system is being put to actual use, while being evaluated by end-users and technical specialists.
- **Maintenance stage:** This is a **post implementation phase** involving **servicing and repair** of the system, **while** making changes in **hardware, software and documentation.**

2. Application software packages:



These are sets of prewritten or coded software programs which are commercially available for sale or lease. Some are specialized while other generalized software applications can be customized.

3. Prototyping:

A Prototype is a preliminary working version of an information system for demonstration and evaluation. It is an *original functional model* of a new product (software) that a developer can put into the hands of potential users or customers, so that they can see it, test it and use it.

Prototyping is one the most effective ways of gauging the viability of a product (an information system).

Dimensions of Prototypes

- Horizontal Prototype. This provides a broad view of an entire system or subsystem, focusing on user interaction more than low-level system functionality, such as database access. It is a common term for a User Interface Prototype
- Vertical Prototype: This is a more complete elaboration of a single subsystem or function. It is useful for obtaining detailed requirements for a given function, with the following benefits:

Types of Prototyping

1. Throwaway Prototyping also called close ended prototyping or Rapid Prototyping: refers to the creation of a model that will eventually be discarded rather than becoming part of the final delivered software.
2. Evolutionary Prototyping: - The main goal when using Evolutionary Prototyping is to build a very robust prototype in a structured manner and constantly refine it. "The reason for this is that the Evolutionary prototype, when built, forms the heart of the new system, and the improvements and further requirements will be built.
3. Incremental Prototyping: This works in such a way that in Evolutionary Prototyping, developers can focus themselves to develop parts of the system that they understand instead of working on developing a whole system.
4. Extreme Prototyping: Extreme Prototyping as a development process is used especially for developing web applications. Basically, it breaks down web development into three phases, each one based on the preceding one:
The process is called Extreme Prototyping to draw attention to the second phase of the process, where a fully-functional UI is developed with very little regard to the services other than their contract.

The DSDM lifecycle of a prototype is to:

1. Identify Prototype: This requires the determination of the basic requirements including the input and output information desired. Well, details, such as security, can typically be ignored at this level.



2. Agree to a Plan: At this stage, the initial prototype is developed that includes only user interfaces. (See Horizontal Prototype, below)
3. Create the INITIAL Prototype: At this stage, the initial prototype is developed that includes only user interfaces. (See Horizontal Prototype, below)
4. Review the Prototype: Using the feedback both the specifications and the prototype can be improved. Negotiation about what is within the scope of the contract/ product may be necessary. If changes are introduced then a repeat of steps #3 and #4 may be needed.

Advantages of Prototyping

1. Reduced Time and Costs: Prototyping can improve the quality of requirements and specifications provided to developers.

2. Improved and Increased User Involvement: Prototyping requires user involvement and allows them to see and interact with a prototype allowing them to provide better and more complete feedback and specifications.

Disadvantages of Prototyping

1. Insufficient Analysis: The focus on a limited prototype can distract developers from properly analyzing the complete project.

2. User Confusion of Prototype and Finished System: Users can begin to think that a prototype, intended to be thrown away, is actually a final system that merely needs to be finished or polished.

3. Developer Misunderstanding of User Objectives: Developers may assume that users share their objectives (e.g. to deliver core functionality on time and within budget), without understanding wider commercial issues. For example, user representatives attending [Enterprise software](#) (e.g. [PeopleSoft](#)) events may have seen demonstrations of "transaction auditing" (where changes are logged and displayed in a difference grid view) without being told that this feature demands additional coding and often requires more hardware to handle extra database accesses.

4. Developer Attachment to Prototype: Developers can also become attached to prototypes they have spent a great deal of effort producing; this can lead to problems like attempting to convert a limited prototype into a final system when it does not have an appropriate underlying architecture.

5. Excessive Development Time of the Prototype: A key property to prototyping is the fact that it is supposed to be done quickly.

6. Expense of Implementing Prototyping: the start up costs for building a development team focused on prototyping may be high. Many companies have development methodologies in place, and changing them can mean retraining, retooling, or both.

7. A common problem with adopting prototyping technology is high expectations for productivity with insufficient effort behind the learning curve. In addition to training for the use of a prototyping technique, there is an often overlooked need for developing corporate and project specific underlying structure to support the technology.





SYSTEM START-UP AND CONFIGURATION

Here we shall look at;

- a) Computer Booting
- b) System Configuration
- c) Software Installation
- d) Computer Troubleshooting

COMPUTER BOOTING

- Booting refers to the process of attaining/getting the normal or operative runtime environment of a computer system.

THE BOOTING PROCESS

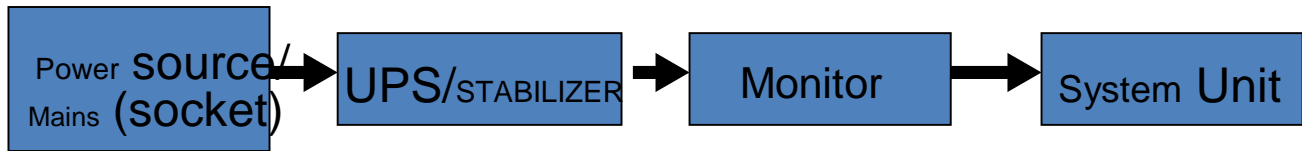
There are two categories of activities involved in the booting process. i.e.;

- Activities done by the computer user
- Activities done by the computer itself.

Hence;

1. Powering the computer or PC. Involves turning on the power socket and Uninterrupted Power Supply (UPS) if any, by Switching on the monitor and then the system unit.
 2. The system accesses the boot strap loader for setting up the basic input and output system (BIOS)
 3. The system then goes into Power-on-self test (POST) state or stage. Here the system checks the functionality of all components connected to it.
 4. The boot strap loader or LILO Loads the Operating System (OS) into memory. After which the OS takes over or manages the following computer activities.
 5. Log-on stage where the user enters her User name and password.
- ✓ Turn on the Power button.
 - ✓ CPU pins are reset and registers are set to specific value.
 - ✓ CPU jump to address of BIOS (0xFFFF0).
 - ✓ BIOS run POST (Power-On Self Test) and other necessary checks.
 - ✓ BIOS jumps to MBR(Master Boot Record).
 - ✓ Primary Bootloader runs from MBR and jumps to Secondary Bootloader.
 - ✓ Secondary Bootloaders loads Operating System.





FORMS OR TYPING OF BOOTING

- **COLD OR HARD BOOTING:** This involves starting a computer from a powerless state. Usually cold booting involves a computer system going through POST.
- **WARM OR SOFT BOOTING:** This refers to restarting a computer which is already on for which the operating system is already into memory. Warm booting can also be initiated by;
 - » Pressing CTRL+ALT+DEL keys at once.
 - » Pressing the reset button on some system cases/units
 - » Select restart from the shutdown menu on the startup menu.

CONDITIONS THAT CAN LEAD TO A WARM BOOT

- When the operating system has frozen or hanged.
- When an application program hangs or refuses to run.
- When changing from one operating system (like windows 7) to another (like Linux), in cases of computers with double or multiple Os.
- When the operating system fails to detect or interact with some peripheral devices like keyboard, mouse, or modem.
- After installation of some software or programs.
- After installation of some device or peripheral drivers.
- When cleaning a malware (like a virus, Worm or Trojan)
- After configuring or setting up a network
- Terminating a suspected data tap or hack

TROUBLE SHOOTING

Troubleshooting is a form of problem solving aimed at fixing or servicing a failed hardware or software process

Troubleshooting process

- ✓ Study or detect the problem or symptoms to a problem
- ✓ Save your work if the system can allow
- ✓ Shutdown the computer and consult the technical team if available
- ✓ Isolate the affected computer/s
- ✓ Do the troubleshooting if you have the technical expertise
- ✓

SYSTEM FAILURE:

A System failure is a prolonged malfunction of a computer that can also cause hardware, software, data and information loss.

COMMON CAUSES OF SYSTEM FAILURE

- Aging hardware such as hard disk.
- Natural disaster e.g. fires, floods, storms or earthquakes
- Electrical power variations. Electrical power variations can cause loss of data or equipment. A single power disturbance can damage multiple systems in a computer network.

COMPUTER HARDWARE PROBLEM.

[?] Excessively low/high temperature causing:-

- -Circuit/bus cracks
- -Connection breaks.
- -Chip crapes small movement\dislocation. Effects of dust:-
- Dust builds thick coatings in slots, ports, internal chips, etc. Dust coating can cause

[?] – unnecessary heat, data and electric insulation. Effects of corrosion:

- Hardware comes into contact with atmospheric chemicals, food, human body, water

[?] etc causing rust.

[?]

MAGNETIC FIELD:

❖ They cause magnetic inductions, which disturb computer data movements and – processing.

[?] ❖ Electrical Noise:

- ❖ This can be in form of;
- ❖ -Electronic static discharge causing short circuits.
- ❖ -Electromagnetic interference, or
- ❖ -Electro magnetic redactions traveling in space.

[?]

ELECTRICAL POWER VARIATIONS

This causes the following.

- Blackouts
- Power transit i.e. excessive low voltage.
- Blown out. Lowered power from the mains

Electrical Power disturbances include:

- Electronic Noise is any unwanted signal, usually varying quickly, which is mixed with the normal voltage or data signals entering the computer.
- An under voltage occurs when the electrical supply drops i.e. below 220 volts in Uganda
- An over voltage or power surge occurs when incoming electrical power increases significantly above the normal 220 volts.
- A surge protector can be used to protect computer equipment against under voltage and over voltage. Many users also connect an Uninterruptible power supply (UPS) to the computer for additional electrical protection.

AUTOMATED TROUBLESHOOTER

- Click the Start button
- Click Control panel
- Click find and fix problems under “systems and security”

PC CONFIGURATIONS

- The hardware and software specifications required for PC or any other type of computer is term as the computer configurations. A typical configuration is given below;
 - Micro Processor Pentium series.
 - Hard disk in the range of gigabytes.
 - Floppy disk drive (3.5, 1.44mb)
 - 104 keyboard
 - 14” or 17” colour digital monitor.
 - Desktop version of an inkjet printer.
 - Multimedia kit which consists of: CD ROM drive, DVD drive , Speakers, sound card e.t.c
 - 3 button mouse with a rolling button.
 - System software with the latest version.
 - Application software with the latest Ms Office version.

Questions

1(a) **Define the term disk formatting**

- Disk formatting is the process of preparing a data storage device such as a hard disk drive, solid-state drive, floppy disk or USB flash drive for initial use.

(b) **Describe the process of formatting a newly bought flash disk**

- Insert the flash in the computer.
- Click start button
- Click my computer icon
- Select the flash drive
- Right click then click format
- It will display message when u format all data will be lost to format click ok or cancel to stop.
- Click ok.
-

(c) Briefly describe the process of installing Microsoft office on your computer.

- Insert a CD, flash disk or DVD into your computer's CD or DVD drive or USB port.
- The software will prompt you to install it click install to start the process.
- The Microsoft office will prompt you to insert the 25 character product code.
- Insert product code and enter
- The software will prompt you either to customize or install full package
- When done it will prompt you to finish
- Finish
- Restart your computer and start using office.

2.(a) Define the term system configuration.

- Refers to the arrangement of functional computer devices according to their nature, number and characteristics to work together.

(b) State two ways of loading an operating system into memory.

- Loading the operating system from the hard drive into memory.
- Loading of the operating system from a compact disc or digital versatile disc into memory.

(c) Briefly state the steps taken by the computer to load an operating system into memory.

- The first step is powering of the computer
- Power-on self test-where a computer checks all connected devices if they are functioning well.
- From BIOS-Then a boot device is located to the I/O system which helps to coordinate communication between hardware and software(BIOS)
- Operating system is loaded into memory.
- Now the boot process relinquishes control to the os.

3.(a) Define the concept of trouble shooting.

- Refers to the process of identifying, planning and resolving a problem, error or fault within a software or hardware.

(b) State the steps that can be taken to solve the following problems on a computer.

(i) The computer has frozen and the program is not responding.



- You can click alt + ctrl + Del to restart the computer.
- Press the power button without releasing it until the computer goes off and then start it again.
- Replace the operating system with a new one.

(ii) The printer is not printing

- Check if there are printing papers in the printer
- Check if there is no paper jam in the printer
- Check the power cable to ascertain if it's is fixed properly.
- Check if the data cable is properly fixed.

(iii) The Keyboard is not working

- ✓ Check if keyboard is properly fixed in the system unit.
- ✓ Replace it with another



TRENDS IN COMPUTING

Defn

Computer Security is the protection of computing systems and the data that they store or access.

Computer security, also known as cyber security or IT security, is the protection of computer systems from the theft or damage to the hardware, software or the information on them, as well as from disruption or misdirection of the services they provide.

It includes controlling physical access to the hardware, as well as protecting against harm that may come via network access, data and code injection, and due to malpractice by operators, whether intentional, accidental, or due to them being tricked into deviating from secure procedures.

Digital forensics (sometimes known as digital forensic science) is a branch of forensic science encompassing the recovery and investigation of material found in digital devices, often in relation to computer crime. The term digital forensics was originally used as a synonym for computer forensics but has expanded to cover investigation of all devices capable of storing digital data.

Security is the ability of a system to protect information and system resources with respect to confidentiality, availability and integrity.

Therefore these elements of security must be considered :-(CIA triaged

- **Confidentiality** is a set of rules that limits access to information or Confidentiality is the concealment of information or resources. The need for keeping information secret arises from the use of computers in sensitive fields such as government and industry.
- **Integrity** refers to the trustworthiness of data or resources, and it is usually phrased in terms of preventing improper or unauthorized change. Integrity includes data integrity (the content of the information) and origin integrity (the source of the data, often called authentication).
- **Availability** refers to the ability to use the information or resource desired. Availability is an important aspect of reliability as well as of system design because an unavailable system is at least as bad as no system at all.

Importance of computer security

- Computer security is important, primarily to keep your information protected.
- It's also important for your computer's overall health
- Helping to prevent viruses and malware and helping programs run more smoothly.
- To help curb the increasing volume and sophistication of cyber security threats – Threats of this nature include targeting phishing scams, data theft, and the exploitation of other vulnerabilities in the network.

COMPUTER INTEGRITY AND SECURITY

Computer integrity refers to methods of ensuring that data is real, accurate and safeguarded from unauthorized user modification.

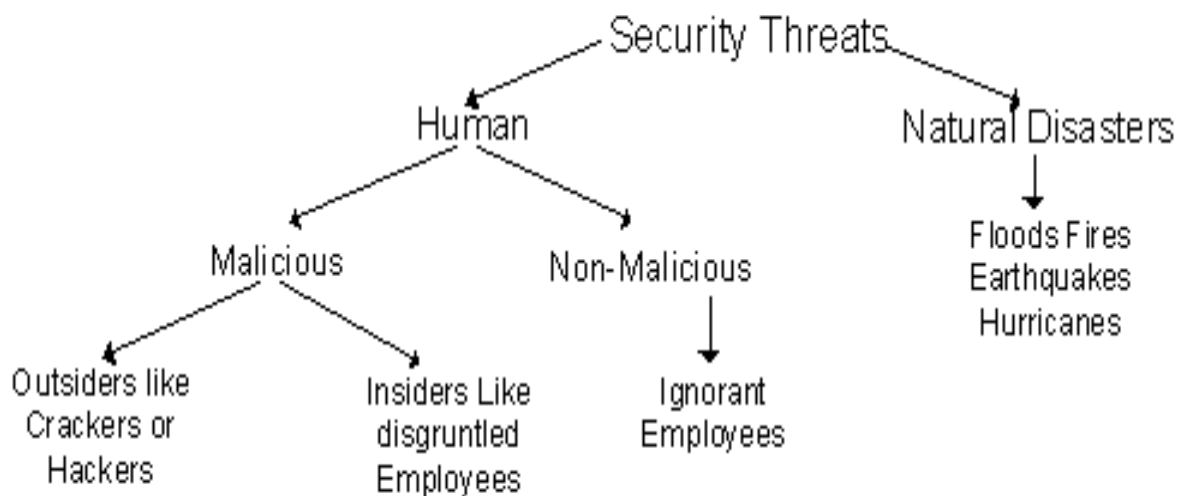


- (a) **Software Integrity** refers to methods of ensuring that software or data is real, accurate and safeguarded from unauthorized user modification.
- (b) **Hardware Integrity** to methods of ensuring that hardware is safeguarded from unauthorized access and modification.
- (c) **Computer Intrusion** refers to compromise computer system by breaking the security of such a system or causing it to enter into an insecure state.

Computer intrusions occur when someone tries to gain access to any part of your computer system. Computer intruders or hackers typically use automated computer programs when they try to compromise a computer's security. There are several ways an intruder can try to gain access to your computer. They can:

- Access your computer to view, change, or delete information on your computer.
- Crash or slow down your computer.
- Access your private data by examining the files on your system.
- Use your computer to access other computers on the Internet.

Security threats



Purpose of Data Security

- Controlling access to machine and data resources.
- Controlling the way *access rights* are passed from user to user.
 - person to person
 - program to program
- Preventing maliciousness and errors from subverting the controls.
- Understanding the challenges/Risks involved and providing solutions.

Major Threats.

COMPUTER SYSTEM SECURITY THREATS ARE BOTH TECHNICAL AND NON-TECHNICAL.

Technical Threats

- **Nonexistent security architecture** (usually due to lack of qualified IT Administrators). Inadequate network protection results in increased vulnerability of the data, hardware,



and software, including susceptibility to malicious software malware, viruses, and hacking.

- **Un-patched Client Side** Software and Applications.
- **“Phishing”**: attempt to acquire information such as usernames, passwords, credit card details by masquerading as a trustworthy member of an organization.
- **Internet Web sites.**
- **Poor Configuration Management.**
- Use of mobile devices; such as laptops or handheld devices, smart phones outside organizations.
- **Cloud computing** (delegating the task of protection to a third party usually through shared resources, or remote storage and host.
- **Removable media**: provide a pathway for malware to move between networks or hosts.
- **Botnets.** Botnets are networks of compromised computers used by hackers for malicious purposes, usually criminal in nature.

Non-Technical Threats

- **Insider**: an insider is defined as someone with legitimate access to the network.
- **Poor Passwords.** Implementing a policy on strong user passwords is critical to data protection.
- **Physical Security.** Physical security is essential to preventing unauthorized access.
- Insufficient Backup and Recovery.
- **Improper Destruction.** Paper documents, such as reports and catalogs, may contain sensitive data.
- **Social Media.** Using organization’s devices and network resources to access social media websites poses a high data security threat. They are target for spam
- **Social Engineering.** Breaking into a network does not require technical skills. Caution should be advised when communicating any account or network information

Common Threats

- Errors and Omissions

It becomes difficult to protect our systems from the people who need to use it day in and day out.

- Fraud and Theft



Employees are responsible for more successful intrusions than outsiders. It becomes very difficult to find the source of internal attacks without alerting the attacker that you suspect him of wrong-doing.

➤ Malicious Hackers

Several groups of Internet users out there that will attack information systems.

They are hackers, Crackers or phreaks.

- Hacking is the process of gaining unauthorized access into a computer system, or group of computer systems. This is done through cracking of passwords and codes which gives access to the systems.
- A cracker is someone who breaks into someone else's computer system, often on a network; bypasses passwords or licenses in computer programs; or in other ways intentionally breaches computer security. A cracker can be doing this for profit, maliciously, for some altruistic purpose or cause, or because the challenge is there.
- A phreak is someone who breaks into the telephone network illegally, typically to make free long-distance phone calls or to tap phone lines. The term is now sometimes used to include anyone who breaks or tries to break the security of any network.

- Malicious Code is software/code that is designed to make a system perform any operation without the knowledge of the system owner.
- Denial-of-Service Attacks is an attempt to make a machine or network resource unavailable to its intended users.
- Social Engineering is the name given to a category of security attacks in which someone manipulates others into revealing information, that can be used to steal data, access to systems, access to cellular phones, money, or even your own identity.

Computer crimes also commonly referred to as cybercrimes refers to any crime that involves a computer and a network.

To commit a cyber crime a user takes advantage of a computer to take or alter data, or to gain unlawful use of computer services.

The crimes include but not limited to;

- a) Tracking
- b) Trespass
- c) Tapping
- d) Cracking
- e) Privacy and Fraud
- f) Sabotage
- g) Spam



h) Alterations

Explanation:

- a) **Tracking:** Monitoring computer usage in a real time environment. This is either done remotely or during a physical session, usually used on internet users.
- b) **Trespass:** when someone is able to access your computer and able to see or use your files illegally.
- c) **Tapping:** when someone gains access to information that is being transmitted via a transmission/communication link. Users should note that any information passed over a network is vulnerable provided security measures are not appropriate.
- d) **Sabotage** is a computer crime which involves deliberate attacks intended to disable computers or networks
- e) **Spamming** is the use of electronic messaging systems like e-mails and other digital delivery systems and broadcast media to send unwanted bulk messages indiscriminately. An unsolicited messages is what we call spam
- f) **Alteration:** When a system is compromised, the data stored in it can be compromised. For example. When students break into a system and alter exam results. Bank accounts can too be altered.

Protection Measures

- Educate users
- Encrypt all important data
- Use secure passwords
- Implement additional security checks (fingerprint, Eye scanners)
- Encrypt all important data
- Restrict Plug and Play

How to buy online safely

- a) Research retailers online to make sure they're legitimate.
- b) Make sure the website is secure.(https)
- c) Know your rights and the company's returns policy.
- d) Keep software and virus protection up-to-date and use strong passwords for online accounts.
- e) Don't use public Wi-Fi. Your standard data connection is more secure.
- f) Pay using a credit card. You will have more protection. Alternatively, online services like PayPal mean scammers will not be able to get hold of your bank details.
- g) Be smart. If a deal looks too good to be true, it probably is not worth taking.

How to be safe on the Internet



- a) Create Complex Passwords. We know you've heard it before, but creating strong, unique passwords for all your critical accounts really is the best way to keep your personal and financial information safe.
- b) Use a Firewall. Even if your network is secure, you should still use a firewall.
- c) Click Smart. Now that you've put smart tech measures into place, make sure that you don't invite danger with careless clicking. Many of today's online threats are based on phishing or social engineering.
- d) Be a Selective Sharer. These days, there are a lot of opportunities to share our personal information online. Just be cautious about what you share, particularly when it comes to your identity information. This can potentially be used to impersonate you, or guess your passwords and logins.
- e) Protect Your Mobile Life. Our mobile devices can be just as vulnerable to online threats as our laptops. In fact, mobile devices face new risks, such as risky apps and dangerous links sent by text message.
- f) Practice Safe Surfing & Shopping. When shopping online, or visiting websites for online banking or other sensitive transactions, always make sure that the site's address starts with "https", instead of just "http", and has a padlock icon in the URL field.
- g) Keep up to date. Keep all your software updated so you have the latest security patches. Turn on automatic updates so you don't have to think about it, and make sure that your security software is set to run regular scans.
- h) Lookout for the latest scams. Online threats are evolving all the time, so make sure you know what to look out for.
- i) Keep your guard up. Always be cautious about what you do online, which sites you visit, and what you share. Use comprehensive security software, and make sure to backup your data on a regular basis in case something goes wrong.

How to avoid viruses, Trojans, worms and spyware

- Use updated antivirus or endpoint security software
- Block file types that often carry malware
- Subscribe to an email alert service
- Use a firewall on all computers
- Stay up to date with software patches
- Back up your data regularly
- Disable Auto Run functionality

Terminologies Related to Computer System Security

- Spyware



- Email spoofing
 - Spear phishing
 - Social networking websites
 - Social engineering
 - A root kit
 - Ransom ware
 - Phishing
 - Autorun worms
 - Boot sector malware
 - Cookies
 - Hoaxes
 - Worms
 - Key logging
 - Malware
 - Parasitic viruses
 - Patches
- **Spyware** is software that permits advertisers or hackers to gather sensitive information without your permission.
 - **Email spoofing** is when the sender address of an email is forged for the purposes of social engineering
 - **Spear phishing** is targeted phishing using spoof emails to persuade people within a company to reveal sensitive information or credentials.
 - **Social networking websites** allow you to communicate and share information. But they can also be used to spread malware and to steal personal information.
 - **Social engineering** refers to the tricks attackers use to fool victims into performing an action. Typically, these actions are opening a malicious webpage or running an unwanted file attachment.
 - **A root kit** is a piece of software that hides programs or processes running on a computer. It can be used to conceal computer misuse or data theft.
 - **Ransom ware** is software that denies you access to your files until you pay a ransom
 - **Phishing** refers to the process of tricking recipients into sharing sensitive information with an unknown third party.
 - **Patch** operating systems or applications.
 - **Parasitic viruses**, also known as file viruses, spread by attaching themselves to programs.



- **Malware** is a general term for malicious software including viruses, worms, Trojans and spyware. Many people use the terms malware and viruses interchangeably.
- **Key logging** is when keystrokes are secretly recorded by an unauthorized third party.
- **Worms** are viruses that create copies of themselves across the Internet or local networks.
- **Hoaxes** are reports of non-existent viruses or threats are software add-ons designed to fix software bugs, including security.
- **An exploit** takes advantage of a vulnerability in order to access or infect a computer.
- **Cookies** are files placed on your computer that allow websites to remember details.
- **Boot sector malware** spreads by modifying the program that enables your computer to start up.
- **Auto run worms** are malicious programs that take advantage of the Windows Auto Run feature. They execute automatically when the device on which they are stored is plugged into a computer.

COMPUTER ETHICS

Computer ethics are the moral guidelines that govern the use of computers and information systems. Frequently concerned areas of computer ethics are;

- Unauthorized use and access of computer systems.
- Software piracy
- Information privacy
- Intellectual property rights
- Codes of conduct

- (a) **Unauthorized access and use of computer systems.** Unauthorized access is the use of a computer or a network without permission.

A **cracker** or a hacker is someone who tries to access a computer or a network illegally. Some hackers break into a computer for the challenge. However, others use or steal computer resources or corrupt a computers' data.

Unauthorized use is the use of a computer or its data for un approved or possibly illegal activities. Examples of unauthorized use of computers include;

- An employee using a company computer to send personal e-mail.
- Someone gaining access to a bank computer and performing an unauthorized transfer.

One way to prevent unauthorized access and unauthorized use of computers is to utilise access controls.

- (b) **Software piracy.** Software piracy refers to the unauthorized and illegal duplication of copyrighted software. Software piracy is the most common form of software theft. Purchasing software only provides a consumer with a license agreement or the right to use the software.



A single user license agreement or end-user license agreement is the most common type of license included with software packages purchased by individual users. It usually permits a consumer to;

- Install the software only once on the computer and make one copy for back up. However, the consumer is usually not permitted to;

- Install the software on a network
- Give away copies of the software to others or
- rent or lease the software

A software site license gives the buyer the right to install the software on multiple computers at a single site. (e.g a school computer laboratory)

A network site license allows network users to share a single copy of the software which resides on the network server.

Risks of software piracy

- Increase the chance of spreading computer viruses.
- No technical support for the software can be received.
- Drive up the software cost for all legal users.
-

(c) **Information piracy.** Information piracy refers to the right of individuals or organizations to deny or restrict the collection and use of information about them.

(d)

Information accuracy becomes an important issue when it is necessary to access information by other people or companies such as that one on the internet.

Inaccurate input can result in erroneous information and incorrect decisions made based on that information. Never assume that information provided on the web is always correct.

(e) **Intellectual property rights.** **Intellectual property (IP)** refers to work created by inventors, authors and artists.

Intellectual property rights are the rights to which creators are entitled for their work.

A copyright© gives authors and artists exclusive rights to duplicate, publish and sell their materials.

A trade mark™ protects a company's logos and brand names

(f) **Codes of conduct.** A code of conduct is a written guideline that helps determine whether a specific action is ethical or unethical.

Sample IT codes of conduct

- Computers may not be used to harm other people.
- Users may not interfere with others' computer work.
- Users may not meddle in others computer files.
- Computers may not be used to steal.
- Computers may not be used to bear false witness.
- Users may not copy or use software illegally.
- Users may not use others' computers resources without authorization.
- Users may not use others output.



- Users should always use computers in a way that demonstrates consideration and respect for other people.

The copy right law

THE COPYRIGHT AND NEIGHBOURING RIGHTS ACT, 2006.

Work eligible for copyright.

- 1) The following literary, scientific and artistic works are eligible for copyright in uganda
 - a. articles, books, pamphlets, lectures, addresses, sermons and other works of a similar nature;
 - b. dramatic, dramatic-musical and musical works;
 - c. audio-visual works and sound recording, including cinematographic works and other work of a similar nature;
 - d. choreographic works and pantomimes;
 - e. computer programmes and electronic data banks and other accompanying materials;
 - f. works of drawing, painting, photography, typography, mosaic, architecture, sculpture, engraving, lithography and tapestry;
 - g. works of applied art, whether handicraft or produced on industrial scale, and works of all types of designing;
 - h. illustrations, maps, plans, sketches and three dimensional works relative to geography, topography, architecture or science;
 - i. derivative work which by selection and arrangement of its content, constitute original work;
 - j. any other work in the field of literature, traditional folklore and knowledge, science and art in whatever manner delivered, known or to be known in the future.

INFORMATION AND COMMUNICATION TECHNOLOGY

The study of computer studies has become too rich that it is now getting had to draw a difference between *Computer Studies* and “ICT”.

Computers and communication have brought and still bringing changes in our lives. Therefore, the following concepts are more or less becoming family names.

- Information technology
- The communication revolution/Telephone revolution
- Internet revolution
- Multimedia (data, sound & video)
- The Binary Age
- Information society
- The information super high way/ “Information” or I-way or Data-Way.
- The digital Age or Dot Age.



The need for better and best ways of doing things has triggered more and more research in the best technologies, more reliable information, and the best communication means.

Therefore, ICT/IT relates to all means, which facilitates information or data capture, processing, storage, and communication or output.

Old Technologies

- Newspaper Paper Printed Photographs
- Recordings Film
- Radio Televisions

New Technologies

- Satellites Fiber optic cables (for communication media)
- Cellular phones Fax machines
- Compact disk Computers
- E-mail
- Internet
- Data warehouses or data bases
- Video conferencing

NB;

ICT/IT concept is quite different from Computer Studies. Computer studies are simply a small section of IT.

Qn.

- (a) Define a telecommunication system, and list its components.**
- (b) Explain the functions of a telecommunication system.**

IMPACT OF IT/ICTs ON SOCIETY(Teacher explains)

ICTs have had both positive and negative contributions to society.

a) BENEFITS/ADVANTAGES OF INFORMATION TECHNOLOGY.

- Increased interaction /collaborations through e-mails, chat rooms, video conferencing, etc
- Increased sharing and access to common databases within and outside organizations through networking.
- Increased access to information through DBMS. Huge amounts of material on all subjects now exist – ease research.
- Increased inventions and innovations.
- More and more technology in management fields.
- Improved and sustained quality goods and services.
- Increased efficiency and effectiveness' leading to increased productivity (hence less wastages & more efficient use of resources).
- Increased investment opportunities in commercial tele-centers, Internet cafes, chart rooms, etc.
- More leisure as people get shorter working hours. Increased use of ICTS implies higher standards of living.

- Highly skilled jobs are being created like programming, systems analysis. Software engineering, etc.
- Many IT products for the disabled.
- Reduced costs of production through less demanding ICTs
- Improved corporate image.

b) Disadvantages

- Widens the gap between the rich and the poor as the rich producing with the help of ICTs produce faster and flood the markets.
- Isolate older people since it is not very easy for them to cope with the many IT changes.
- Bombards (internet) people with too much information- (good and bad)
- Increased instability as people get compelled to learn new things every now and then.
- Health problems e.g. eye sight losses, repetitive strain injury, etc
- Moral problem through access of pornographic materials on the net.
- Erosion of individual privacy as more data about people is stored on databases and can be accessed any time.
- Unemployment as less skilled people get retrenched and their roles taken over by more effective ITs.
- Addictions to computer games plus surfing by young people
- ITs isolate man and also erode the social aspect of work as some people opt for executing their office duties from their homes.
- Initial, maintenance and on-line IT costs are very high segregative.
- Virus threats make data stored on computers very insecure.
- Increased crime through forgeries, piracy, etc.

AREAS OF APPLICATION FOR INFORMATION TECHNOLOGY

(I) Education and training.

Many Universities, Colleges, school and public libraries are on line with websites for purposes of making easy access to educational information..

Education references soft ware e.g. the Infopedia, Encarta, etc are programs used for helping people with English usage, data collection and analysis etc

(2) Information plus data storage.

ITs have got immense internal and external storage devices for storage of huge volumes Data. Hence the common paperless society

(3) Word Processing

Word processor programs e.g. Microsoft word, word star, lotus notes etc are now on market for use to produce professional looking documents like, letters, invoices, orders etc.

They have easy to use document edit, format, table tools etc.

(4) Business

E-Business and **E-commerce** facilitate the buying and selling of goods, services and works on line.

Businesses have got websites and networked computers they use to advertise, processing of orders, receipting of purchased products, etc.

For instance Web sites like: - www. CD-Now for buying music CDs, DVDs & VCDs, and Interflora.com – for flowers.

Other businesses include;



- Computer Secretarial Bureau.
- Internet cafes.
- Commercial computer schools.
- On-line banking

(5) Entertainment and Leisure.

ITs offers lots of leisure and entertainment activities in form of;

- Computer games
- Computer audio music and video players
- Games on line
- Leisure centers on line.
- Leisure websites

Skynet.com for sports and manu.com, are some of the informative leisure websites.

(6) Health & Medicine.

ITs are now being used for;

- Medical tests for instance blood, cancer, Brain damage etc
- Carrying out sensitive operations on sensitive body parts like the brain, heart, kidney, etc.
- Drug mixing and prescriptions.

7) Transport & communication

ITs are also being used for;

- Units of carriage surveyance in logistics management.
- Sending and receiving of messages like sms (E-mail = sms over the internet), and interactive websites.
- Reservations for units of carriage and hotels.
- etc

8) Accounting and Finance.

Software/programs are now available for producing financial reports like income statements, Balance sheets, and cash flow statements. Such programs aid financial planning plus management, determination of NPV, PBP, IRR, etc

Such application/programs include Pastel, Tally, Sand systems, Excels, etc

(9) Climate and Weather:

Programs have now been developed to accurately predict and report changes in climate and weather to aid travelers and farmers.

(10) Security and military.

IT Laser guided cameras and satellites are now used for national and domestic security. Business like Banks, supermarkets etc also use IT Laser guided cameras for customer monitoring in the business hall.

Information technologies are also used in the military to fly and direct combat planes, locate enemy positions and hit/shell them with minimal civilian and property losses.

(11) Manufacturing:-

In many large manufacturing and production processes robots are being used to handle tasks, which cannot be efficiently handled by humans.



Computer Aided Design (CAD) and CAM (Computer Aided Manufacture) are also in this category.

Other areas of application include;

- Hotel and Institutional catering.
- **General Management. For instance;** DSS, HRS, MKT, ESS, tele-working and tele-commuting.
- Information technology helps in the jurisdiction of cases in courts of laws, sports and games; iTs (video evidence) have been adduced to influence decisions.

Emerging technologies and developments in Hardware and Software

CURRENT TRENDS IN HARDWARE PLATFORMS

There are many trends in hardware platforms in recent years

- ✓ Integration of Computing and Telecommunications Platforms
- ✓ High rate of computation via network
- ✓ Integration of telephone and internet
- ✓ High computing power
- ✓ Grid Computing
- ✓ Cost saving on large infrastructures
- ✓ Smaller computer are connected to form a grid
- ✓ Increase the ability of organizations
- ✓ High speed of computing
- ✓ Cloud Computing
- ✓ Cost Saving as no capital investment is needed
- ✓ Automatic Computing
- ✓ Develop systems that can automatically download updates, Protect themselves from hackers and intruders. Recover themselves in case of failure.
- ✓ Virtualization and Multi-core Processors
- ✓ Both reduces power consumption
- ✓ Virtualization – Accessing computing resources in multiple ways irrespective of geographical location and physical configuration.
- ✓ Multi-core Processors – Use multi-core processors to reduce power consumption and heat.

CURRENT TRENDS IN SOFTWARE PLATFORMS

- ✓ Linux and the open-source software movement
- ✓ Linux is one of the most widely used open source software program
- ✓ Linux is supported by almost all platforms like HP, IBM, Intel, Dell, Sun etc.
- ✓ Java Programming language that is independent of the operating system and hardware processor. Java virtual machine has been defined. Java is compatible with any hardware
- ✓ Leading interactive programming language available for the Web is Java.



- ✓ Software for enterprise integration
- ✓ The usage of enterprise-wide software systems by firms is an important trend in last few years.
- ✓ The goal is to achieve an integrated firm-wide information environment, reduce cost, increase reliability, to adopt business best practices which are captured by the software.
- ✓ software outsourcing
- ✓ It is the prewritten software developed by a software company
- ✓ It helps the organizations from developing their own softwares.

Mobile Platform

- ✓ The growth of telecom industry especially in mobile sector has been incredible over last few years. The service providers upgraded the mobile networks with next-Generation services like 3G, WAP and GPRS.
- ✓ The banks are trying to capitalize this growth in the telecom sector and provide the services to the customers through mobile. The main advantage of mobile banking over the Internet banking is that it offers ‘Anywhere Anytime Banking’. Customers can check their accounts, transfer funds, balance statements etc during travel without the access to a computer. The limitations of Internet Banking are overcome in mobile banking since it requires only a mobile which can be accessed by people of developing countries also.
- ✓ Grid Computing

The basic idea of Grid computing is that the computers are connected as a grid and the software running in the grid gives more priority to local users, but when they become idle these computers are used over the grid.

Providing remote access to IT resources

THE FUTURE OF COMPUTERS AND THE INTERNET

Some technological advancements and trends are recognisable and can be predicted. It is easy to predict that the computers and related equipment will get faster in memory, smaller and cheaper. Computer technology will find new application and manufacturers will strive to make computing easier and cheaper. As costs decline and performance and ease of use rises, LAN's play a bigger role in corporate information systems.

Possible future trends in computer capabilities, physical size, price and software.



- (a) **Future computer capabilities.** On the capabilities fronts, computers are going to evolve. They;
- are going to have more powerful, smaller processor and faster access to memory.
 - Will have operating systems that will handle real time data analysis and object oriented.
 - Will have improved user interfaces that offer users easier and more intuitive access to information.
 - Will have multi-media applications that will be fully incorporated into some information systems because data is easy to interpret when presented as a combination of sight, sound and motion.
- (b) **Physical size.** Most hardware components will get smaller and faster. This means computers will become smaller and do more.
- (c) **Price.** As technology advances, the price of computers will go down. Every sphere of life will be permeated by computers, which will be common even among people of average earning.
- (d) **Software.** Software development will also develop to allow users easily operate computer systems. To facilitate document, the best programming and operating systems are moving towards object-oriented system. OS will play an integral part in giving the user more control over how data are linked and shared. New operating systems will focus on object linking, message passing and data sharing.
- (e) **Artificial intelligence.** Artificial intelligence is the process of building computer systems that simulate human thought processes and actions. The goal of artificial intelligence is not to replace human intelligence which is not replaceable; rather it is to help people to become more productive. In the past, computers used calculating power to solve structured problems. This field of artificial intelligence is moving in the mainstream of data processing.

Artificial intelligence attempts to develop computer systems that can mimic or simulate human thought processes and actions. This include reasoning and learning from past actions. True artificial intelligence that corresponds to human intelligence is still a long way off. However, several tools that emulate human problem solving and information processing have been developed. Many of these tools have practical applications for business. They include expert systems, natural language processing, artificial neural network and robots.

Expert systems. Expert systems are computer programs that essentially emulate the knowledge of human experts skilled in a particular field for example of a geologist or a medical doctor. They have both textbook knowledge and tricks of trade that an expert acquires after years of experience as a result of the programs that can be really complicated.

Areas of application

- Finance/Business planning



- Teaching field. They compliment teachers knowledge e.g typing tutor, project planning and monitoring.
- Special areas. Act as substitute for retiring human experts.
- Banking

Natural language processing. Natural language processing is the capacity of computers to “understand” human language and translate it into actions upon which to act.

Artificial Neural Networks. Present computers and super markets are relatively slow because of the build in structural limitations. The processor and the main memory are physically separated.

Robots. Robots is the field of study concerned with developing and building robots. Robots are machines that are used in factories and can be programmed to do more than one task. Robots are used in the manufacturing industry mainly to reduce costs and increase productivity. They are excellent in executing repetitive tasks that human beings find boring. Robots do not get tired. They are also ideal to replace human beings on hazardous jobs. They are different types of robots which include;

- (i) **Industrial Robots.** These are used in factories to perform certain assembly tasks. Examples are machines used in automobile plants to do welding, painting, loading and unloading. In the garment industry, robot pattern cuts and create pieces of fabric for clothing.
- (ii) **Perception Robots.** Some Robots imitate human senses e.g a robot with television camera or vision system can be used for guiding machine tools for inspecting products and for identifying and sorting parts. Other types of perception robots rely on the sense of touch for example those used on micro-computer assembly lines to put parts in place.
- (iii) **Mobile Robots.** Some robots act as transporters e.g mail mobiles which carry mail to offices following a pre-programmed route.



N.B

1. JOB REPLACEMENT. *This is a situation where by certain jobs disappears in an organization but reappears in another form requiring more and high skilled man power e.g copy typists using typewriters are still needed in organizations but now use computers word processors instead of typewriters. Computerization brings about elimination of jobs in most cases but these jobs are replaced with those that have greater responsibility requiring high level of training.*

2. JOB DISPLACEMENT. *This is the process of replacing man power with computerized machines either their own or with the help of a few skilled and highly trained people. In most cases, the eliminated jobs are those involving monotonous and unskilled labour for example factory jobs can be displaced by machines called robots.*

SYSTEM ANALYSIS

This is the process of solving computer problems and use of computer technologies to meet the needs of an organization.

This is the first stage of the system analysis. Here the analyst makes a survey by gathering information needed for the system and the allocation of the requirements to the software.

Here the analyst understands the nature of the information and the function of the software which is required for the system. The analyst makes a brief survey of the requirements and tries to analyze the performance of the system which is to be developed. He also makes sure that he gets enough information and resources for building the appropriate system.

Here the analyst actually makes number of designs of the system on paper or on computer and sees to it that the rough image made of the system comprises of all the requirements or not. Once this is done, the analysis selects and finalizes a best suited design for the development of the system.

The analyst translates the code or the programmes in such a way that they become in machine readable form. The coding step is very time consuming and involves number of rooms for errors.

Once the analyst is through with the coding stage, he tests the system and sees to it that is working as per the expectations. He corrects the false in the system if any.

This is one of the most vital phase. In this phase the analyst actually gives the system to the customer and experts for a positive feed back.

This is the last stage of the system analysis. Here the analyst need s to maintain the system and sees to it that it is working with in the standards set. He needs to maintain the system by removing the defects of errors occurred.

CAREER OPPORTUNITIES IN INFORMATION AND COMMUNICATION TECHNOLOGY

Information and communications technology (ICT) has created new job titles such as;

- Computer operators.
- Computer technicians.
- System analysts
- Computer programmers
- Software engineers
- Information system manager
- Database administrator
- Computer trainer
- Website administrator
- Computer graphics designer



- Network administrators

This section explains some responsibilities of these professionals who are generally called information technology workers.

- a) **Computer technician.** Given that all computers regular maintenance, upgrading as well emergency repairs, demand for computer technicians continue to grow as more and more computerize their work place and homes.

Responsibilities of a computer technician

- Troubleshooting computer hardware and software related problems.
- Ensuring that all computer related accessories such as printers, modems, storage media e.t.c working properly.
- Assembling and upgrading computers and their components.
- In developed countries, technicians help hardware engineers in designing and creating some computer components such as motherboards, storage devices e.t.c.

- b) **System analyst.** The is a person who is responsible for analyzing a company's needs or problems then designs and develops a computer based information system. A good information systems analyst is one who has the following attributes.

- Good problem solving skills, creativity i.e must have experience in solving problems.
- Good communication skills; the analyst must be able to communicate clearly and precisely both in writing and in speech.
- He/she must be able to talk to different groups of people e.g managers, operators, attendant and general public.
- Must have business knowledge; the analyst must be well trained in relevant areas of computer science such as hardware, software and programming knowledge.

Responsibilities

- Reviewing the current manual or redundant information system and making recommendations on how to replace it with a more efficient one.
- Working with programmers to construct and test the system.
- Coordinating training for users of the new system.

- c) **Computer programmer.** Large organizations like insurance companies, banks, manufacturing firms and government agencies hire programmers to work together with system analyst in order to;

- Write in-house applications programs or system programs
- Customise commercial application package to suite the organization needs.
- Test, debug, install and maintain programs developed or customized for the organization.

- d) **Software engineer.** A software engineer is one who is skilled in software development and technical operation of computer hardware.



Responsibilities

- Developing system and application software.
 - Developing user and technical documentations for the new software.
 - Maintaining and updating the software to meet day to day requirements while overcoming challenges.
- e) **Computer engineer.** Computer and electronic engineers are coming up with more efficient and communication technology almost daily. Since computers are electronic devices, hardware designers must be good in electronic engineering in order to be able to;
- Design and develop computer components such as storage devices, motherboards and other electronic components.
 - Re-engineer computer components to enhance its functionality and efficiency.
 - Design and develop engineering an manufacturing computer controlled devices such as robots.
- f) **Information system manager.** The information system manger controls, plans, staffs, schedules and monitors all activities of the ICT department in the organization. Using computerized management information systems (MIS), the manger can test the impact that an alternative course of action might have on the business.

Other responsibilities

- Making sure that all tasks in the IT department are done correctly and on time in order to support business planning, control and decision making processes.
 - Preparing budgets for the department.
 - Keeping the department inventory records up-to-date.
 - Managing the human resource with in the department.
- g) **Computer trainer.** Due to the dynamic nature of computers and information technology, there is a high demand for qualified ICT trainers. Some of the responsibilities of an ICT trainer are;
- Training people on how to use a computer and various application programs.
 - Developing training reference materials.
 - Guide learners on how to acquire knowledge through carrying out research.
 - Advising learners on the best career opportunities in the broad field f ICT.
 - Preparing learners for ICT examinations.
- h) **Database administrator.** The major purpose of computerising organizations or institutions is to store data in an organised way for easy access, retrieval and update. The



organization requires a person who should be responsible for updating records in an information system database. For this reason, a database administrator is responsible for;

- Designing and developing database application for the organization.
 - Setting up security measures needed to control access to data and information.
 - Keeping the database up-to-date by adding new records, modifying or deleting unnecessary records.
- i) **Website administrator/ Web master.** Internet is one of the areas of information and communication technology that has drawn the interests of most people. These people are able to exchange messages, search for information and business through the internet.

Business organizations, educational institutions and individuals put information on the internet by developing websites. Most organizations hire the services of a web developer who is given the role of a company's web administrator also referred to as a web master.

Responsibilities

- Developing and testing websites.
- Maintaining, updating and modifying information on the websites to meet new demands by the users.
- Monitoring the access and use of internet connection by enforcing security measures
- Downloading information needed by an organization or institution from internet websites.

POSSIBLE FUTURE TRENDS OF THE INTERNET

- ❖ The internet will continue to expand and change in several ways; faster connections, more users, new multimedia and virtual reality services.
- ❖ More interactive services such as multimedia newspapers, livestock market tickers, automatic notification of when pre-destinated events take place anywhere on the internet.
- ❖ Internet as universal as a radio and television today.
- ❖ Learning will become any time anywhere.
- ❖ Impact of information technology to the society, morally unemployment vision, laxity and entertainment.



DATABASES

Think of an address book you might buy in a bookshop. In it, you will write all your important contacts; friends, family, relatives, companies, and other people in your circles. The address book contains all names, addresses, location, phone numbers and whatever you need to contact anyone at any time.

INTRODUCTION TO DATABASES

What is Data?

- Data is made up of text, numbers, symbols, images, sounds, etc. that can be processed into information or stored by a computer.
- **Information (Info)** – Refers to the meaningful and processed data.

What is a Database?

- A structured collection of logically related data that is stored so that it can easily be accessed. Logically related data comprises entities, attributes, and relationships of an organization's information.

In normal daily life we make frequent use of databases, and probably don't realize it. Here are a number of simple examples:

- Filing Cabinet
- Personal Address Book
- The Telephone Directory
- Customer Lists
- Membership Lists
- Purchases from the supermarket
- Purchases using your credit card
- Booking a holiday at the travel agents
- Using the local library
- Renting a video
- Using the Internet (Client - Server architecture involved).

Examples of Database Management software (Programs)



The following are some of the examples of Database Programs:

- *Microsoft Access*
- *Oracle*
- *dBASE*
- *FoxPro*
- *Paradox*
- *FoxBase*
- *FileMaker Pro*
- *Lotus Approach*
- *Microsoft Access*

COMPONENTS OF DBMS ENVIRONMENT

1. **Hardware:** Can range from a PC to a network of computers.
2. **Software:** DBMS, operating system, network software (if necessary) and also the DBAs.

What is the difference between DBMS and DBAs?

A **Database Management System (DBMS)** is a software system that enables users to define, create, maintain, and control access to a database. E.g. Microsoft Access.

While

A **Database Application (DBA)** Program is a computer program that interacts with the database by issuing an appropriate request to the DBMS.

A set of computer programs that provides a formal user interface to a database while managing the internal database structures on behalf of the users.

Users interact with the database through a number of application programs that are used to create and maintain the database and to generate information. Examples of DBAs can be conventional batch applications or, more typically nowadays, online web applications.

3. **Data:** Perhaps the most important component of the DBMS environment, certainly from the end-users' point of view, is the data. The database contains both the operational data and the metadata, the 'data about data'.
4. **Procedures:** Instructions and rules that should be applied to the design and use of the database and DBMS.



5. **People:** The users of the database including:

a) **Data Administrators (DA)** (responsible for the management of the data resource and maintenance of standards, policies and procedures)

b) **Database Administrators (DBA)** (responsible for the physical realization of the database, including physical database design and implementation, security and integrity control, maintenance of the operational system, and ensuring satisfactory performance of the applications for users. The role of the DBA is more technically oriented than the role of the DA).

c) **Database Designers (Logical and Physical)** The logical database designer is concerned with identifying the data (that is, the entities and attributes), the relationships between the data, and the constraints on the data that is to be stored in the database. The logical database designer must have a thorough and complete understanding of the organization's data and any constraints on this data (the constraints are sometimes called business rules). The physical database designer decides how the logical database design is to be physically realized.

d) **Application Programmers** (Responsible for implementing the application programs that provide the required functionality for the end-users. Typically, the application developers work from a specification produced by systems analysts. Each application contains statements that request the DBMS to perform some operation on the database. This includes retrieving data, inserting, updating, and deleting data.

e) **End Users (naive and sophisticated)** The end-users are the 'clients' for the database. Naïve users are typically unaware of the DBMS. They access the database through specially written application programs that attempt to make the operations as simple as possible. Sophisticated end-users are familiar with the structure of the database and the facilities offered by the DBMS. Sophisticated end-users may use a high-level query language such as SQL to perform the required operations.

The table structure

Figure showing Domains in some attributes of the Branch and Staff tables (relations).

- The table structure is composed of the following:
- **Data table / relation:** The fundamental structure in Ms- access database. These contain the data that is arranged in rows and columns ie fields and records.
- **Degree:** The degree of a relation is the number of attributes it contains.
- **Field / Attribute.** The entire named column that contains similar data items in a table.



- **Record / tuple:** One complete set of fields relating to the same item. Or set of entire data items in a row.
- **Cardinality** The cardinality of a relation is the number of tuples it contains.
- **Field name:** this the title of particular column (field)
- **Domain:** A domain is the set of allowable values for one or more attributes.
- **Data Type:** This determines the kind of data you can store in a field, and tells Access how to handle it.
- **Field properties:** This is the specific characteristic of a particular field
- **Sort:** An operation that you carry out on a table to change the order in which the records are displayed.
- **Sort Order:** A way of ordering records based on field values. A sort order can be in ascending (1 to 9, A to Z) or descending (9 to 1, Z to A) sequence.
- **Primary Key:** This is a field that identifies record uniquely within a table.
- **Foreign Key:** A field, within one table that matches the primary key of some other related table in the database.

DATABASE TERMINOLOGIES

- **Table:** A collection of records that contain the same fields.
- **Form :**Forms are used to add, modify or even view the data in underlying data tables
- **Query:** Queries are used to repeatedly retrieve database records that match specific criteria and to display them in a specific order. A **Query:** Is a question you ask about your data.
- **Report:** A document (printed or on screen) that presents information in a structured way.
- **Datasheet View:** A view of a database table where you see information presented in rows and columns, with several records visible at the same time.
- **Design View:** A view in which you can change the organizational structure of your table. You create an index in Design View
- **Relationships:** in database, a relationship is an association defined between fields in two or more data tables
- **Filtering:** Is a process of reducing the amount of information displayed by Access, either by showing fewer fields in each record, or by showing only those records that match certain criteria.



- **Form View:** A view in a database table that presents all or selected information from a single record only.
- **Grouped Report:** A report in which information is grouped by the values in one or more fields. Calculations may be performed on the data within each group

Schema: **The general structure (or plan) of the database.**

Alternative terminology

The terminology for the relational model can be quite confusing. The table below shows alternative terminology for database terms:

Alternative 1	Alternative 2	Alternative 3
File	Table	Relation
Record	Row	Tuple
Field	Column	Attribute

ELECTRONIC DATABASES Vs MANUAL DATABASES

Electronic databases allow the user to carry out the same tasks as **paper-based/manual** databases but with the following advantages:

- Increased speed
- Store very large amounts of data
- Allow for easy inputting and editing of data
- Automatic updating and recalculating of data
- Allow for easy searching and selection of data
- Format, arrange and present information in the way that you want it
- Share the information with other software applications/programs
- On networks, electronic databases allow you to share one set of information amongst many users and therefore reduce duplication
- Reduction of duplication prevents the problem of keeping several copies of the same data and easier data updates

TYPES OF ELECTRONIC DATABASES

Two types of electronic databases:



(i) Flat File Databases (FFD) and

(ii) Relational databases.

- **Flat File Databases (FFD)** – These are basically used for simple lists and may have duplications of data much like a simple record card system. FFDs consist of only one table.

File based systems include **Collection of application programs that perform services for the end users (e.g. reports)**. Each program defines and manages its own data.

Limitations of File-Based Approach

6. Separation and isolation of data: Each program maintains its own set of data, Users of one program may be unaware of potentially useful data held by other programs.

7. Duplication of data : Same data is held by different programs, Wasted space and potentially different values and/or different formats for the same item.

8. Changes to an existing structure are difficult to make due to program data dependence.

9. Incompatible file formats: Programs are written in different languages, and so cannot easily access each other's files.

10. Fixed Queries of application programs: Programs are written to satisfy particular functions, Any new requirement needs a new program.

(ii) Relational Databases (RDs)

These are databases where the data is held in a number of cross-referenced tables.

ADVANTAGES OF DBMS

Control of data redundancy: The database approach attempts to eliminate the redundancy by integrating the files so that multiple copies of the same data are not stored. For example: In case of college database, there may be the number of applications like General Office, Library, Account Office, Hostel etc. Each of these applications may maintain the following information into own private file applications:

It is clear from the above file systems, that there is some common data of the student which has to be mentioned in each application, like Rollno, Name, Class, Phone_No~ Address etc. This



will cause the problem of redundancy which results in wastage of storage space and difficult to maintain, but in case of centralized database, data can be shared by number of applications and the whole college can maintain its computerized data with the following database:

It is clear in the above database that Rollno, Name, Class, Father_Name, Address, Phone_No, Date_of_birth which are stored repeatedly in file system in each application, need not be stored repeatedly in case of database, because every other application can access this information by joining of relations on the basis of common column i.e. Rollno. Suppose any user of Library system need the Name, Address of any particular student and by joining of Library and General Office relations on the basis of column Rollno he/she can easily retrieve this information. Thus, we can say that centralized system of DBMS reduces the redundancy of data to great extent but cannot eliminate the redundancy because RollNo is still repeated in all the relations.

Data consistency: If a data item is stored only once in the database, any update to its value has to be performed only once and the new value is available immediately to all users. If a data item is stored more than once and the system is aware of this, the system can ensure that all copies of the item are kept consistent.

More information from the same amount of data: With the integration of the operational data, it may be possible for the organization to derive additional information from the same data. For example, in the file-based system illustrated in Figure 1, in this chapter, the Contracts Department does not know who owns a leased property. Similarly, the Sales Department has no knowledge of lease details. When we integrate these files, the Contracts Department has access to owner details and the Sales Department has access to lease details.

Sharing of data: Typically, files are owned by the people or departments that use them. On the other hand, the database belongs to the entire organization and can be shared by all authorized users. In this way, more users share more of the data.



Improved data integrity: Database integrity refers to the validity and consistency of stored data. Integrity is usually expressed in terms of constraints, which are consistency rules that the database is not permitted to violate.

Improved security: Database security is the protection of the database from unauthorized users. Without suitable security measures, integration makes the data more vulnerable than file-based systems. However, integration allows the DBA to define, and the DBMS to enforce, database security. This may take the form of user names and passwords to identify people authorized to use the database.

Economy of scale: Combining all the organization's operational data into one database, and creating a set of applications that work on this one source of data, can result in cost savings.

Improved data accessibility and responsiveness: Again, as a result of integration, data that crosses departmental boundaries is directly accessible to the end-users. This provides a system with potentially much more functionality that can, for example, be used to provide better services to the end-user or the organization's clients.

Improved maintenance through data independence

Increased concurrency: Many DBMSs manage concurrent database access, ensuring that two or more users are allowed to access the same file simultaneously, without interfering with each other, or resulting in loss of information or its integrity.

Improved backup and recovery services: modern DBMSs provide facilities to minimize the amount of processing that is lost following a failure.

DISADVANTAGES OF A DBMS ENVIRONMENT

Complexity: The provision of the functionality we expect of a good DBMS makes the DBMS an extremely complex piece of software. Database designers and developers, the data and database administrators, and end-users must understand this functionality to take full advantage of it.



Failure to understand the system can lead to bad design decisions, which can have serious consequences for an organization.

Size: The complexity and breadth of functionality makes the DBMS an extremely large piece of software, occupying many megabytes of disk space and requiring substantial amounts of memory to run efficiently.

Cost of DBMS: The cost of setting up DBMSs varies significantly, depending on the environment and functionality provided.

Additional hardware costs: The disk storage requirements for the DBMS and the database may necessitate the purchase of additional storage space, perhaps even a machine dedicated to running the DBMS. The procurement of additional hardware results in further expenditure

Cost of conversion: This includes the cost of converting existing applications to run on the new DBMS and hardware plus the cost of training staff to use these new systems, and possibly the employment of specialist staff to help with the conversion and running of the system.

Performance: Typically, a file-based system is written for a specific application, such as invoicing. As a result, performance is generally very good. However, the DBMS is written to be more general, to cater for many applications rather than just one. The effect is that some applications may not run as fast as they used to.

Higher impact of a failure: The centralization of resources increases the vulnerability of the system. Since all users and applications rely on the availability of the DBMS, the failure of certain components can bring operations to a halt.

DATABASE OBJECTS

Tables	Data is stored in tables.
Queries	You use queries to retrieve specific data from your database and to answer questions about your data.



Forms	Forms give you the ability to choose the format and arrangement of fields. You can use a form to enter, edit, and display data.
Reports	Reports organize or summarize your data so you can print it or view it onscreen. You often use reports when you want to analyze your data or present your data to others.
Macros	Macros give you the ability to automate tasks. You can use a macro to add functionality to a form, report, or control.
Modules	Like macros, modules give you the ability to automate tasks and add functionality to a form, report, or control.

COMMON DATA TYPES

- Access recognizes a number of different data types. The most important ones for our purposes are as follows: Text, Memo, Number, Date/Time, Currency, AutoNumber, and Yes/No.

Why use Microsoft Access?

- Microsoft Access is a relational database management system that together with Word, Excel, PowerPoint etc, makes up Microsoft Office Professional.
- It provides a powerful way of storing, sorting, manipulating and retrieving data.
- As it was developed by the same company that developed other packages in the Microsoft Office suite and so it has a familiar interface.
- The power of Access is that it is easy for beginners, using basic functions, to start developing simple databases straight away. It is also used for the development of sophisticated application systems.
- Access allow users to easily modify fields and tables after you have entered data.

