Al-Hikmah University, Ilorin

COS 102

INTRODUCTION TO PROBLEM SOLVING

DISTANCE LEARNING CENTRE
[HUI-DLC]

www.https://dlc.alhikmahuniversity

COS 102:
INTRODUCTION TO PROBLEM SOLVING 2UNIT (C)

CENTRE FOR DISTANCE LEARNING
AL-HIKMAH UNIVERSITY, ILORIN

HUI-DLC

Published by the Centre for Distance Learning,
Al-Hikmah University, Ilorin, Nigeria


Email: hui-dlc@alhikmah.edu.ng


Website: https://dlc.alhikmah.edu.ng

Courseware Development Team

Subject Matter Expert

ABDURAUF Tosho, PhD

Department of Computer Science

Al-Hikmah University, Ilorin, Nigeria

Instructional Designers

ODEYINKA Joseph Olayinka

Department of Educational Technology
Al-Hikmah University, Ilorin, Nigeria.

SAKA Kamil K., PhD
Department of Computer Science
Al-Hikmah University, Ilorin, Nigeria.

ADEBAYO Aminat O.
Department of Computer Science
Al-Hikmah University, Ilorin, Nigeria.

JIMOH-MAHMUD Aishat

Department of Computer Science
Al-Hikmah University, Ilorin, Nigeria

GIWA-RAHEEM Aolat O.

Department of Computer Science
Al-Hikmah University, Ilorin, Nigeria.

HENRY Buraimoh O.

Department of Computer Science
Al-Hikmah University, Ilorin, Nigeria

Language Editor

Abdulraheem HAMZA, PhD

Distance Learning Centre,
Al-Hikmah University, Ilorin, Nigeria

Vice-Chancellor's Remark

This publication is a manual of the courseware primarily designed by the Centre for Distance Learning (HUI-DLC) of Al-Hikmah University, Ilorin, Nigeria. In particular, this volume is a symbol of the University's commitment to e-learning and unrelenting efforts in making its instructional packages learner-friendly. The courseware is intended to give students of the University an unrestricted access to learning by breaking the barriers of physical distance. According to Marcus Specht, a Professor of Advanced Learning technology, "... students of the future will demand the learning support that is appropriate for their situation or context. Nothing more, nothing less". Those students have arrived here in Al-Hikmah University and the digital learning support is ready on their demand as this courseware is hosted on the HUI-DLC cloud space use at their convenience, even in the comfort of their homes and offices.

In appreciation of the strict limitation of space, this learning material equips the learners with learning support devices and guides that are well domesticated within the learning plan as dictated by the course design and set student's learning objectives (SLOs) of the course in particular and envisioned goals of the programme in general. The language is simple, lucid and accessible. The pictures and illustrative figures (including display of screens) in full colours are added assets that endear the text to readership of all categories. The complementary textual explanations have been done in a coherent manner such that the unintended ambiguities which may result from arbitrariness in the use of images and wordings are avoided.

The University's Management warmly appreciates this giant stride made by HUI-DLC team, while also expressing sturdy optimism that other arms of the University will follow suit in the noble direction of putting the University in the global fold of IT-compliant institutions of the 21st century.

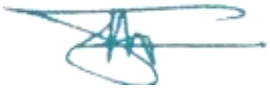
Professor Noah Yusuf
Vice-Chancellor, AL Hikmah University, Ilorin

Director's Foreword

To further attain the vision and mission of Al-Hikmah University in promoting academic and moral excellence, through appropriate learning for wisdom and morality. The Centre for Distance Learning (HUI-DLC) has designed courseware to capture, not only the different ages and time, but also a wide range of information that will reposition Nigeria, Africa and the world at large for the better.

The Centre operates under the leadership of the Vice Chancellor; **Professor Noah Yusuf.** It was established having realized the need to have capable hands to serve humanity as scholars and practitioners in all fields in line with international standards. The courseware have been carefully designed and structured to reflect new developments at the local and global levels, to enable the learners fit in anywhere in the world and be practitioners capable of shaping a better and safer world. The Centre for Distance Learning (HUI-DLC) is made up of competent, reliable and selfless scholars of national and international repute.

The Centre wishes you a blessed and rewarding academic journey in your field of study. This courseware contains course content, course information, course requirement, learning support devices, learning objectives and learning sections for your reading pleasure and assimilation.



Dr. Abdulrauf U. Tosho
Director, HUI-DLC

Table of Contents

Learning Guide

Learning Section 1

Characteristics of Computer and their application

Unit 1: Computer and its application

Learning Section 2

Introductory to Problem Solving

Unit 1: Understanding Problem Solving

Learning Section 3

Problem Solving tools in Software Development

Unit 1: Algorithm and Flowchart

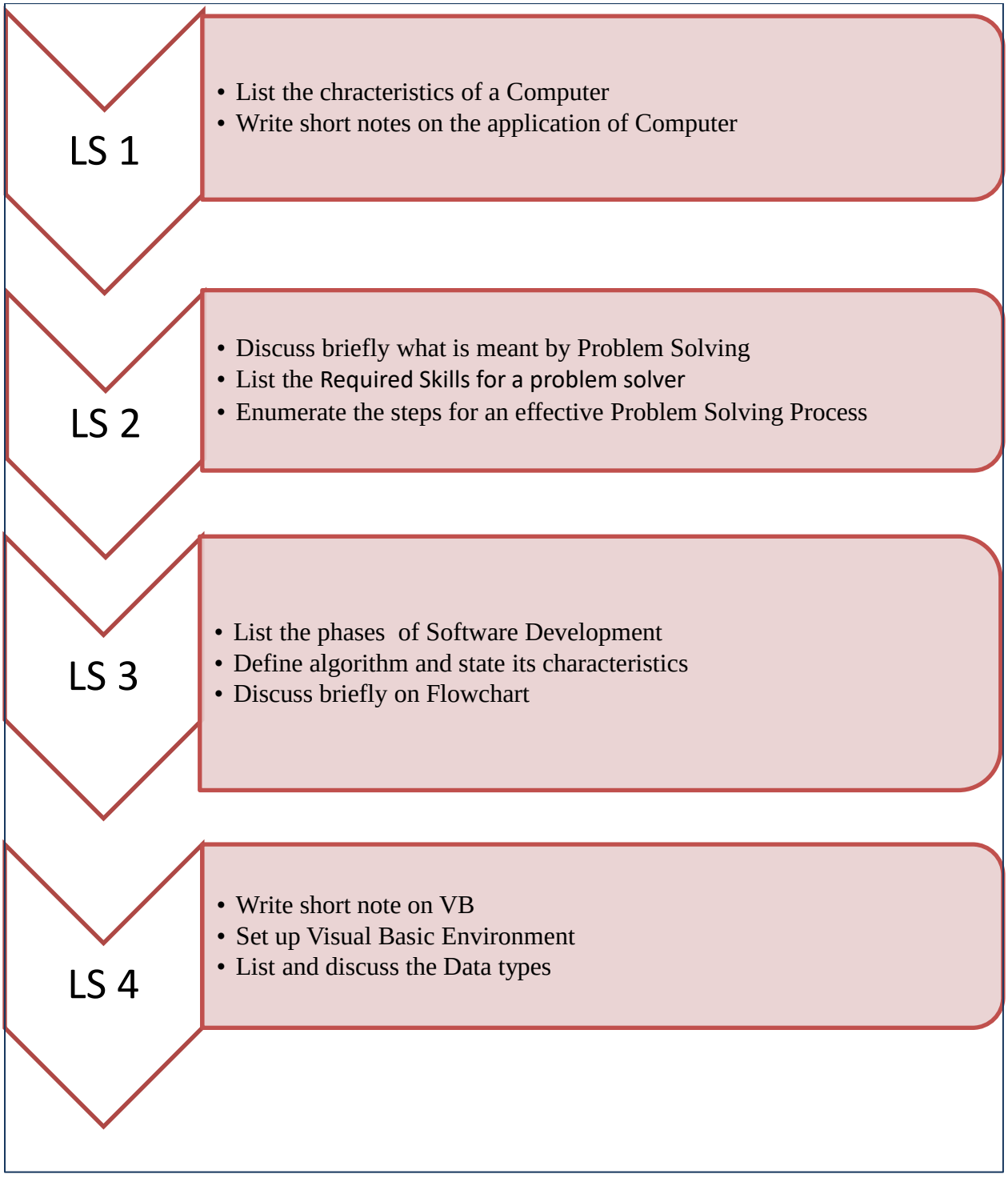
Learning Section 4

Visual Basic

Unit 1: introductory to Visual Basic (V6.0)

Student Learning Objectives (SLOs)

At the end of this course, you should be able to:



Course Information

Basic Characteristics of Computers and Computer Applications, Introduction to problem-solving, methods: algorithm development and flowcharting, stages in System Development Life Cycle, Concepts in BASIC Programming, Designing, coding, debugging and documenting programs using techniques of a good programming language style, Programming examples and questions for practice

Course Requirements: Attaining learning success

All learning relating to open distance learning approach is designed to cater for learners that are separated by space and time for the lecturer. Hence, learners are expected to gain access to learning content through electronic means which makes it imperative to download the instructional content for self-study at own pace with minimal interference from the course tutor.

This courseware is available on the Al-Hikmah University website at www.dlc.alahikmah.edu.ng and it is in printable format for instant access. It is important to note that this material is also packaged on removable storage devices to simplify and provide choice of accessibility and mobility of instruction.

Learners can as well visit the HUI-DLC Virtual Classroom at http://dlclms.alhikmah.edu.ng by logging in with their parameters, navigating the course of study and eventually clicking on the course code for download or read online.

Learners are expected to stick to the schedules of interaction periods and durations with tutors and as well take all the form of assessment as lined in the course outline. It is pertinent to note the concept of ‘open’ in distance learning that learners have the free will of learning time and period and could at the same time determines the examination period of their choice.

The major requirement for open and distance learning is the possession of electronic gadgets/devices for ease of access to all the forms of learning material for this course.

Learning Support Devices

In the attempt to interact with the learning content in the Al-Hikmah University HUI-DLC Learning Management System and the physical material, easy to identify icons have been put together to guide your learning through the courseware. Learners are required to familiarize themselves with each of these icons because it is going to provide fruitful assistance to achieving success in knowledge acquisition and achievement.

The icons are displayed along with their meaning as follows:

 **Introduction**	 **Learning Objectives**	 **Main Content**	 Summary
 Tutor Marked Assignment	 **Self-Assessment**	 **Open Education Resources**	 **Downloadable Material**
 Interaction Medium	 **Referencess**	 **Further Readings**	 **Self-Advancement**
 In-Text Question	 **In-Text Answer**	 **Youtube**	 **Podcast**

Grading Trend and Assessment

Learning Section 1:

Definition of Computer Science, Characteristics of Computer and their application

Units

Unit 1: Computer and its application

Unit 1: Computer and its Application

Introduction

This section introduces us to the definition of a computer and its application in various areas of business, education and engineering.

Student Learning Objectives

At the end of this unit, you should be able to:

i. Definition of Computer Science
ii. List the characteristics of a Computer
iii. Write short notes on the application of Computer

Main Content

COMPUTER

A computer system is a combination of physical tangible things like keyboards, mouse, monitors, internal circuits and communication media known as hardware while the intangible things like stored programs known as software. The two are related and interconnect with each other. Furthermore A computer is a device or set of devices that works under the control of a stored program that spontaneously accepts and processes data to supply information.

In educational institutions such as Computers can perform a task through these media:

Automatic: it performs instructions with least human intervention

Re-programmable: it stores instruction (the program)

A data processor: it performs operations on data (numbers or words) made up of a group of digits to generate information.

One of the key functions of computer is the execution of routine and administrative tasks such as the keeping of academic and administrative records on admissions, examinations, staffing and other routine functions.

In computer, data is the name given to raw facts. Information is the significant data that is relevant, accurate, and up to date and can be used to make decisions in a computer.

A computer accepts and then processes input data according to the instructions given. The element of any sort of processing is input, processing, storage, and output. This can be shown in the figure below:

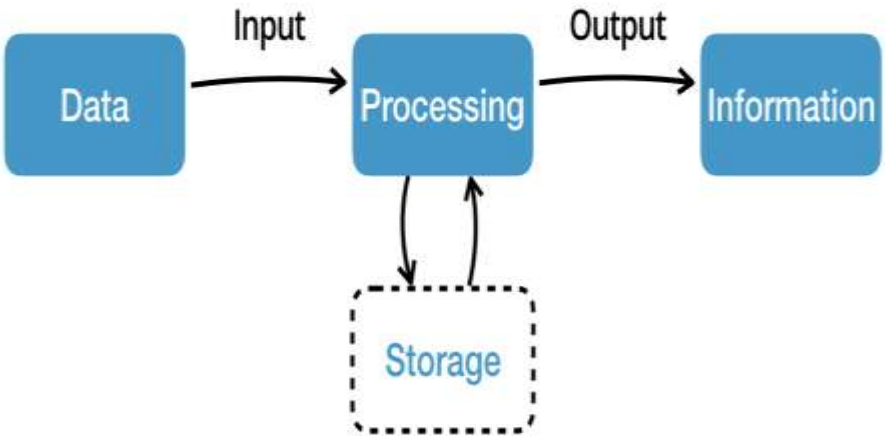


Figure 2: Data Processing Unit (Source: www.cseandeeehelp.blogspot.com)

A Computer operation is executed base on the programmed logical and arithmetical rules.

The arithmetical element might be as easier as x + y = z.

The logic will be something along the lines of if x + y does not equal z then add 3 to x and try again.

A Program can be defined as a set of coded instructions, which informs the computer of what to perform. For as much as the instructions are being carried out, they are normally held in the computer's internal storage or memory.

Application of Computers in Education

Computer has become a universal tool of any modern man (or woman). Literacy today is not defined only in terms of the ability to read and/or write but in addition, it includes the ability to use and communicate with the aid of computer. In the education sector, computers are being used to promote teaching and learning. The field of education provides the most fascinating application of computing system. This has consequently attracted considerable attention from educationist and policy makers since the late 1960s, when computers were introduced into the classroom. The entry of the computer into the classroom has now offered opportunities and possibilities for students to develop their potentials with computer-aided instructions packages.

Box 1.0


What is a Computer?

A Computer can be defined as an electronic device that can accept data as input, process data in order to generate the desired output using instructions (Program).

You should know that computers have been found to be very useful in different areas of human endeavor. Simply put, a computer is an electronic machine that receives data as input, processes and stores the data, and then provides output in a specified format.

As you see, every computer system, have some set of programs running on it. A program is a sequence of instructions that can be executed by a computer to solve some problem or perform a specified task.

Do you know that computers are pervasive these days and have been found to be useful in different sectors of the economy. For this reason, every professional in other disciplines requires some level of literacy in computing. Information and Communication Technology has advanced

greatly and it is important that as undergraduates you are well equipped with ICT know how that will enable you perform better on your job, career and day-to-day living. Our emphasis in this course is on problem solving in relation to computing. We want to remind every undergraduate taking this course to be well aware that in the course of your study and career after graduation, you will require using problem solving skills in various situations. For this reason, pay close attention to the concepts that will be taught therein. In particular, concepts on problem solving using computer systems.

Computer and its Characteristics

Before we go on, it is important to remind the learners of some basic characteristics of computers. This will serve as a reminder on why computers are becoming very popular as a tool in every profession for solving problems.

Some of the main characteristics of computers include:

- Speed-computer systems process data at a very good speed
- Accuracy- computer systems have high level of accuracy once they are fed with the correct data
- Versatility-Computers are versatile
- Electronic in nature-Computer systems are electronic in nature
- Repetitiveness- Computers have the ability to perform tasks in repeated manner without being tired.

Figure 2: Computer and its Characteristics

Areas of Application of Computers

I should let you know that there are uncountable application areas of computers. Different disciplines and sectors have a wide range of applications in which they use computer systems for, on daily basis. The list included herein does not mean the exhaustive. Some of them are as listed and discussed below:

1. Businesses

You should know that computers are widely used in businesses. For instance, Businessmen make bar graphs and pie charts from tedious figures to convey information with far more impact than numbers alone can covey. Furthermore, computers help businesses to predict their future sales, profits, costs etc. making companies more accurate in their accounts. Thus, computers are used for decision making in businesses.

2. Building and Construction Engineering

Did you know that Architects use computer animated graphics to experiment with possible exteriors and to give clients a visual walk-through of their proposed buildings? The computers provide architects numerous amounts of facilities to create different buildings with greater accuracy.

3. Education

Today, Computers and ICT infrastructure are used in different areas of education. For instance, we use computers for testing purposes. They are also used for teaching, learning and research purposes. Computer systems have been fully integrated into schools at all levels for learning purposes. Most schools in the world have computers available for use in the classroom. It has been proved that learning with computers has been more successful and this is why numerous forms of new teaching methods have been introduced. This enhances the knowledge of the students at a much faster pace than the old traditional teaching methods.

4. Oil and Gas Sector

I should let you know that Energy companies use computers to locate oil, coal, natural gas and uranium. With the use of these technological machines, these companies can figure out the site of a natural resource, its concentration and other related figures. Electric companies use computers to monitor vast power networks. In addition, meter readers use hand held computers to record how much energy is used each month in homes and offices.

5. Law Enforcement

Be informed that computers have been widely used in Law and Justice sector. Recent innovation in computerized law enforcement includes national fingerprint files, a national file on the mode of operation of serial killers, and computer modeling of DNA, which can be used to match traces from an alleged criminal's body, such as blood at a crime scene. In fact, computers have been widely used to store and manage people with criminal records.

6. Transportation

Let me informed you that Computers are used in cars to monitor fluid levels, temperatures and electrical systems. Computers are also used to help run rapid transit systems, load containerships and track railroads cars across the country. An important part is the air control traffic systems, where computers are used to control the flow of traffic between airplanes which needs a lot of precision and accuracy to be dealt with.

7. Banking Sector

You should be aware that Computers speed up record keeping and allow banks to offer same-day services and even do-it yourself banking over the phone and internet. Computers have helped fuel the cashless economy, enabling the widespread use of credit cards, debit cards and instantaneous credit checks by banks and retailers. There is also a level of greater

security when computers are involved in money transactions as there is a better chance of detecting forged cheques and using credit/debit cards illegally etc.

8. Agriculture

Farmers use computers to help with billing, researches, crop information, and cost per acre, feed combinations, and market price checks. Cattle ranchers can also use computers for information about livestock breeding and performance.

9. Learning and Entertainment tools at homes

People having computers in their homes justify the fact that it is not only useful and efficient, but it is also revered as a learning system. Personal computers are being used for tasks such as to keep records, write letters and memos, prepare budgets, produce presentations, draw pictures, publish newsletters and most importantly - connect with other in the rest of plant earth.

10. Health Sector (Medicine)

I will like to inform you that Computers are helping immensely to monitor thee extremely ill in the intensive care unit and provide cross-sectional views of the body. This eliminates the need for hired nurses to watch the patient twenty-four hours a day, which is greatly tiring and error prone. Doctors use computers to assist them in diagnosing certain diseases of the sort. This type of computer is called the Expert System, which is basically a collection of accumulated expertise in a specific area of field. Furthermore, computers are used greatly in managing patients, doctors, wards and medicine records, as well as deal with making appointments, scheduling surgeries and other likes.

11. Manufacturing Industries

Computers are widely used in manufacturing industries. have made their way towards jobs that were unpleasant or too dangerous for humans to do, such as working hundreds of feet below the earth or opening a package that might contain an explosive device. In other industries, computers are used to control the production of resources very precisely. All the stages of manufacturing, from designing to production, can be done with the use of computer technology with greater diversity.

12. Computers are used in Scientific Research

Computers are also used for scientific researches. Because of high-speed characteristics of computer systems, researchers can simulate environments, emulate physical characteristics and allow scientists to proof of their theories in a cost-effective manner.

Summary

In this Study Session, you have learnt that:

1. Computer is an electronic machine that receives data as input, processes and stores the data, and then provides output in a specified format.
2. Characteristics of a Computer are:
    i. Speed
    ii. Accuracy
    iii. Versatility
    iv. Electronic in nature
    v. Repetitiveness
3. Some of the areas in which computer technology are applied are:
    i. Business
    ii. Education
    iii. Engineering
    iv. Oil and Gas sector
    v. Law enforcement agencies.

Tutor Marked Assignment

i. What are the generations of computer?

ii. Categorize the generations of computer in terms of Speed

Self-Study Assessment

Now that you have completed this Study Session, you can assess how well you have achieved its Learning outcomes by answering the following questions.

i. Discuss the application of Computer in education.
ii. What is the effect of computer to the Transportation Sector?
iii. Explain the term Repetitiveness as a characteristic of a computer

Further Readings

1. Akinyokun, O.C. (1999). *Principles and Practice of Computing Technology*. Ibadan: International Publishers Limited.
2. Balogun,V.F., Daramola, O.A. Obe, O.O. Ojokoh, B.A., and Oluwadare S.A. (2006). *Introduction to Computing: A Practical Approach.*Akure: Tom- Ray Publications.

References

1. Brookshear, J. G. (2015). Computer Science: An Overview (12th ed.). Pearson Education.
2. Dale, N. B., & Lewis, J. (2016). Computer Science Illuminated (6th ed.). Jones & Bartlett Learning.
3. Forouzan, B. A., & Gilberg, R. F. (2017). Computer Science: A Structured Approach (2nd ed.). Cengage Learning.
4. Klein, D. (2017). Computer Science for Dummies (2nd ed.). Wiley Publishing.
5. Stalin, C. (2017). Introduction to Computer Science (2nd ed.). Cengage Learning.

Learning Section 2:

Introductory to Problem Solving

Units

Unit 1: Understanding Problem Solving

Unit 1: Understanding Problem Solving

Introduction

This section introduces us to problem solving, thus problem solving is the process of identifying a problem, developing an algorithm for the identified problem and finally implementing the algorithm to develop a computer program.

Student Learning Objectives

At the end of this unit, you should be able to:

i. Discuss briefly what is meant by Problem Solving

ii. List the Required Skills for a problem solver

iii. Enumerate the steps for an effective Problem-Solving Process

Main Content

Problem Solving- An Explanation

Do you know that problem solving is an integral part of Computer Science? Computer is used as a problem-solving tool in both public and private organizations. This statement is a testimony to the rate at which computer and ICT solutions are used for driving services and operations of government and private establishments in Nigeria and beyond. From different sectors of the economy, computers are being put to use. They are used for manufacturing, educating, researching, distributing, and increasing productivity.

Let me inform you that Problem solving is the process of identifying a problem, developing possible solution paths, and taking the *appropriate course of action.* While solving problems in real life or developing a software application, set up a network, troubleshoot a computer problem (hardware or software) we engage in problem solving. The problem solver is expected to make use of some skills and techniques while solving problems.

More importantly, a good understand of problem solving enables us to use computers in addressing several problems that you will be encountering in the day-to-day discharge of your duties. This is because problems are at the center of what many people do at work every day. Whether you're solving a problem for a client (internal or external), supporting those who are solving problems, or discovering new problems to solve, the problems you face can be large or small, simple or complex, and easy or difficult.

You should know that Problem solving is a crucial part of Computer Science and/or computing. It is required that when you intend using any ICT tools or techniques, the problems you intend using them for are important. It is the act of defining a *problem*; determining the cause of the *problem*; identifying, prioritizing, and selecting alternatives for a solution; and implementing a solution.

Problem-solving is necessary on every job. It is important that students develop the skills to resolve problems and have the personal resilience to meet the challenges and pressure that may be the result of a problem. Problem-solving requires a variety of both analytical and creative thinking skills which are used depends on the role in the organization and the problem.

What are Problem-Solving Skills?

I should let you know that it has been proven that the ability to solve problems is a basic life skill and is essential to our day-to-day lives, at home, at school, and at work. We solve problems every day without really thinking about how we solve them. Problem solving skills may be grouped into soft skill and hard skill. Considered a soft skill (a personal strength, as opposed to a hard skill that is learned through education or training), an aptitude for creative and effective problem-solving is nonetheless one of the most valued attributes employers seek in their job candidates.

For example, a cable television technician might be trying to resolve a customer problem with a weak signal. A teacher might need to figure out how to improve the performance of her students on a writing proficiency test. A store manager might be trying to reduce theft of merchandise. A computer specialist might be looking for a way to speed up a slow program.

Required Skills for a problem solver

Some of the required skills that a problem solver is expected to have include:

i. Active Listening
ii. Data Gathering
iii. Data Analysis
iv. Fact Finding
v. Historical Analysis
vi. Causal Analysis
vii. Process Analysis
viii. Needs Identification

Some good examples of real-life problems that can be attended to using problem solving skills are: Diagnosing Illnesses, Identifying the Causes for Social Problems, Interpreting Data to Determine the Scope of Problems, Pinpointing Behaviors Contributing to Marital Distress, Recognizing Invalid Research Models

Problem Solving and Decision making

Be informed that Problem-solving and decision-making do go pari-pasu. This is because; a problem solver is providing a solution to a particular problem in his domain with a view to making useful decision. Ask anyone in the workplace if these activities are part of their day and they answer 'Yes!' But how many of us have had training in problem-solving? We know it's a critical element of our work, but do we know how to do it effectively?

Do you know that people tend to do three things when faced with a problem: they get afraid or uncomfortable and wish it would go away; they feel that they have to come up with an answer and it has to be the right answer; and they look for someone to blame. Being faced with a problem becomes a problem. And that's a problem because, in fact, there are always going to be problems!

Also, there are two important things to remember about problems and conflicts: they happen all the time and they are opportunities to improve the system and the relationships. They are actually providing us with information that we can use to fix what needs fixing and do a better job. Looked at in this way, we can almost begin to welcome problems!

Seven-Steps for an Effective Problem-Solving Process

Below are some of the key steps that can be taken in every problem-solving process.

1. Identify the issues.

Be clear about what the problem is.

Remember that different people might have different views of what the issues are.

Separate the listing of issues from the identification of interests.

2. Understand everyone's interests.

This is a critical step that is usually missing.

Interests are the needs that you want satisfied by any given solution. We often ignore our true interests as we become attached to one particular solution.

The best solution is the one that satisfies everyone's interests.

This is the time for active listening. Put down your differences for a while and listen to each other with the intention to understand.

Separate the naming of interests from the listing of solutions.

3. List the possible solutions

This is the time to do some brainstorming. There may be lots of room for creativity.

Separate the listing of options from the evaluation of the options.

4. Evaluate the options.

What are the pluses and minuses?

Separate the evaluation of options from the selection of options.

5. Select an option or options.

What's the best option, in the balance?

Is there a way to "bundle" a number of options together for a more satisfactory solution?

6. Document the agreement(s).

Don't rely on memory.

Writing it down will help you think through all the details and implications.

7. Agree on contingencies, monitoring, and evaluation.

Conditions may change. Make contingency agreements about foreseeable future circumstances (If-then!).

How will you monitor compliance and follow-through?

Create opportunities to evaluate the agreements and their implementation.

Summary

In this Study Unit, you have learnt that:

1. Problem solving is an integral part of Computer Science, computer is used as a problem solving tool in both private and public organizations.
2. Problem solving is the process of identifying a problem, developing possible solution paths, and taking the appropriate course of action.
3. Some of the required skills that a problem solver is expected to have include:
    a. Active Listening
    b. Data Gathering
    c. Data Analysis
    d. Fact Finding
    e. Historical Analysis
    f. Causal Analysis
    g. Process Analysis
4. Effective steps for problem solving processes are
    a. Identify the issue
    b. Understand everyone's interest
    c. List the possible solution
    d. Evaluate the options
    e. Select an option for options
    f. Document the agreement
    g. Agree on contingencies, monitoring and evaluation.

Tutor Marked Assignment

1. List some of the real life problems that can be attended to using problem solving skills.

Self-Study Assessment

Self-Assessment Questions for Learning Section 2: Now that you have completed this Learning Section, you can assess how well you have achieved its Learning outcomes by answering the following questions.

1. List and explain any five areas of applications of computers in your discipline.
2. As a young Nigerian university undergraduate, identify how computers have helped you in learning.

Further Readings

1. Mueller, J., Beckett, D., Hennessey, E., & Shodiev, H. (2017). Assessing computational thinking across the curriculum. In *Emerging research, practice, and policy on computational thinking*(pp. 251-267). Springer, Cham.
2. Saygılı, S. (2017). Examining the problem solving skills and the strategies used by high school students in solving non-routine problems. *E-International Journal of Educational Research*, *8*(2), 91-114.
3. Spielman, R. M., Dumper, K., Jenkins, W., Lacombe, A., Lovett, M., & Perlmutter, M. (2021). Problem Solving. *Psychology-H5P Edition*.

References

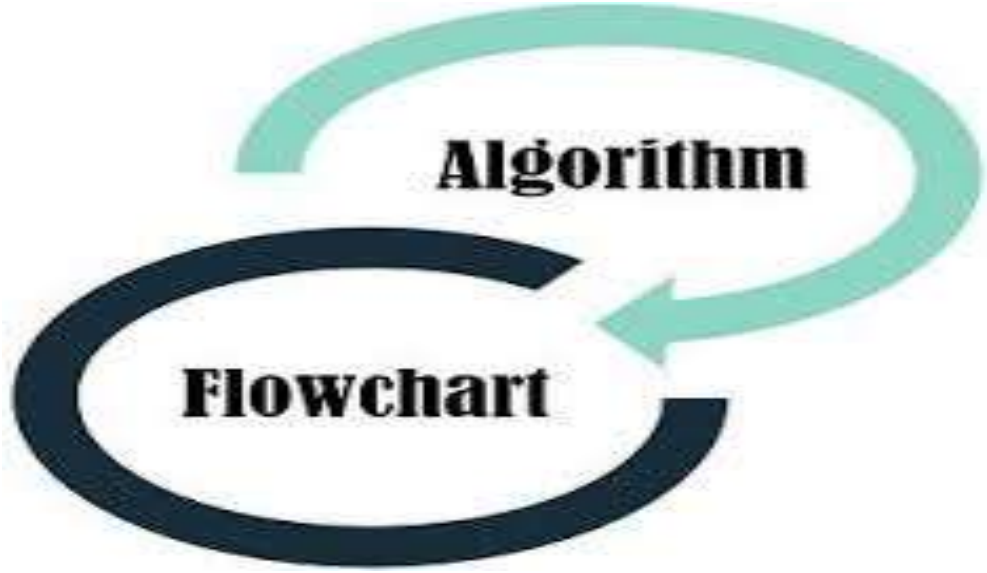
1. Polya, G. (2014). How to Solve It: A New Aspect of Mathematical Method (2nd ed.). Princeton University Press.
2. Wing, J. M. (2006). Computational Thinking. Communications of the ACM, 49(3), 33-35.
3. Harel, D. (2012). Algorithmics: The Spirit of Computing (3rd ed.). Addison-Wesley.
4. Gries, D. (2018). A Logical Approach to Discrete Math (2nd ed.). Springer.
5. Weiss, M. A. (2018). Data Structures and Algorithm Analysis in C (4th ed.). Pearson Education.
6. Tambunan, H. (2019). The Effectiveness of the Problem Solving Strategy and the Scientific Approach to Students' Mathematical Capabilities in High Order Thinking Skills. *International Electronic Journal of Mathematics Education*, *14*(2), 293-302.
7. Yağcı, M. (2019). A valid and reliable tool for examining computational thinking skills. *Education and Information Technologies*, *24*(1), 929-951.
8. Zhao, N., Teng, X., Li, W., Li, Y., Wang, S., Wen, H., & Yi, M. (2019). A path model for metacognition and its relation to problem-solving strategies and achievement for different tasks. *ZDM*, *51*(4), 641-653.

Learning Section 3:

Problem Solving tools in Software Development

Units

Unit 1: Algorithm and Flowchart



Unit 1: Algorithm and Flowchart

Introduction

The algorithm and flowchart are two types of tools to explain the process of a program. Algorithms and flowcharts are two different tools that are helpful for creating new programs, especially in computer programming. An algorithm is a step-by-step analysis of the process, while a flowchart explains the steps of a program in a graphical way.

Student Learning Objectives

At the end of this unit, you should be able to:

i. List the phases of Software Development
ii. Define algorithm and state its characteristics
iii. Discuss briefly on Flowchart

Main Content

PROBLEM SOLVING TOOLS IN SOFTWARE DEVELOPMENT

In the field of Computer Science, there are various problem-solving tools that are widely used. In the area of modeling and developing an application (desktop, mobile or server-based), we make use of problem-solving skills and tools. This is because such a task requires some approaches. Some of the tools used include: Algorithm, Flowchart, Unified Modeling Language (UML), Decision tables and so on.

Note: In the context of this course, only Algorithm and Flowchart will be covered at this introductory level

While developing software, there are stages that the software product (program) must pass through. The stages are generally called Software Development Life Cycle (SDLC).

The phases of Software Development Life Cycle are:

1. **Problem Definition/User Requirement Analysis**
2. **Program Design**
3. **Program coding/System coding**
4. **Program Testing and Debugging**
5. **Program/System Implementation**
6. **System Evaluation and Maintenance**
7. **Algorithm/Flowchart as Problem Solving Tools**

Understanding these stages are is very important. Moreover, while providing solutions to a wide range of IT problems, problem solving tools can be used. Algorithm and Flowchart are being introduced herein as problem solving tools that can help drive varying solutions.

ALGORITHM

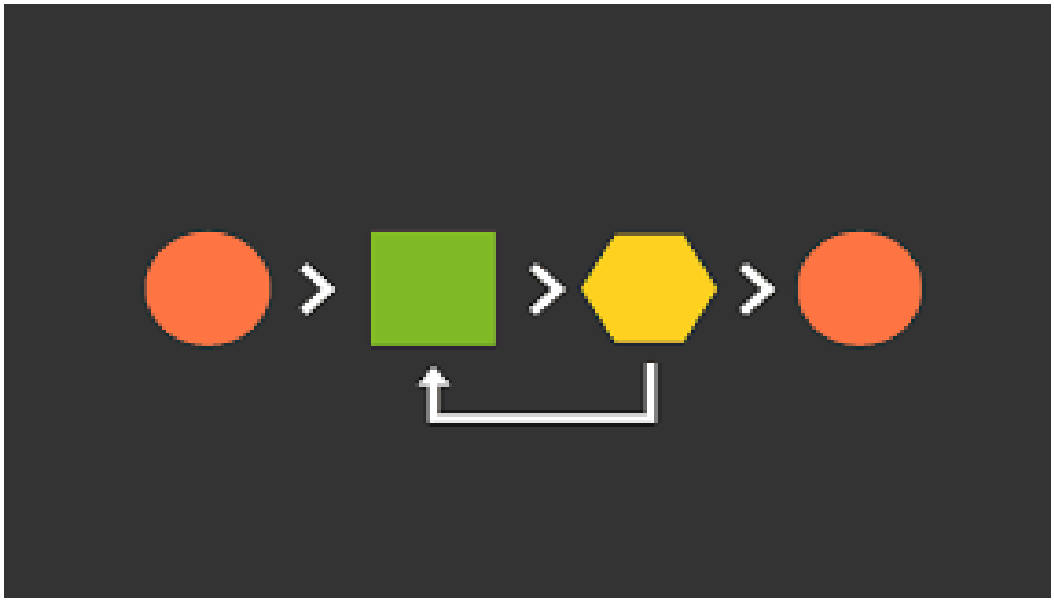


Figure 3: Algorithm tool

An algorithm can be defined as the step-by-step procedure for solving a given problem. An algorithm clearly spells out how a solution to a particular problem is achieved.

Characteristics of a good Algorithm

(i) A good algorithm must be exact in the process of providing solutions to the problem

(ii) A good algorithm must not be ambiguous. That is, the algorithm must be clear enough.

(iii) A good algorithm must be finite. This statement means that a good algorithm must have a beginning and an end. It must not run indefinitely.

(iv) Input- a good algorithm must have a given set of input to be worked upon

(v) Output- A good algorithm must have a given set of output to be generated

What a Problem Solver does

A problem solver can make use of algorithm as a tool. This is because the problem solver thinks critically and is able to list out the various steps, he will use to accomplish a given task or solve a give problem. A problem solver should be able to think critically on problem he intends solving. He is expected to think out of the box in the process of getting a solution provided to an issue. It is expected that a problem solves able to identify the possible approaches for providing solution to the problem at hand.

Example of Algorithm as a problem-solving tool

//This is an algorithm to compute the area of a circle

Step I: Start

Step II: Initialize Pi=3.142

Step III: Enter radius of the circle

Step IV: Compute Area=Pie * square of radius

Step V: Print Area

Step VI: Stop

Another Example of an Algorithm to enter surname, firstname, middlename, faculty, department, gender and age of a student is as shown below:

//An algorithm to accept and display details of a student

Step I: Start

Step II: Input surname

Step III: Input firstname

Step IV: Input middlename

Step V: Input faculty

Step VI: Input department

Step VII: Input gender

Step VIII: Input age

Step IX: Print surname, firstname, middlename,faculty,department,gender,age

Step X; Stop

// **This is another example on Algorithm computing sum of integers**

Start

Sum= 0

For m= 1 to 20

Sum= sum+m

Next m

print sum

End

Question for illustrating the above program

Supposing you are asked to carry out dry running of the above algorithm, what values will you obtain? This question can be tackled by using the appropriate program tracing.

If you look at the program very closely, you will realize that the program involves add integer values from 1 to 20. The initial value is 1 while the last value is 20. FOR LOOP was used to handle the summation from 1 to 20.

M	Sum
-	0 (initial sum)
1	1
2	3
3	6
4	10
5	15
6	21
…	
20	Compute the remaining values upto when m=20

Note: Different problems require the use of appropriate approaches while designing algorithms. For instance, some problems may require you to test for conditions and thus you will need to use control structures such as IF statement, IF THEN ELSE or IF THEN ELSE IF statements.

During lectures, efforts will be made to explain these further.

FLOWCHART

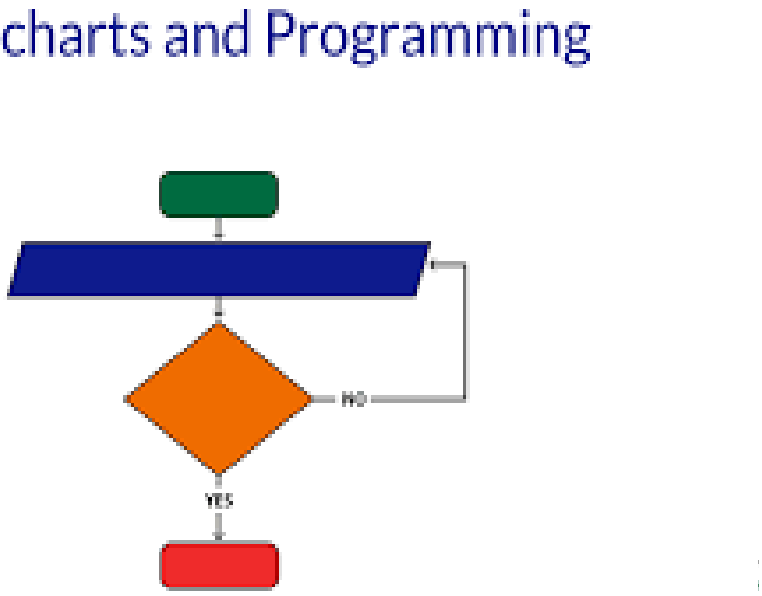


Figure 4: Flowchart tool

A flowchart is the pictorial representation of an algorithm. That is a flowchart refers to as the diagrammatic representation of steps followed in solving a given problem. A problem solver should be able to sketch an acceptable flowchart for a problem, the different flowchart symbols must be understood.

Benefits/Advantages of Flowcharting in Problem Solving

(i) Visual Clarity. One of the biggest benefits of a flowchart is the tool's ability to visualize multiple progresses and their sequence into a single document.

(ii) Instant Communication

(iii) Effective Coordination

(iv) Efficiency Increase

(v) Effective Analysis

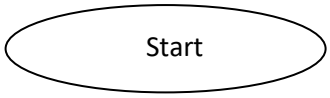
(vi) Problem Solving

(vii) Proper Documentation

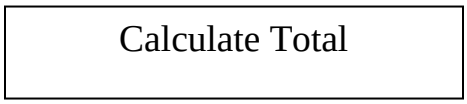
To be able to draw a flowchart for a given problem, flowchart symbols are used. The designer is expected to master the problem he wants to solve and then use flowchart symbols for the design.

Examples of these flowchart symbols include:

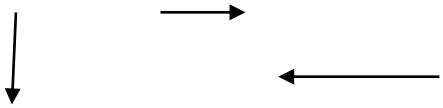
Terminal Symbol-This is the symbol that is used to indicate the beginning and ending of a flowchart.



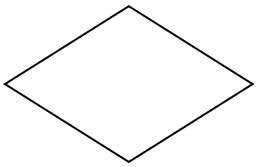
Processing Symbol-This is the symbol that is used to denote processing and computational activities.



Flow Arrow-This is the symbol that is used to indicate the direction in which a particular operation is going.



Decision Symbol-This is the flowchart symbol that is used while making decision.

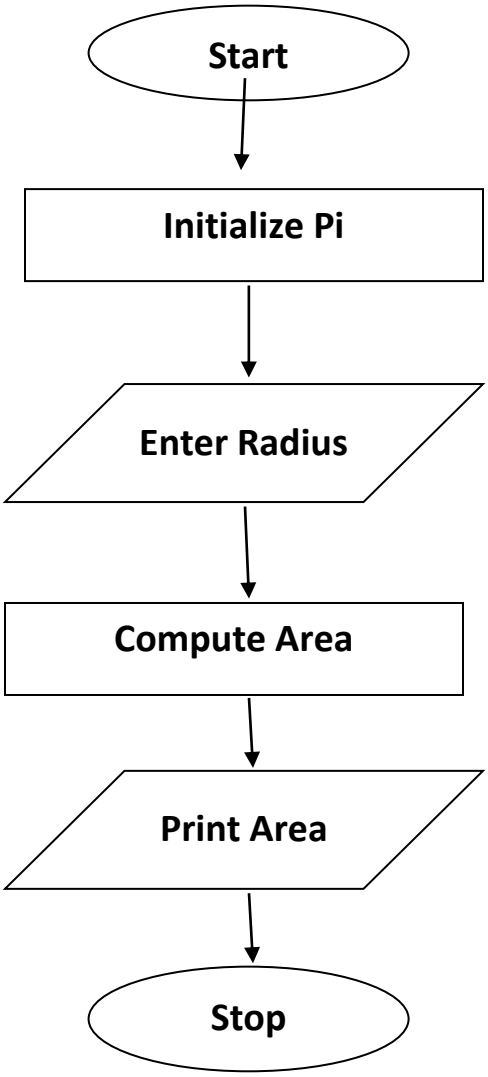


Input and Output Symbol-This is the kind of symbol that is used for feeding the computers with the set of needed inputs. The symbol is equally used for generating outputs.

Connector-This is used to join a flowchart diagram from one page to another. It should be properly labelled so as to avoid confusing the user of the diagram.

In every problem that requires the drawing of a flowchart, the problem solver must take his time to study the logic involved. This will enable him/her to know which of the symbols will be used for the different stages in getting the problem solved.

Flowchart for the computation of area of a circle

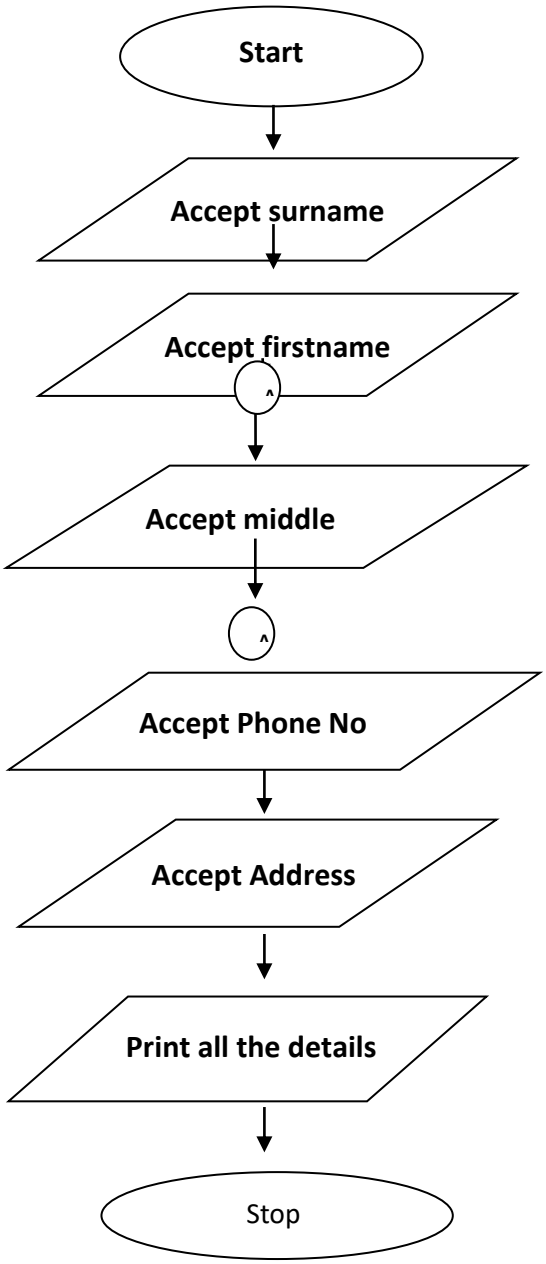


Another example

Design a flowchart that can be used to accept surname, firstname, middlename, gender, phone number and address of a patient at XYZ Hospital

Solution

When you look at this problem, we are using flowchart to capture and print the personal details of a patient in the hypothetical hospital



If you look at the flowchart provided, you will realize that the solution to the problem has been provided.

Note: Once a proper algorithm or flowchart is designed, it can be implemented using a choice programming language.

Recall that examples of High Level Programming Language include: Java, C#, PASCAL, FORTRAN, C, C++, Python, Scala, Delphi, and so on.

Introduction Programming Language Concepts

As part of solving problems, programming languages are used in computing. There are tens of thousands of programming languages. It is important for a problem solver to be familiar with some concepts that will help them use the languages in providing programming solutions or developing programs.

To understand programming languages better, it may be necessary to have mastery of some of the basic concepts. The list of programming language concepts is numerous. Some of them are:

Program

Syntax

Syntax Error

Translator (Compiler, Interpreter and Assembler)

Logical Error

Loop

Data Types

Looping

Identifier-this can be a variable name, a function name and so on.

Constant

Control Structures

Program logic

Functions (In-built function, user-defined function) and many others.

Lets briefly explain few of these concepts. Others will be discussed during lectures.

Program- A program is the set of instructions that tells the computer system how to perform a given task.

Syntax-This simply refers to as the set of rules which have to be followed while writing a valid program statement in the chosen programming language. For instance, the language we are using in this course is BASIC (Visual BASIC 6). As a way to be able to use the language to develop applications, the syntax of the language must be mastered.

If you intend entering a values in VB 6 environment, you make use of InputBox function and so on.

Syntax Error- This is defined as the type of errors that occurs when the syntax of a programming language is violated.

Translator- A translate is defined as the type of software that is used to convert a program written in high level or low level language to machine language. This translator is of three types, namely: Assembler, Interpreter and Compiler.

Low Level Language (Assembly Language) uses Assembler. That is an assembler converts low level language source codes to machine code.

Interpreter-This is the type of translator that converts program written in high level language to machine code, statement by statement (or one-by-one)

Compiler-This is the type of program translator that converts program written in High Level Language to machine code all at once. It is faster when compared to the interpreter.

Note: Some of the terms listed above and others will be defined in the course of treating topics under which they are relevant. The language we are introducing you to in this course is a good example of High Level Language.

Computer Programming is the act of coding instructions for computer to carry out. Providing solution to a problem is achieved with the use of suitable programming language. The choice of a programming language for a given problem depends on a number of factors. These factors include:

a. **the programming needs,**
b. **the domain of the problem (education, enterprise, hospitality, banking, e.t.c)**
c. **the ease of use of the programming language**
d. **the level of education/technical expertise of the programmer**
e. **among others.**

There are three levels of programming languages. They are:

1. Machine Language;
2. Low Level Language (LLL) or Assembly Language and
3. High Level language (HLL).

Examples of High-Level Languages are: BASIC, FORTRAN, Scala, C++, C. PASCAL, Ada, Python, Java, Smalltalk, Delphi, and so on.

More so, programming languages can be classified into Imperative, Functional, Structured, Object-Oriented programming languages and so on. Object Oriented Programming is a programming method that combines data and instructions for processing that data into a self-sufficient 'object' that can be used within a program or in other programs. In OOP, Objects are modeled on real world entities. This enables modeling complex systems of real world into manageable software solutions.

These languages are written using human language and have their well-defined syntaxes. A programmer in whatever level has to obey the syntax of the chosen language he/she wants to use to develop the targeted applications/software.

Summary

In this Study Unit, you have learnt that:

1. The phases of Software Development Life Cycle are:
   Problem Definition/User Requirement Analysis
   Program Design
   Program coding/System coding
   Program Testing and Debugging
   Program/System Implementation
   System Evaluation and Maintenance
   Algorithm/Flowchart as Problem Solving Tools

2. An algorithm can be defined as the step-by-step procedure for solving a given problem. An algorithm clearly spells out how a solution to a particular problem is achieved
3. Characteristics of a good Algorithm
   a. A good algorithm must be exact in the process of providing solutions to the problem
   b. A good algorithm must not be ambiguous. That is, the algorithm must be clear enough.
   c. A good algorithm must be finite. This statement means that a good algorithm must have a beginning and an end. It must not run indefinitely.
4. A problem solver can make use of algorithm as a tool.

5. A flowchart is the pictorial representation of an algorithm. That is a flowchart refers to as the diagrammatic representation of steps followed in solving a given problem.
6. Some of the benefit of flowcharting are:
    a. Efficiency Increase
    b. Effective Analysis
    c. Problem Solving
7. Components of a flowchart are:
    a. Terminal symbol
    b. Processing symbol
    c. Flow arrow
    d. Decision symbol
    e. Input and Output symbol and,
    f. Connector

Tutor Marked Assignment

1. List the various programming language concept

Self-Study Assessment

Self-Assessment Questions for Learning Section 2: Now that you have completed this Learning Section, you can assess how well you have achieved its Learning outcomes by answering the following questions.

1. Define translator
2. List the component of a flowchart
3. Differentiate between Algorithm and Flowchart
4. Design a **Flowchart** and an **Algorithm** that can be used to accept surname, first name, middle name, gender, phone number and address of a patient at XYZ Hospital

Further Readings

1. Kirn, A., & Benson, L. (2018). Engineering students' perceptions of problem solving and their future. *Journal of engineering education*, *107*(1), 87-112.
2. Koren, I. (2018). *Computer arithmetic algorithms*: AK Peters/CRC Press. doi:10.3389/frhum.2018.00261.
3. Price, A. M., Kim, C. J., Burkholder, E. W., Fritz, A. V., & Wieman, C. E. (2021). A detailed characterization of the expert problem solving process in science and

engineering: Guidance for teaching and assessment. *CBE—Life Sciences Education*, *20*(3), ar43.

References

1. Pressman, R. S. (2020). Software Engineering: A Practitioner's Approach (9th ed.). McGraw-Hill Education.
2. Sommerville, I. (2016). Software Engineering (10th ed.). Pearson Education.
3. Ghezzi, C., Jazayeri, M., & Mandrioli, D. (2013). Fundamentals of Software Engineering (3rd ed.). Prentice Hall.
4. Kurt Jensen, W. (2019). Coloured Petri Nets: Basic Concepts, Analysis Methods and Practical Use (5th ed.). Springer.
5. Shaffer, C. A. (2019). Data Structures and Algorithm Analysis in Java (3rd ed.). Dover Publications.
6. Sarathy, V. (2018). Real world problem-solving. *Frontiers in human neuroscience*, *12*, 261
7. Spielman, R. M., Dumper, K., Jenkins, W., Lacombe, A., Lovett, M., & Perlmutter, M. (2021). Problem Solving. *Psychology-H5P Edition*.

Learning Section 4:

Visual Basic

Units

Unit 1: introductory to Visual Basic (V6.0)

Unit 1: Introductory to Visual Basic

Introduction

Visual Basic is a third-generation event-driven programming language first released by Microsoft in 1991. It evolved from the earlier DOS version called. BASIC. **BASIC** means **B**eginners' **A**ll-purpose **S**ymbolic **I**nstruction **C**ode. In this section you will be introduced into the environment of VB.

Student Learning Objectives

At the end of this unit, you should be able to:

i. Write short note on VB
ii. Set up Visual Basic Environment
iii. List and discuss the Data types

Main Content

INTRODUCTORY PROGRAMMING IN VISUAL BASIC

i. BASIC is a High-level programming language,

ii. BASIC is a procedural programming language

iii. It produces efficient programs

iv. BASIC is Easy to learn and use for programming problems

v. It is a good example of interpreted programming language. That is, it makes use of an interpreter

Note:

I should informed you that while writing programs in BASIC or any other language, efforts should be made to have a good understanding of the syntaxes of the language. Syntax simply means the set of rules that have to be followed while writing valid program statement in the language. When the syntax of the language is violated, we have what is called syntax error.

BASIC has several versions and has evolved over years. Examples of versions of BASIC that we have include: *Standard BASIC, Quick Basic, GW BASIC, Visual BASIC (V6, VB.NET. VB2010, VB2013 and so on).*

BASIC (Beginners' All-purpose Symbolic Instruction Code) is a family of general-purpose, high-level programming languages whose design philosophy emphasizes ease of use. The version of BASIC programming language that we recommend for practicing the art of problem solving in this is Visual BASIC. It is a third-generation event-driven programming language released by Microsoft Corporation for its Component Object Model programming model first released in 1991 and is still being used to introduce students to the art of visual programming.

Figure 5: Visual Basic Environment (VB 6.0)

Do you know that Visual Basic is a high level programming language that is used for building applications? Visual Basic is a version of BASIC Programming language that is used for building applications of various types and functionalities. The programming language uses interpreter, meaning that the program source codes are converted into object codes, statement by statement. The Visual BASIC working environment is an IDE (Integrated Development Environment) that allows programmers to write, compile and execute program instructions.

Note:

Note that as a language, BASIC supports the use of comments in a program. The purpose of commenting is for program documentation. The comment can appear at the beginning of the program or any other parts, depending on the message that is intended to be passed. Figures 1,2, and 3 are images of the Visual Basic working environment.

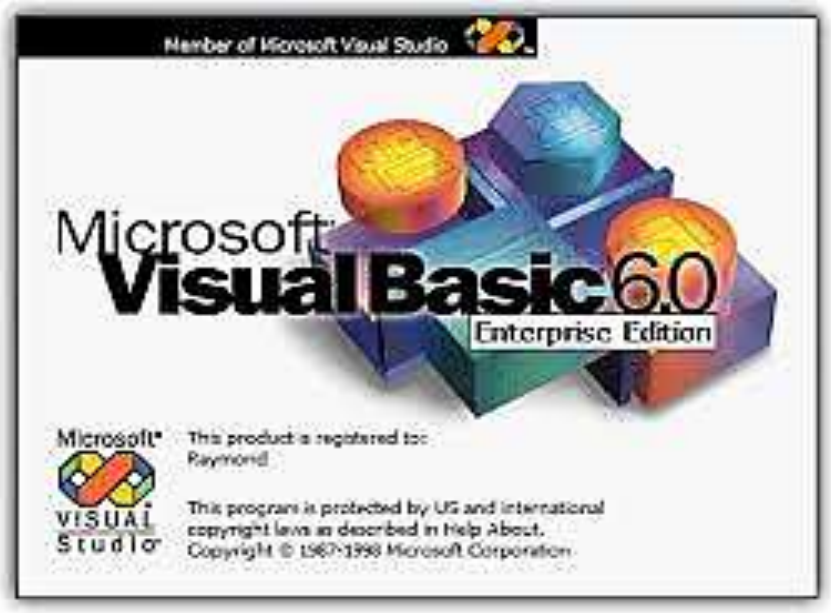


Figure 6: Visual Basic 6 Splashcreen at start up

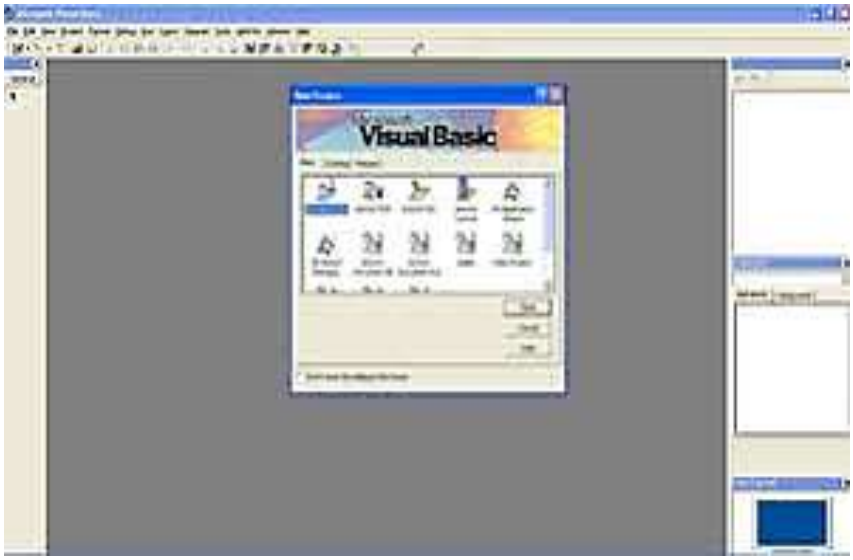


Figure 7: Start up page for selecting Project Type

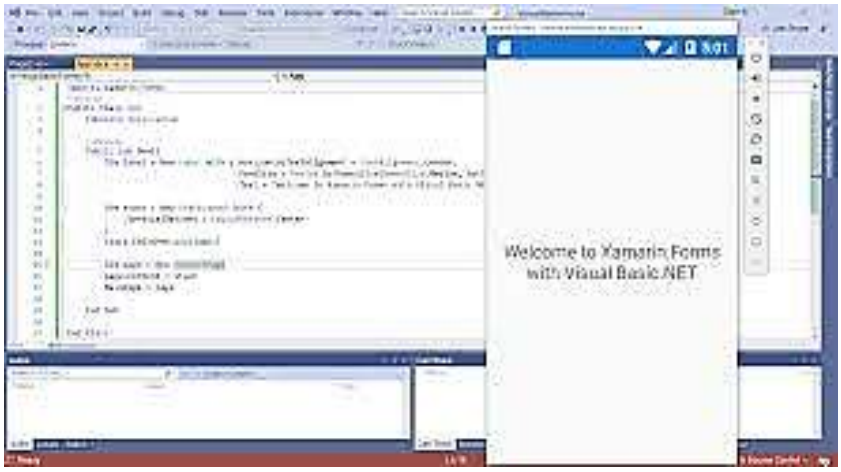


Figure 8: Visual Basic 6 Code Window

Note:

Also, be informed that it is recommended that students get installation disc of VB 6 and install it on their systems. The department also provides the installation software for the students. You can contact the course handlers for the collection and installation of the software, free of charge.

The Visual Basic 6 environment is an integrated environment with a lot of tools (forms, controls, menus, properties window and so on. During lectures, efforts will be made to show you some of these features and how to use them.

Keywords in Visual BASIC Programming Language

Do you know that a keyword refers to as the word that has predefined meaning to the BASIC interpreter. Some good examples of keywords in BASIC include: DIM, Inputbox, MsgBox, if, then, else, do, while, for, next, for, switch, end, end if, byte, call, goto, dim, while, do, switch and so on. The list is very long.

Note:

For the purpose of this course, you are only being introduced to some of them. To be able to program effectively in any programming language, it is required that the programmer masters the syntaxes of such language and then develop the ability for reasoning based on the required program logic of each problem. Programmer does not need to cram anything as problem varies.

Choosing Variable Names in BASIC Programming Language

In BASIC programming language, a variable or variable name is used as the storage location for data. Depending on the data type that we want to use in a program, we declare the variable as

such. To have a valid variable name in BASIC, one is expected to have a mastery of the rules for declaring the variables.

Some of such rules include:

i. A valid variable name in BASIC should start with an alphabet or letter Initial Value, Num, Value
ii. A variable name in BASIC can be a mixture of alphabet or number (but must not start with the number) e.g. Traveller45,T78,A5,Value34,num23,number892
iii. A valid variable name must not be BASIC keyword
iv. A valid variable name must not contain blank space.
v. A valid variable name may contain alphabets, numbers and/or with underscore (_) e.g., sum_score
vi. A variable name can contain up to 255 characters

More Examples (for clarification purposes only, pls. Efforts will be made to explain these during lectures)

For instance:

The following are valid variable names because they obey one or a combination of the rules mentioned above:

(i) sum (ii) studentscore (iii)Totalsalary23 (iv) Manager_Pay (v) StudentAdd4 e.t.c

Also, the following variable names are not valid because they violate the rules to be followed by choosing variable names in Visual Basic.

(i) 34Name (ii) Sum total (iii) 7President name* (iv)printf (v) getchar (vi) N89}

What are data types in Visual BASIC 6?

I should notify you that Visual Basic programming language supports different data types. The data types enable computer programmers to specify the type of data they want their programs to allow. A data type describes the kinds of data that can be entered into the computer system at a time.

By default, Visual Basic variables are of variant data types. The variant data type can store numeric, date/time or string data. When a variable is declared, a data type is supplied for it that determines the kind of data they can store. The fundamental data types in Visual Basic including variant are integer, long, single, double, string, currency, byte and boolean. Visual Basic supports a vast array of data types. Each data type has limits to the kind of information and the minimum

and maximum values it can hold. In addition, some types can interchange with some other types. A list of Visual Basic's simple data types are given below.

1. Numeric

Byte	Store integer values in the range of 0 – 255
Integer	Store integer values in the range of (-32,768) - (+ 32,767)
Long	Store integer values in the range of (- 2,147,483,468) - (+ 2,147,483,468)
Single	Store floating point value in the range of (-3.4x10-38) - (+ 3.4x1038)
Double	Store large floating value which exceeding the single data type value
Currency	store monetary values. It supports 4 digits to the right of decimal point and 15 digits to the left

2. String

Use to store alphanumeric values. A variable length string can store approximately 4 billion characters

3. Date

Use to store date and time values. A variable declared as date type can store both date and time values and it can store date values 01/01/0100 up to 12/31/9999

4. Boolean

Boolean data types hold either a true or false value. These are not stored as numeric values and cannot be used as such. Values are internally stored as -1 (True) and 0 (False) and any non-zero value is considered as true.

5. Variant

Stores any type of data and is the default Visual Basic data type. In Visual Basic if we declare a variable without any data type by default the data type is assigned as default.

Note: It is expected that a programmer determines and use the most appropriate data type in a particular program before proceeding to writing the codes.

This course being an introductory course considers only simple data types in some of the examples and exercises.

Understanding Looping Structures in BASIC (Visual Basic 6) Language

BASIC, as a programming language, supports a wide range of loop structures. The popular among them are FOR LOOP, DO WHILE and WHILE DO. Emphasis will be on FOR LOOP, DO WHILE LOOP and WHILE DO LOOP. The main purpose of using loops is to perform some program segments in a repeated manner.

Like any other program constructs, these loops have their syntax which must be adequately mastered and put to use for proper practical mastery. Before, we go further; there may be a need to define looping. Let says, the problem solver wants to display or generate some values or statement several times and does not need to that one-by-one, he/she will resort to using loops as may be required.

What is looping?

Looping can be defined as the process of performing certain segment of a program n a repeated manner until the specified condition is met. The loop allows programmer to write program codes that are able to run repeatedly.

Syntax of FOR LOOP in BASIC

This is the simplest and mostly used loop statement for beginners.

It has the general syntax:

The syntax of a FOR LOOP in a Visual Basic Program is as follows:

FOR index variable=initial condition TO Finalvalue

Program codes

NEXT (index variable)

It has to be pointed out that in some of the program examples provided herein, the programmer must first of all use the form and all other needed controls to design the interface and then add the codes in the code window.

Visual BASIC 6 Program Examples:

(i)

```
Private Sub cmdMessage
Dim k as Integer
FOR k=1 To 50
Msg=(" We are learning Problem Solving at Al-Hikmah University")
Msgbox(Msg)
List1.AddItem(Msg)
NEXT k
End Sub
```

This code above runs repeatedly until the specified value of fifty count of the message is reached. The index variable is incremented by 1,one at a time. Also note that each of the program in VB 6 is expected to have a program interface where

(ii)

```
Private sub cmdSum
Dim J As Integer
Dim  Sum As Integer
LET Sum=0
FOR J= 1 TO 122
LET  Sum=Sum+J
Msgbox(Sum)
NEXT
EndSub
```

The lines of Visual BASIC code above add and print sum of integers from 1 to 122

THE WHILE LOOP /WHILE Statement

The while statement continually executes a block of statements while a particular condition is true. Its syntax can be expressed as:

while (expression)

{+

```
    //Program statement(s)
}
```

The while statement evaluates expression, which must return a boolean value. If the expression evaluates to true, the while statement executes the statement(s) in the while block. The while statement continues testing the expression and executing its block until the expression evaluates to false.

DEBUGGING

I should inform you that at every stage of software development or programming, debugging is very necessary. Debugging can be defined as the process of identifying and removing errors (bugs) in a program. Depending on the type of translator being used by a programming language, debugging can be easy or very difficult.

It is recommended herein that you should master the art of debugging you program as this course introduces you to elementary aspect of programming computers (which is a good problem-solving skill in computing).

Summary

In this Study Unit, you have learnt that:

1. The Visual BASIC working environment is an IDE (Integrated Development Environment) that allows programmers to write, compile and execute program instructions.
2. A keyword refers to as the word that has predefined meaning to the BASIC interpreter. Some good examples of keywords in BASIC include: DIM, Inputbox, MsgBox, if, then, else, do, while, for, next, for, switch, end, etc.
3. A variable or variable name is used as the storage location for data.
4. A data type describes the kinds of data that can be entered into the computer system at a time. Some of the data types are
    a. Number
    b. String
    c. Date
    d. Boolean
    e. Variant
5. Looping can be defined as the process of performing certain segment of a program in a repeated manner until the specified condition is met.

6. Debugging can be defined as the process of identifying and removing errors (bugs) in a program.

Tutor Marked Assignment

1. Write a BASIC program to display the message “Al-Hikmah University is waxing stronger” five hundred times

Self-Study Assessment

Self-Assessment Questions for Learning Section 2: Now that you have completed this Learning Section, you can assess how well you have achieved its Learning outcomes by answering the following questions.

1. List and explain the different LOOP statement.
2. 1. Define each of the following terms: (i) Program (ii) Programming (iii) Problem solving
3. 2. Write a C program to find the perimeter of a rectangle given that P=2(L+B) where L and B are length and Breath respectively.
4. 3. Design and algorithm and a flowchart to find the perimeter of a rectangle
5. 4. Why is there a need for commenting in a BASIC Program?
6. 5. Design an algorithm and a flowchart to compute the value of T given that T=23M-4G/3
7. Note: M and G are input variables.
8. 6. Write a Visual Basic program code to find the sum of four integers entered from the keyboard.
9. 7. Itemise the stages of Software Development Process/Software Development Life Cycle
10. 8. Design a flowchart to generate integer values from 1250 to 350
11. 9. Write a BASIC program to display the message “Al-Hikmah University is waxing stronger” five hundred times
12. 10. Comment on the importance of problem solving skills in programming as a student programmer
13. 11. Write a Visual BASIC program to find the roots of a quadratic equation given that ax2+bx+c=0 **Hint:** Use Almighty formula for your problem
14. 12. Identify any five flowchart symbols that you know
15. 13. List and explain any seven skills that a problem solver should possess

16. 14. Why is it necessary for a programmer to understand the type of data he wants to handle in a programming problem?
17. 15. List and explain the key stages in problem solving process.
18. 16. Explain how a good understanding

Further Readings

1. Mastering Visual Basic 6, by Envangelos Petroutsos
2. **Tim Hiks (n.d.). Seven Steps for Effective Problem Solving in the Workplace, retrieved from https://www.mediate.com/articles/thicks.cfm**
3. **Problem Solving Skills: Definition, Steps, and Examples**

References

1. Microsoft Corporation. (2019). Visual Basic Documentation. Microsoft Docs.
2. Gaddis, T. (2018). Starting Out with Visual Basic (8th ed.). Pearson Education.
3. Reid, C. (2019). Visual Basic 2019 Programmer's References (2nd ed.). Wiley Publishing.
4. Ferguson, P. (2018). Learning Visual Basic .NET (2nd ed.). O'Reilly Media.
5. Mann, C. (2019). Visual Basic: A Beginner's Guide (2nd ed.). McGraw-Hill Education.
6. Alison Doyle (2020). https://www.thebalancecareers.com/problem-solving-skills-with-examples-2063764
7. FreeTures.com (n.d.) Visual Basic Tutorials, retrieved from https://www.freetutes.com/learn-vb6/lesson2.html

K. Recommended books/Materials /Web Documents

1. Mastering Visual Basic 6, by Envangelos Petroutsos
2. **Tim Hiks (n.d.). Seven Steps for Effective Problem Solving in the Workplace, retrieved from https://www.mediate.com/articles/thicks.cfm**