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Kurumbapalayam (Po), Coimbatore – 641 107
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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

19IT103 – COMPUTATIONAL THINKING AND PYTHON PROGRAMMING

Recap:

• A Computer is an electronic machine that can be programmed to accept data (*input*), and process it into useful information (*output*). Data is put into secondary storage (*storage*) for safekeeping or later use.

• The computer has evolved from a large-sized simple calculating machine to a smaller but much more powerful machine.

• Problem is a thing that requires logical thought and /or mathematics to solve.

• Problem solving is the systematic approach to define the problem and creating number of solutions.

Recap:

• Computers are built to solve problems with algorithmic solutions, which are often difficult or very time consuming when input is large.

• **A computational problem** is a problem that a computer might be able to solve or a question that a computer may be able to answer.

• **Computational thinking** is an approach to problem-solving that involves using a set of practices and principles from computer science to formulate a solution that's executable by a computer.

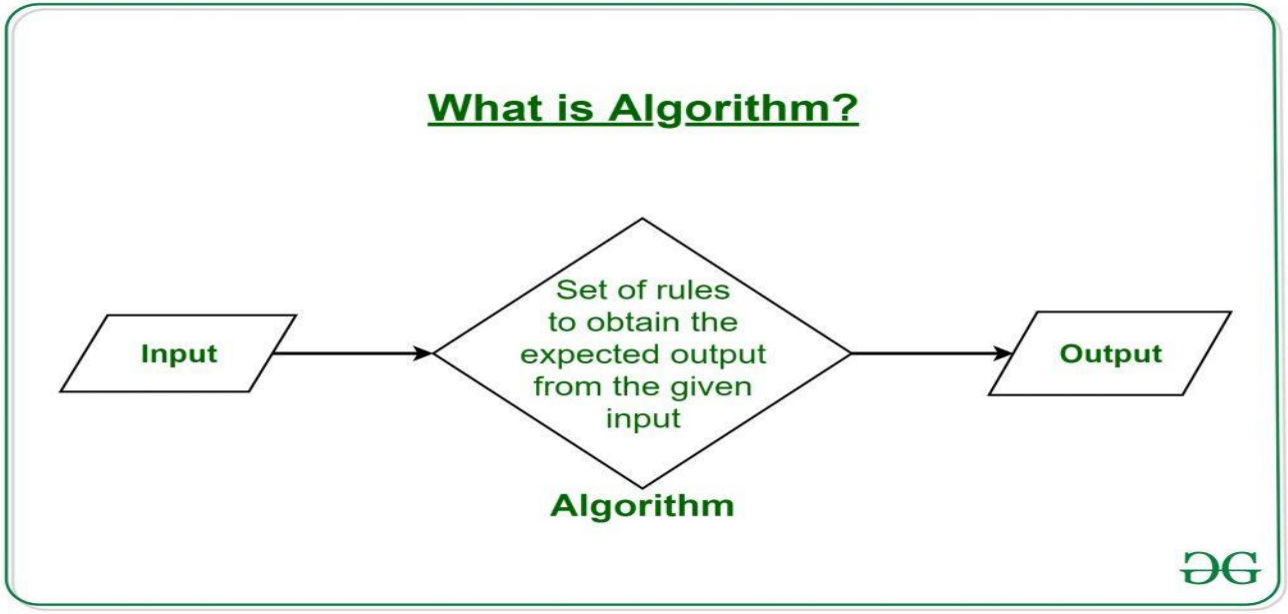
1.3 ALGORITHM:

- Algorithm is defined as a sequence of instructions that describe a method for solving a problem.
- Algorithm - ***a sequence of clearly defined steps*** that describe a process to follow a finite set of unambiguous instructions with clear start and end points.
- In other words algorithm is a step by step procedure for solving a problem.
- The term "algorithm" was derived from the name of Mohammed al Khowarizmi, a Persian mathematician in the ninth century.
- Al-Khowarizmi → Algorismus (in Latin) → Algorithm

1.3 ALGORITHM:

A recipe is a good **example** of an **algorithm** because, says what must be done, ***step by step***.

It takes inputs (ingredients) and produces an output (the completed dish).



1.3 ALGORITHM:

Defining algorithms:

The definition of an algorithm is complex and involves several properties.

Those properties are:

- Collection of individual steps
- Definiteness
- Sequential

1.3 ALGORITHM:

Defining algorithms:

1) Collection of individual steps:

- An algorithm is a **collection of individual steps**.
- A recipe fits this analogy quite simply, filled as it is with steps like:
  - ‘pre-heat the oven to 180 degrees Celsius’

    or

  - ‘add two tablespoons of sugar to the bowl’

1.3 ALGORITHM:

Defining algorithms:

2) Definiteness:

- Definiteness, meaning that **every step must be precisely defined**.
- Each step in an algorithm can have one and only one meaning, otherwise it is ambiguous.
- Similarly, chefs have come to the same conclusion, which is why they produce recipes using precise measurements instead of writing things like ‘some sugar’ or ‘cook it for a while’.

1.3 ALGORITHM:

Defining algorithms:

3) Sequential:

- Algorithms are also **sequential**.
- **The steps that make up the process must be carried out in the order specified.**
- Failing to do this means that the result of executing the algorithm is likely incorrect.

1.3 ALGORITHM:

Defining algorithms:

3) Sequential..

Think back to the analogy.

- Dicing an onion and frying an onion are different steps.
- Dicing an onion before you fry it has a different outcome than the reverse.
- Similarly, multiplying a number by 2 then adding 5 to it yields a different result from adding 5 first then doubling it.
- Like a recipe, you must respect the sequence when running through an algorithm for it to have any meaningful result.

1.3 ALGORITHM:

Properties of Algorithms:

Every algorithm must have five essential properties:

(1) **Inputs specified:** An algorithm must have zero or more inputs, We must specify the type of the data, the amount of data, and the form that the data will take.

(2) **Outputs specified :** An algorithm has one or more outputs, which have a specified relation to the inputs.

(3) **Definiteness:** Every detail of each step must be clearly specified.

(4) **Effectiveness:** All operations to be performed must be sufficiently basic that they can be done exactly and in finite length.

(5) **Finiteness:** An algorithm must always terminate after a finite number of steps.

1.3 ALGORITHM:

Method for Developing an Algorithm:

(1) Define the problem: State the problem to be solved in clear and concise manner.

(2) List the inputs and outputs

(3) Describe the steps needed to convert input to output

(4) Test the algorithm: Choose input data and verify that the algorithm works.

1.3 ALGORITHM:

The Characteristics of a Good Algorithm :

- **Precision** – the steps are precisely stated (defined).
- **Uniqueness** – results of each step are uniquely defined and only depend on the input and the result of the preceding steps.
- **Finiteness** – the algorithm stops after a finite number of instructions are executed.
- **Effectiveness –** algorithm should be most effective among many different ways to solve a problem.
- **Input** – the algorithm receives input.
- **Output** – the algorithm produces output.
- **Generality** – the algorithm applies to a set of inputs.

1.3 ALGORITHM:

Real Life Example Procedure to cook Bread Toast :

Step 1 : Grab a loaf of bread

Step 2 : Get a pan and place it on the stove let it heat

Step 3 : Pour some oil on the pan and wait for oil to be heated

Step 4 : Put a slice on the pan and roast until it become brown in shade

Step 5 : Turn the slice and roast until it become brown in shade

Step 6 : Get the toasted bread from the pan and serve it on a plate with anything or nothing.

1.3 ALGORITHM:

Example 1 : Algorithm for adding two numbers:

Step 1 : Get the 2 numbers from the user as input.

Step 2 : Perform addition of those 2 numbers.

Step 3 : Store the answer for display.

Step 4 : Display the stored value to the user.

1.4 Building blocks of algorithms (statements, state, control flow, functions):

An algorithm includes basic building blocks that are used to express any kind of the task to the computer.

Algorithms can be constructed from basic building blocks namely, sequence, selection and iteration.

1. Instructions/ Statements

2. State

3. Control Flow

4. Functions

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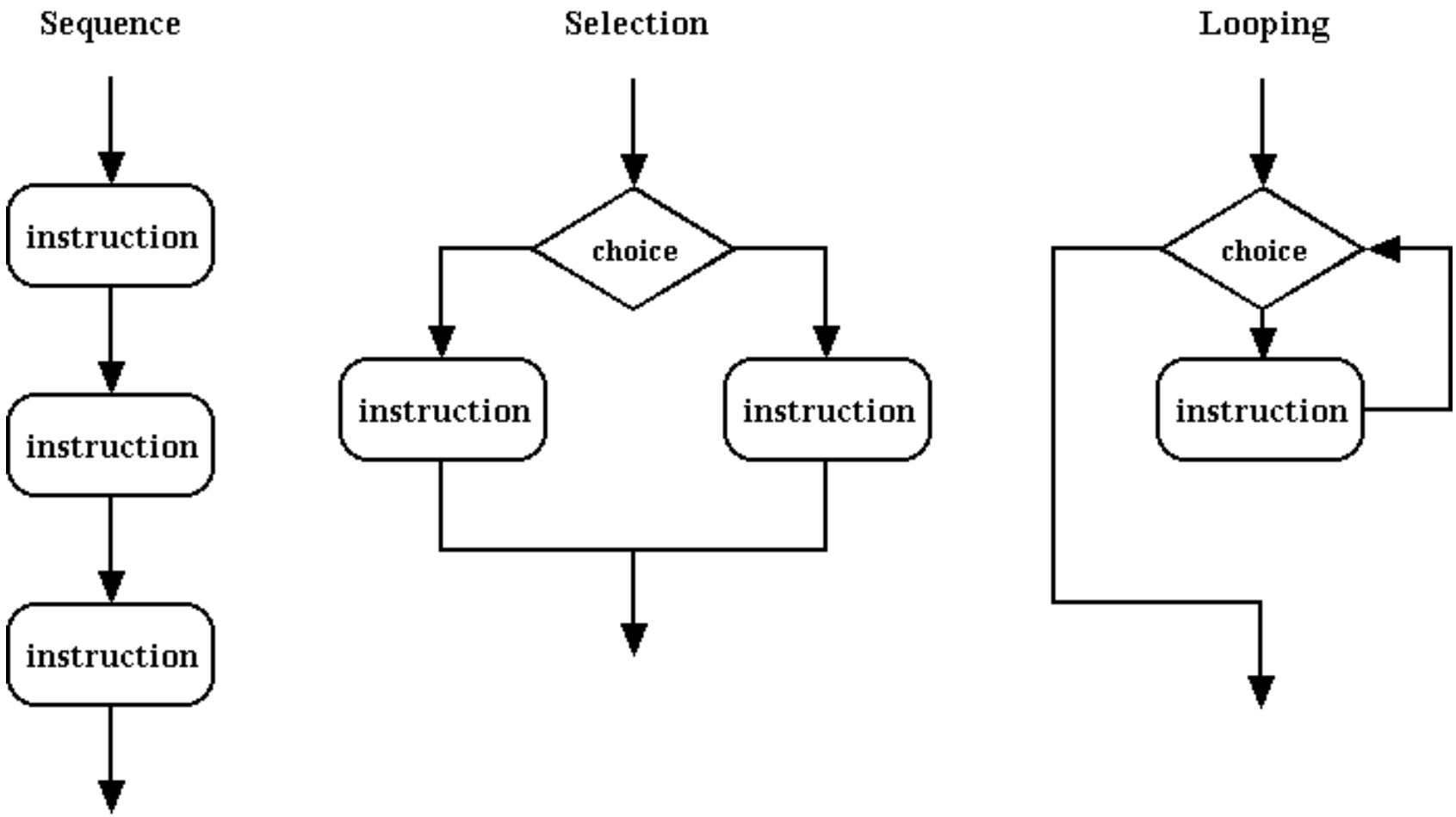

1.4 Building blocks of algorithms (statements, state, control flow, functions):

Statements:

Statement is a single action in a computer. In a computer statements might include some of the following actions:

- input data-information given to the program
- process data-perform operation on a given input
- output data-processed result

State:

Transition from one process to another process under specified condition with in a time is called ***state.***

1.4 Building blocks of algorithms (statements, state, control flow, functions):

Control flow:

The process of executing the individual statements in a given order is called control flow.

The control can be executed in three ways:

1. sequence
2. selection
3. iteration

Functions:

A section of computer code that performs a specific task.

1.4.1 Statements:

- A statement is the smallest standalone element of an imperative programming language that expresses some action to be carried out.
- There are two types of statement,
  - Simple Statement
  - Compound Statement

1.4.1 Statements:

- **Simple statements:** It is used to represent single action need to be done.
  - **assertion**: assert(ptr != NULL);

    Comparison
  - **assignment**: A:= A + 5

    Assigning a value 5 to A
  - **goto**: goto next;

    Sent the control to different block of same program
  - **return**: return 5;

    Return a value 5 after the execution of function
  - **call**: clearScreen()

    Calling the Function (clearScreen) which performs clearing previous outputs from the computer screen

1.4.1 Statements:

- **Compound statements:**
  - It is a set of statements, that used to perform a sequence of operations repeatedly or condition based executions.

block: Set of statements

```
begin
    integer NUMBER;
    WRITE('Number? ');
    READLN(NUMBER);
    A:= A*NUMBER
end
```

1.4.1 Statements:

Compound statements:

do-loop:

```
Do
{
    computation(&i);
} while (i< 10);
```

Looping a set of statements repeatedly until some condition is satisfied. We can’t predict when the condition becomes satisfiable. At least it will do the loop sequence once.

1.4.1 Statements:

Compound statements:

for-loop:

```
for A:=1 to 10 do
        WRITELN(A)
end
```

Looping a set of statements repeatedly until some condition is satisfied. We can run the loop for certain iterations. Prediction of loop termination is possible.

1.4.1 Statements:

Compound statements:

***if-statement*:**

```
if A > 3 then
    WRITELN(A)
else
    WRITELN("NOT YET");
end
```

Normally it contains two sets of statements. State or value is compared with a conditions if it is satisfied the “if” block will be executed otherwise else part will be executed.

1.4.1 Statements:

Compound statements:

***switch-statement*:**

```
switch (c)
 {
case 'a': alert(); break;
case 'q': quit(); break;
}
```

It contains more than two blocks of statement each one has the conditions. When the program reaches a state with a value, first hit of matching conditions block will be executed. If nothing matches then default block of statements will be executed.

1.4.1 Statements:

Compound statements:

while-loop:

```
while NOT EOF DO
    begin
        READLN
    end
```

- Looping a set of statements repeatedly until some condition is satisfied.
- We can’t predict when the condition becomes satisfiable.
- This is loop is entry controlled.
- Control will enter into the loop only if condition is satisfiable.

1.4.2 State:

- State: the current configuration of all information kept track of by a program at any one instant in time.
- As a computer progresses through an algorithm, just as you progress through a recipe, the state of things can change.
- Clearly sequencing the steps of an algorithm ensures that state always changes in the same way whenever the algorithm is executed.

1.4.2 State:

- In computer science, a program is described as stateful if it is designed to remember preceding events or user interactions; the remembered information is called the state of the system.
- If a program gets sufficient data processed then it moves to another state. A successful execution of program include the reaching the final state of the program.

1.4.2 State:

- At each instant in time, the environment in which the algorithm is being run exists in some particular state.
- But by the time the next step is executed, something might have changed. The environment really exists as a series of snapshots, one for each step of the algorithm.

1.4.2 State:

- The recipe analogy spells this out.
- At the start you might have butter, flour, milk, eggs and sugar. After each step, you take a photograph of the kitchen. The photos will show that, bit by bit, the state of the ingredients changes. Flour goes into a bowl; then the eggs join it; then the butter goes into the pan; and so on. There is no global view of the ingredients; just a series of snapshots.

Summary:

- Algorithm is a sequence of clearly defined steps that describe a process to follow a finite set of unambiguous instructions with clear start and end points.
- The definition of an algorithm is complex and involves several properties such as , i) Collection of individual steps, 2) Definiteness, 3)Sequential.
- An algorithm includes basic building blocks that are used to express any kind of the task to the computer.
- Building blocks of an algorithms are:1. Instructions/ Statements , 2. State ,3. Control Flow , 4. Functions.


THANK YOU