Unit II | Algorithmic Problem Solving CHAPTER 6

Specification and Abstraction

1.Distinguish between an algorithm and a process.

Algorithms.

- An algorithm is a **step-by-step** sequence of instruction to solve a problem.
- When an algorithm executed with **input data**, it generates a **process** and ends with **output data**.

Process.

- Processes are generated by executing algorithms to solve the given problem.

2.When do you say that a problem is algorithmic in nature?

- There are some principles and techniques for constructing algorithms.
- A problem is algorithmic in nature when its solution involves the construction of an algorithm.
- Some types of problems can be immediately recognized as algorithmic.

3. What are the building blocks of Algorithms? Explain

- Data
- Variables
- Control flow
- Functions

Data

- Algorithms take input data, process the data, and produce output data

Variables

- Variables are named boxes for storing data.

Control flow

- An algorithm is a sequence of statements.
- The order of execution of statements is known as the control flow.

There are three important control flow statements.

- Sequential control flow
- Alternative control flow
- Iterative control flow

Sequential control flow

- Statements are executed one after another in the same order

Alternative control flow

A condition of the state is tested,

- if the condition is **true**, one statement is executed;
- if the condition is **false**, an alternative statement is executed.

Iterative control flow

- A condition of the state is tested,
- if the condition is **true**,
- A statement is executed and executing the statement are **repeated** until the condition becomes **false**.

Define control flow in algorithm. or
What are the types of control flow ?Explain. or
Differentiate between alternative control flow and iterative control flow.

Ref.above answer

4.Define function or define Decomposition

- Some algorithms can become very complex,

In such situations,

- we break an algorithm into Parts.
- The parts of an algorithm are known as functions.
- A function is like a sub algorithm.
- Construct each part (function)separately,
- and then integrate the parts to the complete algorithm.

5.What are the basic principles and techniques for designing algorithms?.

1. Specification
2. Abstraction
3. Composition
4. Decomposition

Specification

- To solve a problem, first we must state the problem clearly.
- A problem is specified by the given input and the desired output.

Abstraction

- A problem can involve a lot of details.
- **Ignoring or hiding** unnecessary details and modeling only by its essential properties is known as **abstraction**.

Composition

- An algorithm is composed of assignment and control flow statements.
- A control flow statement tests a condition of the state
- depending on the value of the condition,
- decides the next statement to be execute

Decomposition

- Some algorithms can become very complex,

In such situations,

- we break an algorithm into Parts.
- The parts of an algorithm are known as functions.
- A function is like a sub algorithm.

- Construct each part (function) separately, and then integrate the parts to the complete algorithm.

6.What is abstraction? Ref. above ans.

7.Define State.

- State is a basic and important abstraction.
- A computational process starts with an initial state.
- As actions are performed, It ends with a final state.
- State of a process is abstracted by a set of variables in the algorithm.

8.Define Assignment statement. Or
What is the form and meaning of assignment statement?

- **Assignment operator (=)**is used to assign **Variable** on the **left** side and a **value** on the **right** side.
- Assignment statement is used to store a value in a variable.
- Ex. **variable = value/expression; a:=2 (**variable a stores value 2)

9.Define Equality operator.

- **Equality operator(==)** is used to **compare** the value of both left hand and right hand side variable
- Results in either **true** or **false**.
- Ex.**Variable1 = = variable 2**

What is the difference between assignment operator and equality operator? Ref.Q6 & 7

10.What is command statements? How commands are indicated?

- **Comments** are statements which are used to add notes to a program for the human readers and **not executed** by the computer.
- A **double dash --** indicates that the rest of the line is a comment

11.Initially,
Farmer, goat, grass, wolf = L, L, L, L and the farmer crosses the river with goat.
Model the action with an assignment statement.

- Let us name the variables farmer, goat, grass,wolf.
- Their possible values L and R.
- A value of L means "at the left side".
- A value of R means "at the right side".
- In the initial state, all four variables
- farmer, goat, grass, wolf have the value L.

--farmer, goat, grass, wolf = L, L, L, L
The **farmer** crosses the river with **goat**.
--input : farmer ,goat = R,R
--output: farmer, goat, grass, wolf = R,R, L, L

12.What is the format of the specification of an algorithm?

- Let P be the required property of the inputs
- Q the property of the desired outputs.

Then the algorithm S is specified as

1. Algorithm_name (inputs)
2. -- inputs : P
3. -- outputs: Q

13.Specify a function to find the minimum of two numbers.

1.Minimum (a,b)
2.--inputs: a,b are integers or real numbers
3.--outputs: a is minimum if a<b
B is minimum if b<a

14.If √2 = 1.414, and the square_root() function returns -1.414, does it violate the following specification?

-- square_root (x)
-- inputs: x is a real number , $x \geq 0$
-- outputs: y is a real number such that $y^2=x$
Ans .Yes.

15.Write the specification of an algorithm hypotenuse whose inputs are the lengths of the two shorter sides of a right angled triangle, and the output is the length of the third side.

Hypotenuse (S1,S2)
--inputs: S1 and S2 are Integers or real numbers
--output: $\ell^2 = S1^2 + S2^2$ ℓ is a real or integer

16.Suppose you want to solve the quadratic equation $ax^2 + bx + c = 0$ by an algorithm.
quadratic_solve (a, b, c)
-- inputs : ?
-- outputs: ?
You intend to use the formula and you are prepared to handle only real number roots.
Write a suitable specification.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

quadratic_solve (**a, b, c**)
-- inputs : **a,b,c** are **real** numbers .
-- outputs: **x 1 , x2** are **real** numbers

$$X1 = \frac{-b+\sqrt{b^2-4ac}}{2a}$$

$$X2 = \frac{-b-\sqrt{b^2-4ac}}{2a}$$

17.Exchange the contents: Given two glasses marked A and B. Glass A is full of apple drink and glass B is full of grape drink. For exchanging the contents of glasses A and B,represent the state by suitable variables, and write the specification of the algorithm.

Exchange(A,B)
--input: A , B are integers
--output: A,B are integers T=0
T : = A
A:= B
B:= T