PROGRAM DESIGN TOOLS

Algorithms, Flow Charts, Pseudo codes and Decision Tables

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Introduction

- The various tools collectively referred to as program design tools, that helps in planning the program are:-
  - Algorithm.
  - Flowchart.
  - Pseudo-code.

Algorithms

- An *algorithm* is defined as a finite sequence of instructions defining the solution of a particular problem, where each instruction is numbered.

- However, in order to qualify as an algorithm, every sequence of instructions must satisfy the following criteria:

Algorithms

- *Input*: There are zero or more values which are externally supplied.
- *Output*: At least one value is produced.
- *Definiteness*: Each step must be clear and unambiguous, i.e., having one and only one meaning.
- *Finiteness*: If we trace the steps of an algorithm, then for all cases, the algorithm must terminate after a finite number of steps.

Algorithms

- *Effectiveness:* Each step must be sufficiently basic that it can in principle be carried out by a person using only one paper and pencil.
  - *In addition, not only each step is definite, it must also be feasible.*

Formulation of Algorithm

- Formulate an algorithm to display the nature of roots of a quadratic equation of the type:

$ax^2 + bx + c = 0$ provided $a \neq 0$

Formulation of Algorithm

- The roots of the quadratic equation are given by the formula:

$$\text{Root}_{1,2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

where the expression b^2-4ac is known as the discriminant.

Formulation of Algorithm

- Depending on the sign of the discriminant, there are three mutually exclusive possibilities for the roots:

1. If $b^2 - 4ac < 0$, then the root are imaginary.
2. If $b^2 - 4ac = 0$, then the roots are real and equal.
3. If $b^2 - 4ac > 0$, then the roots are real and distinct.

Formulation of Algorithm

- The complete algorithm will look like this:

Step 1:	Input values of a, b and c.
Step 2:	Compute $b^2 – 4ac$ and denote its value by variable disc.
Step 3:	Is disc < 0 ? If yes then goto step 7 else goto step 4.
Step 4:	Is disc > 0 ? If yes then goto step 9 else goto step 5.
Step 5:	Output “ Roots are real and equal”.
Step 6:	Goto step 10.
Step 7:	Output “ Roots are imaginary”.
Step 8:	Goto step 11.
Step 9:	Output “ Roots are real and distinct”.
Step 10:	Compute roots R1 and R2 and print them.
Step 11:	Stop.

Flowcharts

- A *flowchart* is a pictorial representation of an algorithm.
- A *flowchart* uses different shapes to denote different types of instructions.
- The actual instructions are written within the shapes using clear and concise statements.
- These shapes are connected by directed lines to indicate the sequence in which instructions are to be executed.

Flowcharts

- A *flowchart,* therefore, is a picture of the logic to be implemented by the program.

- It is simply a tool assisting the programmer to lay out, in a visual, two-dimensional format, ideas on how to organize a sequence of steps necessary to solve a problem by computer.

- It is basically the plan to be followed when the program is written.

Flowcharts

- *It acts like a roadmap for a programmer and guides him/her how to go from the starting point to the final point while writing a program.*

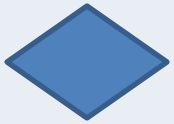
Flowchart Symbols

- *As* mentioned, flowchart uses boxes of different shapes to denote different types of instructions.

- The communication of the program logic through flowcharts is made easier through the use of symbols that have standardized meanings.

Flowchart Symbols

- *Various* flowchart symbols and their brief description:

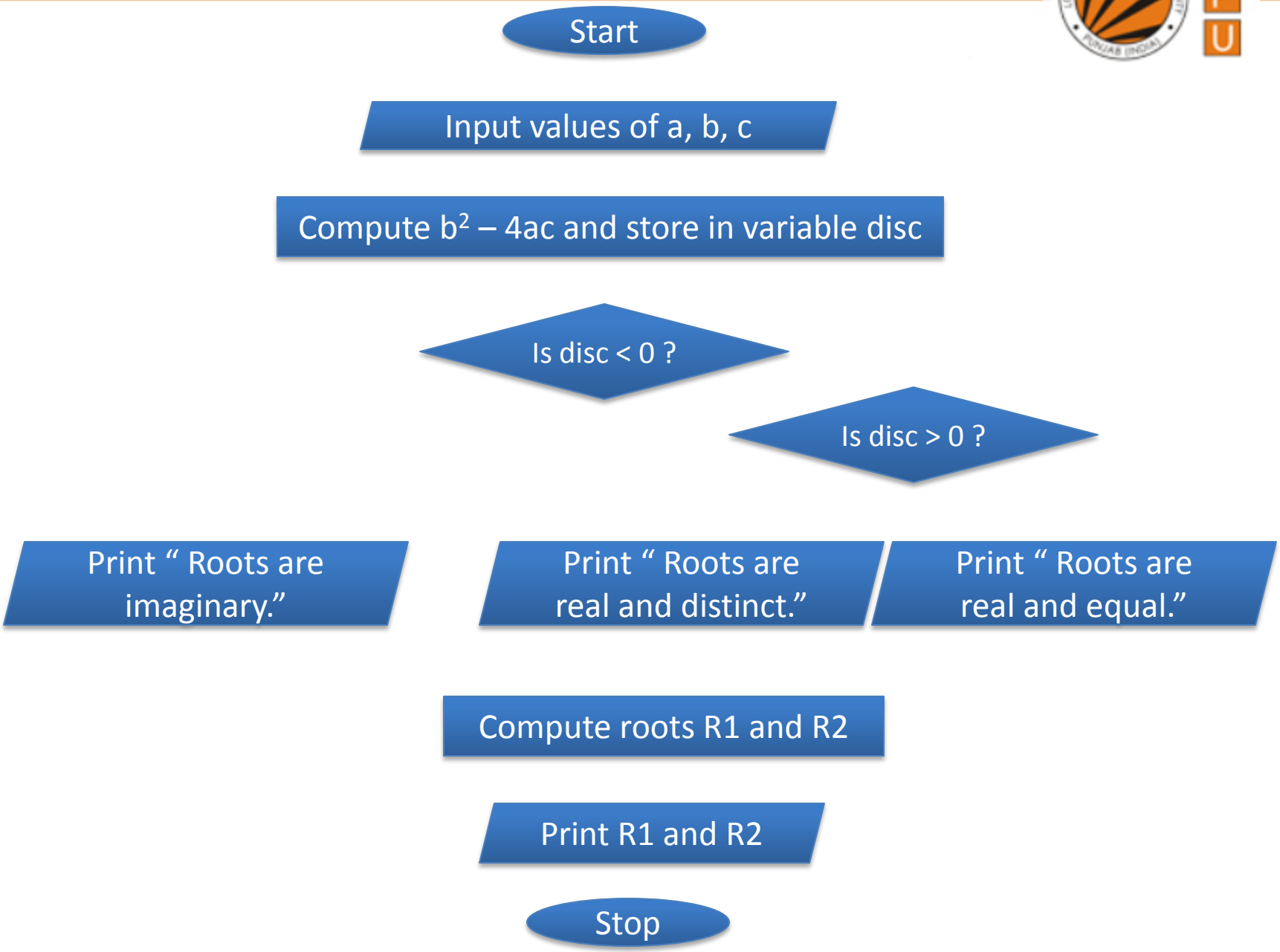
Symbol	Name	Purpose
	**Oval**	**Terminal** – to mark the beginning and end of the program logic flow.
	**Parallelogram**	**Input / Output** – to denote the input to the program or output from the program.
	**Rectangle**	**Processing** – to denote the arithmetic operations and movement of data.
	**Diamond**	**Decision** – to denote a point where decision has to be made to branch to one of the alternatives.
	**Small circle**	**Connector** – to provide a logical link between segments of a flowchart.
	**Directed lines**	**Flow lines** - to indicate the sequence in which instructions are to be executed.

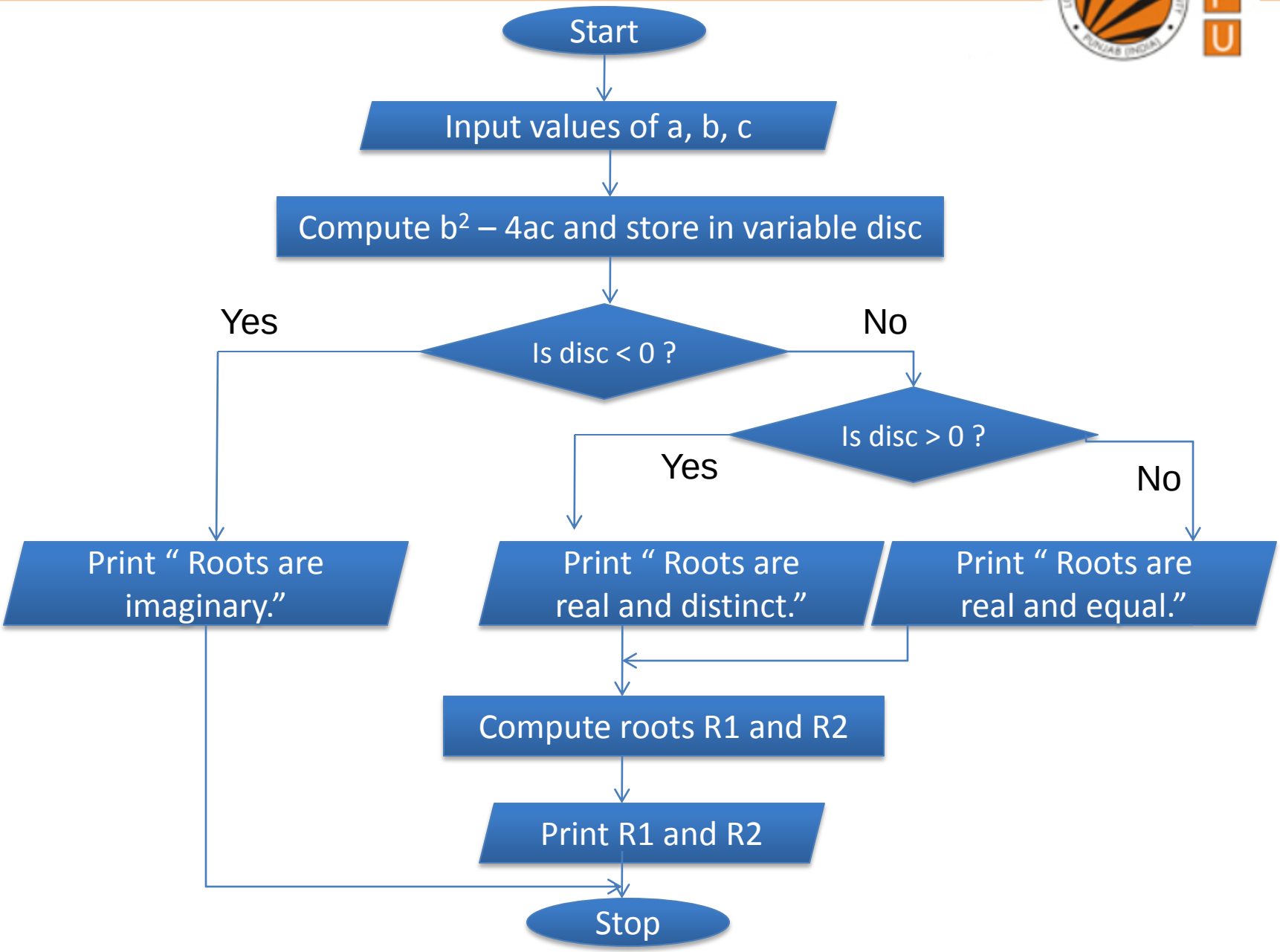
Flowchart Example

FLOWCHART

TO FIND ROOTS OF A

QUADRATIC EQUATION


Start
Input values of a, b, c
Compute b2 – 4ac and store in variable disc
Is disc < 0 ?
Is disc > 0 ?
Print " Roots are imaginary."
Print " Roots are real and distinct."
Print " Roots are real and equal."
Compute roots R1 and R2
Print R1 and R2
Stop


Start
Input values of a, b, c
Compute b² – 4ac and store in variable disc
Is disc < 0 ?
Yes
No
Is disc > 0 ?
Yes
No
Print " Roots are imaginary."
Print " Roots are real and distinct."
Print " Roots are real and equal."
Compute roots R1 and R2
Print R1 and R2
Stop

Practice Questions

- Design an algorithm to compute simple interest and total amount for given principal, rate and time.
- Write an algorithm to determine the largest of two numbers.
- Write an algorithm to find the smallest of three numbers.
- Write an algorithm to interchange(swap) two values.
- Write an algorithm to print the factorial of n natural numbers.
- *Draw the flowcharts for each of the above algorithms.*