

Algorithm and its Characteristics

Unit 1: Problem Solving using Flowchart and Algorithm
Lecture 2: Algorithm and its characteristics

Agenda

Definition of an Algorithm
Real-world Analogy
Why Algorithms Matter
Characteristics of a Good Algorithm
Example Analysis
Summary

What is an Algorithm?

An algorithm is a finite set of unambiguous instructions that, given some set of initial conditions, can be performed in a prescribed sequence to achieve a certain goal and that has a recognizable set of end conditions. It is the logical blueprint of the solution.

Real-world Analogy

A recipe for baking a cake.

Inputs: Ingredients.

Steps: Mixing, baking at a specific temperature for a specific time.

Output: A baked cake.

If a step says 'bake until done', it is ambiguous (not a good algorithm).

Why Algorithms Matter

- They provide a standard way to solve a problem.
- They can be evaluated for efficiency (time and space).
- They allow solutions to be implemented in any programming language.

Characteristic 1: Unambiguous

Each step must be clear and have only one interpretation.

No room for subjective execution.

Poor example: 'Add some salt.'

Good example: 'Add 1 teaspoon of salt.'

Characteristic 2: Finiteness

The algorithm must terminate after a finite number of steps.
It cannot loop indefinitely.
Infinite loops are a common bug caused by violating this characteristic.

Characteristic 3: Feasibility (Effectiveness)

Every instruction must be basic enough to be carried out.

It must be doable with available resources.

Example: 'Calculate the exact value of Pi' is not feasible as it has infinite digits.

Characteristic 4: Independent

The algorithm should be independent of any computer code.
It should rely on basic mathematical and logical operations.
Anyone reading it should be able to implement it in Python, C++, or Java.

Characteristic 5: Input and Output

Input: An algorithm takes zero or more well-defined inputs.

Output: An algorithm must produce at least one well-defined output.

An algorithm without output is doing no useful work.

Analyzing an Algorithm

Problem: Check if a number is even.

1. Start
2. Read integer N
3. Divide N by 2 and store remainder in R
4. If $R == 0$, Print 'Even'
5. Else Print 'Odd'
6. Stop

Check: Unambiguous? Yes. Finite? Yes. I/O defined? Yes.

Summary

An algorithm is a finite sequence of precise instructions.

Key characteristics: Unambiguous, Finiteness, Feasibility, Independent, Defined I/O.