# Design and Analysis of Algorithms

An Algorithm is a sequence of steps to solve a problem. Design and Analysis of Algorithm is very important for designing algorithm to solve different types of problems in the branch of computer science and information technology.

An algorithm is an efficient method that can be expressed within finite amount of time and space.

The important aspects of algorithm design include creating an efficient algorithm to solve a problem in an efficient way using minimum time and space.

## Problem Development Steps

The following steps are involved in solving computational problems.

* Problem definition
* Development of a model
* Specification of an Algorithm
* Designing an Algorithm
* Checking the correctness of an Algorithm
* Analysis of an Algorithm
* Implementation of an Algorithm
* Program testing
* Documentation

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## Characteristics of Algorithms

The main characteristics of algorithms are as follows −

* Algorithms must have a unique name
* Algorithms should have explicitly defined set of inputs and outputs
* Algorithms are well-ordered with unambiguous operations
* Algorithms halt in a finite amount of time. Algorithms should not run for infinity, i.e., an algorithm must end at some point

## Pseudocode

Pseudocode gives a high-level description of an algorithm without the ambiguity associated with plain text but also without the need to know the syntax of a particular programming language.

## Difference between Algorithm and Pseudocode

An algorithm is a formal definition with some specific characteristics that describes a process, which could be executed by a Turing-complete computer machine to perform a specific task.

On the other hand, pseudocode is an informal and (often rudimentary) human readable description of an algorithm leaving many granular details of it. Writing a pseudocode has no restriction of styles and its only objective is to describe the high level steps of algorithm in a much realistic manner in natural language.

In theoretical analysis of algorithms, it is common to estimate their complexity in the asymptotic sense, i.e., to estimate the complexity function for arbitrarily large input.

Analysis of algorithms is the determination of the amount of time and space resources required to execute it.

## The Need for Analysis

need for analysis of algorithms and how to choose a better algorithm for a particular problem as one computational problem can be solved by different algorithms.

Analysis of algorithm is the process of analyzing the problem-solving capability of the algorithm in terms of the time and size required (the size of memory for storage while implementation).

Generally, we perform the following types of analysis −

* Worst-case − The maximum number of steps taken on any instance of size a.
* Best-case − The minimum number of steps taken on any instance of size a.
* Average case − An average number of steps taken on any instance of size a.
* Amortized − A sequence of operations applied to the input of size aaveraged over time.