

UNIT I INTRODUCTION:

Introduction to Algorithms – Fundamentals of Algorithmic Problem Solving – Fundamentals of the Analysis of Algorithmic Efficiency – Analysis Framework – Asymptotic Notations and Basic Efficiency Classes – Mathematical Analysis of Recursive Algorithms – Mathematical Analysis of Non-recursive Algorithms

Analysis Framework

Fundamentals of the Analysis of Algorithm Efficiency

Issues:

- correctness
- time efficiency
- space efficiency
- optimality

Approaches:

- theoretical analysis
- empirical analysis

Fundamentals of the Analysis of Algorithm Efficiency

two kinds of efficiency: time efficiency and space efficiency.

Time efficiency, also called ***time complexity***, indicates how fast an algorithm in question runs.

Space efficiency, also called ***space complexity***, refers to the amount of memory units required by the algorithm in addition to the space needed for its input and output.

In the early days of electronic computing, both resources—time and space—were at a premium

Theoretical analysis of time efficiency

- Time efficiency is analyzed by determining the number of repetitions of the basic operation as a function of input size
- Basic operation: the operation that contributes the most towards the running time of the algorithm

$$T(n) \approx c_{op} C(n)$$

$T(n)$ Running Time, n input size,

c_{op} execution time for basic operation or cost

$C(n)$ Number of times basic operation is executed

Input size and basic operation examples

<i>Problem</i>	<i>Input size measure</i>	<i>Basic operation</i>
Searching for key in a list of n items	Number of list's items, i.e. n	Key comparison
Multiplication of two matrices	Matrix dimensions or total number of elements	Multiplication of two numbers
Checking primality of a given integer n	n'size = number of digits (in binary representation)	Division
Typical graph problem	#vertices and/or edges	Visiting a vertex or traversing an edge

Empirical analysis of time efficiency

- Select a specific (typical) sample of inputs
- Use physical unit of time (e.g., milliseconds) or
Count actual number of basic operation's executions
- Analyze the empirical data



Thank You