

# Analysis of Algorithms

Chapter 1 : Asymptotic Analysis

0xSaad Chapters

# Analysis of Algorithms

## Introduction

**Algorithm** is finite set to perform a computation for solving a problem.

# Analysis of Algorithms

## Introduction

**N** is input size , examples :

- Size of an array
- Polynomial Degree

# Analysis of Algorithms

## Introduction

**Worst Case** : provides an upper bound

**Best Case** : provides a lower bound

**Average Case** : provides a prediction about running time

**Lower Bound $\leq$ Running Time $\leq$ Upper Bound**

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## Time Complexity

Algorithm 1 :

$\text{arr}[0] = 0; \text{cost}$

$\text{arr}[1] = 0; \text{cost}$

$\text{arr}[2] = 0; \text{cost}$

$c_1 + c_1 + c_1 + \dots$

$= c_1 \times N$

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## Time Complexity

Algorithm 2 :

```
for(i=0; i < N; i++) c1  
    arr[i] = 0; c2
```

$$= c_1 \times (N+1) + c_2 \times N$$

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## Rate of Growth

- $500n^3$  is  $O(n^3)$
- $3n$  is  $O(n)$
- $n \lg n$  is  $O(n \lg n)$

# Analysis of Algorithms

## Prove Questions

1- Show that  $6n^2+8n+2$  is  $O(n^2)$

$$6n^2 + 8n + 2 \leq cn^2 \quad c=17$$
$$6(1)^2 + 8(1) + 2 \leq 17 \quad n_0=1$$
$$6 + 8 + 2 \leq 17 \quad \checkmark$$

# Analysis of Algorithms

## Prove Questions

2- Show that  $20n+6$  is  $O(n)$

$$20n + 6 \leq cn$$
$$\cancel{20}n + 6 \leq \cancel{21}n$$
$$6 \leq n$$

$c=21$   
 $n_0=6$  ✓

# Analysis of Algorithms

## Prove Questions

2- Show that  $20n+6$  is  $O(n)$

$$20n + 6 \leq cn$$
$$\cancel{20}n + 6 \leq \cancel{21}n$$
$$6 \leq n$$

$c=21$   
 $n_0=6$  ✓

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