

Course

- ❖ Course No.: CSE2207
Course Title: Algorithms
- ❖ Course Teacher: Md. Khairul Hasan (Paris)
Contact: Provided in Google Classroom
- ❖ Department of Computer Science and Engineering
Ahsanullah University of Science and Technology

Text Books

- Introduction to Algorithms
Third Edition
by Thomas H. **Cormen**, Leiserson, Rivest & Stein
- Fundamentals of Computer Algorithms
Second Edition
by Horowitz, Sartaj **Sahni**, & Rajasekaran

Hope/Assumption: Topics Covered in Previous Semesters

- **Sorting Algorithms: Bubble, Selection, Insertion, Quick, Merge**
- **Heap, Heapify, Heapsort**
- **Priority Queue**
- **Linear Search, Binary Search**
- **Tree, Binary Search Tree**
- **Graph, BFS, DFS**

Algorithm: Definition

An algorithm is a finite set of instructions that, if followed, accomplishes a particular task.

Input (x, y)

Output (z)

$z = x + y$

Input (x, y)

$z = x + y$

Output (z)

$z = x + y$

Input (x, y)

Output (z)

Algorithm: Characteristics/Criteria/Properties

- (1) Input: Zero or more quantities that are externally **supplied**.
- (2) Output: At least one quantity is **produced**.
- (3) Definiteness: Each instruction is **clear and unambiguous**.
Not permitted: $7/0$, add 7 or 8 to x , $\sqrt{-1}$, $0/0$
- (4) Finiteness: If we trace out the instructions of an algorithm, then for all cases, the algorithm **terminates** after **finite number of steps**.
- (5) Effectiveness: Every instruction must be very basic so that it can be carried out, in principle, by a person using only pencil and paper. It is not enough that each operation be definite as in criterion 3; it also must be **feasible**.

Algorithm vs. Program

Algorithm	Program
Written at Design time	Written at Implementation time
He who has Domain Knowledge	Programmer
Written in any language	Written in Programming Language
H/W and S/W independent	H/W and S/W dependent
Can Analyze	Can Test

Algorithm: Effectiveness/ Why efficient algorithm needed (1)

- Suppose, Time complexity of Insertion sort: $c_1 n^2$
Merge sort: $c_2 n \lg n$ [$\lg n = \lg_2 n$]
- Insertion sort requires $2n^2$ [$c_1=2$] instructions
Merge sort requires $50n \lg n$ [$c_2=50$] instructions
- Computer A executes 10 billion(10^{10}) instructions/sec [Insertion]
Computer B executes 10 million(10^7) instructions/sec [Merge]
So, A is 1000 times faster than B
- Sort $n=10$ million (10^7) numbers

Algorithm: Effectiveness/ Why efficient algorithm needed (2)

- Computer A takes, $2 \cdot (10^7)^2 / 10^{10} = 20,000$ sec
= more than 5.5 hours

[10¹⁰ instructions ----- 1 sec

1 instruction ----- 1 / 10¹⁰ sec

2*(10⁷)² instructions ----- 2*(10⁷)² / 10¹⁰ sec]
- Computer B takes, $50 \cdot (10^7) \lg 10^7 / 10^7 = 1163$ sec
= less than 20 minutes
- B runs more than 17 times faster than A

Practice for Exam

- Exercises:
Cormen (Page - 14): 1.2-2, 1.2-3
- Problem:
Cormen (Page - 14): 1-1

Next Class

- Topic:
Analysis of Insertion Sort
- Prerequisite:
Insertion Sort Algorithm



Thank You



Stay Safe