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)	Input (x, y)	z = x + y
Output (z)	z = x + y	Input (x, y)
z = x + y	Output (z)	Output (z)

Algorithm: Chatacteristics/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, $2*(10^7)^2 / 10^{10}$ = 20,000 sec

  = more than 5.5 hours

  [10^{10} instructions -------- 1 sec

  1 instruction -------- $1 / 10^{10}$ sec

  $2*(10^7)^2$ instructions -------- $2*(10^7)^2 / 10^{10}$ sec]

- Computer B takes, $50*(10^7) \lg 10^7 / 10^7)$ = 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

Stay Safe