Design and Analysis of Algorithms

(Week 1, Lecture 1)

Google Classroom Code: yduxr2l

Course Outline

Marks Distribution

	Frequency	Marks	Total
Quizzes	3	5	15
Assignments	3	5	15
Mid-Term	1	25	25
Mid-Term Viva	1	5	5
Final Exam	1	30	30
Final Viva	1	10	10

Algorithm

- An algorithm is a well-defined and effective sequence of computation steps that takes some value, or set of values, as input and produces some value, or set of values, as output.

Questions?

- What are algorithms?
- Why is the study of algorithms worthwhile?
- What is the role of algorithms relative to other technologies used in computers?

Example: Sorting

- Input: A sequence of n numbers <a1,a2,a3…an>
- Output: A permutation (re-ordering) <b1,b2,b3…bn> of the input sequence such that b1<b2<b3…<bn

Correctness

- An algorithm is said to be correct if, for every **input instance**, it halts with the correct output.
- An incorrect algorithm
  - might not halt at all on some input instances, or
  - It might halt with an answer other than desired one.

Problems Solved

- Sorting/searching are by no mean the only computational problem for which algorithms have been developed.
- Otherwise, we wouldn't have the whole course on this topic
- Practical application of algorithms are ubiquitous and include the following examples

Practical Applications

- Internet world
- Electronic commerce
- Manufacturing and other commercial settings
- Shortest path
- Matrices multiplication order
- DNA sequence matching

Common about algorithms

- There are many candidate solutions, most of which are not what we want, finding one that we do want can present quite a challenge.

- There are practical applications (its not just mathematical exercises to develop algorithms.)

Why Study Algorithms & Performance

- Algorithms help us to understand scalability.
- Performance often draws the line between what is feasible and what is impossible.
- Algorithmic mathematics provides a language for talking about program behavior.
- Performance is the currency of computing.
- The lessons of program performance generalize to other computing resources.
- Speed is fun!

Abstract Data Type

A definition for a data type solely in terms of

- a set of values and a
- set of operations on that data type.

The definition consists of:

- **storage structures (data structures) to store the data items**

and

- **algorithms for the basic operations.**

Data Structure

- A data structure is a way to store and organize data in order to facilitate access and modifications.
- No single data structure works well for all purposes
- Need to know the strengths and limitations of several of them.

Technique

- Can’t get a “cookbook” for algorithms?
- Many problems you will encounter don’t have any published algorithm.
- So need to learn “techniques” of algorithms design and analysis
- So you develop algorithms in your own, show that they give correct answer and understand their efficiency.
- We will learn several such techniques in later part of this course.

Algorithms & Other Technologies

- Is an algorithm a technology like hardware, etc?
- Total system performance depends on choosing “efficient” algorithms as much as choosing fast hardware.

Algorithms & Other Adv. Techs.

- Hardware with high clock rates, pipelining and superscalar architecture.
- Easy to use graphical user interface (GUI’s)
- Object oriented systems.
- Local-area and wide-area networking.

- Are algorithms as important as above technologies?