preamble

Analysis and Design of Algorithms

Lecture Notes by Dr. Wang, Rui
Fall 2009
Department of Computer Science
Ocean University of China

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General Information

Venue: 3-5-05

time: 6:30pm–9:30pm, Thursday

Instructor: Dr. Rui Wang, contact information:

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Telephone: 13969809328

Consultant hour: After class, or by appointment

Assessment: Assignment 40%, Examination 60%.

Course Webpage http://www.plcamr.com/ruiwang/teaching/Alg2010/, Students are required to check this page regularly

Course Objective

This course exposes students to algorithmic approaches and methods by showing a number of useful ideas and techniques. In particular, it introduces techniques for analyzing upper bounds for algorithms and lower bounds for problems. The emphasis is on the mathematical aspects of programming. The particular problems and algorithms studied will be chosen by the instructor from application areas such as graphs, computational geometry, string and DNA computing, distributed and parallel systems, machine learning, and other areas of active research.

Course Outline (tentative)

- Paradigms for designing Algorithms
- NP-completeness
- Approximation algorithms
- Randomized algorithms
- Other topics, may include
  - Kolmogorov complexity, derandomization, and other tools to support the application areas chosen by the instructor

Actual topics covered will depend on the availability of time and the depth of each topic.

Course Content

This course is **NOT**:

- A list of algorithms.
  - Learn their code.
  - Trace them until you are convinced that they work.
  - Implement them.
  - Worry about details.

```
class InsertionSortAlgorithm extends SortAlgorithm
{
void sort(int a[]) throws Exception {

    for (int i = 1; i < a.length; i++) {
    int j = i;
    int B = a[i];
    while ((j > 0) && (a[j-1] > B)) {
        a[j] = a[j-1];
        j–; }
    a[j] = B; }}
```

This course **DOES** intend to let student think about algorithms **ABSTRACTLY!**

Recommended Literatures

- Cormen, Leiserson, Rivest, and Stein, Introduction to Algorithms (2nd ed.), MIT Press, 2001.
- D.S. Hochbaum, ed., Approximation Algorithms For NP-Hard Problems, PWS, 1997
- X.P. Cao, Design of Analysis of Algorithms (in Chinese).
- M.R. GAREY & D.S. JOHNSON, Computers and Intractability: A Guide to the Theory of NP-Completeness, W. H. Freeman & Co., San Francisco, 1979, 1983. (a Chinese version may be available)
- D.M. Zhu & S.H. Ma, Design and Analysis of Algorithms (in Chinese), Higher Education Press, 2009.
- Note that:
  - No single standard text.
  - Recommended, not required.
  - Students are expected to read the lecture notes.
  - Discussion and feedback are also important.

Useful Resource

A number of forums (web sites) I know and often visit are:

- Complexity Zoo
- The P-versus-NP
- Computational complexity
- Bulletin of European Association for Computer Science
- NP-Completeness Columns
- A compendium of NP optimization problems
- Theoretical Computer Science Cheat Sheet prepared by Steve Seiden
- A collection of useful formulas compiled by Micha Hofri.

Prerequisites

The primary prerequisite for this course is only “Mathematical Maturity”.

- Though this course involves Discrete Math and algorithms, the instructor will develop almost every thing from scratch so that to keep the prerequisites to a minimum.
- But as it is mathematical as much as it is a course in computer science, “Mathematical Maturity” and clever combinatorial reasoning will play a key role.
- Anyway, an acquaintance with Discrete Math and Graph Theory will be helpful.

Assessment Scheme

- Assignment 40%+Examination 60%.
- Each assignment is expected to be intensively drilled for 5 hours. However, it depends on the background of individual students.
- Each assignment will be announced with a due date. The due date is a hard deadline–late submission is generally unacceptable.
- Assignments will be marked based on correctness but also on quality of explanations: strive for clarity and precision

Other Information

- A refinement of assignment policy can be found at the web page of last year course.
- In the same place, an explanation why using English to the students of the last year can be found.