EECE 431 Design and Analysis of Algorithms

August 30, 2017

Lectures

- Time: MWF 10:00 - 11:00 am.
- Place: Bechtel 204
- Lecturer: Professor Louay Bazzi
  Becthel 412, AUB extension: 3550
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  Office hours: Mondays and Wednesdays 11:15 am - 1:15 pm.

Catalog Description

This course covers techniques for the design and analysis of efficient algorithms. Topics include: sorting algorithms including merge-sort, quick-sort, and counting-sort; median and order statistics algorithms; sorting lower bound; divide-and-conquer design strategy; polynomial and matrix multiplication algorithms; balanced search trees; hash tables; augmenting data structures; number-theoretic algorithms; dynamic programming; greedy algorithms; graph algorithms including graph traversal algorithms and applications, minimum spanning tree, shortest path algorithms; distributed algorithms; network flows; introduction to NP-completeness and intractability. 3 Cerdits.

Prerequisites

By course: EECE 330.

By topic: programming and elementary data structures.

Textbook

"Introduction to Algorithms", by Cormen, Leiserson, Rivest, and Stein, MIT press, third edition.

Course objectives

- Teach the student the fundamental algorithms
- Teach the student how to analyze the performance of algorithms
- Teach the student the fundamental algorithmic design strategies

Topics

1. Foundations 8 hours
    - Introduction: design and analysis of algorithms, insertion-sort, merge-sort
    - Asymptotic notations, solving recurrences
    - Divide-and-conquer algorithms: modular exponentiation; Strassen's algorithm.
    - Polynomials and long integers multiplication; division algorithm; Euclid's algorithm.
2. Dynamic programming 3 hours

    Longest common subsequence, and Matrix chain multiplication
3. Introduction to graphs and trees 1 hour

    Proofs
3. Sorting and order statistics 8 hours
    - Quick-sort, randomized algorithms
    - Sorting lower bounds, and counting-sort
    - Medians and order statistics algorithms
4. Data structures 8 hours
    - Review of elementary data structures, binary-search trees, and priority queues
    - Red-Black trees

- Augmenting data structures: dynamic order statistics.
- Hash functions

5. Graph algorithms 10 hours

   - Elementary graph algorithms
     Breadth-first search, depth-first search, and applications.
   - Minimum spanning tree:
     Greedy algorithms, Prim's minimum spanning tree algorithm
   - Shortest path algorithms
     Dijkastra's algorithm, Bellman-Ford algorithm, and Floyd-Warshall algorithm
   - Network Flow

6. Introduction to complexity theory 3 hours

   Tractable and intractable problems, definition of the classes P and NP, NP-completeness, standard NP-complete problems.

7. Selected topics as time permits 2 hours

Problem sets, exams, and grading

We will have around 9 problem sets, a midterm, and a final exam.

The following grading system will be adopted:

- Weekly problem sets: 25 %

  The problem sets are intended to help you understand the material. If you do not work on the problem sets, do not expect to pass the exams.

- Exams: 70 %
  - Midterm (35%): TBA
  - Final (35%): TBA
- Assessment of the instructor: 5 %

Web

Course webpage on Moodle.