CS 455: Advanced Design and Analysis of Computer Algorithms

Prof. Qiang Shawn Cheng

Department of Computer Science
Southern Illinois University Carbondale
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Syllabus

Lectures. Qiang (Shawn) Cheng
- MWF 3:00 - 3:50pm.
- Attendance is expected.
- Office hours: MWF 12:00-1:00pm, 3:50-4:50pm, ASA 118.
  Other times, appointment needed.
- Email: qcheng@cs.siu.edu

TA: Wei Rang
- Phone: TBA; Email: weirang@siu.edu
- Office: EGRA409; Office hours: 10:00-11:30 am MW.
- Grades home works and/or tests, and answers questions regarding the homework and grading.
Background and Books

Purpose: a rigorous introduction to the design and analysis of algorithms
- Not a lab or programming course
- Not a math course, either

Prereq. Data structure, programming courses; and Introduction to Algorithms (equivalent to CS 330).
Or instructor's permission (see me after class).

Textbook. Algorithm Design
by Éva Tardos and Jon Kleinberg.
- Available at university bookstore.

Recommended books:
1. Analysis of Algorithms.
2. Introduction to Algorithms, Cormen, Leiserson, Rivest, Stein
   - The “Big White Book”; Second edition: now “Smaller Green Book”
   - An excellent reference you should own
Grades

Grading.

- "Weekly" or biweekly problem sets (about 3 sets of machine problems), due Wednesday 3:00pm in class. No late homework will be accepted.
- Class participation, staff discretion for borderline cases.
- Optional project and in-class presentation: encouraged, ~15min, on applications of problems, techniques, or results related to class materials. May lead to bonus points.
- Four quizzes (out of which, three best scores will be used)
- Three exams, one optional final (replaces the worst of the first three).
- Grade determination: tests 25%+25%+25%, HW: 15%, quizzes: 10%

Course grades.

- Undergrads: determined without considering grad students.
- Grads: determined by considering undergrad scale.
- Definitely A if above 90.
Collaboration

Collaboration policy. (ask if unsure)

- Course materials are always permitted.
- You are encouraged to attend office hours as needed.
- No external resources, e.g., Google, Yahoo.

"Collaboration permitted" problem sets.

- Default permission level, unless otherwise stated.
- Can form study group of up to 3 students.
- Study group may work on problems jointly, but you must write up solutions individually.

"No collaboration" problem sets.

- Can always consult course staff.

You need “independently” work out problems in tests and quizzes:

- Text book is permitted; class notes are permitted.
- No other book is permitted.
Algorithms

Algorithm.

- [webster.com] A procedure for solving a mathematical problem (as of finding the greatest common divisor) in a finite number of steps that frequently involves repetition of an operation.

- [Knuth, TAOCP] An algorithm is a finite, definite, effective procedure, with some input and some output.

Great algorithms are the poetry of computation. Just like verse, they can be terse, allusive, dense, and even mysterious. But once unlocked, they cast a brilliant new light on some aspect of computing. – Francis Sullivan
Algorithmic Paradigms

Design and analysis of computer algorithms.

- Two cornerstone topics in computer science
  (the other is theory of computation/automata theory)

- Paradigms and Contents to be covered:
  - Greed.
  - Divide-and-conquer.
  - Dynamic programming.
  - Network flow.
  - Randomized algorithms.
  - Intractability.
  - Coping with intractability.

Critical thinking and problem-solving.
Applications

Wide range of applications.

- Caching.
- Compilers.
- Databases.
- Scheduling.
- Networking.
- Data analysis.
- Signal processing.
- Computer graphics.
- Scientific computing.
- Operations research.
- Artificial intelligence.
- Computational biology.
- ...