Spring 2024

CS 667-002: Design Techniques for Algorithms

Pan Xu

CS 667 (002), Design Techniques for Algorithms, Spring 2024

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1 Basic Information

Instructor: Pan Xu, GITC 4310, pxu@njit.edu. Here is his website: https://sites.google.com/site/panxupi/. Office Hours: by appointment. Feel free to email the instructor to schedule an appointment.

Teaching Assistant (TA):

- Ali Parviz, ap2248@njit.edu. Link to his online Webex room: https://njit.webex.com/meet/ap2248. Office hours: **Tuesday (2 PM to 3 PM)** each week.
- An Hai Tran, at738@njit.edu. Here is the link to his online Webex room: https://njit.webex.com/meet/at738. Office hours: **Tuesday (2 PM to 3 PM)** each week.

The TAs will hold the office hours via Webex by default. Generally, at least one TA will be present to host the office hour each week in their Webex meeting rooms. Please email to the two TAs 24 hours before the office hour to confirm their availabilities. Feel free to email the TAs to schedule an online appointment outside the TAs' office hours.

Class schedule and location: Friday, 2:30 PM to 5:20 PM. Location: KUPF 203. The class is delivered Face-to-Face.

Course overview: The course will focus on algorithm design and analysis (not implementations). The first half semester is devoted to standard topics, including sorting algorithms, dynamic programming, and basic algorithm design paradigms such as Divide and Conquer. The second half is for advanced algorithm design and analysis, with topics of approximation and randomized algorithm design and analysis for NP-hard problems such as Vertex Cover and Coverage Maximization.

Prerequisite: CS 610. Students are expected to have good knowledge of discrete mathematics, probability theory, linear algebra, and calculus I and II. Also, it assumes students have basic programming skills.

Textbooks: No textbooks are required. Below is a list of useful online references:

- Algorithm Design and Analysis:
  https://www.cs.princeton.edu/~wayne/kleinberg-tardos/
  https://courses.cs.duke.edu/fall08/cps230/Book.pdf

- Approximation Algorithms:
  https://www.designofapproxalgs.com/book.pdf
  https://cs-web.bu.edu/faculty/gacs/papers/approx-alg-notes.pdf
- Randomized Algorithms:
  http://www.cs.yale.edu/homes/aspnes/classes/469/notes.pdf
  https://courses.engr.illinois.edu/cs574/sp2022/lec/old_notes/rand_alg_sp18.pdf

2 Course Contents and Schedule

Dates	Topics
W1	Introduction, Asymptotic notations and analysis
W2	Bubble Sort, Merge Sort, and Quick Sort (HW1 will be posted)
W3	Bubble Sort, Merge Sort, and (Randomized) Quick Sort
W4	Shortest Path, Dijkstra's ALG (HW1 due on Friday night of W4)
W5	Shortest Path, Dynamic Programming (HW2 will be posted)
W6	Introduction to NP-hard and Approximation Algorithms
W7	Pricing and LP-Based for Vertex Cover
W8	(Midterm on Friday) (HW2 due on Monday mid-night)
W9	No Class (Spring Break)
W10	Set Cover, LP-Based Approx (HW3 will be posted)
W11	No Class (Good Friday)
W12	Set Cover, Greedy (HW3 due on Monday night on W13)
W13-W15	COV-MAX, Greedy and LP-Based (HW4 will be posted on W13)
W16	TBD (Class on Tues, April 30, HW4 due on Monday night on W16)

There are several components to this course as follows:

1. Instructor lectures.
2. Individual assignments: There will be expectedly four homework assignments, involving algorithm design, analysis, and implementations.
3. Midterm and final exams.
4. Class participation and one scribing assignment.

3 Submissions and Grading of Assignments

Items	Grade (% of final grade)
HW1	10
HW2	10
HW3	10
HW4	10
Midterm	25
Final Exam	30
Scribing Assignment	5

Below are a few important notes.

- Generally, all HWs will be posted on the Fridays of the week.
- For the scribing assignment: Every student is expected to formally write down the materials covered in one lecture. Please email your submission to pxu@njit.edu with the subject "CS 667 Scribing Assignment," which is due **two weeks** after the lecture is given (specifically, by midnight on the Friday two weeks after the lecture is delivered).

  Submissions after the deadline will NOT be accepted. Every student should type the notes using LaTeX, and no handwritten scripts will be accepted. Students are expected not only to clearly write down all materials covered in the class but also to fill in any missing information mentioned by the instructor.
- The midterm will take place in the classroom on Friday of Week 8 (W8), from 2:30 PM to 4:30 PM, and the final is yet to be determined. Both are open book exams, allowing the use of lecture notes. Every student is expected to take both the midterm and final exams in person. During the exams (midterm and final), any digital devices that can potentially be connected to the Internet must be powered off, including PCs, Apple watches, smartphones, and tablets. Students are encouraged to bring calculators and conventional watches for the exams. For paper exams, if any, please do not use pencils to write down your answers; otherwise, you will automatically be deprived of the right to complain about grading after the exam.
- 20% late submission penalty will be applied if submitted within 24 hours of the deadline. Beyond that, late submission is not accepted. Unless otherwise stated, all submissions are due by 11:59 PM (EST) on the designated date.
- For all HWs, students are required to upload a PDF on Canvas by the deadline. Note that only PDF files are accepted and all students are required to type their solutions. It is strongly encouraged that all students should use LaTeX editors to type their solutions, including all equations and math symbols in a proper way. A very useful online cloud-based LaTeX editor is overleaf: `https://www.overleaf.com/`, which is free to all NJIT students.

- Grading Scale: A: Top 25%; B+: Top 26-50%; B: Top 51-75%; C+/C/D/F/W: TBD.

4 Statement on academic integrity

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu.