

Spring 2023

CS 610: Data Structures and Algorithms

Pan Xu

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CS 610 (002), Data Structure and Algorithms, Spring 2023

January 15, 2023

1 Basic information

Instructor: Pan Xu, GITC 4310, pxu@njit.edu. Here is his website: <https://sites.google.com/site/panxupi/about-me--1?authuser=0>. Office Hours: by appointment. Feel free to email the instructor to schedule an appointment.

Teaching assistant (TA):

- An Hai Tran, at738@njit.edu. Office hours: 1:30 PM to 2:30 PM on Tues, Wed, and Friday. Here is the link to his online Webex room: <https://njit.webex.com/meet/at738>.

The TA will hold the office hours via Webex by default. If you want to meet him face-to-face, please email the TA 24 hours before the default office hours, and then he will accommodate the request accordingly. Feel free to email TA to schedule an online appointment outside the TA's office hours.

Class schedule: Wed/Friday, 10 AM to 11:20 AM. Location: **GITC 1400**. The class is delivered **Face-to-Face** and **on Webex** simultaneously. Every student has two options to take the class: either to go to classroom to attend it physically OR take the class online by visiting the instructor's online Webex room: <https://njit.webex.com/meet/pxunjit.edu>. In case to attend it face-to-face, every student is *recommended* to wear a face mask by following the latest university COVID-19 policy; see details here: <https://www.njit.edu/pandemicrecovery/pandemic-recovery-update-0>.

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: (CS506 or CS241) and (CS505 or CS114). 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 content and detailed schedule

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. Both in-person and online participations count.

Dates	Topics
W1	Introduction, Asymptotic notations and analysis
W2	Asymptotic notations and analysis (HW1 will be posted)
W3	Bubble Sort, Insertion Sort
W4	Divide and Conquer: Merge Sort
W5	Divide and Conquer: QuickSort (HW2 will be posted)
W6	Dynamic Programming
W7	Dynamic Programming
W8	Introduction to NP-hard and Approximation Algorithms (Midterm on Friday)
W9	No class (Spring Break)
W10	Vertex Cover, Pricing for Vertex Cover (HW3 will be posted)
W11	Linear Programming (LP), LP-based Approx. for Vertex Cover
W12	Introduction to Randomized Algorithms, Max SAT
W13	Randomized Algorithms for Max SAT (HW4 will be posted)
W14	Coverage Maximization, Greedy
W15	LP-based Sampling for Coverage Maximization, Design and Analysis
W16	Guest lecture, TBD (There will be only one class on Tues, May 2)

Remarks. Materials starting from W10 to W15 are advanced part of modern algorithm design.

3 Submission and grading of assignments

Here are a few important notes.

- Generally, all HWs will be posted and due on the Fridays of the week.

Items	Grade (% of final grade)	(Posted date, Due date)
HW1	10	(W2,W4)
HW2	10	(W5,W7)
HW3	10	(W10, W12)
HW4	10	(W13, W15)
Midterm	25	W8, Friday
Final Exam	35	W16

- The midterm will take place in the classroom on Friday of Week 8 (W8), from 10 AM to 11:20 AM, and the final is to be determined. **Both are open books and lecture notes.** Every student is expected to take the mid 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 are automatically 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/>.
- 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.