Fall 2020

CS 610-101: Data Stucture & Algorithm

Alex Gerbessiotis

1.1 CONTACT INFORMATION

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Contact Hours: Tue and Thu 4-5:20pm (Webex)
Contact Hours: Tue 1-2:20pm (NJIT;check web-page)
Assistant: TBA on WEB
Class Hours: 6:00-8:50pm
Web-Page: http://www.cs.njit.edu/∼alexg/courses/cs610/index.html
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1.2 COURSE ADMINISTRATION

CourseWork: 2 exams ; 4 Homeworks (HW) ; Programming project (aka PrP).
Points: 1000points=PrP(160)+Ex1(360)+ Ex2(360)+HW(120)

PrP: A programming project (PrP) with 2 options each one worth 160 points. A student may submit one or two options in ONE archive per Handout 2 **AND SUBMITTED VIA Canvas BEFORE 12-o'clock 'noon'** of the date specified in the Calendar which is a Wednesday that is not a class day! Turnitin will be activated in canvas.

HW, PS: Several problem sets (PS) will be periodically posted that would include problems with accompanying solutions. Homeworks will be given out. Submission through Canvas;on a non-class Wednesday cycle. PSes are not for credit; HWs are for credit.

Exams: Dates in Course Calendar and on a class day starting at 6pm. Exam1 (120mn) is midterm. Exam2 (120mn) is final. The two exams are on canvas and through ProctorU; you need to create a ProctorU account early, at least three FULL weeks before the first exam, if you don't have one. Exam 1 and Exam 2 are closed everything and cumulative.

1.3 BASELINE COURSE SYLLABUS

Course: CS610. Data structures and algorithms.

Credits: 3 credits.

Prerequisites: (CS506 or CS241) and (CS505 or CS114).

Description: Intensive study of the fundamentals of data structures and algorithms. Presents the definitions, representations, processing algorithms for data structures, general design and analysis techniques for algorithms. Covers a broad variety of data structures, algorithms and their applications including linked lists, various tree organizations, hash tables, strings, storage allocation, algorithms for searching and sorting, and a selected collection of other algorithms.

Textbook: [Recommended, designated] Algorithm Design: Foundations, analysis, and internet examples. M. T. Goodrich and R. Tamassia. Wiley, 2001, ISBN 0-471-38365-1.
Referred to hereafter as **GT.**

Learning Outcomes:

1. Learn how and be able to understand and formulate the input-output relationship of computational problems, and formulate the requirements, data and operations of abstract data types (ADT).
2. Learn how and be able to asymptotically compare functions using $o, O, \omega, \Omega, \Theta$, and be able to solve recurrences using the master, iteration/recursion tree, and the substitution methods.
3. Learn how and be able to describe, derive and determine, the asymptotic performance of algorithms for computational problems and operations on elementary and more advanced data structures.
4. Learn how they operate and be able to understand fundamental algorithms and data-structures, and understand their characteristics for problems related to searching, sorting, selection, operations on numbers and polynmials and matrices and graphs. Be able to choose among a variety of similar ones based on problem/program specification and requirements.
5. Learn how and be able to compose more complex algorithms using as building blocks the fundamental algorithms introduced in class.
6. Learn how and be able to compose more complex algorithms using the algorithmic design techniques introduced in class.
7. Learn how and be able to compose advanced data structures using as building blocks the elementary data structures introduced in class.
8. Learn how and be able to implement in a high-level imperative language some of the algorithms and data structures introduced in class in the form of a programming project of considerable complexity.
9. Learn how and be able to understand and possibly identify that some problems are complex and are not susceptible to 'easy' solutions. Learn how and be able to understand the benefits and complexities of using randomness in computation.

Topics (with references to chapters of the designated textbook):

T1. Ch1,2.1-2.2,4.1-4.2,5.1-5.2: Introduction. Algorithm Analysis. Asymptotic notation. Sorting. Algorithm Design Techniques. Elementary data structures.

T2. Ch1,5.2: Asymptotic growth of functions and Recurrence relations.

T3. Ch2.3,5,6.1-6.4: Graphs and their representation. Traversals. Union-find.

T4. Ch2.5-2.7: Hashing (by chaining and open-addressing). Google Example.

T5. Ch2.4,5.1,9.3: Heaps and Priority Queues. Greedy Method. Huffman codes.

T6. Ch4: QuickSort. Complexity of sorting. Linear-time sorting.

T7. Ch4: Selection; Order statistics

T8. Ch4.2,6,7: Graphs and their representation. Graph traversals. Strong connectivity. Topological sorting. Shortest paths. Minimum cost spanning trees.

T8. Not in GT: Graphs and Web-page Ranking: Google's PageRank, Kleinberg's HITS algorithm.

T9. Ch5.2-5.3: Integer and Polynomials. Matrices. The WORD and BIT models.

T10. Ch3: Binary Search Trees and Balanced Binary Search trees.

T11. Ch3.3, 14.1.2: Search Trees of Bounded Depth (and Height)

T12. Ch9.1: String and Pattern matching algorithms (if time permits).

T13. Ch13.1-13.2: The theory of NP-completeness: P, NP, co-NP, NPC, NP-hard.

1.4 CALENDAR

Fall 2020(Week starts on Tuesday)		
Week	Item Out	Item In
W01	HW are Wed-Wed	HW in before noon on a Wed
W02	HW1 out on 9/09	
W03		HW1 in on 9/16
W04	HW2 out on 9/23	
W05	HW3 out on 9/30	HW2 in on 9/30
W06		HW3 in on 10/7
W07		
W08	FULLY ONLINE	Ex1:Midterm ProctorU on class day
W09		
W10	HW4 out on 11/4	
W11		
W12		HW4 in on 11/18
W13	Wed is NJIT Fri	Thanksgiving is on 11/26
W14		PrP before noon on Wed 12/2
W15		
W16	FULLY ONLINE	Ex2:Final ProctorU on class day

Any modification/deviation from the calendar and its items will be done in consultation with the attending a class students and be posted on the course web-page. It is imperative that students check the course web-page regularly and frequently. Exceptions are as announced by the Provost's Office.

1.5 COURSE POLICIES

OARS: If you need special accommodations, contact the Office of Accessibility Resources and Services, KUPF 201, to discuss your specific needs. A Letter of Accommodation Eligibility from OARS authorizing your accommodations will be required and should be received by us at least two weeks plus two days before the first exam, if it also relates to exams.

MISSING: If you miss a class, you make up for lost time. No PrP extensions for any reason, medical or otherwise; you have 3 months to submit it: submit EARLY. If you miss an exam you MUST CONTACT the Dean of Students (DOS) within 2 working days from the day the reason for the absence is lifted with all necessary documentation and email the instructor of your intent and absence. The maximum accommodation period will be the number of missing days to the exam date: it is imperative then that you contact DOS even before the 2 working day period has expired if the accommodation period would be shorter. A makeup will be given in the rarest of cases.

Devices: Power down and switch off (not just silence) mobile and other devices and place them in a bag or backpack or on the floor, screen facing down. **IF A STUDENT GETS CAUGHT HAVING A DEVICE (on or off) ON HIM/HER, the exam receives a 0. DEVICES MUST BE OFF and NOT ON YOU. For ProctorU exams "ON YOU" means anywhere viewable including at a distance of less than 6ft. A not completely powered down device of yours is assumed to be "ON YOU" independently of proximity.**

1.5 COURSE POLICIES (continued)

Grading: For paper exams, if any, do not use pencils to write down your answers. If you do use a pencil do not complain about grading after an exam. Scratch paper is forbidden unless explicitly allowed in an online exam. Work submitted will be graded for conciseness and correctness; be brief and to the point and write clearly. Material covered in class and appearing in the relevant notes and chapters of the designated textbook can be used without proof. Everything else requires a proof (justification) of solution. For PrP-grading see Handout 2 for details (section Testing and Grading). On the sum of the grades of the options, a 0-60 grade is accounted as 0; an over-60 grade is cut-off at 160 points. Over-160 points are excess points.

Grades: Check marks and report errors promptly. **Resolve any issues WITHIN 2 CALENDAR WEEKS and before the first Reading Day** starting from the day an exam is returned/released, or homework graded. For PrP or the Final exam, within 5 calendar days from the day grades are posted on canvas or Banner, as applicable. Talk to the grader first, and then to the instructor (if different). The final grade is decided on a 0 to 1000 point scale. If you get less than 500 points in the class, expect an F. If you collect at least 500 points you should expect a C or better. 850 points or more are usually needed for an A including robust programming work but this threshold can be lower. (All these assuming no violation of the Collaboration policy.) After letter grades are decided, excess points are then applied to determine if an upgrade by one level (eg B to B+) is possible.

Incomplete: A grade of I(incomplete) is given in rare cases where work cannot be completed during the semester due to documented long-term illness or absence (e.g. unexpected national guard duty). A student needs to be in good standing (i.e. passing the course before the absence). An email (in lieu of a written letter) with a timeline of what is needed to be done will be sent to the student and the Department Chairperson. Not showing up in the final will probably get you an F rather than an I.

Collaboration: Collaboration of any kind (in HW, Exams, PrP) is PROHIBITED. Students must turn in work that has fully been composed and written by them and no-one else. Finding an answer on the Internet, Web, or otherwise, or it is product of someone else's work, or it is common with another student submission, in the same or other section/course risks punishment as outlined by the University. All parties of such interaction receive a 0 and letter grade is lowered by one or two levels. The work you submit must be the result of your own mental effort.

Email/SPAM: Use an NJIT email address or your email might not reach us. Send email to the designated course email address per Handout 0 instructions!

The NJIT Academic Integrity (Honor) Code will be upheld; violations will be reported to the Dean of Students (DOS). Read this handout carefully! ■.