



INFO 6205: Program Structures and Algorithms

Course Information

Course Title: **Program Structure and Algorithms**

Course Number: INFO6205

Term and Year: Fall 2024

Credit Hour: 4

CRN

Course Format: On- On-Ground /ZOOM as decided by Northeastern

Instructor Information

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Instructor Biography

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Teaching Assistant Information

Course Prerequisites

Graduate Level CSYE 6200 Minimum Grade of B- or Undergraduate Level INFO 5100 Minimum Grade of B- or Graduate Level INFO 5100 Minimum Grade of B-

Course Description

This course covers fundamental programming constructs and their performance. These include lists, stacks, queues, trees, trees, trees, trees, trees, tries, and graphs. The course emphasizes several problems- solving techniques: brute force, recursion, divide-and-conquer, dynamic programming, greedy algorithms, iterative improvement and backtracking. The course also covers both theoretical and experimental measurement of performance, as well as the concept of complexity. The course will also illustrate the various design techniques with problems in graph theory as it applies to social networking paradigms.

Data structures and algorithms are two facets of one fundamental technique of programming. It is impossible to have one without the other. The class will be detail oriented and will provide an essential component for anyone contemplating a career as a software developer. Although the subject could be studied using any language, the language of this class is Python 3.7 and above

Course Learning Outcomes

1. Describe, explain, and use abstract data types including stacks, queues, lists, tree, hash, and graphs.

2. Describe, explain, and implement using varieties of algorithmic techniques like divide and conquer, greedy algorithms, dynamic programming, and back tracking.
3. Describe the asymptotic performance of the algorithms studied in this course and understand the practical implications of that information.
4. Read, criticize, and analyze complexity of Python programs written by some other author.
5. Solve many of the interview problems efficiently on the Leetcode and Hacker Rank interview web sites and confidently attend Google, Amazon, and Facebook interviews. This course is a gold mine for students seeking jobs.

Required Tools and Course Textbooks.

No textbook required. You must install Jupyter notebook to solve the assignment.

Course Schedule/Topics Covered.

Week	Date	In Class Topic	Assignment Due
1	09/04	. Introduction 2. Basic data type 3. Pass by value 4. Swapping two objects in constant time 5. Class and objects 6. Int class 7. Data structure of Int 8. Need for private and public 9. Convert int to Python list 10. Convert Python list to int 11. How to reverse in place Python List 12. Need for operator overloading 1. <code>__str__</code> 2. <code>__len__</code> 3. <code>__getitem__</code> 4. <code>__setitem__</code> 5. <code>__add__</code> 6. <code>__sub__</code> 7. <code>__lt__</code> 8. <code>__eq__</code>	09/11
2	09/11	1. Introduction 2. OOP 3. Class 4. Objects 5. Test bench 6. Solution 7. Product of Array Except Self 8. How to write testbench as a class 9. $O(n^2)$ time complexity 9. $O(n)$ time complexity 10. $O(n)$ space complexity 11 $O(1)$ space complexity 12. How to use Leetcode to evaluate software	09/18

3	09/18	<ol style="list-style-type: none"> 1. Pass by value 2. Implementing python list as a dynamic growable array 3. Table doubling algorithm 4. Amortized cost 5. O(1) 6. Problem in prepending a list 7. Problem in deleting an element from slist 8. Need for a singly linked list 9. append, prepend, find and delete objects from slist 10. a[i] in a slist 11. stack 12. Queue 13. Deque 	09/25
4	09/25	<ol style="list-style-type: none"> 1. Need for recursion 2. Factorial using iteration and recursion 3. Printing a digit of a number iteration and recursion 3. Return the reverse value of an integer 4. Need for helper function 5. Merge sort 6. Recurrence tree 	10/2
5	10/2	<ol style="list-style-type: none"> 1. Solution to HW 2. Need for hash. 3. Building hash from basic Python 4. Using hash. 	10/9
6	10/9	<p>Graph Data Structure. Representation of million node graphs</p> <ol style="list-style-type: none"> 1 class Graph 2. Build a graph from a file 3 Dump of a graph as a text file 4. Visualizing graphs using Graphviz package 	10/16
7	10/16	<ol style="list-style-type: none"> 1. Binary tree 2. Complete binary tree 3. Need for heap 4. Max heap and min heap 5. Representing heap an array 6. Finding left, right and parent in THETA(1) 7. How to build heap in nlogn and O(n) time 8. Heap sort 9. How to use heap from Python Library 	NO HW
8	10/23	Midterm	
9	10/30	<ol style="list-style-type: none"> 1. Greedy algorithm 2. Need for dynamic programming 3. Memorization and optimal table building 4. Coin change problem 	11/6

		5. How to get answers back 6. 0/1 Knapsack problem	
10	11/6	1. Need for graph 2. Transportation problem 3. Minimal spanning tree 4. Course selection 5. Activity problem 6. Directed and undirected graph 7. Directed acyclic graph (DAG) 8. Graph representation using matrices 9. Graph representation using fan-in and fan-out list	11/13
11	11/13	1. DFS using time stamps BFS. 2. BFS 3. Topological sort 4. Dijkstra Algorithm	11/20
12	11/20	Binary tree 1. Need for left and right pointers 2. Why is parent pointer not required? 3 Tree traversals 4 Preorder, In order, post order, and Level order traversal 5 Level order traversal. 6 Tree visualization using Graphviz.	
13	11/27	Huffman encoding	13/4
14	12/4	1.Binary search tree 2.Implementing Tree hash using BST 3.Need for Trie Data structure. 4. Implementing Trie	12/11
15	12/11	1. Why Disjoint Set? 2. Need for union and find 3. Disjoint set data structure 4. Union by size 5. Path compression 6. Inverse Ackerman function	NO HW
16	12/18	Final	

Assignment Grading

- Attendance – 5%
- 12 Programming assignments -45%
- Midterm Exam – 25%
- Final Exam – 25%

Grading Scale

Letter	Total Marks
A	97.0 - 100
A-	92.0 - 96.9
B+	85.0 - 91.9
??	< 85

The instructor reserves the right to change the above grading without informing students if required.

20% Midterm
20% Final
60% Homeworks

Attendance/Late Work Policy

Attendance Policy

Students registered in MGEN courses (INFO, CSYE, and DAMG) are allowed **a maximum of 2 absences per course, with 3 or more absences resulting in an automatic 'F' for that course.** Students are expected to inform their instructors of any absences in advance of the class; if a student is sick long-term or experiences a medical issue that prevents class attendance, it is strongly encouraged that they speak with their Academic Advisor (coe-mgen-gradadvising@northeastern.edu) to learn more about the Medical Leave of Absence. Should a student anticipate being unable to attend 3 or more classes, they should discuss their situation with their Academic Advisor to explore other types of leave in accordance with the University's academic and global entry expectations. International students should review the Office of Global Services webpage to understand their visa compliance requirements.

Teaching Assistants (TAs) or Instructional Assistants (IAs) will be present at each class to collect student attendance.

Late Work Policy

Students must submit assignments by the deadline in the time zone noted in the syllabus. Students must communicate with the faculty prior to the deadline if they anticipate work will be submitted late. Work submitted late without prior communication with faculty will not be graded.

End-of-Course Evaluation Surveys

Your feedback regarding your educational experience in this class is particularly important to the College of Engineering. Your comments will make a difference in the future planning and presentation of our curriculum.

At the end of this course, please take the time to complete the evaluation survey at

<https://neu.evaluationkit.com>. Your survey responses are **completely anonymous and confidential**.

For courses 6 weeks in length or shorter, surveys will be open one week prior to the end of the courses; for courses greater than 6 weeks in length, surveys will be open for two weeks. An email will be sent to your Northeastern University Mail account notifying you when surveys are available.

Academic Integrity

A commitment to the principles of academic integrity is essential to the mission of Northeastern University. The promotion of independent and original scholarship ensures that students derive the most from their educational experience and their pursuit of knowledge. Academic dishonesty violates the most fundamental values of an intellectual community and undermines the achievements of the entire University.

As members of the academic community, students must become familiar with their rights and responsibilities. In each course, they are responsible for knowing the requirements and restrictions regarding research and writing, examinations of whatever kind, collaborative work, the use of study aids, the appropriateness of assistance, and other issues. Students are responsible for learning the conventions of documentation and acknowledgment of sources in their fields. Northeastern University expects students to complete all examinations, tests, papers, creative projects, and assignments of any kind according to the highest ethical standards, as set forth either explicitly or implicitly in this Code or by the direction of instructors.

Go to <http://www.northeastern.edu/osccr/academic-integrity-policy/> to access the full academic integrity policy.

MGEN Student Feedback

Students who would like to provide the MGEN unit with anonymous feedback on this particular course, Teaching Assistants, Instructional Assistants, professors, or to provide general feedback regarding their program, may do so using this survey: https://neu.co1.qualtrics.com/jfe/form/SV_cTIAbH7ZRaaW0Ki

University Health and Counseling Services

As a student enrolled in this course, you are fully responsible for assignments, work, and course materials as outlined in this syllabus and in the classroom. Over the course of the semester if you experience any health issues, please contact UHCS.

For more information, visit <https://www.northeastern.edu/uahcs>.

Student Accommodations

Northeastern University and the Disability Resource Center (DRC) are committed to providing disability services that enable students who qualify under Section 504 of the Rehabilitation Act and the Americans with Disabilities Act Amendments Act (ADAAA) to participate fully in the activities of the university. To receive accommodations through the DRC, students must provide appropriate documentation that demonstrates a current substantially limiting disability.

For more information, visit <https://drc.sites.northeastern.edu>.

Library Services

The Northeastern University Library is at the hub of campus intellectual life. Resources include over 900,000 print volumes, 206,500 e-books, and 70,225 electronic journals.

For more information and for education specific resources, visit <https://library.northeastern.edu>
Network Campus Library Services: [Northeastern University Library Global Campus Portals](#)

24/7 Canvas Technical Help

For immediate technical support for Canvas, call 617-373-4357 or email help@northeastern.edu

Canvas Student Resources: <https://canvas.northeastern.edu/student-resources/>

For assistance with my Northeastern e-mail, and basic technical support:

Visit ITS at <https://its.northeastern.edu>

Email: help@northeastern.edu

ITS Customer Service Desk: 617-373-4357

Diversity and Inclusion

Northeastern University is committed to equal opportunity, affirmative action, diversity, and social justice while building a climate of inclusion on and beyond campus. In the classroom, members of the University community work to cultivate an inclusive environment that denounces discrimination through innovation, collaboration, and an awareness of global perspectives on social justice.

Please visit <http://www.northeastern.edu/oidi/> for complete information on Diversity and Inclusion

Title IX

Title IX of the Education Amendments of 1972 protects individuals from sex or gender-based discrimination, including discrimination based on gender-identity, in educational programs and activities that receive federal financial assistance.

Northeastern's Title IX Policy prohibits Prohibited Offenses, which are defined as sexual harassment, sexual assault, relationship or domestic violence, and stalking. The Title IX Policy applies to the entire community, including male, female, transgender students, faculty, and staff.

In case of an emergency, please call 911.

Please visit <https://www.northeastern.edu/ouec> for a complete list of reporting options and resources both on- and off-campus.