



INFO 6205: Program Structures and Algorithms

Course Information

Course Title: Program Structure and Algorithms

Course Number: INFO 6205

Term and Year: Fall 2024

Credit Hour: 4

CRN: 17298

Course Format: On-Ground

Instructor Information

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Instructor Biography

Dr. Zheng is an Assistant Teaching Professor in the College of Engineering at the Toronto Campus. Before joining Northeastern University, he served as the Technical Vice President and the Head of Artificial Intelligence (AI) Institute at a NASDAQ-listed company. Dr. Zheng earned his Ph.D. in Computer Science from McMaster University and his Master of Engineering degree from the University of Chinese Academy of Sciences. His research interests broadly encompass data management and AI, focusing on data quality, data analytics, text mining, and machine learning. He has published numerous papers in top-tier conferences and journals in his field.

Course Prerequisites

Students should have basic knowledge of discrete mathematics and basic programming skills (especially in Java). It is assumed that the students know Java sufficiently to understand all simple codes used in the slides and textbook.

Course Description

The mission of this course is to give students an understanding of the foundations of data structures and algorithms, to teach them basic implementation techniques and to show how they can be applied to solve practical problems. Focuses on understanding the application of the abstract data structure and the circumstances that affect implementation decisions. Covers lists, stacks, queues, trees, hash tables, graphs, strings, and dynamic programming. Covers recursion and searching and sorting algorithms in detail. Emphasizes data abstraction and encapsulation in code design. Explores external storage structures, time permitting.

Course Learning Outcomes

- 1) **Comprehension of Program Structures and Algorithms:** By the end of the course, students will be able to explain fundamental program structures, data structures, and algorithms. They will have the ability to analyze diverse computational challenges using various methods and tools.
- 2) **Proficiency in Algorithmic Problem Solving:** Upon completion of the course, students will be proficient in designing, implementing, and analyzing algorithms for tasks such as searching, sorting, and recursion.

- 3) Application of Data Abstraction and Encapsulation Principles: Emphasizing modular and reusable programming practices, students will develop proficiency in applying principles of data abstraction and encapsulation in code design.

Required Tools and Course Textbooks.

Textbook: Algorithms, 4th Edition by Robert Sedgewick and Kevin Wayne, Addison-Wesley Professional, 2011.

Lecture Notes designed by the authors of the textbook can be found at <https://algs4.cs.princeton.edu/home/>.

Other resources:

- Algorithm Visualizer: <https://algorithm-visualizer.org/>
- Algorithm Practice: <https://leetcode.com/>
- Algorithm Bible: The Art of Computer Programming (Completed: Volume 1, 2, 3, 4A, 4B; Planned: Volume 4C, 5, 6, 7), by Donald Knuth, 1968

Topics Covered.

Lecture	Topic	Content
1	Introduction and Data Structure	<ol style="list-style-type: none"> 1. Abstract data types (ADT) 2. Array and List 3. Stacks and Queues
2	Basic of Algorithms Analysis	<ol style="list-style-type: none"> 1. Running time 2. Complexity and notation
3	Sorting	<ol style="list-style-type: none"> 1. Elementary sort 2. Mergesort 3. Bound 4. Quick sort
4	Priority Queues and Heapsort	<ol style="list-style-type: none"> 1. Priority queue 2. Binary heap 3. Heapsort
5	Trees	<ol style="list-style-type: none"> 1. Binary search tree: search, insert, delete, and traversal 2. Balanced Search Trees: 2-3 trees, read-black trees, B-trees
6	Hash Tables and Hash Functions	<ol style="list-style-type: none"> 1. Hash function and hash table 2. Separate chaining 3. Open addressing 4. Bitmap and hash
7	Graphs	<ol style="list-style-type: none"> 1. Undirected graphs and directed graphs 2. Breadth first search (BFS) and depth first search (DFS) 3. Connected components
8	Minimum Spanning Trees	<ol style="list-style-type: none"> 1. Union-find 2. Minimum spanning tree 3. Kruskal’s algorithm 4. Prim’s algorithm
9	Shortest Paths	<ol style="list-style-type: none"> 1. Generic algorithm 2. Dijkstra’s algorithm 3. Acyclic shortest path 4. Bellman-ford algorithm

10	Strings	<ol style="list-style-type: none"> 1. String sorts and tries 2. Bucket sort 3. Substring search: brute force algorithm, Knuth-Morris-Pratt algorithm, Boyer-Moore algorithm, and Rabin-Karp algorithm
11	Dynamic Programming (optional)	<ol style="list-style-type: none"> 1. Dynamic programming

Assignment Grading

Evaluation: There will be two 1.5 hours coding tests (35% per test, closed book) and one presentation (30%).

Detailed grading scheme: $\text{Grade} = 2 * 0.35 * \text{coding test} + 0.3 * \text{presentation}$.

Presentation

- Find a medium level problem (acceptance $\leq 55\%$) in Leetcode: <https://leetcode.com/>. The problem is related to one of the followings topics: lists, trees, graphs, strings and dynamic programming.
- Send the problem to the instructor at least 5 days in advance before the presentation date.
- Solve the problem with at least two different approaches.
- Present your solution in the class, solution should include (a) your thoughts of solving the problem, (b) the detailed code, and (c) the complexity analysis.
- The evaluation is based on the difficulty of the problem, solutions, presentation, and Q&A.

Grading Scale

	87-89.9% B+	77-79.9% C+	
95-100% A	84-86.9% B	74-76.9% C	
90-94.9% A-	80-83.9%B-	70-73.9% C-	69.9% or below F

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.