Northeastern
College of Engineering

Program Structure and Algorithms (INFO 6205)

Course Information
Course Title: Introduction to Machine Learning/Data Science
Course Number: INFO 6205
Term and Year: Spring 2024
Credit Hour: 4
CRN: 40669 (OAK), 41136 (BOS)
Course Format: In-person in-class (OAK), virtual (BOS)

Instructor Information
Full Name: Siddhartha (Sid) Nath
Email Address: s.nath@northeastern.edu

Instructor Biography
Sid is a Principal Machine Learning Scientist at Intel Corp since August 2022. Prior to that he was a Sr. Research Scientist at NVIDIA Corp. and Sr. Staff R&D and ML Lead at Synopsys Inc. His research focus is on applications of machine learning to chip design, combinatorial optimization and large-scale optimization. He has productized many ML solutions in chip design tools that have been used to fabricate chips by leading semiconductor design companies.

Sid obtained his Ph.D. in Computer Science and Engineering from UC San Diego in 2016. He was awarded the Powell Fellowship to further research in science and technology. He is a technical committee member of leading VLSI/CAD conferences and journals. Sid is an adjunct faculty at NorthEastern University since Fall 2023, and he has taught Data Science Engineering Methods (INFO 6105). He is also an adjunct faculty at Santa Clara University where he teaches Design and Analysis of Algorithms at the graduate level.

Teaching Assistant Information
Full Name: NA
Email Address: NA
Office Hours: NA

Course Prerequisites
Basics of discrete mathematics, some familiarity with linear algebra, and either knowledge of Python/C/C++.

Course Description

This course covers the fundamentals of designing data structures and the algorithms which manipulate them. This is an important class for any aspiring developer as data structures and algorithms are at the core of every application. The goal of the course is not only to teach the fundamentals of the subject, but also to give an understanding of why.

Standard Learning Outcomes

A. Develop an approach to problem-solving at scale.
B. Utilize different strategies to develop and improve various algorithms.
C. Articulate the relationship between data structures, algorithms, and invariants.
D. Choose the most effective algorithm (e.g., dynamic programming) for a particular problem-solving task.
E. Develop an algorithm-first mindset to prepare for and excel at software interviews.

Required Tools and Course Textbooks.

Introduction to algorithms 4th edition, Cormen et al., ISBN: 978-0-262-53305-8, MIT Press 2022

Topics Covered.

- Memory architecture to run software on computers
- Asymptotic growth of functions, running time analyses
- Data structures – arrays, linked lists, stacks, heaps, priority queues, union-find
- Non-optimization algorithms: search, sort, divide-and-conquer, graph algorithms (DFS, SCC, BFS)
- Optimization algorithms: greedy, dynamic programming, linear programming, network flows
- Intractability: Reductions to NP-Complete
- Practical implementations and applications of algorithms

Course Activities

1. **Homeworks -- 5**
2. **Quizzes - 6**
3. **Programming Assignments (in either Python or C++)– 3**
4. **Midterm exam – 1**
5. **Final exams – 1**
6. **Extra credit questions -- ~10-11**

Course Schedule

(Subject to some adjustments as the course progresses)

Week 1	Course introduction, algorithms and data structures widely used in industry; memory usage by software running on a computer
Week 2	Data structures: arrays and linked lists; stacks and heaps; priority queues and union-find
Week 3	Asymptotic growth of functions, insertion sort, quicksort
Week 4	Solving recursions, divide-and-conquer algorithms

Week 5	Graph algorithms
Week 6	Greedy
Week 7	Midterm
Week 8	Dynamic programming-1
Week 9	Dynamic programming-2
Week 10	Network Flows and Linear Programming
Week 11	Linear Programming
Week 12	Intractability-1
Week 13	Intractability-2
Week 14	Problem solving and final exam review
Week 15	Final exam

Grading Scale.

Relative scale.
Homeworks – 15%
Programming assignments – 15%
Quizzes – 20%
Midterm – 25%
Final – 25%
Extra credit (bonus) – 5%

Attendance/Late Work Policy.

Attendance Policy

Students are expected to complete assigned in-class labs, participate in class discussions or other learning activities during the unit, and complete written assignments for each unit during the time of that unit. It is understood that there might be one week when active participation in ongoing class conversations and learning activities might be delayed. Beyond one week's time, if there is an absence or lateness in participation (1) faculty must be notified in advance; (2) grades will be adjusted accordingly.

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 Professional Studies. 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 Husky 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.

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/uhcs.

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.

24/7 Canvas Technical Help

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

Canvas Faculty Resources: https://canvas.northeastern.edu/faculty-resources/

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.*