Department of Electrical and Computer Engineering
University of Massachusetts Amherst
ECE341 - Algorithms for Computer Engineering,
Spring 2020

Credits: 3

Prerequisites: ECE 241 - Advanced Programming I or equivalent

Course Objective:

Algorithms lie at the core of computer engineering. They are essentially a branch of applied mathematics; the foundation upon which computer programs are based. With computers increasingly embedded in every realm of modern life, understanding how to rigorously design and analyze algorithms is an important part of the computer engineering curriculum.

An algorithm is, at its heart, nothing more than a precise sequence of computational steps to be carried out in the achievement of some given objective. An incorrect algorithm can result in severely malfunctioning software; an algorithm chosen without regard to its scalability can fail to meet performance objectives.

The purpose of this course is to introduce students to core algorithms, understand how to prove their correctness and guide them in evaluating their performance. Students will be exposed to the handful of standard mathematical techniques used to prove algorithms correct. They will be shown how effective performance analysis can be carried out to guide the selection of algorithms for particular purposes and for given problem sizes. They will be taught how the structure of the computational platform can affect algorithm performance. They will be made familiar with the most commonly used algorithms.

Textbook: T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, *Introduction to Algorithms,* MIT Press, 2009 (Third Edition). Additional readings will be placed on Moodle as appropriate.

Topics Include:

- Algorithm complexity; asymptotic concepts and notation; amortized analysis.
- Recurrences and their solution.
- Complexity; NP-completeness.
- Distributed algorithms: Concept of time in a distributed system.
- Sorting algorithms.
- Optimization algorithms.
- Graph algorithms.
- Optimization basics and applications.
- Case studies from application areas (as time permits): Embedded systems, data analytics, machine intelligence.

Course Objectives: Upon successful completion of this course, students should be able to do the following:

- Apply standard mathematical techniques to prove the correctness of given algorithms.

- Analyze the asymptotic performance of algorithms.
- Display familiarity with the core algorithms in computer engineering.
- Be able to select the appropriate algorithm or set of algorithms for a given engineering problem.

Grading Scheme:

Homework: 10%
Midterm I: 25%
Midterm II: 25%
Final Exam: 40%

Statements from the College of Engineering

Health and Wellbeing. Success in this course and the College of Engineering depends heavily on your personal health and wellbeing. Recognize that stress is an expected part of the college experience, and it often can be compounded by unexpected setbacks or life changes outside the classroom. I strongly encourage you to reframe challenges as an unavoidable pathway to success. Reflect on your role in taking care of yourself throughout the term, before the demands of exams and projects reach their peak. Please feel free to reach out to me about any difficulty you may be having that may impact your performance in your courses or campus life as soon as it occurs and before it becomes too overwhelming. I encourage you to contact support services on campus that stand ready to assist you. Within the College, you may reach out to your academic advisor, the Office of Student Affairs (126 Marston) or the Office of Community Equity and Inclusion (128 Marcus). You can learn about the confidential mental health services available on campus by calling the Center for Counseling and Psychological Health (CCPH) at 413.545.2337 or visiting their website at umass.edu/counseling. There are many other resources on campus for students facing personal, financial or life challenges to find support, stay in school, and graduate. See a comprehensive list at umass.studentlife/single-stop. Help is always available. Please reach out for support finding the resources you need.

Disability Accommodation and Inclusive Learning Statement. Your success in this class is important to me. We all learn differently and bring different strengths and needs to the class. The University of Massachusetts Amherst is committed to making reasonable, effective and appropriate accommodations to meet the needs of students with disabilities and help create a barrier-free campus. If you have a qualifying disability and require accommodations while participating in this course, please work with Disability Services to have an accommodation letter sent to me in a timely manner. If you have a disability but are not yet affiliated with Disability Services, please register with Disability Services (161 Whitmore Administration building; phone 413-545-0892). Information on services and materials for registering are also available on their website www.umass.edu/disability. If you are eligible for exam accommodations, your exams will be administered by the exam proctoring center. Contact Disability Services immediately, and comply with their exam scheduling policies, including the requirement that you book your exams at least seven days in advance of the exam date. *It is incumbent upon you contact*

me during the first few weeks of the semester, or shortly following registration with Disability Services, to ensure that your accommodations are being sufficiently met, including extra time and note-taking access, as applicable. Finally, beyond disability accommodations, if there are aspects of the course that prevent you from learning or make you feel excluded, please let me know as soon as possible. Together we'll develop strategies to meet both your needs and the requirements of the course.

Integrity. There is no place for a dishonest engineer! Please read and be aware of the academic honesty policy: http://www.umass.edu/dean_students/academic_policy. While this isn't something that should arise, it is something we should be aware of and discuss as a class, as integrity is a core value of the engineering profession.

Inclusivity: The diversity of the participants of this course is a valuable source of ideas, problem solving strategies, and engineering creativity. If you feel that your contribution is not being valued or respected for any reason, please speak with me privately. If you wish to communicate with someone else in the College, speak with Assistant Dean Dr. Paula Rees (rees@umass.edu, 413.545.6324, 128b Marcus Hall). You may also submit anonymously through the College of Engineering Climate Concerns and Suggestions on-line form (https://tinyurl.com/UMassEngineerClimate) and/or the Positive and Negative Classroom Experience online form (https://tinyurl.com/UMassEngineerClassroom). We are all members of an academic community with a shared responsibility to cultivate a climate where all students/individuals are valued and where both they and their ideas are treated with respect.

Pronouns and Names. Everyone has the right to be addressed by the name and pronouns that they use for themselves. Students can indicate their preferred/chosen first name and pronouns on SPIRE, which appear on class rosters. Please let me know what name and pronouns I should use for you if they are not on the roster. A student's chosen name and pronouns are to be respected at all times in the classroom. To learn more, read the Intro Handout on Pronouns: https://www.umass.edu/stonewall/sites/default/files/pronouns_intro.pdf

Title IX. Any conduct that has the purpose or effect of unreasonably interfering with an individual's performance by creating an intimidating, hostile, or sexually offensive educational, academic, residential, or working environment is considered sexual harassment. Faculty have the responsibility to inform students of the resources and reporting options relevant to reporting an incident of sexual assault, sexual harassment, relationship violence or stalking for all genders. You may go to the Title IX webpage at http://www.umass.edu/titleix/ and the Sexual & Relationship Violence Resource Guide at (https://www.umass.edu/titleix/sites/default/files/documents/sexual_violence_resource_guide-fall2019.pdf) to find more information about resources and reporting options. Please reach out to me if you would like assistance connecting with any of these resources/options. You may also contact William Brady, the Interim Title IX Coordinator by email at wdbrady@umass.edu or by phone at (413) 545-6204

if they have any questions or want to make a report, file a complaint, find out about resources and/or academic support.