



THE CATHOLIC UNIVERSITY OF AMERICA
DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

CSC411: Design and Analysis of Algorithms
Spring 2023

Credit Hours: 3

Prerequisites: CSC 280 – Data Structure

Meeting Time/Location:

Tuesday & Thursday 2:10PM - 3:25PM
Pangborn 302

Instructor Contact Information:

Instructor: Dr. Minhee Jun
E-mail: junm@cua.edu
Office: Pangborn 220
Office Hours: Tuesday and Thursday 1:00 PM - 2:00 PM or by appointment

Course Description

This course presents the fundamental techniques for designing efficient computer algorithms, providing the correctness, and analyzing the complexity of algorithms. General topics include methods for expressing and comparing complexity of algorithms: worst and average cases, sorting, selection, graph algorithms, and basic algorithm design techniques such as divide-and-conquer, greedy method, backtracking, and dynamic programming.

Textbooks

Introduction to the Design and Analysis of Algorithms, 3rd Edition (**required**)

Author: Anany V. Levitin

Publisher: Addison Wesley; 3rd edition (October 9, 2011)

ISBN-10: 0132316811 / ISBN-13: 978-0132316811

Introduction to Algorithms, 3rd Edition (**recommended**)

Author: Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein

Publisher: The MIT Press; 3rd edition (July 31, 2009)

ISBN-10: 9780262033848 / ISBN-13: 978-0262033848

Course Objectives

This course deals with design and analysis of algorithms organized around algorithm design techniques. The algorithms analysis and design techniques are important in order to design an efficient computer programs in computer science and engineering. Upon completion of this course, students will be able to do the following:

- Analyze asymptotic runtime complexity of algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Understand and design algorithms using greedy strategy, divide and conquer approach, and dynamic programming etc.
- Apply important algorithmic design paradigms and methods of analysis.

Tentative Course Topics Covered

1. Fundamentals of the Analysis of Algorithm Efficiency
2. Review of Fundamental Data Structure
3. Big-O Notation
4. Algorithm Design Techniques
5. Brute Force and Exhaustive Search
6. Greedy Technique
7. Divide-and-Conquer
8. Back Tracking
9. Dynamic Programming

Contribution of Course to Professional Component

This course builds the computer science foundation in the area of programming. Students learn how to analyze the complexity of algorithms and how to design computer algorithms using proper methods when dealing with different real world problems.

Evaluation:

The instructor uses the assessment of the homework, quizzes, and exams to determine the achievement level of the course objectives and take proper actions to improve the course.

Participation	10%
Homework	20%
Midterm exam	30%
Final exam	40%

- Homework can be challenge in this course. Working on your homework is critical to doing well on the midterm and final exams. The homework assignments will be graded based on the correctness and your efforts in solving the assigned problems.
- Final Grades will be assigned based on all the work you have completed during the semester. Grading for this course will be as follows: $A \geq 90\%$, $90\% > A- \geq 87\%$, $87\% > B+ \geq 83\%$, $83\% > B \geq 80\%$, $80\% > B- \geq 77\%$, $77\% > C+ \geq 73\%$, $73\% > C \geq 70\%$, $70\% > C- \geq 67\%$, $67\% > D \geq 60\%$, $F < 60\%$.

Tentative Class Schedule

Available on Blackboard (<http://learn.cua.edu>)

Progress of Improvement:

The instructor will continuously try to improve the course. The instructor will frequently evaluate the student performance based on homework, projects, quizzes, and exams. The instructor will strongly encourage the students to ask questions, engage in the discussions, and provide feedbacks, and carefully examines the feedbacks. The instructor is available after class for any discussion referring to the course. The instructor will take proper steps, such as adjusting the pace of the lectures, to correct problems (if any), in order to maximize the students' learning. The university conducts a formal course evaluation at the end of each semester. The results of the evaluation are used to assess various aspects of effectiveness of learning in the course. At the end of every calendar year, the EECS faculty will conduct ABET course review on the course. The evaluation result and recommendations will be provided to the instructor for continuous improvement on the course.

Class Attendance, Participation, and Student Feedback:

- As a hybrid course, students are required to attend on-line (via Zoom) and off-line classes and participate in discussions. If you anticipate not being able to attend class for a particular reason, it is best to e-mail me with the information. Students are responsible for all materials covered and assigned during the semester. No student will perform poorly because of lack of access to the Instructor.
- Students are suggested to seek advice from the Instructor in case of any problem, academic, personal or otherwise. The classroom learning experience depends on both a professional teaching environment and student participation. Please ask questions! Let me know if you do or do not understand what is being lectured. All students are expected to be respectful to other students.
- Student feedback is required to ensure that a suitable learning environment is maintained in the class. The university conducts a formal course evaluation at the end of each semester. The results of the evaluation are used to assess various aspects of effectiveness of learning in the course. Students are strongly encouraged to provide the instructor with constructive criticisms regarding all aspects of class activities.

Expectations and Policies:

- **Homework & Project:** Homework and project reports are required to be submitted before the class on the due date.
- **Late assignment policy:** In order to enable us to provide timely solutions to assignments, we have the following policy regarding submission of late assignments.
 - An assignment that is turned in no more than 24 hours late will be scored with a 10% penalty.
 - An assignment that is turned in more than 24 and no less than 48 hours late will be scored with a 20% penalty.
 - An assignment that is turned in more than 48 hours late will receive the score of zero, though we will review it and comment on it.
- **Exams:** There will be no make-up exams unless an official excuse (document) is submitted and pre-approved by the instructor.

Academic honesty: Academic honesty is expected of all CUA students. Faculty are required to initiate the imposition of sanctions when they find violations of academic honesty, such as plagiarism, improper use of a student's own work, cheating, and fabrication.

The following sanctions are presented in the University procedures related to Student Academic Dishonesty (from <http://policies.cua.edu/academicundergrad/integrityprocedures.cfm>): "The presumed sanction for undergraduate students for academic dishonesty will be failure for the course. There may be circumstances, however, where, perhaps because of an undergraduate student's past record, a more serious sanction, such as suspension or expulsion, would be appropriate. In the context of graduate studies, the expectations for academic honesty are greater, and therefore the presumed sanction for dishonesty is likely to be more severe, e.g., expulsion. ...In the more unusual case, mitigating circumstances may exist that would warrant a lesser sanction than the presumed sanction."

Please review the complete texts of the University policy and procedures regarding Student Academic Dishonesty, including requirements for appeals, at <http://policies.cua.edu/academicundergrad/integrityfull.cfm> and <http://policies.cua.edu/academicundergrad/integrityprocedures.cfm>.

Accommodations for students with disabilities: Any student who feels s/he may need an accommodation based on the impact of a disability should contact the instructor privately to discuss specific needs. Please contact Disability Support (dss.cua.edu) to coordinate reasonable accommodations for students with documented disabilities.

Academic Support Services

- Any student who is struggling for any reason and believes this may impact your performance in the course is urged to contact the Dean of Students at (202) 319-5619 or cua-deanofstudents@cua.edu for support. Furthermore, please approach me if you are comfortable in doing so. This will enable me to provide any resources or accommodations that I can. If

immediate mental health assistance is needed, call the Counseling Center at (202) 319-5764 during business hours or the Counselor-on-Call after hours through Public Safety at (202) 319-5111.

- Also, the university's primary academic support resources are located on the 2nd floor of the Pryzbyla Center. These affiliated offices and services include:

- **The Undergraduate Advising Center** offers guidance to all undergraduates, especially first-year students, as they move toward their academic goals.

Phone: (202) 319-5545 **Email:** cua-advising@cua.edu **Web:** advising.cua.edu

- **The Center for Academic Success** provides academic support services for all students through a broad base of programs and services, including Tutoring Services, Workshops, Academic Coaching, Individual Skills Meetings, Peer Mentoring, and more.

Phone: (202) 319-5655 **Email:** cua-academicsuccess@cua.edu **Web:** success.cua.edu

- **The Writing Center** provides free, one-on-one consultations with trained graduate instructors for writing projects across all disciplines at any stage of the process, from brainstorming to revising. Appointments in the main location, 202 Pryz, can be scheduled in advance online (<http://english.cua.edu/wc/>). Drop-in appointments are also welcome based on availability in the Pryz and at the satellite location in the Mullen Library Lobby (see website for days and hours).

Phone: (202) 319-4286 **Email:** cua-writingcenter@cua.edu **Web:** english.cua.edu/wc/

- **The Math Center** is staffed with Math Faculty and Tutors who are trained to assist students struggling in areas ranging from the basics to complex problems in calculus and statistics. Any student who feels he or she may need assistance in this or any other math class is welcome to visit the Math Center in Pryz 204 Monday through Thursday between the hours of 4:00 and 10:00pm. No appointment is necessary and services are absolutely free.

Phone: (202) 319-5655 **Email:** cua-academicsuccess@cua.edu

- **Disability Support Services** provides programs and services designed to support and encourage the integration of students with disabilities into the mainstream of the university community.

Phone: (202) 319-5211 **Email:** cua-disabilityservices@cua.edu **Web:** dss.cua.edu

- **The Counseling Center** provides free individual and group counseling services, psychiatric consultation, alternative testing, and emergency services to CUA students. In addition, we provide consultation services and outreach programs to the CUA community. Appointments can be scheduled in person in 127 O'Boyle Hall, or by phone.

Phone: (202) 319-5765. **Web:** counseling.cua.edu

Expected Course Outcomes

Students at the end of the course should have a clear understanding of the following concepts and topics:

1. Learn good principles of algorithm design
2. Understand the limiting factors of resources in algorithm design (such as time and space in algorithmic solutions)

3. Learn basic algorithm design methods (such as the greedy technique, divide-and-conquer, and backtracking)
4. Learn how to analyze the performance of algorithms, i.e., learn how to analyze algorithms and estimate their worst-case and average-case behaviors, and estimate the time complexity using the big-O notation
5. Understand how to approach the algorithm design and analysis, i.e., which principles and/or design methods to use for a given problem; how to compare the quality of different algorithms.

ABET Student Outcomes Addressed by this Course

- SO1. Demonstrate ability to analyze a complex computing problem, recognize key components and algorithms necessary for a solution to a given problem, and apply principles of computing to identify solution to a given problem
- SO2. Design a computing-based system, process, component, or program to meet requirements
- SO6. Apply computer science theory and software development fundamentals in the design and implementation of a computing-based system.

Outcome Assessment

The course employs the following mechanisms to assess the above learning outcomes:

1. Homework is assigned and graded to assess the level of student understanding of course topics. The learning outcomes are also assessed through quizzes, mid-term and final exams given during the semester.
2. The classroom questions (in-class exercises) are used by the instructor to check the degree of students' understanding on the subjects.
3. The overall assessment of the course is done through the University student course evaluation.

Revised by : Minhee Jun

Date of Last Revision : January 07, 2023