COM S 311: Introduction to the Design and Analysis of Algorithms

Catalog Description Prereq: Minimum of C- in COM S 228; MATH 166, ENGL 150; COM S 230 or CPR E 310 Basic techniques for design and analysis of algorithms. Sorting, searching, graph algorithms, string matching, and NP-completeness. Design techniques such as dynamic programming, divide and conquer, greedy method, and approximation. Asymptotic, worst-case, average-case and amortized analyses. Topics from advanced data structures such as balanced trees and hashing.

Teaching Staff

	Monday	Tuesday	Wednesday	Thursday	Friday
Office Hours and Class					
Samik Basu (Instructor; sbasu@)		2:10-3:25pm* 3:40-4:55pm*		2:10-3:25pm* 3:40-4:55pm*	10am-12pm
Seyedehzahra Hosseini (Instructor; hosseini@)		8-9:15am* 9:30-11:30am		8-9:15am*	
Feifei Cheng (TA; fch777@)	9-10am		9-10am	11:30am-12:30pm	
Qiao Qiao (TA; qqiao1@)	11am-12:30pm	11:30am-1pm			
Siyuan Sun (TA; sxs14473@)					9-10am
Ling Tang (TA; ling@)			10am-12pm		
Samrajya Thapa (TA; svthapa@)	10-11am		12-1pm		12-1pm
Recitations					
Section 1 (Siyuan)			2:15-3:05pm		
Section 2 (Ling)				2:10-3:00pm	
Section 3 (Ling)	2:15-3:05pm				
Section 5 (Siyuan)		12:40-1:30pm			
Section 6 (Ling)	3:20-4:10pm				

There will be no recitation or office hours in the first week.

- **TA office hours will be held in Pearson 0112.**
- **Instructor office hours will be held in Atanasoff 213.**

Recitation rooms and class-lecture rooms are already announced at class.iastate.edu and on accessplus.
$*$: class time.

Text Book Algorithm Design by Jon Kleinberg and Éva Tardos

This course is enrolled in the Iowa State University Immediate Access Program. Last day to opt out if you have access to the book already is 09/03. Further details is provided on the Canvas page under Syllabus Module.

Topics (Tentative)

1. Runtime Analysis, big-O notation
2. Data structures, Heap
3. Hashing
4. Graphs and graph exploration
5. Algorithm Strategies

(a) Greedy Algorithms

(b) Divide and Conquer

(c) Algorithms related to RSA security protocol

(d) Dynamic Programming

(e) Network Flow (if time permits)

6. NP and Computational Intractability

Assignments and Exams

1. 6-8 homework assignments with at least one week turn-around time. **Assignment can be due during the Prep week**.

   There will be two main types of problems in the homework assignments: (a) problems that involve designing and analyzing algorithms, proving/solving mathematical/logical statements (e.g., solving recurrences or proving properties of algorithms); (b) problems that involve writing Java programs as per the specification and satisfying certain runtime constraints. There may be at most two assignments due any point of time.

2. 3 exams. The dates for exams 1 and 2 are Sept 30 (8:15pm-9:45pm) and Nov 3 (8:15pm-9:45pm) as per Registrar-link. The final exam date will announced during the semester.

Assessment The homework assignments will account for 50% of the overall grade. The exam 1 will account for 10% of the overall grade. The exam 2 will account for 15% of the overall grade. The final exam will account for 25% of the overall grade.

Example scenario: There are 6 homework assignments, where the i-th assignment has a max score of x_i and contributes to the overall grade w_i. (Note $\sum_{i=1}^{6} w_i = 50$)

The exam 1 max score is e_1; the exam 2 max score is e_2; the final exam max score is e_3.
If a student score in i-th homework assignment is a_i and in exam 1 is b_1, in exam 2 is b_2, in final exam is b_3, the overall score for the student is

$$\sum_{i=1}^{6} \frac{a_i}{x_i} \times w_i \quad + \quad \frac{b_1}{e_1} \times 10 \quad + \quad \frac{b_2}{e_2} \times 15 \quad + \quad \frac{b_3}{e_3} \times 25$$

Grading Scale The following scale will be used for assigning the final grades.

> 90	A/A-
> 75	B+/B/B-
> 60	C+/C/C-
> 45	D+/D/D-
Else	F

Outcomes *Learning objectives*:

1. Ability to understand problem statement based on mathematical/logical specification.
2. Ability to design solutions using standard algorithmic strategies (graph-modeling, divide and conquer, dynamic programming, etc.).
3. Ability to develop correct and efficient implementation of algorithms from their description.
4. Knowledge of computational intractability.

ABET student outcomes:

1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
2. Apply computer science theory and software development fundamentals to produce computing-based solutions.

Basic Logistics

1. All students are expected to attend class-lectures and
2. Recitation sessions will be held at the specified room at the scheduled time. Students will attend the sessions in which they are registered. Recitation sessions will be conducted by teaching assistants. Students, attending the recitation sessions, are expected to participate with specific questions related to the lectures, problem sets. Additionally, homework solutions may be discussed during recitations.
3. All homework submissions will be through Canvas. The format of the homework submissions will depend on the type of the assignment and will be specified in the assignment. *It may be useful for you to learn how to use latex for type-setting your non-programming homework assignment submission. There are lot of resources online and you can also use overleaf. We will post the latex source of the questions to get your started. It is not a requirement to use latex.*
4. Supplementary notes, assignments, exams will be posted on Canvas. Each aspect will have a separate module and will be accessible from the Canvas homepage for the course.
5. **All course discussions will be conducted on Piazza**. Students should check whether they have access to 311-Piazza page by the end of first week of classes and notify instructors if such access is absent. Students, who register late, should notify instructor to get access to Piazza page.
   (a) Students will post queries on Piazza with appropriate and relevant subject line. If a query does not have a response for over a day, student should reach out to the teaching staff directly via email.
   (b) Students will post queries that directly relates to their assignment solution in private.
6. For any assignment that involve submitting written code
   (a) Students are expected to design tests and validate solution. Some example outputs for specific inputs may be provided as part of the assignment specification. Submissions that successfully produce the outputs for these specific inputs do not automatically get any points (or partial credits).
   (b) Grading programming assignment will involve assessment based on test suit (T) designed by the teaching staff members. Failing to pass any of the tests in T will result in 0 points.
   (c) Solutions must follow assignment specification; for instance, the assignment description may include specification of output in a specific format or the implementation of a specific method (with a specific signature). Submissions that do not conform to such specifications will be considered incorrect.
7. Re-grading queries must be submitted within 7 days of the release of the grades. The queries must be submitted via email with appropriate subject line (311: Grading Query $\langle$ Assignment #$\rangle$). Each assignment and exam will specify the recipient of the queries. **The queries must be submitted from students' ISU email address**.

Free Expression Iowa State University supports and upholds the First Amendment protection of freedom of speech[1] and the principle of academic freedom in order to foster a learning environment[2] where open inquiry and the vigorous debate of a diversity of ideas are encouraged. Students will not be penalized for the content or viewpoints of their speech as long as student expression in a class context is germane to the subject matter of the class and conveyed in an appropriate manner.

Student Academic Accommodation Request Iowa State University is committed to assuring that all educational activities are free from discrimination and harassment based on disability status. All students requesting accommodations are required to meet with staff in Student Disability Resources (SDR) to establish eligibility. A Student Academic Accommodation Request (SAAR) form will be provided to eligible students. The provision of reasonable accommodations in this course will be arranged after timely delivery of the SAAR form to the instructor. Students are encouraged to deliver completed SAAR forms as early in the semester as possible. SDR, a unit in the Dean of Students Office, is located in room 1076, Student Services Building or online at `www.dso.iastate.edu/dr/`. Contact SDR by e-mail at `disabilityresources@iastate.edu` or by phone at 515-294-7220 for additional information.

Policy for Academic Dishonesty You are encouraged to discuss course materials with classmates and organize online group study sessions. Studying together and explaining each other concepts and materials discussed in class and recitations often help in improving the understanding of the topics and enhance the learning experience. However, each of you must work separately on your assignments (homework assignments and exams). For instance, the following (non-exhaustive) activities are strictly prohibited:

1. Writing solutions together
2. Copying from another student
3. Copying solutions posted online
4. Sharing part of or whole solutions (e.g., posting, emailing, printing and handing over)
5. Posting course assignments on the Web and asking for solutions

In short, apply common sense and when in doubt, ask the instructor and TAs to ascertain that your activities are not prohibited.

In an unfortunate event that we suspect academic misconduct, the case will pursued in accordance to ISU policies ISU policies. Anyone found responsible for academic misconduct may receive a failing grade **F** in the course.

COVID-19 health and safety (*Aug 10, 2021 Memo from Provost Wickert*)

- **Face Masks Encouraged**: Because of the continuing COVID-19 pandemic, all students are encouragedbut not requiredto wear face masks, consistent with current recommendations from the Centers for Disease Control and Prevention. Further information on the proper use of face masks is available at: cdc-gov.

  For more information about this statement, view the memo from August 10, 2021.

- **Vaccinations Encouraged**: All students are encouraged to receive a vaccination against COVID-19. Multiple locations are available on campus for free, convenient vaccination. Further information is available at: ISU-safety-updates. Vaccinations may also be obtained from health care providers and pharmacies.

[1] https://www.studentconduct.dso.iastate.edu/know-the-code-resources/resources-for-students/harassment-and-free-speech/free-speech

[2] https://www.iowaregents.edu/plans-and-policies/board-policy-manual/39-academic-freedom

- **Physical Distancing Encouraged for Unvaccinated Individuals**: Classrooms and other campus spaces are operating at normal capacities, and physical distancing by faculty, staff, students, and visitors to campus is not required. However, unvaccinated individuals are encouraged to continue to physically distance themselves from others when possible.