CSC 545 - Design and Analysis of Algorithms

Fall 2016
Gould Simpson 906
Monday and Wednesday, 9:30-10:45am

Description of Course
The course begins with a brief review of basic analysis techniques (approximating functions asymptotically, bounding sums, and solving recurrences). Student are expected to have familiarity with this material. We will study problems that are efficiently solvable, focusing on basic design techniques (divide-and-conquer, dynamic programming, and greedy). We present some graph algorithms (minimum spanning trees, shortest paths, and maximum flow). We will see how some of these, and similar algorithms can be used to solve practical problems. Complexity issues (NP-hardness and NP-completeness) will be reviewed, and practical approaches to dealing with intractable problems will be considered (approximation algorithms, randomized algorithms).

The emphasis throughout is on algorithm design: the ability to synthesize correct and efficient procedures for new combinatorial problems. This skill is developed through written assignments containing challenging exercises.

Course Prerequisites
Undegraduate courses in data structures and algorithms.

Instructor and Contact Information
Stephen Kobourov
Gould Simpson 715
520-626-5320
kobourov@cs.arizona.edu
Office Hours: 10:45-11:30 Monday and Wednesday and whenever my door is open.

http://www.cs.arizona.edu/classes/cs545
http://www.cs.arizona.edu/~kobourov
Grader: TBA

Course Objectives and Expected Learning Outcomes
Students who complete this course will be familiar with the standard algorithmic techniques, such as divide-and-conquer, dynamic programming, and greedy. Students will become experienced in formal correctness analysis and runtime analysis of algorithms. Finally, classic graph and tree algorithms and techniques for dealing with intractable problems will be mastered.

Absence and Class Participation Policy
The UA’s policy concerning Class Attendance, Participation, and Administrative Drops is available at http://catalog.arizona.edu/2015-16/policies/classatten.htm
The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable:
http://policy.arizona.edu/human-resources/religious-accommodation-policy.
Absences preapproved by the UA Dean of Students (or dean’s designee) will be honored. See
Assignments and Examinations: Schedule/Due Dates

Course Communications

Makeup Policy for Students Who Register Late
Students who register after the first class meeting must make up missed assignments/quizzes by the assigned date.

Course Communications
Online communication will be conducted via piazza and students are expected to check the webpage daily: https://piazza.com/arizona/fall2016/cs545/home

Required Texts or Readings
Required textbook: Introduction to Algorithms, by Cormen, Leiserson, Rivest and Stein (MIT Press 3rd edition)

Note that the second edition of the book is acceptable for this course; used copies of this edition can be purchased for $10-20 at Amazon.

Assignments and Examinations: Schedule/Due Dates
Preliminary exam (5%): Monday, August 22, 10:15-10:45am
Midterm exam (20%): Wednesday, September 21, 9:30-10:45am
Final exam (33%): Wednesday, December 7, 9:30-10:45am
Homework assignments (42%)

Without prior arrangement, missed exams and late homework assignments are not graded for credit.

There will be six homework assignments, assigned on Mondays and due in 2 weeks. Late homework will not be graded for credit. Failure to turn in a homework on time will result in a zero for that assignment. Yes, this lateness policy is harsh. Why? Because in the past, those who have fallen behind have had a very hard time catching up. So we are trying to prevent you falling behind. In the past, I have had students complain that they could have handed in something substandard on time and gotten more points than if they had handed in something really good a little late. Too bad. It is up to you to plan your time carefully and get your work in on time! You have been warned. In exceptional circumstances extra time can be requested. If you discuss with me well before the due date, requests will be considered reasonably. The closer to the due date it gets, the less likely I am to give you extra time.

Grading: Neat and concise solutions are required in order to receive full credit. If you cannot solve a particular problem, state this clearly in your write-up, and write down only what you know to be correct; rambling at length about ideas that don't quite work may cause additional points to be deducted. A problem solution that is technically perfect, but which is presented in a difficult-to-understand manner, might lose 10-20% of the available points.

Extra credit: Sometimes the homework assignments will have extra credit work. Extra credit in this course will be tallied separately from regular scores. If you end up on the borderline between two grades at the end of the course, extra credit will count in your favor. However, failure to do extra credit will never be counted against you, as grades are assigned on the basis of regular scores. You should do extra credit if you find it interesting and think that it might teach you something. It would not be wise to skimp on the regular assignment in order to do extra credit.
**Grading Scale and Policies**

Your final grade will be based on the percentage of all available points that you receive. A typical example of how percentages might translate into letter grades is A: 91-100, B: 81-90, C: 66-80, D: 50-65, E: 0-50. I do not claim that the grade cutoffs for this class will be the same. These cutoffs are merely to give you an idea of how I have graded in the past. I reserve the right to fail any student who has a failing average on the homework portion, or on the exam portion, or on the comprehensive final exam.

University policy regarding grades and grading systems is available at

http://catalog.arizona.edu/2015-16/policies/grade.htm

Department of Computer Science Grading Policy:

1. Instructors will explicitly promise when every assignment and exam will be graded and returned to students. These promised dates will appear in the syllabus, associated with the corresponding due dates and exam dates.
2. Graded homework will be returned before the next homework is due.
3. Exams will be returned "promptly", as defined by the instructor (and as promised in the syllabus).
4. Grading delays beyond promised return-by dates will be announced as soon as possible with an explanation for the delay.

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at http://catalog.arizona.edu/2015-16/policies/grade.htm#I and http://catalog.arizona.edu/2015-16/policies/grade.htm#W, respectively.

Dispute of Grade Policy: Instructor review of the grading for an exam must be requested no later than one week after the graded exam is returned to you. Be aware that as a result of such a review your grade is just as likely to go down as it is to go up. Review of the grading for a homework assignment must be requested first from the grader and then, if the issue is not resolved, from the instructor. This must be done no later than one week after the graded assignment is returned to you. Be aware that as a result of such a review your grade is just as likely to go down as it is to go up.

**Scheduled Topics/Activities**

- Review of asymptotic analysis, recurrences, sorting, basic data structures
- Greedy algorithms (e.g., Huffman codes)
- Dynamic programming (e.g., longest common subsequence)
- Divide and Conquer (e.g., closest pair of points)
- Graph algorithms (e.g., BFS, DFS, MST)
- Shortest paths (e.g., Bellman-Ford, Dijkstra, Floyd-Warshall)
- Planar graphs (e.g., planarity testing, embedding, Schnyder realizor)
- Maximum flow (e.g., Ford-Fulkerson)
- PageRank
- The classes P and NP
- NP-completeness
- Approximation algorithms (e.g., vertex cover, TSP)
- Randomized algorithms (e.g., Las Vegas, Monte Carlo)

**Department of Computer Science Code of Conduct**

The Department of Computer Science is committed to providing and maintaining a supportive educational environment for all. We strive to be welcoming and inclusive, respect privacy and confidentiality, behave respectfully and courteously, and practice intellectual honesty. Disruptive behaviors (such as physical or emotional harassment, dismissive attitudes, and abuse of department resources) will not be tolerated. The complete Code of Conduct is available on our department web site. We expect that you will adhere to this code, as well as the UA Student Code of Conduct, while you are a member of this class.
**Classroom Behavior Policy**
To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, web surfing, chatting, etc.).

**Threatening Behavior Policy**
The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself; see [http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students](http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students).

**Accessibility and Accommodations**
Our goal in this classroom is that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please let me know immediately so that we can discuss options. You are also welcome to contact the Disability Resource Center (520-621-3268) to establish reasonable accommodations. For additional information on the Disability Resource Center and reasonable accommodations, please visit [http://drc.arizona.edu](http://drc.arizona.edu).

If you have reasonable accommodations, please plan to meet with me by appointment or during office hours to discuss accommodations and how my course requirements and activities may impact your ability to fully participate.

Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

**Code of Academic Integrity**
Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See [http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity](http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity).

The University Libraries have some excellent tips for avoiding plagiarism, available at [http://www.library.arizona.edu/help/tutorials/plagiarism/index.html](http://www.library.arizona.edu/help/tutorials/plagiarism/index.html).

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor’s express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

**UA Nondiscrimination and Anti-harassment Policy**
The University is committed to creating and maintaining an environment free of discrimination; see [http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy](http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy).

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

**Additional Resources for Students**
UA Academic policies and procedures are available at [http://catalog.arizona.edu/2015-16/policies/aaindex.html](http://catalog.arizona.edu/2015-16/policies/aaindex.html)

Student Assistance and Advocacy: [http://deanofstudents.arizona.edu/student-assistance/students/student-assistance](http://deanofstudents.arizona.edu/student-assistance/students/student-assistance)

**Subject to Change Statement**
Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.