

# Course Syllabus

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## CS 331: Algorithms and Complexity

Unique Numbers: 51825, 51830, 51835, 51840

Spring 2015

## 1 Course Overview

### 1.1 Prerequisites

The following coursework with a grade of at least C- in each course: CS 311 or 311H, 314 or 314H, 429 or 429H; M 408C or 408N; SSC 321 or M 362K; and a pre-req or co-req of M 340L or SSC 329C.

### 1.2 Textbook

Algorithm Design by Kleinberg and Tardos (Addison-Wesley, 2006). Other materials will be made available through Canvas.

### 1.3 Course Outline

The following major topics will be covered.

- Analysis of algorithms
- Graph algorithms
- Greedy algorithms
- Divide-and-conquer
- Dynamic programming
- Network flow
- NP-completeness
- Undecidability
- Approximation algorithms
- Randomized algorithms

See the schedule for a detailed lecture plan.

### 1.4 Note on Quantitative Reasoning (QR) flag

- This course carries the Quantitative Reasoning flag. Quantitative Reasoning courses are designed to equip you with skills that are necessary for understanding the types of quantitative arguments you will regularly encounter in your adult and professional life. You should therefore expect a substantial portion of your grade to come from your use of quantitative skills to analyze real-world problems.

### 1.5 Lecture Time and Location

- Sections 51825, 51830: MW 12.30-2:00 pm UTC 4.132
- Sections 51835, 51840: MW 2.00-3:30 pm CLA 0.102

### 1.6 Discussion Section Times and Locations

- Section 51825: Friday 10-11 am CMA 3.114 (led by George)
- Section 51830: Friday 12-1 pm GDC 4.302 (led by George)
- Section 51835: Friday 1-2 pm CBA 4.348 (led by Siddhesh)
- Section 51840: Friday 2-3 pm CBA 4.348 (led by Siddhesh)

## 2 Instructors, Office hours, and Discussion

### 2.1 Instructor

Muhibur Rasheed

- Office hours- Tuesday 12-2pm, Wednesday 3.30-5pm (at GDC 4.404)
- Contact: muhibur at utexas dot edu

### 2.2 Teaching Assistants

- Siddhesh Chaubal
  - Office hours: Tuesday 2-3pm, Wednesday 5-6pm (at the CS TA stations in the GDC basement)
  - Contact: siddhesh at utexas dot edu
- Xue Chen
  - Office hours: Monday 5.30-6.30pm, Tuesday and Thursday 9-10am (at the CS TA stations in the GDC basement)
  - Contact: xchen at cs dot utexas dot edu
- Chi-Kit (George) Lam
  - Office hours: Tuesday and Wednesday 11am-12pm (at the CS TA station 4 in the GDC basement)
  - Contact: geocklam at cs dot utexas dot edu

### 2.3 Proctors

- Paul Bae
  - Office hours: Monday 3-5pm, Tuesday 3.30-5.30pm, Friday 5-6pm (Third floor lab)
  - Contact: pbae at utexas dot edu
- Ge Gao
  - Office hours: Tuesday 4-6pm, Thursday 4-6pm, Friday 3-5pm (Third floor lab)
  - Contact: gegao1118 at utexas dot edu

NOTE: Most questions should be submitted to Piazza rather than by sending an email to the instructors

### 2.4 Feedback

- Throughout the semester, please feel free to provide feedback to the instructor regarding any aspect of the course.

### 2.5 Piazza

- Sign up for the piazza discussion board for this class using this [link](http://piazza.com/utexas/spring2015/cs331) ↗ (<http://piazza.com/utexas/spring2015/cs331>)
- Participation in Piazza is highly encouraged. You can discuss any topics, including the assignments. The only restriction is that you should not post any part of your solution for assignment related posts. If it is necessary to post part of your solution to clarify a question or get feedback, then make the post private and only visible to the instructors. The instructors will decide whether the post will be made public.
- Make sure that you use the proper tag for your question.
  - Essentially, we have a large class and also a large instructional team. Different TA/proctors will be most familiar with different things and will respond to posts on piazza accordingly, and they will look at the tags to identify the posts that requires their attention.
    - So to ensure that you get the best or most relevant answer, use the correct tag.
  - Some examples
    - say you are in section 51835 and you need clarification on a solution discussed in a discussion section, then use the discussion\_51835 tag. That way the TA who led the section will answer that question.
    - If you have a question about the lecture, or a quiz- then use the corresponding tags.
    - For topic related questions like- 'Can someone explain why Disjktra's algorithm might fail if there are negative weights in the graph?'- use the 'course\_material' tag.
    - For course organization, schedule related questions- use 'general' or 'logistics' tags.

- Use your best judgment
- To promote student participation, bonus points will be awarded for good contributions. Instructors will monitor all questions and answers and endorse good questions (well-posed questions that would help other students), good notes (well-written explanation of some topic, links to useful videos/tutorials etc), and good responses (which correctly and clearly respond to a non-trivial question posted by another student).
  - Every 4 good question, response and/or note will earn 1 bonus raw point.
  - A student can get up to 5 bonus raw points in the entire semester.

### 3 Evaluation

#### 3.1 Overall breakdown

- Raw score will be computed as follows
  - Tests = 45
  - Assignments = 40
  - Quizzes = 15
- Letter grades
  - The mapping from overall raw scores to letter grades will depend somewhat on the overall performance of the class. The nominal A/A- cutoff is 90; A-/B+ is 85; B+/B is 80; B/B- is 75; B-/C+ is 70; C+/C is 65; C/C- is 60; C-/D is 55. These nominal cutoffs will not be increased; for example, a student achieving a raw score of 90 is guaranteed to receive an A in the course. However, these cutoffs might be lowered if necessary in order to improve the grade distribution.

#### 3.2 Assignments

- There will be **ten** assignments. Each assignment will contribute **4 points** to the overall raw score.
- Typically there will be 4 problems to solve in each assignment.
- High level point breakdown will be given in the question.
- The assignments will be **due at 11:59pm every Wednesday**. Each assignment will be posted on Canvas 1 week prior to their due date. The assignments must be submitted as a pdf, doc or txt file using canvas' assignments page. Late submissions will not be accepted.
- Assignments can be done in **pairs**. In fact we encourage you to work in pairs. Discussing problems, possible solutions, proofs and disproofs can greatly enhance your understanding.
- Suggested solutions will be posted on canvas the day after the assignment is due.
- Scores will be uploaded to canvas within 5-10 days. Note that it is a large class and a single TA will be responsible for grading around 100 assignments. And given the varied nature of answers that can be expected in algorithms, grading requires extra attention and care. So, 5-10 days is a very quick turnaround.
- You shall be able to access the feedback through canvas. The TAs will try their best to mention why some points were taken off, why your proof or algorithm does not work etc on the assignment. It is quite possible that the feedback may sometimes be too short or hard to understand. Feel free to contact the corresponding TA during office hours or via email (NOT piazza).
- After the scores are posted, detailed grading rubric along with some common mistakes will be posted on the assignment page by the grader. If you notice any errors in the grading, or need more clarifications, then contact the corresponding TA during his/her office hours, or contact via email. DO NOT respond on piazza.
- You must raise any grading issues within **7 days** from the day the graded assignments are handed back in class.

#### 3.3 Tests

- There will be **three** midterms each worth **15 points**.
  - See the class schedule for the dates of each test.
- Each of the tests will have two segments.
  - Segment 1: **in-class exam**.
    - Worth 10 points
    - Closed book and closed notes. You are only allowed to bring one page of notes (both sides may be used).

- Will consist of many short questions. These questions will test how much you understood the topics covered in class, and whether you can apply and/or expand upon those. Expect small proofs, why/why not type questions, reductions etc.
- Please try to arrive in class a few minutes early on the test dates; this will allow us to start the test right at the beginning of the class period.

◦ Segment 2: **take-home exam**

- Worth 5 points.
- Will be posted on canvas on the day of the in-class exam. These are due by 11:59pm two days after the in-class exam.
- This segment will consist of longer problems, more akin to the assignment problems.
- You must solve the problems on your own without consulting anyone (even the student you are paired with for the assignments), or the internet.

See academic honesty policy at the end of the syllabus. You are also not allowed to discuss these on piazza. However, you are free to see the book, the notes and other course materials.

- You might notice that segment 2 is graded more strictly than segment 1. The reason is that in the in-class exam, you are under time pressure and hence the grader will be a little bit accommodating if you make small errors.
- Solutions to the tests will not be posted. These will be discussed during the next discussion section.
- Exams will be graded and returned in 5-10 days. If you have any concerns about the exam scores, contact the instructor during office hours or by email.
- Please note that no make-up tests will be given in this course. If a student has a legitimate and properly documented excuse for missing one of the tests, the missing test score will be estimated as the average of the other two test scores. More complicated scenarios, e.g., where a student misses two tests for legitimate reasons, will be treated on a case-by-case basis. In the event of a non-excused absence, a score of zero will be assigned.

### 3.4 Quizzes

- There will be a quiz for almost every lecture.
- Quiz questions will be posted 1-2 days before class. Each quiz will be based on topics covered on the previous class and to help prepare for the next class.
- During class, we shall go over the questions. Multiple possible answers will be displayed and you shall have to select the correct answer using **iClickers**. There will be no participation points.
- The quizzes will be administered using **clickers**. Bringing a iClicker to class is a requirement.
- The worst 20% of your quizzes will be dropped. Then, the scores of the remaining quizzes will be normalized, added, and finally scaled to get the raw score out of 15.
  - For example, say we have quizzes on 5 different days and you got 3/4, 1/2, 3/3, 2/3 and 1/4 questions correct on those quizzes. Your normalized scores for these are 0.75/1.0, 0.5/1.0, 1.0/1.0, 0.67/1.0, and 0.25/1.0 respectively. The worst 1 (0.25/1.0) will be dropped. So, you would get 2.92/4.0 in total, which would get scaled to 10.95/15.0.

## 4 How to do well

The topics we cover in this course is going to be at the core of your skills no matter which career path you choose after graduation. So, the focus should be on learning as much as you can, rather than on looking for the shortest/easiest way to achieve a certain grade you are okay with. Having said that here is a bunch of things you need to understand and remember if you want to do well in this course, both in terms of your knowledge and your grades.

- This is a dense course. I mean dense, not just voluminous. Most topics in this course involve some level of abstraction, and mathematical formalism which make it difficult, and sometimes nearly impossible to understand an algorithm, a proof, a paragraph, or even a single sentence without re-reading it many times, breaking it down, trying out some examples, drawing figures etc.

Bottom line is you must be prepared to spend a lot of time on every single topic. If a topic spans 10 pages on the book, be prepared to spend at least 2-4 hours for this. Typically you would need between 6-8 hours of study per week to keep up with the topics.

- On any topic, do not simply read (and understand) the prescribed solution. Think deeper. Why does it work? Can something else also work? Would that be faster/slower? Would a solution work for all cases? If not, then how can one handle such cases? Did we not see a similar problem in another chapter? Are there some subtle differences? Why are we designing another algorithm for the same problem? Why did the book use proof by induction here? Let's see if I can prove it by contradiction instead....
- These types of deeper thinking and questioning will help you absorb the topic and also prepare you for the quizzes and the tests.
- Start the assignments as soon as you can. The assignments are mainly there to let you apply or extend what you learn in class. They are never going

to be just simple regurgitation of known facts. Sometimes, even understanding the problem/question can be a challenge. So, read the problems and discuss with your partner as soon as the assignment is posted (Wednesday+Thursday). Ask questions to get clarifications on the problems during the discussion section (Friday). Maybe get some hints during the sections, or during office hours. Then spend some time during the weekend to actually find solutions, discuss ideas on piazza etc. Bring your solutions to the office hours to get them vetted and finally write them up cleanly and precisely. Overall, I believe you would need to spend 5-6 hours on an assignment.

- Make the best of the lectures
  - Before coming to class, take a quick skim through of the topics that are going to be covered. You do not need to understand everything at this point, but you should be aware of the general content.
  - During class, take notes and also see how it relates to the book. Which part of the topic did the instructor emphasize more? did the instructor discuss a slightly different proof? ...
  - Ask questions during class.
- Make the best of the discussion sections
  - Discussion sections will be mainly focused on getting clarifications on assignment problems and discussing textbook problems.
  - Make sure that you have carefully read the homework problems before coming to the discussion and ask as many questions as required to remove any lingering confusions.
  - Spend a little bit of time to read the textbook problems and maybe try to think of possible solutions to a few, specially ones that seem related to homework problems. You can ask questions about those and get solution hints during the section.
    - Note that there are many problems to discuss, and very little time. So the TA will probably only be able to provide the high level idea during these sections.
- Make the best of the office hours
  - With such a large class, the only possible personalized discussion you can have is going to be during office hours. Make a list of topics/ideas that are a little unclear and go over those, discuss/review your answers/proofs to improve your reasoning skills, and your ability to write precisely.
- Participate on piazza

5 Other Notices

Academic Honesty Policy

See the following departmental document.

<http://www.cs.utexas.edu/undergraduate-program/code-conduct/>

as well as the University Honor Code

<http://catalog.utexas.edu/general-information/the-university/#universitycodeofconduct>

Students with Disabilities

Students with disabilities may request appropriate academic accommodations from the Division of Diversity and Community Engagement, Services for Students with Disabilities, 512-471-6259, <http://www.utexas.edu/diversity/ddce/ssd/>

Notice Regarding Accommodations for Religious Holidays

By UT Austin policy, you must notify me of your pending absence at least 14 days prior to the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence. See special note above regarding exams.

6 Schedule

\* Disregard the times mentioned in the schedule below. Check out the times and places listed at the top of the syllabus.

Date	Details
	