CS580
Syllabus, Policies, and Procedures

Kent Quanrud

Spring 2021[*]

Contents

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Welcome to CS580. This is a sweeping course about fundamental algorithm design and analysis, spanning both the core parts of the undergraduate curriculum as well as many more advanced topics that we believe will serve you in your careers. See the Spring 2020 class for a sense (and pace) of the topics we will cover.

The class will be conducted *online over Zoom* on Tuesdays and Thursdays from 3:00 to 4:15 EST, at the following Zoom meeting room.

$$\texttt{https://purdue-edu.zoom.us/j/93829189665}$$

This meeting room will also be used for the instructor's office hours.

The staff have discussed and committed themselves to several practices to try to overcome the difficulties of learning remotely. One of these is to be explicit on policies and plans, hence the emphasis on concrete details at several points in this document. Please reach out to the staff about points that need to be clarified, so we can update this document accordingly.

1 Registration

There are some restrictions on registration placed by the department and that I have no control over; see here: `https://www.cs.purdue.edu/academic-programs/courses/course-access-request.html`.

Last year it was the case that registration did not open up for some students until partway through the semester. If you are in this situation and are not currently registered for the course, you may continue to submit homework in the meantime.

2 On the COVID-19 pandemic

This course is heavily impacted by the ongoing COVID-19 pandemic. Purdue has been very active about making the campus safe and more information can be found at the following url.

$$\texttt{https://protect.purdue.edu}$$

In particular, we are all expected to uphold the *Protect Purdue Pledge*. Please read the following, which is provided by the school.

> The Protect Purdue Plan, which includes the Protect Purdue Pledge, is campus policy and as such all members of the Purdue community must comply with the required health and safety guidelines. Required behaviors in this class include: staying home and contacting the Protect Purdue Health Center (496-INFO) if you feel ill or know you have been exposed to the virus, properly wearing a mask in classrooms and campus building, at all times (e.g., mask covers nose and mouth, no eating/drinking in the classroom), disinfecting desk/workspace before and after use, maintaining appropriate social distancing with peers and instructors (including when entering/exiting classrooms), refraining from moving furniture, avoiding shared use of personal items, maintaining robust hygiene (e.g.,

handwashing, disposal of tissues) prior to, during and after class, and following all safety directions from the instructor.

Students who are not engaging in these behaviors (e.g., wearing a mask) will be offered the opportunity to comply. If non-compliance continues, possible results include instructors asking the student to leave class and instructors dismissing the whole class. Students who do not comply with the required health behaviors are violating the University Code of Conduct and will be reported to the Dean of Students Office with sanctions ranging from educational requirements to dismissal from the university.

Any student who has substantial reason to believe that another person in a campus room (e.g., classroom) is threatening the safety of others by not complying (e.g., not properly wearing a mask) may leave the room without consequence. The student is encouraged to report the behavior to and discuss the next steps with their instructor. Students also have the option of reporting the behavior to the Office of the Student Rights and Responsibilities. See also Purdue University Bill of Student Rights.

2.1 Quarantining

If you must quarantine or isolate at any point in time during the semester, please reach out to any of the staff via email so that we can communicate about how you can continue to learn remotely. Work with the Protect Purdue Health Center (PPHC) to get documentation and support, including access to an Academic Case Manager who can provide you with general guidelines/resources around communicating with your instructors, be available for academic support, and offer suggestions for how to be successful when learning remotely. Your Academic Case Manager can be reached at acmq@purdue.edu. Importantly, if you find yourself too sick to progress in the course, notify your academic case manager and notify a staff member via email. We will make arrangements based on your particular situation.

3   Textbooks

No textbook is strictly required as lecture notes and pointers to other references on the web will be provided. However, the following textbooks are all very good, and each have their own merits. We will give pointers to relevant sections in these textbooks as well. You will probably have to get to know all of them over the course of your computer science careers, anyway.

1. *Algorithms*, by Jeff Erickson. Jeff makes his notes freely available at `algorithms.wtf`.

2. *Algorithm design*, by Kleinberg and Tardos.

3. *Algorithms*, by Dasgupta, Papadimitriou, and Vazirani.

4. *Introduction to algorithms* by Cormen, Leiserson, Rivest and Stein.

There are several classes across the country that have put lecture videos online. You may find the following videos helpful.

1. Introduction to algorithms by Erik Demaine and Srini Devadas (`http://courses.csail.mit.edu/6.006/fall11/notes.shtml`).

2. Design and analysis of algorithms by Erik Demaine, Srinivas Devadas, and Nancy Ann Lynch (`https://www.youtube.com/playlist?list=PLUl4u3cNGP6317WaSNfmCvGym2ucw3oGp`).

4 Correspondence

The course website is

$$\texttt{www.fundamentalalgorithms.com/s21},$$

where notes, references, and homeworks will be posted.

4.1 Piazza

There is a Piazza for the course at the following address.

$$\texttt{https://piazza.com/class/kjxomrpgh8l7jy}$$

The first goal of Piazza is to increase interactions among the students, and the students are strongly encouraged to help one another. Piazza will also be used to make course announcements. The staff will check Piazza regularly (but not continuously).

4.2 Email

The staff can also be reached at their `@purdue.edu` email addresses. The instructor admits up front that he processes his emails periodically in batch, so emails may not get immediate responses. If the email concerns a question that could benefit others in the class, please post the question to Piazza instead.

5 Grading

- 25% Homework
- 20% Midterm 1
- 25% Midterm 2
- 30% Final

We make midterm 1 worth a little less because everyone goofs up midterm 1.

6   Exams

The midterms and final are each one part multiple choice and one part word problems. It used to be that we would reserve a classroom to give students an extended period of time for the tests. Of course we cannot do that and instead we plan to conduct the tests as follows.

We are planning to have exams during the scheduled lecture time. To give more time, we will break up the midterms into two classes – one for the multiple choice / short answer, and the other for the word problems. We're hoping that having a break is easier than the old way of having one long exam. The midterms are scheduled for the following dates, which roughly divide the semester into thirds.

1. Midterm 1 is on February 16 and 18.

2. Midterm 2 is on March 30 and April 1.

3. The Final is on May 5th from 3:30 PM to 5:30PM

The date for the final is set by the school and will be announced when we find out.

We will conduct the exams over Zoom, with submissions uploaded to Gradescope.

Many more details are listed below. Our goal is to lay out as much of the ground rules as possible so that the only surprises on the exam are the questions themselves. Please follow up for clarifications or with concerns so we can fix everything before the test.

6.1   The Final

The final will be the same format as the midterms - one part multiple choice and one part word problems. The final is 2 hours long whereas the midterms were two and a half hours long (combined). The final will have fewer questions than the midterms in proportion to the examination time.

6.2   Most essential points

1. The goal is to keep the logistics of the exam as straightforward, simple, and as much like normal times as possible. The default answer for any question is to assume whatever we would normally do in an in-person setting.

2. **If there is something exceptional or unusual about your setup, please write an email to the staff about it, so that we can keep a record, and try to anticipate any potential problems.**

3. We will use the same zoom room as lectures to hold the exam. We will ask everyone to have their camera on and positioned so the staff can clearly see you.

4. On the camera positioning:

   (a) Mostly we want to be able to tell that you are working on the test on paper and not using resources that are not permitted. Ideally there would be some moderate distance from the laptop to get a clearer view.

(b) We realize that there are constraints as to what is possible with individual setups.

(c) If we feel it is necessary, we may ask you to make some adjustments to your camera setup.

5. The staff will proctor over zoom and we will use two breakout rooms to divide up the load.

6. It is a closed book exam but we plan to include a "cheat sheet" listing the running times of basic algorithms, and definitions of standard NP-Hard problems. The test should not require memorizing names.

7. We will distribute the exam online as `.pdf`'s once the test time begins.

8. Everyone will be asked to do their tests on blank printer paper. For word problems, please do each problem on a separate sheets of paper.

9. For multiple choice, everyone will write the answers on a blank sheet of paper and then scan them this paper into gradescope at the end. The gradescope submission will open up at exactly 4:15 EST. After scanning, everyone will also fill in their answers in an "electronic assignment" on gradescope.

10. When the allotted time for the exam has ended, everyone will have a few minutes to submit their solutions to gradescope. To this end you will need a camera to take pictures of your submission. We point out that there are phone apps for scanning that work better than normal photos (I have used an app called swiftscan).

6.3   Additional details

1. You may want additional scratch paper for the multiple choice/short answer portion.

2. To ask a question in the exam, please use the "hand raise" reaction and then the proctor will follow up with a direct message in the chat.

3. By "on paper", we mean old fashioned real paper. (e.g., no ipad's.) In general, no electronics except your computer which is for the Zoom and for reading the `pdf` exam.

4. For simplicity, no printing of the exam[1].

5. For the first exam, we will record the Zoom session just for the sake of having some kind of record if an unfortunate situation does arise. If we do, we would delete the recording as soon as we no longer need it. (We many not do this on the second midterm if we feel it was excessive).

6. We will have makeup exams on the same basis as in-person settings - they need to be formally excused. We anticipate few exceptions because the test is during the regularly scheduled class time. Please reach out early as possible if you have an unavoidable

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[1] We may revisit this for the second exam.

conflict. We will create different exams and proctor them at rescheduled times (which could possibly be a day earlier). Please try to take the regularly scheduled exam if possible, which ensures the most consistent experience with the rest of your peers.

7. Please do not discuss the exam on Piazza or other similar places until we finish administering the makeup exams.

8. There are 25 short answer problems and 3 word problems.

6.4 Extra study tips

1. The best preparation is practice. Start with the easiest problems you can find in Jeff's notes and Kleinberg-Tardos, which will build up your confidence. Crowd-source solutions to these problems from your peers so you can get feedback on your effort. (Kleinberg-Tardos has sample solutions for some of their problems.) The problems in the lecture notes are on average a little trickier.

2. The second midterm and final exam are cumulative, so your prep won't go to waste.

3. We do not think the word problems will be as hard as the homework problems.[2] This is all subjective, of course.

4. Like the homework problems, the word problems may be such that the first idea that comes to mind doesn't do the trick. Keep cool and carry on.

7 Homework

This course has regular homework assignments including both word problems and multiple choice. We are planning for one word problem and a set of multiple choice problems per lecture - except the first lecture, which has two word problems and no multiple choice. They will be both due before the lecture one week after they are assigned - unless there is a midterm, in which case they will be due a week later.

7.1 Typesetting

Homework submissions that are not typeset in LaTeX or equivalent will not be graded. Some tips on typesetting are listed below.

7.2 On writing

The onus is on the student to make the arguments in their solution clear, and points will be docked if the grader cannot easily verify that the solution is correct. The class is as much about *communicating complicated ideas* as solving problems and applying techniques.

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[2]You might also find the homework problems to not be as hard in hindsight, having learned some tricks along the way.

Particularly clear exposition may be selected as homework solutions which is rewarded with extra credit (see below).

7.3 Gradescope

The word problems will be collected online at `gradescope.com`. The multiple choice questions will be posted on `gradescope.com` as well. To enroll, either use the code `ERV56G`, or follow the link in BrightSpace.

7.4 Collaboration

Collaboration is allowed and interaction among students is encouraged. Currently we are allowing up to two students per submission for the word problems. Please also indicate any other students that you may have worked on the problems with.

Multiple choice is expected to be done individually (and it's good practice for the exams).

7.5 Dropping scores

In the overall homework grade, the bottom 10% of word problem scores will be dropped. More precisely, if there are n total world problems assigned in homework, then the $\lceil n/10 \rceil$ lowest scores will be dropped. This is largely to help catch the arbitrary exceptions that arise throughout a semester.

7.6 Late policy

For word problems, we have a simple late policy where you can submit up to two days late, at a cost of half the total points.

There is no late policy for the multiple choice.

We try not to make exceptions for minor things and expect the late policies and score-dropping policy to handle these cases. Of course when real and formal exceptions arise we will adjust accordingly on an individual basis. In this case, please email the staff ASAP (and not, say, after or just before the deadline.)

7.7 Solutions

The staff will select exemplary submissions and publish them on Piazza as solutions. If you have a strong preference to be excluded from consideration for a particular homework problem, please indicate it clearly and explicitly at the top of your submission (for each problem). If you a strong preference to be anonymous if your homework is selected, please indicate that on your document.

Selected solutions will get 10% extra credit.

We plan to put up the solutions quickly, on the same day that the homework is collected.

7.8   Resubmitting homework

You might have noticed that there is both a late policy and a plan to post solutions on the same day as the submission deadline. You can take advantage of this by comparing the answer key to your own submission, and possibly resubmit your homework late even with the benefit of the answer key. If you do use the posted answer key in a resubmission, we expect you to cite it accordingly, and still express the solution in your own words.

7.9   IDK

One may simply write "I don't know" or "IDK" and automatically get 25% of the possible points.

7.10   Typesetting tips

- The standard for typesetting mathematical and scientific articles is LaTeX. Even if you do not know LaTeX now, you will definitely have to learn it sooner or later in your graduate studies.

- The instructor uses `emacs` to write LaTeX, but any editor will do. There is also a website called `overleaf.com` for typesetting LaTeX.

- Alternatively, the software `typora` allows one to write LaTeX within a markdown document, which is particularly easy to use.

- `LyX` is another popular latex editor that is WYSIWYG.

- There are several apps for scanning documents (e.g., when inserting pictures) that are much better than taking a photo. The instructor recommends `scanbot`, and other popular apps include `microsoft office lens`, `camscanner`, and `evernote scannable`.

8   Tips for success

Many students ask for suggestions to help them in the course (especially the day after the midterm). Of course, one can always put in more effort and expect better results, but nobody needs to hear that. Here I will instead try to suggest some *efficient* strategies.

If I had to restrict myself to just one suggestion, it would be: *practice*. Algorithms is fortunate to have an almost endless supply of exercises. Some extra problems are included in the lecture notes, and there are many more problems in the recommended texts. We compiled a list of problems in last year's class, available at `https://www.overleaf.com/read/zsgmnznxtxkk`. These problems are interesting and often fun. I have seen students improve rapidly once they commit themselves to extra exercises. The students who figure out this strategy from the get-go have a huge advantage over those who wait until after the first midterm. Honestly, we would give more exercises for homework if we had the capacity to grade them. Please feel free to run your answers by any of the staff. Better yet, if you ask around on Piazza, you should be able to find other students to discuss the problems

with. Several of the books have solved problems that can be very helpful - try solving them yourself before looking at the answer.

If I were allowed one more suggestion, it would be to frontload your effort and get ahead early. The beginning of the semester covers the most basic and important material. Moreover, much of the class will have seen much of this content before because it is fairly standard; if you have not, then this is exactly the point to get caught up. With a firm grip on the fundamentals, the rest of the material will come more easily.

It might be helpful, then, to get some sense of what to expect for midterm 1. Very roughly speaking, in terms of the textbook by Jeff Erickson (`algorithms.wtf`), we expect to cover (parts of) chapters 1, 3, 5, 6, 8, 9, and 12. In terms of the textbook by Jon Kleinberg and Eva Tardos, we expect to cover (parts of) chapters 2, 3, 6, 8, and 5. Of course the points of emphasis and order of presentation in our discussions will differ from these books (which already differ from each other), and lecture notes will be provided that are customized to the class.

9   Academic integrity

Behavior consistent with cheating, copying, and academic dishonesty is not tolerated. Depending on the severity, this may result in a zero score on the assignment or exam, and could result in a failing grade for the class or even expulsion. Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty." (Part 5, Section III-B-2-a, University Regulations) Furthermore, the University Senate has stipulated that "the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest." (University Senate Document 7218, December 15, 1972). You are expected to read both Purdue's guide to academic integrity (http://www.purdue.edu/purdue/about/integrity_statement.html) and Prof. Gene's Spafford's guide (http://spaf.cerias.purdue.edu/integrity.html) as well. You are responsible for understanding their contents and how it applies to this class.

10   Posting Class Material

Posting material associated with this class (e.g., solutions to homework sets or exams) without the written permission of the instructor is forbidden and may be a violation of copyright.

11   Purdue's Honor Pledge

As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue. https://www.purdue.edu/provost/teachinglearning/honor-pledge.html

12 Grief Absence Policy

Purdue University recognizes that a time of bereavement is very difficult for a student. The University therefore provides the following rights to students facing the loss of a family member through the Grief Absence Policy for Students (GAPS). According to GAPS Policy, students will be excused for funeral leave and given the opportunity to earn equivalent credit and to demonstrate evidence of meeting the learning outcomes for missed assignments or assessments in the event of the death of a member of the student's family.

13 Conduct and Courtesy

Students are expected to maintain a professional and respectful classroom environment. This includes: silencing cellular phones, arriving on time for class, speaking respectfully to others and participating in class discussion. You may use non-disruptive personal electronics for the purpose class participation (e.g., taking notes).

14 Students with Disabilities

Purdue University is required to respond to the needs of the students with disabilities as outlined in both the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 through the provision of auxiliary aids and services that allow a student with a disability to fully access and participate in the programs, services, and activities at Purdue University. If you have a disability that requires special academic accommodation, please make an appointment to speak with the instructor within the first three (3) weeks of the semester in order to discuss any adjustments.

It is the student's responsibility to notify the Disability Resource Center (http://www.purdue.edu/drc) of an impairment/condition that may require accommodations and/or classroom modifications. We cannot arrange special accommodations without confirmation from the Disability Resource Center.

15 Emergencies

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website and/or announced via email. You are expected to read your purdue.edu email on a frequent basis. Emergency Preparedness: Emergency notification procedures are based on a simple concept: If you hear an alarm inside, proceed outside. If you hear a siren outside, proceed inside. Indoor Fire Alarms are mean to stop class or research and immediately evacuate the building. Proceed to your Emergency Assembly Area away from building doors. Remain outside until police, fire, or other emergency response personnel provide additional guidance or tell you it is safe to leave. All Hazards Outdoor Emergency Warning sirens mean to immediately seek shelter (Shelter in Place) in a safe location within

the closest building. "Shelter in place" means seeking immediate shelter inside a building or University residence. This course of action may need to be taken during a tornado, a civil disturbance including a shooting or release of hazardous materials in the outside air. Once safely inside, find out more details about the emergency. Remain in place until police, fire, or other emergency response personnel provide additional guidance or tell you it is safe to leave. In both cases, you should seek additional clarifying information by all means possible: Purdue Home page, email alert, TV, radio, etc. Review the Purdue Emergency Warning Notification System multi-communication layers at `http://www.purdue.edu/ehps/emergencypreparedness/warning-system.html`. Please review the Emergency Response Procedures at *https://www.purdue.edu/emergencypreparedness/flipchart/index.html*. Please review the evacuation routes, exit points, emergency assembly area and shelter in place procedures and locations for the building. Video resources include a 20-minute active shooter awareness video that illustrates what to look for and how to prepare and react to this type of incident. See http://www.purdue.edu/securepurdue/police/video/

16 Violent Behavior Policy

Purdue University is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activity.

17 Mental Health and Wellness

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack (`https://purdue.welltrack.com`). Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please contact or see the Office of the Dean of Students (`www.purdue.edu/odos`). Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc. sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell (`https://www.purdue.edu/recwell/fitness-wellness/wellness/one-on-one-coaching/wellness-coaching.php`). Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at `evans240@purdue.edu`.

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services

are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) (`https://www.purdue.edu/caps/`) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at (765) 494-6995 and http://www.purdue.edu/caps/ during and after hours, on weekends and holidays, or through its counselors physically located in the Purdue University Student Health Center (PUSH) during business hours.

18   Nondiscrimination

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. Purdue University prohibits discrimination against any member of the University community on the basis of race, religion, color, sex, age, national origin or ancestry, marital status, parental status, sexual orientation, disability, or status as a veteran. The University will conduct its programs, services and activities consistent with applicable federal, state and local laws, regulations and orders and in conformance with the procedures and limitations as set forth in Executive Memorandum No. D-1, which provides specific contractual rights and remedies.

19   Privacy

The Federal Educational Records Privacy Act (FERPA) protects information about students, such as grades. If you apply for a job and wish to use the instructor as a reference, you should tell the instructor beforehand. Otherwise, the instructor cannot say anything about you to a prospective employer who might call. The instructor is happy to provide references and to write letters of recommendation for his students as needed.

20   Changes to the syllabus

This syllabus is subject to change and changes will be announced appropriately.