

# Chapter 4: Teaching

In this chapter, I'm going to talk about one of the main responsibilities for a professor: teaching. As students, you would have seen the classroom lectures and some part of the grading involved in teaching. If you were a teaching assistant (TA), you would have seen a lot more of the grading. But there is a lot more to teaching, as you will soon find out!

Teaching is one of the parts of my job that I enjoy the most, and it is the one of the main reasons I became a professor. There is nothing like explaining something to a group of students, and seeing the light bulb go off in their heads. A class filled with bright, motivated students, one that is interactive and full of back-and-forth, is a joy to teach.

Another benefit you get as the teacher is understanding the material deeply – students are going to ask you questions you may not have thought about yourself, questions that make you look at the material in a new way. Sometimes, questions from students spur new research! Many professors have spoken about the beneficial effect of teaching on their research.

## 4.1 Teaching at an R1 university

Overall, teaching an undergraduate or graduate course at an R1 university in the USA involves four things: **designing the course** (including exams, projects, and assignments), **classroom lectures**, **grading**, and **course administration** (including managing TAs and handling academic dishonesty). I'll cover each of these in detail in later subsections.

The teaching load (number of courses you teach per year) varies from two to four at R1 universities. It is higher at more teaching-focussed universities where you might be teaching two or more courses each semester/quarter. Typically, the department will contact you at least one semester before (sometimes one year before) to figure out what you will be teaching. For example, you will be asked in Fall 2023 what you would like to teach in Spring 23. Sometimes, you are asked in Fall 23 what you would like to teach in Fall 24! So it is good to plan ahead.

## Balancing teaching and other responsibilities

Note that the importance of teaching varies depending on the type of institution you are at. If you are at an undergrad-focused university, this is an important part of your job, and it will be a significant part of your evaluation. At such universities, you will be teaching multiple courses each semester, and it is not uncommon to have teaching loads of four courses or more per year.

At an R1 research university, the most important thing you are judged on is research; you can get tenure doing great research and being a mediocre teacher, but you cannot get tenure doing mediocre research and being a great teacher. Of course, if you are a terrible teacher, you might not get tenure (every part of your tenure application carries non-zero weight). One potential

failure mode for new profs is to focus on teaching to the neglect of their research: make sure you don't do this.

This is not to say you should do a bad job at teaching or that you shouldn't spend time on it. But you can always spend more time on teaching – you can always make the slides better, spend time on demos, etc. So it is important to carefully manage how much time you spend on teaching.

When I started as a professor, I used to spend about 2 days a week on teaching. I had “teaching” days each week where I knew I wouldn't get anything else done. I would focus on research and service on the other days of the week, and make sure my teaching responsibilities didn't overflow too much (sometimes it will, like during midterms etc). I would not recommend spending more than 3 days a week on teaching-related activities.

## How is teaching evaluated?

So how will you know when you have done a good job? How will you be evaluated?

Every semester, students will be asked to take a survey about your course. This will happen before the final exams, during the final days of the class. Students will be asked to answer questions like “Is the course well-organized?”, “Was the instructor available for office hours?” and whether they would recommend the course to others. These surveys are part of how the department evaluates you – they will look at the survey scores, and trend of the scores. Are you improving at teaching over time? Are you fixing problems you faced in one instance of the course in the next instance?

These surveys do have some problems, though. For example, female instructors and instructors from under-represented minorities often get worse scores simply due to their identity (see [this](#) and [this](#)). It is known that scores are affected by things like [whether you give your students cookies](#). This is all known by the administrative folks as well, so they take a nuanced view of your teaching evaluation scores.

As part of the tenure process, your department might also have one or two faculty members sit in your class and observe your class. They will then provide feedback, both to you and the department. This is useful since it is a different kind of feedback to the ones the students give you, more considered and grounded in pedagogy.

Sometimes, students will just email at the end of the semester to tell you they enjoyed the course. These emails are the best, and you should treasure them. It will be handy to go back in rough times and look at these emails, to remind yourself why you do what you do.

## Planning your teaching

**Teaching your first course.** At some R1 research universities, you get one or two semesters of “teaching relief” as part of your start-up package. This means that you can opt out of teaching

for one or two semesters. One way to use this benefit is to not teach your first year, completely focussing on getting your research lab set up. I would advise against doing so.

Teaching in your first semester has a number of benefits. First, teaching a graduate-level course in your area of interest is an excellent way to find your first students (it is how I found my first students). Second, it is useful to front-load the work of preparing for a class – since you are already on (or should be on) a break from research following your graduation, this is the best time to prepare for teaching; you don't want to take time out once your research is going well. Finally, teaching introduces some structure and regularity to your day – if you are not teaching and you don't have any students, it is harder to establish a regular routine at your new department.

For your first course, I would recommend teaching a graduate-level seminar type course where the students read and discuss papers, and do research projects. This will attract students who like your area of interest, and you will be able to evaluate their research potential through the class. At the end of class, you should be able to tell if some of the best students in class are a good match for your research group.

**Teaching relief.** As to when to utilize the teaching relief (if it is offered), I would recommend spreading it out over a couple of years. When I started at UT, the annual SOSP/OSDI deadline was in Spring. So I would teach in the fall and focus on research in the spring. Work out a similar rhythm for your research group.

**Teaching multiple sections.** At some universities, you can opt to teach multiple sections of a course in the same semester. This would then count as teaching two separate courses. I know professors who do this so that they finish off their teaching requirements in one semester, and then travel in the second semester or focus on research. This can be a viable strategy since it amortizes some of the teaching effort (such as class preparation and setting exams/projects) across the different sections; some work like grading cannot be amortized though. This can be a good option to focus your teaching efforts on one semester.

**Teaching a new course.** Teaching a course you have already taught is significantly simpler than first designing and creating a course. Ideally, you would not have to create a course from scratch: you can borrow the teaching materials of professors at the university who taught the course before you, and customize it according to your teaching style. I created a new undergraduate course (Virtualization) in my second year at UT Austin: it was a lot of work, but I enjoyed doing it. However, I still would not advocate doing this early on: if you are not careful, it could end up consuming all your time, impacting your research.

## 4.2 Designing a course

Typically, when you start out as an assistant professor, what you do is take over an existing course from a faculty member. This is usually the graduate-level course in your area of expertise. For example, I taught the graduate-level Advanced Operating Systems course when I

first started at UT. You should talk to the person who taught it previously, get their slides, notes and other teaching material (this is common and encouraged, so don't feel shy). You can then customize it as required. For the Advanced OS course, Emmett Witchel generously shared his teaching materials with me, and I built upon it.

Sometimes you might want to design a new graduate-level course, focusing on your expertise. This can be a great way to find students interested in your area, and train them on the basics that they would need for your area. For a course based on reading papers and doing research projects, it will not take up a lot of your time since these are papers you are closely familiar with.

I would definitely not recommend teaching a *new* undergraduate course as your first course. I designed a new undergrad course in my 2nd year at UT, and it was a big time investment (more than I had planned). I would recommend putting this off until you are somewhat established in your research and then doing it.

When designing a new course (or customizing an old course), it is important to think about the **learning objectives** that you want the students to achieve, and then design the course components to aid this. For example, you might want the students to be familiar with a certain tool or a certain technique; creating an assignment around this is a good idea. Similarly, you might want to think about what other concepts they need to understand to do the assignment, and work backwards to populate the course.

## Designing a graduate course

In general, teaching a graduate course is easier than teaching an undergraduate course (though not as fun, in my opinion). This is because the class sizes for graduate courses are smaller (anywhere from a few students to 40).

There are two flavors of graduate courses: a reading-based course where the class reads and discusses research papers (along with doing one or more research projects), and a seminar course where the professor lectures in each class (in addition to the research project). The reading-based course, especially if it is your area of interest, needs little preparation, as these are mostly papers you are familiar with in your research. A certain amount of thought needs to go into research projects that can be done by junior grad students in about two months. But overall, a reading-based graduate course is one of the easiest to teach (that's partly why I recommend teaching it as your first course).

The second type of graduate course is a seminar course. This is much closer to an undergraduate course in that you need to prepare for each lecture. This type of course is useful when undergraduates are also taking the course, since they are more used to this mode of instruction rather than reading papers. Seminar courses have exams and much more defined projects (what I would term an "implementation project" rather than a "research project").

A variant of the seminar course is where students present some material (sometimes a research paper) each class, with the instructor adding context and extra knowledge, and provoking discussion among students. From the professor's viewpoint, this is similar to the reading-based course, and doesn't take much effort to teach if the subject is in your area of expertise.

## **Designing an undergraduate course**

An undergraduate course is different from a graduate course in many ways. The biggest difference is structure – you might tell your graduate students, “let us sit and ponder the mysteries of the universe (or of distributed systems)” and there is a reasonable chance the grad students will take you up on that. Undergraduates have no time for this; they are taking 4 courses (or more), and they want classes where it is clear what they need to do to pass/do well in the course. So your undergraduate course needs to be much more structured.

There are a few more differences. The class size is significantly bigger than a graduate course – popular undergraduate classes can have hundreds of students! Due to the big class size, evaluating students on projects and exams becomes a challenge – you need to structure the class so that you can efficiently (and fairly) evaluate the student submissions. Designing the class so that TAs can evaluate the student submissions also becomes a priority. For example, open-ended questions that can be interpreted multiple ways with many possible answers is not a great fit for an undergraduate class of 100 students (you can have maybe one such question on the exam, but if all the questions are like this, you are going to have a hard time).

Designing an undergraduate course from scratch consumes a lot of time, both for preparing lectures and designing projects and exams. It is also a lot of fun, so you have to be careful to manage the amount of time you pour into your undergraduate course. When designing the course, it helps to first write down the learning objectives you want students to achieve, and then design course components that help achieve each learning objective.

Undergraduate students are much more likely to ask for re-grades and extra points than graduate students (understandable given how much GPA matters for undergraduate students). To reduce this overhead, it helps to be concrete about each exam question/assignment and what exactly will fetch points. The clearer students are about what gets points, the fewer regrade questions you and your TAs will get.

I love teaching undergraduate courses, especially because I teach an upper-level elective undergraduate course (so all the students in class want to be there, and aren't taking it to satisfy a requirement). The undergraduate students at UT Austin are amazing, and I learn something new about the material everytime I teach due to their questions. The energy in class is amazing, and it is always interactive. I highly recommend teaching an upper-level undergraduate class in your area of expertise if it is possible.

## 4.3 Classroom lectures

Classroom lectures are the most visible part of teaching, and (at least to me) the most fun part about teaching. When you have an interactive class that is buzzing with questions, it is a joy to teach!

### What does good teaching look like?

Good teaching comes in various forms, but the root of it is **engaging students**. You want students to listen to your lectures, to think and understand the material, and absorb the main points that you are trying to communicate.

I've found that many good teachers are **enthusiastic** about whatever it is teaching, and pass on that enthusiasm to their students. It is hard to be a good teacher if you are not interested in the material – this might happen if your department is short on staff and needs you to teach a course you would rather not teach.

Given these two things, engaging students and being enthusiastic, the other mechanics of how you teach can vary a lot. For example, I like to teach without slides, using the blackboard – a style I picked up from great teachers such as Remzi Arpaci-Dusseau, Michael Swift, and Jeff Naughton at Wisconsin. I find that my students are more engaged when there isn't a projected slide in front of them. I share notes with students so that they can review the material later. The act of drawing figures on the blackboard also slows me down, and gives students time to think and ask questions.

Some of my colleagues at UT Austin like to teach with slides, and are immensely successful at it. So I don't think it is the media that matters, it is about how you engage your students.

### Other tips for lectures

Some basic tips I've gotten over the years:

- Ask questions in class, and give students 30 seconds to a minute to respond. When you first do this, the wait can get uncomfortable for you (and for your students). But do it anyway – maybe drink some water while waiting for an answer. If your students see that you are serious about questions, they will ask.
- Students learn how the dynamics of the course work from the first few classes. If in the first few classes you are not asking questions (and establishing that culture), it will be harder to do it later on.
- A common mistake is to try and cover too much in each lecture. Despite your best efforts, students are not going to absorb or remember everything. Think about what the major points you want to communicate are, and focus the lecture around those.
- Start each class with a recap of what was covered in the previous class, and finish each class with a summary of what you had just talked about
- Something I like to do: if your class is scheduled for 75 minutes, wrap up the lecture at around 65 minutes. Give students about 10 minutes to get to the next class, and to come



up and ask questions. Many students are shy and won't raise their hands, but will come and ask questions at the end of the class.

- Different students excel at different things. Some do well on exams. Some do well on projects. If possible, design your course to offer a way for all these students to shine.
- If you see that a student is doing well (either in class, or when grading their exams), add a note saying so, and that you think they might do well in grad school. It might be the first time they ever think about that career path. I've successfully nudged several students towards grad school in this manner.
- It is inevitable that some students will not like your class. Part of it would be what they are going through themselves – undergrads lead incredibly busy lives. So don't take it personally.
- Similarly, it is inevitable that there will be students in your class who just want to pass and get this over with (this happens more if students are required to take your class, less so in elective classes). Don't take this personally either. There will be others who will take your class out of interest, focus on them.

## 4.4 Grading

Grading exams and assignments is one of the least enjoyable aspects of teaching. Grading and course design go hand in hand – how the course is designed affects how easy or fair it is to grade.

When grading, we want to achieve two goals. The first to **grade fairly**. Similar answers or similar code should get the same points. The points awarded should not depend upon the person grading. Even with the same person, bias can creep in and other external factors (such as whether they were hungry when grading) can affect grading.

The second is to **grade efficiently**. You want to design your assignments and exams such that you or your TAs can grade each item in a few minutes. The answer for each assignment should be concrete: you should have the breakdown of how points are going to be awarded (for example, "2 points if they say X") or taken off. If it takes hours to grade each student submission, you are probably doing something wrong. While the grading time definitely goes up as the number of students increases, you can manage this by automating the grading as much as possible. For example, you can have a grading script that you run on student submissions that automatically determines the grade. One potential problem with automating grading is it is harder to discover students cheating; you might want to have your TAs scan student submissions anyway to catch obvious cheating.

**Grading order.** When grading exams, do not grade all the questions for each student: if the student does well on an earlier question, it introduces bias when grading the later questions; instead, grade one question for all students in class and then grade the next question. Have the student write their name and ID *\*only\** on the first sheet, such that it is not known when you are grading the other questions. When distributing the grading work among the TAs, do not split

based on students – it will lead to uneven grading; instead, have each TA grade a set of questions consistently across the whole class.

## 4.5 Course Administration

### Managing TAs

An important aspect of teaching courses with a lot of students is managing TAs. A rough rule of thumb is that you want about 30 students for each TA (this number might vary based on the course); so if you have 90 students in your class, you need three TAs. As the number of TAs increases, managing them becomes a task in itself. In such circumstances, you should appoint a “Head TA”: someone who is responsible for making sure all the TAs are on the same page, handling things like dividing up the work among TAs and scheduling discussion or office hours.

Good TAs are worth their weight in gold. If you can get a good TA to TA for your course again, it is great: the TA knows the material, and knows what question students will ask. It is usually less work for them as well, compared to TAing a new course. Always try to have good TAs return to your course.

**Managing your TA's workload.** You want to make sure you aren't overloading your TA. For each task you assign the TA, have a rough estimate of how long it would take you to do it; double that estimate to get a sense of how long it might take the TA. Make sure the total amount of time the TA requires is not over 20 hours a week (or whatever their assigned work hours are). Holding office hours and grading are all part of their official workload.

Another part of managing your TA is figuring out what tasks you can offload to them. For example, “design a project for this course” is probably too high-level for your TA. You could instead say “here is the project I've designed, could you take a shot at it and give me your feedback”. Make your TA tasks as concrete as possible. With a more senior and experienced TA, you could give them more freedom in designing assignments. Make sure you guide them on how to design assignments such that it is easy to grade fairly and efficiently.

### Handling academic dishonesty

One of the unfortunate aspects about teaching is that you have to handle situations where students are cheating in class. This can happen in a variety of ways: you might be grading an assignment and notice that two submissions are similar, or notice that submitted code looks identical (sometimes down to comments!). Sometimes the submitted code reads very differently from the rest of the submission, indicating it has been copied from somewhere.

Why is academic dishonesty bad? One way to look at this is that the person being harmed the most is the student themselves: they are paying a lot of money to get an education, and instead they are just getting a degree. The things they didn't learn will become apparent once they graduate and get a job. However, if cheating is rampant in a course or a university (and publicly



known to be so), it can harm the value of the education for *all* students: the value of the degree drops significantly even for honest students. Moreover, if the class is graded on a curve (a bad idea that I don't recommend), cheating influences the grade of all the students in the class.

So given this, how much effort should you spend on detecting academic dishonesty? You could run tools such as [MOSS](#) to detect similarity between submissions. There are also plagiarism detectors for text submissions. Canvas (the course management system used at UT) now provides some of these tools built in, making it easy to run. You can imagine writing your own tools to detect cheating. There is a big spectrum of how much effort to put into this.

Personally, I use built in/easy-to-use tools for this purpose. I don't spend a lot of time on detecting academic dishonesty. My classes use absolute grading (for example, if you score 87, you are guaranteed to get an B+, regardless of how anyone else in class performs), except for the top grade (A). This limits the bad impact of cheaters on the rest of the class.

Once you detect cheating, what should you do? Your university might have a protocol for you to follow. Typically, the first step is to talk to the student. Talk about the rules and expectations for the course, and the evidence you have for cheating. Sometimes, the students immediately accept their mistake – they will explain they did it in a moment of panic or fear (or that they didn't know what they did was against the rules), and that they are sorry. This is the best outcome. You explain the penalty to the student (typically, if they cheated on an assignment, they get zero points for that assignment; if the penalty is too light, it will encourage further cheating) and implement the penalty. In some cases, the incident and the resolution (whether the student accepted, and what was the penalty) will have to be reported to Student Affairs.

In other, more unfortunate, cases, the student will not accept that they did anything wrong. In such cases, you will once again report the incident to Student Affairs, and they will investigate whether any academic misconduct occurred. They will talk to the student, the TA involved, to you, look at the evidence, and finally come to a conclusion. This is a big process: depending on the university, it can be quick (takes about 2 weeks) or extremely long (several months). Generally, it takes up a lot of everyone's time, so it is always unpleasant to handle. But once Student Affairs reaches a decision, the student and the professor are notified, and the appropriate penalty is then applied.

Due to how expensive (in terms of time) it is to handle misconduct cases, it is worth trying to design your course and your assignments and exams to minimize opportunities for misconduct. For example, if your exam is online, and your exam questions are google-able, a small percentage of students *will* cheat. I find proctoring software repulsive and degrading, with significant impact to the dignity and privacy of those who take exams online. So the solution turns out to be to design exam questions that require *application* of material learnt in class, such that it is hard to google the answer in a couple of hours (as a side note, this also makes the exam much more fun!). This requires more effort on your part in setting exams and assignments (especially coding projects, where it is not so easy to come up and test new

projects) – so the tradeoff is between how much time you spend creating exams and assignments versus how much time you spend in meetings with Student Affairs committees.

## Handling requests for extensions

Another administrative aspect of teaching is handling requests from students for extensions on their assignments. Students often email and ask for extensions, with reasons ranging from “I was sick” to “my parent/grandparent/significant other is sick”.

There are two things to consider here. First, do you require documentation to prove that their reason for the extension is valid? For example, you could ask for a doctor’s note if they say they are sick. Second, assuming the reason is valid, do you grant the extension? For what reasons do you grant extensions? For example, do you grant it if the student is personally sick? What if their grandparent died?

At some universities, if you are a student and you are sick (or have an emergency), you can contact a service similar to UT’s [Student Emergency Services](#) . They will verify your sickness/emergency, and then contact professors for all your courses to get extra time on your behalf. This is great when it works! But I find the % of students who contact Student Emergency Services when sick/having an emergency to be low.

Here is how I handle requests for extensions. Typically, I do not ask for documentation for sickness or other reasons for an extension. I cannot imagine saying, “please prove that your grandparent died”. I take the student’s requests at face value and assume they are speaking the truth. I generally grant extensions if the reason was something out of their control – sickness on their part or family, internet outages, literal war (for students of my online masters course in Ukraine).

Why am I not inundated with fake requests for extensions? I always include grace/late days in my course that each student can use for any reason on assignments (if you submit a day late and use one grace day, it will be as if you submitted on time). I am generous with the grace days – typically there are 10 grace days each semester. I find that if a student is contacting me beyond using the grace days for an extension, it is something serious.

Overall, I think that there is a trade-off between being merciful and being fair. If you give someone an extension because of some circumstances in their life, it is not fair for all the other students who did not contact you, but nevertheless had troubles. The students are not really completing the assignment under the same constraints, so you could argue that to be fair, you must decline all extensions unless health-related. I personally find that being merciful, and helping students in trouble who reach out to you, results in a much better course experience overall (both for students and for you).