When I first made the transition from teaching in lab environments to teaching in lecture halls, I started running up against the feeling that I could not tell what my students were thinking and that it was holding me back from educating them. After one class, a student stayed to ask a question but could not articulate why an answer felt wrong to him. I reached instinctively for paper, jotted down a variation on the problem, and asked how he would answer the new problem. His answer revealed his misconception instantly, and in that moment I realized how much more insight lab environments and practice-centric interactions had given me into student understanding. From that day forward, whether I am teaching a standard classroom populated with upper-division Berkeley undergraduates, a roomful of high schoolers in an afterschool coding program, or a fellow PhD student, I shape my teaching practice around working through exercises and identifying misconceptions early.

My views on teaching are heavily influenced by the two sigma finding: essentially, the finding that almost anyone can be taught content at what we currently consider elite levels — if offered enough resources, enough one-on-one tutoring[1]. While I clearly cannot offer one-on-one tutoring to classes with hundreds of students, my approach to teaching revolves around what I consider the best substitutes currently available: active learning, peer tutoring, and fast student feedback loops. Applying this approach to the undergraduate programming languages and compilers course earned me the **UC Berkeley Outstanding Graduate Student Instructor (GSI) Award**. Student feedback was overwhelmingly positive [2] [3].

[1] Benjamin S. Bloom. The 2 sigma problem: The search for methods of group instruction as effective as one-to-one tutoring. *Educational Researcher*, 13(6):4–16, 1984

[2] "Sarah was the most phenomenal GSI I have ever had at Berkeley. Her explanations were really clear, and she was **especially tuned to when students were having trouble understanding section material** (which was always really helpful itself!). Sarah was also an incredibly helpful resource during office hours. I sat in on quite a few of hers and no matter what the question was, she was able to answer it... On top of all of that, Sarah comes across as incredibly kind, genuine, and knowledgeable without being arrogant."

[3] "In my fourth year at Berkeley, I can say that Sarah is one of the best GSIs I have had. She was amazingly prepared for each section, with ample material that covered the most confusing concepts of the course. The REs and DFAs/NFAs section stands out in memory. Sarah was able to effectively manage a section of over 75 students, and I quickly picked up how to translate NFAs to DFAs. She **taught it so clearly that I did not need to review it for the final because it seemed so simple** after section was over."

Teaching Strategies

When I started as a Berkeley GSI, I realized that designing section materials was too time consuming without structural constraints, so I took a day to make a research-backed formula, then designed all future sections loosely around my formula:

1. As students enter, have them put their names in a hat.
2. At section start, have students sort themselves according to a silly metric — in order of their favorite animal, their favorite visual artist, anything that gets them adjusted to speaking in the classroom about a low-stakes topic. Form groups by pairing the leftmost and rightmost students.
3. For a sequence of increasingly difficult paper-and-pencil or computer-based exercises:
   (a) Have each pair work on the exercise together. Encourage the room to get louder, for students to talk with their partners.
   (b) Circulate to (i) answer questions, (ii) identify which concepts are confusing to the largest proportion of students, and (iii) offer quick one-on-two tutoring to the rare pair that does not complete the exercise independently.

(c) Bring the class back together to discuss the solution. For each small subcomponent of the solution, call on a student by pulling a name from the hat, ask the student to provide the solution subcomponent that his or her pair produced, either orally or on a whiteboard.
(d) Following the student answers, discuss the whole exercise and its solution at a higher level, emphasizing the concepts that students found confusing during their pair-work time.

Following this formula allowed me to incorporate a variety of insights from education research without having to strategize about how to apply them in each new section design. First and foremost, it centers active learning, organizing each section around a set of hands-on exercises [4,5]. The sorting mechanism served double duty as a means to shuffle student pairings (to distribute students with different resources and expertise levels)[6,7,8] and to get students speaking early in each class on casual topics so they would feel comfortable speaking on class topics later[9]. Drawing students' names from a hat encouraged all students to understand their pairs' work and prevented a few students from dominating class discussion; doing so only after pairs already had a chance to work through an exercise together diffused the responsibility and anxiety associated with 'cold calling.'[10]

Active Learning I will certainly continue to structure my own teaching practice around active learning, but I am also keen to improve my students' experiences by training TAs to use active learning. Although I will not by myself be able to work through hands-on exercises with all students, I will set up my TAs' responsibilities such that providing their sections with hands-on practice and individualized feedback is feasible and prioritized. My goal is to offer active learning experiences in lecture and sections, but also to encourage TAs to offer something even closer to the one-on-one tutoring that produces the two sigma effect. In addition to the positive effects on learning outcomes, I have found students enjoy the active learning style. (In response to "What do you like most about sections?", 70% of my students respond with a variant on "The interactivity! I feel like I learn a lot in Sarah's sections" or "exercises that make me understand the lecture material better.")

Peer Tutoring Pairing students randomly typically produces groups in which one student can help teach course content to the other, and although the 'tutor' in this case is untrained, he or she can give one-on-one feedback about concept understanding. This helps meet the goal of offering personalized tutoring to students who need additional resources to tackle advanced topics. Further, having half the class receiving informal tutoring and half the class offering it is a practical approach to handling the fact that students enter upper-division classes with different levels of exposure to course content. Both the teacher

[4] Michael Prince. Does active learning work? a review of the research. *J. Engr. Education*, pages 223–231, 2004

[5] Scott Freeman, Sarah L. Eddy, Miles McDonough, Michelle K. Smith, Nnadozie Okoroafor, Hannah Jordt, and Mary Pat Wenderoth. Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, 111(23):8410–8415, 2014

[6] Patricia Heller and Mark Hollabaugh. Teaching problem solving through cooperative grouping. part 2: Designing problems and structuring groups. *Am. J. Phys.*, 60(7):637–644, July 1992

[7] E.F. Barkley, C.H. Major, and K.P. Cross. *Collaborative Learning Techniques: A Handbook for College Faculty*. The Jossey-Bass Higher and Adult Education series. Wiley, 2014

[8] L.B. Nilson. *Teaching at Its Best: A Research-Based Resource for College Instructors*. Wiley, 2016

[9] B.G. Davis. *Tools for Teaching*. Jossey-Bass Higher and Adult Education. Wiley, 2009

[10] Elise J. Dallimore, Julie H. Hertenstein, and Marjorie B. Platt. Nonvoluntary class participation in graduate discussion courses: Effects of grading and cold calling. *Journal of Management Education*, 30(2):354–377, 2006

and learner find the interactions valuable. (From my own course feedback, "I got to explain my reasoning to others and it helps me understand better," "partner work is most helpful because it allows me to work on the stuff myself, but still have someone to discuss things when I get stuck.")

Feedback and Formative Assessment I like to administer midsemester surveys [11] to solicit high-level feedback about course structure, but my strongest interest is in immediate, low-level feedback about student understanding. My ideal is to solicit it at a per-concept granularity during a given session or at least at the per-session granularity. The fast feedback loops I established in sections — listening for student confusion at each exercise and correcting misconceptions before moving on to the next exercise — serves this role. In a lecture setting, I would use tools like Socrative to gain this feedback on immediate student confusions within lectures and tools like 'mud cards' [12,13] to obtain feedback at the per-lecture granularity. My dedication to adapting to student needs discovered during class means I have to be willing to go off-script, and my comfort doing this is one of the key skills my students appreciate and point out in their feedback. ("We were going over the complicated example...and Sarah was able to adjust the [section material] on the fly," "especially tuned to when students were having trouble understanding section material," "she would feel personally responsible if her students didn't understand a concept.")

[11] Carolin S. Keutzer. Midterm evaluation of teaching provides helpful feedback to instructors. *Teaching of Psychology*, 20(4):238–240, 1993

[12] Frederick Mosteller. The 'muddiest point in the lecture' as a feedback device. *On Teaching and Learning: The Journal of the Harvard-Danforth Center*, 3:10–21, 1989

[13] Steven R Hall, Ian Waitz, Doris R Brodeur, Diane H Soderholm, and Reem Nasr. Adoption of active learning in a lecture-based engineering class. In *Frontiers in Education, 2002. FIE 2002. 32nd Annual*, volume 1, pages T2A–T2A. IEEE, 2002

Teaching a Diverse Student Body

I treat diversity as a first-class concern in my teaching practice. For instance, I avoid designing problem sets or exams that rely on a particular cultural experience — *e.g.*, game- or sports-based problems that assume familiarity with the game rules or equipment[14]. Recognizing that educators tend to offer more "linguistic space" — essentially speaking time — to some groups[15], I ensured that in sections I had a mechanism for randomizing how I called on students (by pulling their names from a hat). Finally, I focus heavily on active learning, which both benefits all students and reduces the achievement gap for underrepresented minorities and first-generation college students [16] [17].

[14] William F. Tate. Race, retrenchment, and the reform of school mathematics. Phi Delta Kappan 75, No. 6, 477-80,482-84 (1994)

[15] D. Sadker and K.R. Zittleman. *Still Failing at Fairness: How Gender Bias Cheats Girls and Boys in School and What We Can Do About It*. Scribner, 2009

[16] David C. Haak, Janneke HilleRisLambers, Emile Pitre, and Scott Freeman. Increased structure and active learning reduce the achievement gap in introductory biology. *Science*, 332(6034):1213–1216, 2011

[17] Cissy J. Ballen, Carl Wieman, Shima Salehi, Jeremy B. Searle, Kelly R. Zamudio, and Erin L. Dolan. Enhancing diversity in undergraduate science: Self-efficacy drives performance gains with active learning. *Life Sciences Education*, 16(4):ar56, 2017. PMID: 29054921

Research-Guided Teaching Practices

In the context of teaching, I take a "work smarter, not longer" approach. Knowing that teaching can easily become an over-large time commitment, I approach teaching already armed with strategies to limit how long I spend preparing lessons. That said, I expect to devote one day per year to reviewing education research, a time commitment I expect will be manageable even in the midst of a full research calendar.

This small upfront time commitment allows me to focus my later planning times on the strategies and interventions that have the biggest effects on student leaning. Many of the practices I have described in this statement are strongly influenced by the education research I cited throughout, and this research-backed approach has served me well.

Mentoring

During my time as a PhD student, I have had the privilege of working with and mentoring many talented younger students. With six undergraduate students and seven graduate students, these mentor relationships have been close and long-lasting. The form of the mentoring has ranged from primarily research-oriented (coaching them on how to select research problems or navigate the publication process, co-authoring papers, providing talk feedback) to primarily content-focused (coaching them through implementing a side project of their own design, introducing them to a subfield they want to enter) to primarily process-oriented (offering advice about picking advisors and collaborators, time management, the relative importance of their various tasks based on their career goals).

To promote mentorship within the department at large, I led the Berkeley EECS Peers organization for a year, connecting fellow graduate students with near-peer mentorship and directly mentoring many students myself. I have also volunteered with the University of Washington First Year Graduate Mentoring program.

Courses

I am qualified and interested to teach a broad range of compilers and programming languages courses, at the undergraduate and graduate levels, with a preference for compilers courses. At the undergraduate level, I especially like teaching compilers courses that focus on the design and implementation of domain-specific languages, skills for learning and understanding new languages and features, and other language-centric skills that are useful for a broad range of students; I would enjoy designing a course like this. I am also interested in teaching HCI courses that focus on usability and user research (human- or user-centered design or research courses, quantitative methods) and data science courses. As a means of training my own students and recruiting new collaborators, I would love to teach a program synthesis course at the graduate level. I would also be extremely interested in developing a graduate course on end-user programming and another on human-AI interaction. Since new courses must fit into the ecosystem of existing courses, my preference is to develop courses in collaboration with other faculty. I am also open to teaching introductory courses, in part for the selfish reason that I research how to make programming easier, and teaching novices always reminds me what makes programming hard.