Teaching Statement

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Teaching Philosophy and Values

Developing critical and logical thinking skills for engineering work is a skill, whereas teaching is an art. Following the philosophy of "Tell Me, and I Forget; Teach Me and I May Remember; Involve Me and I Learn", I aspire to engage and motivate students to learn exciting fields of science. Nowadays, various resources and media are available to explain the *What* and *How* of concepts, but explaining *Why* things are the way they are – requires effort. In teaching, building intuitions and distilling core principles underlying the security primitives is critical. Such core understanding adapts students to solve new problems.

During my school education, I was curious to observe the interaction dynamic between a teacher and a student. I realized that a teacher's way of motivation, his peculiar perspective on a topic, and his comprehension of a student's learning psychology play a vital role. Many times I imagined–"How would I teach the topics my teacher just taught me?". Here is an example of teaching Bernoulli's principle to a student: Rather than starting by describing it over the board, I start by making a paper plane and a flying disc [Enter the game]. Next, I ask him/her to fly those and to play along with them. [Involve Into]. Next, I flatten the flying disc and deform the paper plane, after which those stop rising up and fly to a shorter length. Wondered, the student asks me, "What's wrong?" [Motivated]. In response, I ask him/her to correct those by himself [Taste the Trouble]. Finally, I bring out the simplicity of the texty book's explanation of Bernoulli's principle. In this way similar to Prof Manish at IIT Gandhinagar running Center for Creative Learning (https://www.ccl.iitgn.ac.in), I want to make science engaging, hands-on and interactive.

Methods

In addition to classroom learning, students undergo a hidden curriculum: managing their time, wellness, and other responsibilities. I will strive to remind students to balance life and provide resources to ensure their well-being. To ensure that no one is left behind, intentionally practicing inclusion and equity will be an integral part of my teaching.

Connecting every learned knowledge with real-world applications provides strong motivation. Therefore, I would seek partnerships with industries and practitioners in the local community. A visit to these industries and a demonstration from these folks can provide hands-on insight. For students to develop holistically and impact society, it is important to encourage them to practice leadership and develop communication skills. To this end, I plan to advise existing student organizations and initiate new ones to provide broader opportunities to students.

I am Inspired by the teaching style of Prof. Shai Simonson at Stone Hill College in Boston, USA. I drove to Boston to interview him. Shai has a remarkable capability of introducing complex topics with real-life puzzles. For example, he introduces RSA cryptosystems using the puzzle of measuring 4-gallon jugs using a 3-gallon and a 5-gallon jugs, which connects back to the group theory mechanisms underlying RSA. Similarly, I remember a sense of "aha" moment when I first learned the mathematical proof by induction with the analogy of a line of dominoes falling, knocking one after the other. In the same way, I will strive to excite students by connecting topics with creative activities and relatable experiences.

Intentionally practicing being a student in other classes would help me to be in students' shoes. I would design assignments that involve group work, speaking, and sharing in the class to enhance collaborative and communication skills. For classroom discussion, experimenting with different group discussion structures (e.g., Snowball, Debate, Fishbowl, Jigsaw) would cater to introverts and extroverts in the class. Finally, inviting guest faculty members to discuss interesting topics would broaden students' understanding. I will continue to learn and grow in teaching skills by joining workshops and conferences and interviewing other inspiring teachers.

Assessment

Effective assessment is essential for continuous improvement in teaching, and it goes hand in hand with practicing all the above methods. Beyond student feedback, I actively observe student body language and

reactions to gauge their comprehension. Inviting peer faculty to observe my class provides an additional layer of constructive feedback. Furthermore, recording my lectures and reviewing them later would allow me to identify areas for improvement. A case in point: during my CSE System class, I would frequently ask students to speak openly about any problems they were facing in the class. During one of the office hours, students reported a problem of delayed grading due to the absence of grader allocation. I promptly consulted with the department of teaching for alternative strategies and our department office to assign the graders and was able to manage the grading of all the assignments by the end of the semester. As it was also reflected in one of my SEI feedbacks, "[my care for student] went a long way towards making students feel comfortable to speak up and talk to him whenever they were feeling confused about course content."

Teaching and Mentorship Experiences

I am fortunate to be able to volunteer to teach demonstrations of 30 science experiments, basic computer science applications, and mathematics at my boarding school and NGO Parva School. Later, during my teaching assistant opportunity, I taught a 4-credit hour class – CSE 2421: Systems I: Introduction to Low-Level Programming and Computer Organization – at The Ohio State University, Columbus, in Fall 2023 with a class size of 37 undergraduate students from diverse backgrounds. I learned and grew in my ability to articulate complex systems, formulate exam problems for students, work with the assigned grader, and manage administrative responsibilities as an instructor. In the class, I demonstrated security exploits and TLS communication to help students connect concepts of memory layout and the performance of low-level C programming. Further, every Friday of the week, I engaged students to engage with each other by organizing activities in the class. Similarly, in the class, there were two students, C and H (anonymised for privacy), with whom I mentored more closely. These students were part of security and computer science skill development clubs. I mentored them with note management tools, developer tools, and career planning. My diverse background, including serving as an emcee at international student conferences and security events, leading student organizations and sports groups have equipped me to foster a welcoming classroom environment, deliver clear communication, and create enriching learning experiences for my students.

Teaching Plan

In order to work deeply into the security and formal methods of systems, I had to have a sound understanding of core subjects, operating systems, programming languages, compilers, computer organization, analysis and design of algorithms, computer networks, network & system security, theory of computation and complexity, foundations of automatic verification, cryptography and computer security, wireless networks and protocol design. Therefore, I can teach these foundational courses to undergraduate students and corresponding advanced courses to graduate students. By teaching the additional security aspects and formal techniques, I can gradually build up the skill set for focused research. I plan to break down security concepts into the following courses:

- **Mathematical Structures for Cryptography.** Introduce basic cryptosystems – symmetric and asymmetric encryption, message authentication code, and digital signature – and underlying hardness assumption of the discrete logarithm, integer factoring, and elliptic curve that set the basis for unbreakability. By connecting the underlying mathematical structures of group theory and number theory to the basic cryptosystems, students can build intuition and think foundationally for novel cryptosystems.
- **Automated solutions for security and privacy.** This consists of formal and non-formal methods. In the former case, I will introduce a variety of mathematical logic and reasoning systems at the design/functional/implementation level and their applications in verification tools, including the mechanism of constraint solvers. In the non-formal techniques, fuzzing, trusted execution environment, and other software-based solutions (e.g., distributed security) will be discussed.

As I mentioned about the importance of connecting science to relatable experiences for students, I will relate the security concepts with widely deployed systems, such as Linux security, trusted execution environments, blockchain, and smart contracts; and protocols, such as TLS, WiFi, Bluetooth, and group messaging protocols. I want the students to appreciate complex systems and arm them with a variety of crypto tools to solve new problems.