

Teaching Statement

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“Education is an admirable thing” wrote Oscar Wilde, “but it is well to remember from time to time that nothing that is worth knowing can be taught.” This quote has been resonating in my mind since I first read it as an undergraduate student. After years of study accompanied by the experience of being a teaching assistant and mentoring junior students, I personally tend to hold that this quote is not meant to look down upon education. Rather, it highlights the essence of any form of teaching in my mind—*orienting the gaze of ‘students’ so that they see the world for themselves and then experience the Aha! moment naturally.*

In this statement, I will describe how **Aha! moment** (or eureka moment) serves as the cornerstone of my teaching philosophy from two main aspects—teaching as classic style writing and lifting the ‘curse of knowledge’. I will then conclude with my mentorship experience and potential courses that I look forward to teaching or developing.

Teaching as classic style writing. At OSU, I was fortunate to have the opportunity to teach classes for undergraduate and graduate students. I have been a teaching assistant for the course *ECE 5101/CSE 5463: Introduction to Wireless Networking*, which holds both undergraduate and graduate students coming from both ECE and CSE departments. At Tsinghua, I was a teaching assistant for the undergraduate courses of *Communications and Networks* and *Data Structures and Algorithms*, with about 100 students for both. Unlike most courses, for which TAs are mainly responsible for grading homeworks and exams, those courses gave me valuable opportunity to practice and refine my Aha! moment based pedagogical beliefs.

Teaching is similar to writing in the sense that they both serve as a propagation medium of truth or ideas. Among different styles of writing, there is one named *classic style* that stands out. As advocated in the bestseller book *The Sense of Style* by Steven Pinker, classic style writing—that is, the writer aims to depict a world and position readers in such a perfect vantage point that they can see it for themselves—is an antidote for many kinds of stuffy prose. In classic style, the writer acts as if a guide of a national park who leads ‘tourists’ to the best viewpoint of the sunset so that they cannot help saying “Wow!”. Inspired by this viewpoint, my own preferred style of teaching shares the same spirit as classic style writing—the teacher tries to get students to experience Aha! moment by providing them with an unobstructed view. I will illustrate this idea with the following example.

As the teaching assistant of the course *ECE 5101/CSE 5463: Introduction to Wireless Networking*, I gave a guest lecture on the TCP/IP protocol, which is the foundation for the Internet. In order to help students fully understand this concept, I connect it with the postal network. That is, the data link layer which moves data within LANs is similar to the USPS trucks that move letters within a city; the Internet layer which moves data between networks is like the airplanes that move letters between cities. People use pens to write letters while the physical layer specifies the means of representing ones and zeros; there are chances that people will be informed that their letters cannot be delivered, which parallels the error control scheme under the reliable TCP protocol. After I present it in this way this year, I can immediately feel that most of the students had experienced the Aha! moment through the expressions on their faces. This is in sharp contrast to the puzzled faces when I just presented this concept plainly in the class of last year. The best compliment I have heard from students about my lectures is that it enables him to think of TCP/IP protocol whenever he sends or receives an item by mail.

It is worth noting that what I presented above is just an example or an attempt to practice teaching as classic style writing. The basic idea would be—minimize abstractions by narrating an unfolding plot with real characters doing things—rather than by packaging abstract concepts into concepts. It turns out that through this way students not only tend to have their own Aha! moment naturally, which makes them feel like genius, but also they would reinforce the concepts or ideas by themselves.

Lifting the “curse of knowledge”. The “curse of knowledge” refers to the difficulty in imagining what it is like for someone else not to know something that you know. This difficult obviously exists in every aspect of a teacher who is assumed to know much more than his or her students in a certain field. To some kind

of disappointment, the traditional advice—remember the audience over the shoulder—is not as effective as one may think. It has been found that people who have learned something so well are not easily disabused of their curse of knowledge to remember what it was like to learn something, or to ignore what they know. To escape the curse of knowledge, I personally find it that reverse-engineering the Aha! moment could be a start. That is, when I want to teach or explain a concept, I would always try to first recall the Aha! moment I experienced (if there is none, it is with high probability that I did not fully understand this concept.) Then, I will start with the information behind my Aha! moment and trace back step by step. This not only gives me a clear route for my presentation (which can follow the classic style as mentioned before), but allows me to keep the real excitement when I teach. I will illustrate this idea with the following example.

In the probability review lecture, *conditional expectation* (e.g., $\mathbb{E}[X | Y]$) is a fundamental concept. When I first taught it in 2018, I found that there is large portion of students tended to incorrectly interpret it as a real number rather than a random variable, let alone the various properties about it. This year, I first recall my own Aha! moment about it—regarding it as the best guess of X under given information revealed by Y . This simple way of seeing it allows me to design a die-based example to demonstrate it, which in fact follows the rule of classic style writing mentioned before. For instance, suppose X is the value of fair die, then $\mathbb{E}[X]$ is our best guess without any additional information, which should equal to 3.5. However, if we have the additional information that X is even, then our best guess changes to 4; Conversely, if we know X is odd, then our best guess is now 3. Finally, if we incorporate the parity information of X into a random variable Y (since it can be either odd or even), then we can easily see that $\mathbb{E}[X | Y]$ is now a random variable—you guess 3 if I tell you it is odd and you guess 4 if I tell you it is even. After I presented this idea, I was very happy to see that a lot of students succeeded in generalizing this simple idea to understand all the other properties related to it.

Mentorship. I was fortunate to work with very smart undergraduates through *Student Research Training* program when I pursued my master degree at Tsinghua. As an example, I worked with Tian Tong, now a PhD student at CMU, on an energy efficient communication problem. This experience enables me to learn how to challenge smart students and push them to the limit. For instance, at the beginning, I just asked him to analyze the performance based on ergodic capacity, which was easily accomplished by him within just two weeks. Impressed by his learning speed and mature of math, I further challenged him with the analysis from the perspective of outage probability, which requires a sophisticated investigation of Meijers G-function. This time, with just a bit of hints from me, he not only achieved my goal, but provided me with insightful simulation results. In the end, we co-authored and successfully published our results on *IEEE Communications Letters*.

In addition to students in school, I have also been ‘mentoring’ a broad scope of students by writing blogs on the Internet. I have a Chinese blog¹ where I have written several posts on information theory and communications that are popular with students. For instance, my blog would appear at the top place of Google search with key words (in Chinese) such as ‘typical set’, ‘channel estimation’, ‘Kraft inequality’ and so on. In the meantime, I also replied to every comment on my blog to help. Now, I turn to write in English on my new blog². My posts on ‘strong convexity’ and ‘Lipschitz continuous gradient’ have around 800 reads in total per week, and again occupy the top place in Google search.

Teaching plan. I am ready to teach undergraduate students on probabilistic models and methods, computer networking, and graduate students on stochastic processes, queueing networks and optimization. With some additional preparation, I will be able to teach courses on algorithms, machine learning and statistics. Meanwhile, I am also eager to develop new courses based on my own research expertise and emerging technologies. For instance, for graduate students, I plan to give a course on large-scale computing systems for big-data analytics. This course will focus on network architecture, load balancing, scheduling, and performance analysis along with mathematical tools such as probability theory and optimization theory.

¹<https://blog.csdn.net/mike190267481>

²<https://xingyuzhou.org/blog>