My passion for teaching is one of the main reasons for my pursuit of a career as a university professor. Examples of undergraduate courses I would like to teach include introduction to probability, artificial intelligence, game theory, algorithms and data structures, and elementary data analysis. I would be interested in teaching beginner graduate courses like machine learning, graph mining, intermediate statistics and optimization. For advanced graduate students, I have found journal clubs or seminars to be very effective if run well - I would be interested in doing this for modern high-dimensional statistics, advanced optimization and learning theory. Much of the rest of this statement is relevant for courses directed at senior undergraduates or junior PhD students.

In my experience, a large number of students from varying backgrounds take these courses, with varying personal aims for the course. Hence, my primary goal is for all students to build foundational knowledge of the field, and I aim to facilitate individualization and interaction in large introductory classes. I believe that any one of the above courses can only scratch the tip of “the large iceberg of interesting applications”. Hence, my second goal is for students to independently explore the field, my role being to promote such exploration of these vast topics in a structured manner. A final goal is for students to appreciate the subject matter and develop a long-term inspiration to continue learning outside the classroom. Below, I detail some methods I intend to employ to accomplish each of these goals.

Building Foundational Knowledge

I aim to help students build foundational knowledge in the field, even in large diverse classes. For example, the ML department’s flagship course had become so popular, that about 400 students took either the Masters or PhD level Introduction to ML each semester, from departments as varied as Public Policy, Business and Mechanical Engineering. This makes it challenging to adapt the courses to the varying depths of their mathematical backgrounds and the breadth of their interests in a scalable manner, and the students often complained about this issue.

To partially address this concern, I voluntarily made a series of 12 review videos using a laptop and tablet, each about 10-15 minutes long, on topics of multivariate calculus, multivariate probability and linear algebra. They were meant as a refresher for students who knew this material from their undergraduate days but had forgotten it, but not meant to teach it to them for the first time. I uploaded them to YouTube and made an accompanying webpage describing the pre-requisites for the videos and why they would later be useful. Employed since Fall 2014, they have thousands of views in total, and were positively received by the faculty, TAs and students (some of whom reached out to thank me by email).

Another good example of this arose when I was twice a teaching assistant for Convex Optimization, a fairly large class taken by over 50 PhD students. I requested to participate in the design and planning of the course, incorporating anonymous student feedback obtained from the first offering. During the summer before the course, I helped the instructors rehash the syllabus and reorder the contents, adding modern material that was relevant to the PhD students in machine learning and statistics, with the aim of improving student motivation. We also decided to offer a 9 and 12 credit version of the course (with and without a research project) so that students with a heavier semester course load did not get overwhelmed and feel the need to drop the course at a later point. On my suggestion, we decided to introduce more structure and flexibility into the assignments. Every homework had one “mastery” set to test fundamentals, one theoretical question (on mathematical depths), one practical programming question (on real world problems). The assignment ended with a student option for an advanced theory or advanced programming question, which they could choose depending on their inclinations.

These changes were very positively received by the students, enabling them to understand both theory and practice better, identify their strengths, weaknesses and interests, and explore advanced
material according to personal tendencies. These ideas were recognized by the department, which gave me the “best TA award” for my contributions over two years.

Exploring, Beyond The Classroom

While research can be thought of as creating new knowledge and teaching is about communicating and consuming that created knowledge, their complementary nature can be advantageously used in a course. This can be done by providing interesting avenues for exploring ideas and new topics outside the classroom; in fact, one of the most joyous parts of research is just exploration of the literature, and reading related work can often fill in neighboring jigsaw pieces into the big puzzle.

One way in which I like to provide support to students who want to explore further, is by providing links to specific research papers on the topic, or other course notes that cover related topics, and sometimes even Wikipedia pages or graphical applets that have good explanations of a concept. I consciously attempt to provide examples from a wide variety of sources (data from music, medical, finance, weather, sports, etc) and possibly provide further sources of such well-organized data.

I also intend to encourage students to play around with real data of their choice for a course project. Further, I will also encourage them to take part in competitions, either hosted on websites (like Kaggle), or run by conferences (like the KDD Cup), or financed by companies (like the Netflix Prize), allowing them the possibility to substitute a course project with a well-implemented solution to the competition problem statement.

Engaging and Inspiring Students, Long-Term

My outlook towards teaching mathematical subjects can be broadly summarized by my pet phrase *teach Math using English*, reinforced by success during my teaching experiences when I *emphasize intuition over algebra*. This ideology is attributed to my high-school math teacher, over 80 years old at the time, who expertly taught 25 students extremely difficult math topics for the notoriously difficult IIT entrance exams in India, for two whole years *without a blackboard in the room*.

Not as skilled or experienced as my idol, I do like to use a blackboard, and have a strong preference for teaching on a blackboard as opposed to powerpoint presentations, allowing me to proceed at a pace where students can slowly read and process what is being written. While the latter is more useful for displaying graphs and simulations, education research (and my experience) suggests that the former is typically more effective for student learning. It also allows for better lecture organization, like being able to keep an outline on one board, or an important definition on another.

I like to engage students in my classrooms - I am usually very cheerful, pause often for questions and like to start discussions among the students. As an example, I volunteered for consecutive years at CMU’s Andrew’s Leap summer program for high school students, lecturing on topics like Multi-Armed Bandits as well as Auctions and Voting Theory; the students were as involved and excited as I was about the topic, and gave very positive feedback about the lectures.

I personally love learning about the history of a topic and the lives of the people involved. In the classroom, I try to bring mathematics to life by transforming theorem statements into stories, tales about people’s lives and various failed attempts at solving a problem. In most of my talks and classes, I make it a point to throw in interesting tidbits of the lives of one of the scientists involved in the topic being discussed. This has been very well received by students as well as faculty members, and often strikes up interesting conversations afterwards.

These examples together reflect my philosophy, that emphasizing the bigger jigsaw around the details of the pieces, while providing structured avenues for exploration with wiggle room for individual flexibility, jointly leave a long-lasting impact on student engagement, interest and motivation.