Teaching Statement

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My goal as an educator is to train the creative minds in engineering, especially for those with interdisciplinary knowledge in image processing and high performance computing, so that they have a strong background in technical knowledge, but are also passionate about research frontier. To achieve this goal, I will try the following ideas: (1) adaptive learning individualized for each person, (2) using analogy to relate abstract theory with tangible real-life examples, (3) project-based teaching, and (4) interdisciplinary teaching. But before I elaborate on my teaching methods, I will first briefly summarize my teaching experience and my teaching plan.

1 Teaching and Tutoring Experience

At Purdue University and St. John's University, I was fortunate to have opportunities teach undergraduate and graduate students in Mathematics, Computer Science, as well as signal processing. The roles for my teaching positions are varied and listed below:

1. In mathematics MA 124 (Probability and Statistical Inference), my job is to grade homework, give exams, and answer questions in office hours.
2. In computer science classes CSCI 150 (Introduction to the Science of Computing), CSCI 160 (Problem Solving, Programming and Computers) and Purdue ECE 637 (Digital Image Processing), my role is to give lab instructions and help students finish lab projects. In addition, I designed new lab projects for CSCI 150, in which I taught students how to use python and Alice programming language to create 3D computer animations.
3. In Purdue ECE 563 (Programming Parallel Machines), I was a guest lecturer and I gave lectures to about 40 students on how to supercompute and achieve a high computation efficiency.
4. Besides the teaching experience above, I was a one-on-one mathematics tutor at Math Skills Center, and I helped students with Calculus, both through giving private lessons and answering homework questions.

2 Teaching Plan

I am ready to teach classes on C programming, object-oriented programming, data structure, parallel computing, probability and statistical inference. With some preparations, I can also teach computer algorithms, data science, image processing, numerical methods, machine learning, bayesian estimation, and medical physics for imaging.

In addition to the above classes, I also have interest in developing a new class on *High Performance Computing*, based in part on my research expertise in the field. For most of the high performance computing classes offered to students, high performance computing is synonymous to parallel computing. However, parallel computing is only one aspect of high performance computing. To achieve a fast computation speed with a high computation efficiency, an algorithm must not only be parallel, but is also cache efficient with a high memory bandwidth throughput, high cache bandwidth throughput, and with a low data access latency. In addition, the algorithm must be redesigned to enable a regular data access to achieve a high SIMD operations and hardware prefetching for each computing core. In this class, I will cover how to design parallel algorithms, and teach theory knowledge on how latency, bandwidth, cache, memory, SIMD operations, compiler, and parallelism are related to each other. In addition, I will teach students how to use softwares, such as Intel Vtune Amplifier and IPM tool, to identify program hotspots that have worst computing performance. Then, I will give students hands-on assignments to teach them how to redesign parallel algorithms for better per-core and parallel efficiency. I will also reserve a few lecture hours for advanced topics in high performance computing, such as quantum computing, CPU and GPU hybrid computing, and high performance computing for machine learning.

3 Teaching Methods

1. Adaptive learning individualized for each person. Each student in the class has different background knowledge, skill sets, and aptitude, and with different career goals in mind. Therefore, I propose to assign different homework sets to different students, so that my assigned homework is best suitable for their interest. For students with an outstanding exam and homework assignment scores, they will be assigned with more difficult and challenging homework questions and fewer easy questions. For others who struggle in the class, they will be assigned with easier questions to encourage them to catch up with others. As the poorly performed students improve their scores, their homework questions will become more difficult. Such an adaptive teaching method can be complemented and facilitated by online learning platform. Based on the accuracy rate and how long students answer each question, students are automatically assigned with homework questions. At the end of each week, the homework difficulty level is reset based on the previous week's homework performance.

2. Using analogy to relate abstract theory with tangible real-life examples. Many concepts in engineering and mathematics are difficult to comprehend. However, a good analogy that relates an abstract concept to tangible real-life examples can be a life saver for students struggling in the class. When I took Purdue ECE 641 image processing class with Professor Charles Bouman, I find it difficult to understand why some numerical methods, such as coordinate descent, are fast converging but difficult to parallelize, while other numerical methods, such as gradient descent, are slow converging but easy to parallelize. Professor Bouman has an analogy and he says coordinate descent is like trying to find a radio station on a vintage radio with many knobs, and coordinate descent method turns radio knobs one by one. It is often the fastest way to find a radio station, but it is sequential in nature. Gradient descent, however, is like turning all radio knobs at the same time. It is a slow way to find a radio station, but is parallel in nature. This analogy helps me better understand numerical methods and algorithmic convergence, and leaves me with a deep appreciation for the importance of practical and relatable analogy. Therefore in my classes, I will be intentional in using analogy to explain difficult concepts.

3. Project-oriented teaching. An easy way to help students get a deep understanding on class materials is through hands-on projects, in which students implement their codes and do experiments. Through my past experience, the understanding students get from hands-on projects is often deeper and more practical than from books or lectures. Therefore, I will design mini lab projects for students with easy-to-follow lab instructions and the lab projects are directly related to lectures but oriented around real-life applications. I will also design lab exams whose format and content is similar to the mini lab projects, and ask students to finish lab exams in given time. Furthermore, I will give students a few open-ended project questions, and ask students to explore innovative ways to solve the project questions and experiment different methods. At the end of the semester, I will grade their project report based on how innovative their methods are and how good their experiment results are.

4. Interdisciplinary teaching. I have a diverse education and training background, as I have received degrees or formal training in mathematics, computer science and engineering, signal processing, and radiology. I deeply appreciate such diverse education background as it gives me a very unique perspective to view research problems. In a similar way, I want students to enjoy a diverse perspective when solving technical problems. Therefore, I want to try interdisciplinary teaching, and bring students from different background to the same class and work on a project that all find mutual interest. This can be achieved through independent study class, and students from different departments can pick a class project in common interest, and depending on their education goal, each one works on a different aspect of the project.