TEACHING STATEMENT

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My primary goal in teaching is to empower students with both the motivation to explore the unknown world and the methodology for applying their knowledge to solve hard problems. I aim to cultivate in students the capability of both creative thinking and practical implementation, and to give my most personalized guidance to help them reach diverse study goals. To this end, I have dedicated myself to a variety of teaching activities at Stanford and MIT, such as assisting and co-teaching undergraduate and graduate courses, mentoring students with various backgrounds, leading a research subgroup, and giving lectures to the public.

TEACHING EXPERIENCE

To help a diverse group of students achieve their different study goals in a class is challenging. I gained my first and unique teaching experience in addressing this challenge by assisting CS148, "Introduction to Computer Graphics and Imaging," for three consecutive years under Prof. Ron Fedkiw at Stanford. Students taking this course ranged in different majors from computer science to mathematics to biology. They were all expected to apply the techniques learned to generate a visually compelling digital image at the end of the quarter to show their creativity in bridging computer graphics and innovative ideas. As one of the head TAs, I took leadership in developing this course to stimulate both technical skills and ways of creative expression in students. To convey technical skills, I built the course framework for ray tracing by designing course materials, code infrastructures, three assignments, and a final project to teach students the concepts and programming skills within four weeks. The curriculum was intense and could be intimidating for many students without a strong programming background. I alleviated this by smoothing the learning curve. When designing each assignment, I let students observe immediate cool effects by modifying a few lines of code and then threw out more and more challenging problems to push motivated students to go beyond their original expectations. I also gave online tutorials to help students smoothly start their homework. To encourage creative expression, I held one-on-one grading sessions and office hours every week to give each student individualized guidance. I stayed aware of the strengths and weaknesses of students. For a student having difficulty in finding the theme of his picture, I nurtured an aesthetic perspective by encouraging him to think outside of the "Cornell Box" and discover the beauty from the surrounding world. For a student with an ambitious yet vague goal, I helped subdivide the plan into multiple realizable parts and guided him to explore these parts step by step. In the end, the excellent pieces of work the students created exhibited a rich diversity of stories, techniques, and creative ideas (see Figure 1 and more in [1]), demonstrating the success of everyone in the class.

Figure 1: Students in CS148 created images with various themes from the sample code (a). Authors of images are Tao Du and Jing Xiong (b), Moritz Sudhof (c) and Robin Woodby (d).

To know what to teach in class is essential for a teacher. I acquired this skill when I played my combined role as both a guest lecturer and a teaching assistant for CS248, "Interactive Computer Graphics," for two years at Stanford. I independently developed the track of mobile game programming in this class. As a guest instructor, I gave lectures on OpenGL ES programming and Unity mobile game design; as a teaching assistant, I created course materials and assignments and guided students to develop both ideas and techniques to realize the game in their minds. The combination of these two roles allowed me to think more about the gap between the content delivered in class and the students' actual need, and further motivated me to devote my efforts to filling this gap. I believe that the saying, "the best way of learning is by doing," applies to both students and teachers. To

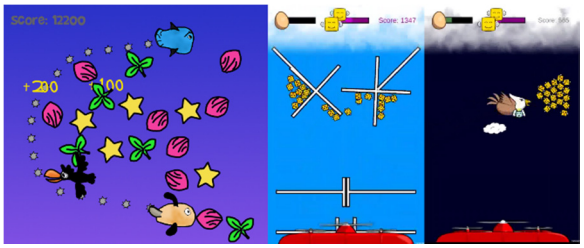

Figure 2: Greedy birds (left) and Windy birds (right).

better understand the potential difficulties facing students in their projects, I spent a few weeks writing a sample Unity game, "Greedy Birds" (see Figure 2 left). Then I shared with students my philosophy, experience, and the potential pitfalls in creating fun mobile games to help them start their voyages. My efforts inspired some excellent mobile games from students [2]. For example, "Windy Birds" (see Figure 2 right), a mobile game developed by a group of undergraduate, graduate and distance-learning students, won an award in the final game competition of the class.

I further developed my lecturing skills at MIT by delivering lectures with varied contents to diverse audiences. I gave lectures as a guest or replacement instructor in MIT 6.S079, "Computer Fabrication," for Prof. Wojciech Matusik and MIT 6.837, "Introduction to Computer Graphics," for Prof. Justin Solomon. These lectures covered a variety of topics in computer science and numerical mathematics such as hierarchical data structures, and numerical optimization algorithms. Also, I gave public lectures to a wide range of audiences with mixed backgrounds. For example, I annually co-taught a course on "Developing Technologies for Hollywood Special Effects" with Prof. Ron Fedkiw at Stanford to professionals with different industrial and commercial backgrounds. I cultivated my teaching and communication skills in front of such audiences by interpreting the complicated concepts of mathematics and computer science using simple examples and intuitive metaphors to convey the key ideas.

STUDENT ADVISING

I was fortunate to mentor more than ten excellent students during my Ph.D. and postdoctoral studies, including visiting students, undergraduate interns, and Master's and junior Ph.D. students. In each summer during my Ph.D., I was responsible for mentoring an undergraduate research group at Stanford consisting of Stanford students, U.S. Army students, and visiting Chinese students supported by different summer programs. Students' goals and expectations were varied. Some of them were well-trained in computer science and had high expections on their roles in the team, while some others needed a quick adaptation in their very first journey to a new country. As their mentor, I talked to each of them at the beginning to learn his individual goal and designed everyone a particular research path consisting of multiple sub-tasks. The combination of these paths converged to the common aim of the team—to explore some challenging undergraduate research problem combining computer graphics and physics simulation. For example, one of the team's research goals was to develop a real-time virtual vehicle simulator on mobile devices (Figure 3). I designed for each student a research track accommodating their interests and backgrounds, such as collision handling, articulated body simulation, Android programming, real-time rendering, etc. Meanwhile, I assembled subgroups to encourage students to collaborate and learn from each other on some higher-level tasks, such as the simulation of the vehicle on complex terrain. By doing these, I enabled the team to deliver high-quality output and simultaneously let each student achieve his individual research goal. The final research demo consistently received high evaluations from committees at Stanford, AHPCRC, and China (see [3] for example). This experience also motivated students in the group to pursue their Ph.D.s in computer graphics at top universities including Stanford, Berkeley, and Cornell.

Figure 3: Simulation of vehicle on Android, by William Chargin, Peter Huang, Justine Zhang, Kuan Fang, etc., summer 2013-2014.

At MIT CSAIL, I added an important dimension to my skill sets by mentoring Ph.D. students on their research projects. I developed my mentoring skills by leading a project as both a "general" and a "soldier," i.e., to work with students to explore the unknown that could be an intellectual challenge for both the mentor and the mentee. For example, in my first year at CSAIL, I advised a first-year Ph.D. student, Tao Du, on his computational multicopter design project. I used both experience and insight to help him identify the fundamental problem—flying a drone with arbitrary structure—and figure out the practical solutions of focusing on the linear approximation. I created for him a global roadmap toward the final goal and where he

was currently. This guidance provided fuel to drive the student at the beginning, alleviated his anxieties before the paper deadline, and eventually helped him finish the project successfully.

FUTURE PLANS

Teaching is a challenging but essential skill that I am developing throughout my entire academic career, and I am keen to learn from my new colleagues and mentors after I become a faculty member. I am particularly looking forward to teaching core undergraduate courses such as Algorithms and Data Structures, Linear Algebra, and Introduction to Computer Graphics, as well as advanced graduate courses relevant to my research expertise such as Interactive Graphics and Game Design, Physically-based Animation, Scientific Computing, Computational Geometry, Robotics, HCI, and Parallel Computing. I would also love to teach interdisciplinary courses combining the knowledge of math, physics, robotics and computation, such as Computational Design and Fabrication, Biomedical Modeling and Simulation, and Computational Robotics. I desire to organize seminars and teach state-of-the-art topics to graduate students in order to prepare them for their own research. My teaching and research experience in these areas at both Stanford and MIT will enable me to teach and motivate students in these interdisciplinary fields.

For student advising, I would love to give each student the most individualized support to develop his/her passion and skills in scientific research. I plan to form an open and collaborative research group consisting of students from multiple disciplines, including computer science, mathematics, physical sciences, and so on. I want to create a motivating and friendly environment in the group to enable both graduate and undergraduate students to participate in research activities, learn from each other, and explore their interests.

References

[1] Stanford CS148 showcase: http://physbam.stanford.edu/cs148/showcase.html

[2] Stanford CS248 showcase: http://web.stanford.edu/class/cs248/showcase.html

[3] Real-time multi-body vehicle simulation on Android mobile devices. AHPCRC project page (Figure 4): https://ahpcrc.stanford.edu/research/project/scalable-shared-and-distributed-memory-algorithms-computational-solids-fluids-and