Teaching Statement | Zachary Kingston

Understanding the full breadth of the state-of-the-art is complex, challenging, and requires reasoning over a menagerie of approaches, all with their drawbacks, strengths, and history. To help students overcome these hurdles, I believe teaching should be based around the core tenets of *intuition*, *reasoning*, and *articulation*; students should understand how the myriad components of the system interact, can be composed and glued together, and be able to explain to others how these pieces fit together and why they are essential. These skills are necessary for students no matter what course their life takes; they will apply these tenets to craft and share creative solutions while understanding course material, their research topic, or their daily lives. *I want to be a teacher who can distill and impart these concepts to students so they can become independent learners and clear, engaging communicators.*

§ Prior Teaching

I briefly served as an instructor for the *Algorithmic Robotics* course at Rice and taught lectures virtually during Covid lockdowns—it was a challenge to keep students engaged and present material in an exciting way. These experiences also made me realize that it is essential to be dynamic to keep students engaged with the material through interactive elements of the class. For example, during a lecture on topology for configuration spaces, I had small breaks that quizzed students on curious systems. Small assessments keep students engaged, and the feedback helped me understand when students did not sufficiently understand the material. Feedback was vital when it was difficult to "see" how the class was doing, and I will continue to use this in the future.

I also was an in-class and in-lab teaching assistant for both the introductory computer science and systems programming courses, aiding students in grasping intricate concepts; in these classes, I witnessed the growth of students who came to trust me as a reliable figure capable of demystifying complex subject matter. Through these experiences, I learned that an effective way to make sure a student truly understood the material was to have the student *rearticulate* the concepts to their peers, both improving their understanding and developing a stronger bond between the students. For example, during a lab teaching details of pointers in C, after helping one student with her issue, I supervised her in explaining the problem with another student's code. Through these experiences, I also learned that different students require different learning techniques and levels of support; it is essential to be flexible and supportive to encourage students no matter the circumstance. In the introductory course, the skill levels of students vary wildly given their prior background—I made sure to go the extra mile to provide additional examples and hands-on instruction to those who needed the helping hand. To build a community and rapport with students similar to what I experienced above, I would like to teach courses that are project- and team-based, *e.g.*, flipped classrooms with asynchronous lectures and material, pre-class assessments, and in-class assignments.

Projects In tandem with my research interest, hands-on tools useful for researchers are also helpful for students. For example, I adapted a research tool into a class project—its visualization capabilities were beneficial for students to understand the behavior of sampling-based planning algorithms, robot kinematics, and abstract representations in the configuration space (shown in Fig. 1). This project was given in the *Algorithmic Robotics* course taught at Rice University; students were asked to flex their creativity to design robots and environments to get specific behavior out of the planning algorithms. Students from all disciplines (as the class teaches computer

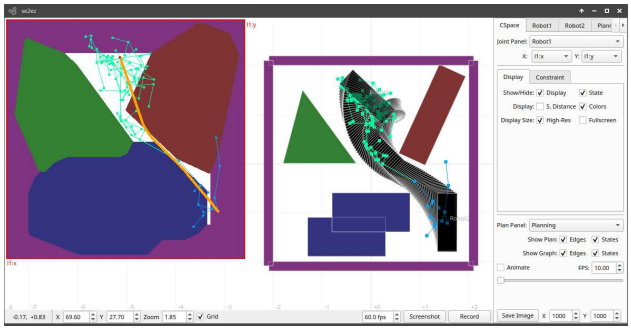

Fig. 1. SE(2)EZ, a tool I developed to visualize kinematics, planners, and configuration space. A plan in workspace and a slice of configuration space, along with planning tree, is visualized.

science, electrical, and mechanical engineering students) described this project as "very vivid and fun!" and "easy to use and very helpful!"—I derived great satisfaction from turning these intimidating concepts into something entertaining. I plan to continue from this successful test and develop projects that enable creative solutions, require visualizing results, and are specific in their goals.

Communication As mentioned above, communication skills are essential—presenting research (or any topic) is critical for students to have successful careers. I always focus heavily on writing, graphic design, and story-telling techniques—I served as a consultant at Rice's writing center, which helped me focus my ability to give helpful critique and feedback to students and apply these skills to my students personally. Different students are receptive to different styles of presentation critique, and it is critical to be careful given how personal it can feel; being positive and constructive is essential, as well as providing detailed reasons for why I made specific suggestions. I use my talks as examples to help my students understand the principles of presentation, how to tell a story, what I felt I did poorly, and emphasize the key points for their audience—I've been awarded multiple times for having the best seminar presentation during my PH.D. It is a point of pride for me when my student referred to me as a source of inspiration for the design of his presentation and paper. Continuing this vein, I want to teach short courses or workshops on proper presentation techniques, slide design, and graphic design.

Mentorship I consistently emphasize the importance of open communication with my mentees, ensuring that I value their questions and encourage them to seek clarification rather than struggle in silence. It is crucial to provide unwavering support in their journey, helping them develop essential skills like creating concise surveys and comprehensively exploring the existing literature, as well as setting an example through the thoroughness of my work. I have been a direct mentor to 4 graduate and 5 undergraduate students, one of whom was from Rice's Summer Undergraduate Research Fellowship[1] and received an award for excellence in poster presentation. I have also mentored visiting students from Colombia[2] and Serbia[3]; I firmly believe in sharing knowledge beyond my immediate academic community and can adapt to people with different backgrounds and skills successfully.

§ Future Teaching

I am confident in teaching courses in four areas: algorithms (*e.g.*, AI, data structures, introductory algorithms), systems (*e.g.*, operating systems), applied mathematics (*e.g.*, numerical methods, optimization), and robotics (*e.g.*, motion planning, more practical topics like ROS), as well as introductory computer science courses. Whatever the course, I will provide students with assignments and projects that are open to creativity and that reward the further investment of the student and build their intuition.

I also want to teach research-focused courses that delve deeper into modern threads of the literature, such as task and motion planning, manipulation planning, and more, with the goal of the class to expose students to the forefront of the field. These courses will develop their skills as independent researchers by teaching them how to read and understand the literature and also give practical experience in using modern approaches on real systems—seeing algorithms and methods make the actual system move is always inspiring and concretizes things for the student. I also plan to develop and support open-source software and tools to support these advanced topics. Moreover, robotics, machine learning, and AI have come sharply into focus as significant ethical and societal concerns. Students must understand their position as technologists for the future, and I want to include these topics in what I teach.

I aim to become a teacher who inspires students to become self-propelled learners by encouraging critical thinking through literature discussion, creative team projects, and crafting exemplary presentations. I am confident I can contribute positively to any teaching environment, and I hope that by interacting with my students, I will also continue to grow as an educator and become a valued mentor.

[1] https://ouri.rice.edu/research-programs/surf
[2] https://www.100kstrongamericas.org/
[3] https://sacch.org/cssap/