

# Teaching Statement

In a world defined by interconnected challenges, my mission as an educator in the *Davidson School of Chemical Engineering at Purdue University* is to cultivate **systems thinking** in students, fostering an understanding of interdependencies, feedback loops, and emergent behaviors across diverse domains. I am committed to equipping students with **transferable skills** to tackle open-ended problems with adaptability, integrative reasoning, and confidence. Through a student-centered, active learning environment, I will design collaborative, real-world projects that bridge course concepts and highlight their societal relevance. *Drawing on my experience co-instructing a machine learning course at Princeton University, mentoring diverse scholars, and contributing to a textbook*, I will continuously refine my teaching approach to empower students to address complex challenges, driving meaningful societal impact.

## 1. Teaching and Mentoring Experience

**Unconventional Beginnings as an Online Tutor.** My teaching journey began during my undergraduate years, when I created online courses in physical chemistry to clarify complex concepts like chemical potential and fugacity. Fueled by a passion for making challenging topics accessible, I designed engaging video tutorials and practice problems that garnered thousands of views. This initiative evolved into direct tutoring, supporting 20 students in exam preparation. To refine my approach, I attended workshops, including one on *systems thinking*, which shaped my pedagogy. I restructured lessons to emphasize conceptual connections, such as linking thermodynamics to materials design to illustrate how chemical potential drives phase behavior. A student remarked, “*Your method of connecting ideas reshaped how I study across all courses!*” This experience solidified my commitment to innovative teaching that guides students through complex concepts.

**Systems Thinking in Ph.D. and Postdoctoral Teaching.** As a teaching assistant for *Introduction to Chemical Process Modeling* and *Statistics for Chemical Engineers* at the University of Wisconsin-Madison, I applied systems thinking to connect abstract concepts to applications in materials science, energy, and sustainability. I designed problem sets integrating multiple concepts within practical scenarios, promoting critical analysis. For example, I developed a project where students analyzed mixed plastic infrared spectra by standardizing data, removing outliers, building a classification algorithm, and quantifying uncertainty, while exploring model interpretability to address real-world materials engineering challenges. To enhance engagement, I created a course website with Python-based coding examples, statistical method explanations, and tailored practice problems, increasing student participation and fostering a deeper understanding of interconnected concepts.

During my postdoctoral role at Princeton University, I co-taught *Machine Learning in Chemical Science and Engineering*, delivering lectures and designing assignments for a diverse cohort of over 40 students. I tailored the curriculum to teach practical machine learning skills, such as predicting molecular properties and optimizing materials. To promote inclusivity, I implemented a class Slack channel for open communication and accessible support. By incorporating student feedback, I offered whiteboard-based code reviews and workshops on Python libraries like `scikit-learn`, earning positive feedback for clarity and relevance.

**Contributions to a Chemical Engineering Textbook.** I contributed to the textbook *Statistics for Chemical Engineers* by Prof. Victor Zavala, developing exercises and solution code for three data science chapters. Using real research datasets, I created exercises on statistical modeling of sensor signals, machine learning for plastic waste sorting, and chemoresponsive liquid crystal analysis. For example, one exercise guided students to transform liquid crystal optical response data, demonstrating how different representations (e.g., matrix or manifold) reveal insights into material behavior. These efforts fostered skills in data-driven decision-making and sustainable processing, reinforcing my dedication to equipping engineers with critical data-driven skills.

**Mentoring a Diverse Group of Junior Scholars.** During my Ph.D. and postdoctoral studies, I mentored 11 Ph.D., undergraduate, and high school students from diverse backgrounds, creating a supportive environment to build technical and professional confidence. At the University of Wisconsin-Madison, I guided a first-generation international student skilled in coding but hesitant in public speaking. I designed programming projects, such

as air quality forecasting using Python, and provided coaching through mock presentations, leading to a successful presentation at the national ACS meeting and a pharmaceutical company internship. At Princeton, I mentored an undergraduate passionate about molecular simulation and data science, developing a research plan integrating molecular modeling with machine learning to study soft material properties, and assisted with graduate school applications. This resulted in acceptances to four top-tier programs, with the student noting, “*Thank you for detailed explanations and constant availability. Your support with applications was invaluable.*” These experiences strengthened my commitment to personalized mentorship that fosters academic and personal growth in an inclusive environment.

## 2. Teaching Interests and Mentoring Plans

**Teaching Qualifications and Interests.** I am qualified to teach courses broadly related to statistics, machine learning, thermodynamics, molecular modeling, and process design at both undergraduate and graduate levels. Specifically, I am ready to teach *Design And Analysis Of Processing Systems* (CHE 45000), *Process Dynamics And Control* (CHE 45600), *Introductory Chemical Engineering Thermodynamics* (CHE 21100), and *Statistical Modeling And Quality Enhancement* (CHE 32000), and with additional preparation, I am equipped to teach *Chemical Engineering Laboratory* (CHE 43500) and *Chemistry and Engineering of High Polymers* (CHE 44200).

**Enhancing the Core Curriculum with Machine Learning.** I aim to contribute to the undergraduate and graduate curricula by integrating concise machine learning modules into core courses, such as *Introductory Chemical Engineering Thermodynamics* (CHE 21100) and *Process Dynamics And Control* (CHE 45600). These modules will blend physics-informed computational methods with fundamental chemical engineering principles to equip students with practical tools for addressing real-world challenges. For example, in *Introductory Chemical Engineering Thermodynamics* (CHE 21100), students will leverage neural networks and conservation laws to predict multicomponent phase coexistence. Similarly, in *Process Dynamics And Control* (CHE 45600), students will explore machine learning techniques to develop digital twins, enabling real-time simulation and optimization of chemical processes. By embedding these modules, I aim to empower students to bridge traditional chemical engineering with cutting-edge computational approaches, fostering critical thinking and innovative problem-solving skills for industry and research applications.

**Developing a Machine Learning Elective.** I plan to develop a new elective course, *Machine Learning for Chemical Engineering*, to expand computational course offerings in the department. The course will guide students through a comprehensive pipeline—from dataset curation and feature engineering to model development and validation—using tools such as `PyTorch` and `scikit-learn`. Students will explore domain-specific applications, including predicting phase behavior in polymeric blends, characterizing infrared spectra for mixed plastic waste, and analyzing microscopy images for biomaterials. Through hands-on group projects, students will apply machine learning to research topics of their choice or established online datasets, gaining deep insights into applications relevant to chemical engineering, materials science, and bioengineering. To promote inclusivity, the course will feature tiered assignments to accommodate diverse skill levels, virtual office hours for equitable access to support, and collaborative projects to foster teamwork, empowering students to confidently apply machine learning in their own research.

**Establishing Inclusive Mentorship.** Within my research group, I will establish a mentorship program to involve diverse undergraduate and high school students in summer research internships focused on computational chemical engineering. I plan to collaborate with the *Boilermaker Opportunity Program Plus* at Purdue University to provide structured guidance that fosters technical skills and career development through clear milestones. Through targeted outreach, such as STEM workshops at regional high schools in partnership with the *Seminar for Top Engineering Prospects (STEP)* and the *Purdue Science K-12 Outreach*, I will engage students in exploring data-driven applications in soft materials, promoting an inclusive environment that supports academic and professional growth.