

Acknowledgments

First and foremost, I want to thank my PhD advisor, Professor Scott Moura. What Scott taught me went far beyond how to carry out a project or write a paper, and even beyond research style and taste. What mattered most to me was something he never told me but demonstrated every day: being a good researcher begins, and ultimately ends, with being a good person. I have been fortunate to know many professors who are good people. In my mind, Scott stands out even among them.

For nearly five years, I learned how to do research under Scott. The notes from our one-on-one meetings alone now run to more than 170 pages. He would occasionally hurry in a few minutes late from another commitment. Standing outside his office, I would hear a ring of keys jingling down the hallway and know he was coming. I do not remember him ever missing a single meeting. Many people know that his Google Calendar is almost fully public: if he says he will be there, he will; if he has no time, he tells you directly. He answers our emails and Slack messages, but rarely drops a message asking us to do something at the last minute. These may seem like small things. But in the built-in asymmetry of an advisor-student relationship, reliability and respect for boundaries are quiet forms of self-discipline and kindness.

Scott once sent me his dissertation for reference. In the acknowledgments, he wrote that his advisor had described him, when he first arrived, as “as green as green can be.” With me, equally green, Scott did almost the opposite. When I started my first project, I had never studied optimization theory or even used Gurobi. One evening I learned how to linearize the product of two binary variables; the next day I showed it to him, and from then on he would even introduce me to others as an “expert in discrete optimization.” He liked the GIF I made of the RoboChargers moving around and charging vehicles. While I was still nervously reading from a script to explain the animation, he jumped in front of the screen and traced the moving dot with his hand so the audience would follow it. I am a fairly proud person. Once, when Scott gave me private feedback after a presentation, he said, “Let’s skip the good stuff,” and went straight to what I could improve. I was oddly pleased. It felt as though, in Scott’s eyes, I had finally grown up. Still, I know that his generous praise mattered. It was like the small stones we collect as children: we may no longer need them once we grow up, but that does not mean they did not accompany us as we grew, happily and well.

No PhD is entirely smooth. I went through a fairly long stretch with little output and, worse, little sense of what I should produce. I am sure Scott noticed. But he never made it a special intervention, and never sat me down to warn that time was running out. We kept meeting as usual, and he kept engaging with every question and idea I brought him, large or small, on topic or not. But I do remember once, as we were discussing a talk he was preparing for the MIT Mobility Forum, he said, “As I was putting our work together, I realized that for someone as smart and productive as you, we should have had more work

to share.” Another time, I asked what I should change during my postdoc. He paused and thought for a moment, then said, “If I could do it again, I think I should have told you sooner which ideas not to pursue, though they were all interesting.” Neither time did he turn the remark into a lesson. I honestly do not remember whether, during that period, I might have preferred Scott to push me harder to finish a project and submit a paper. Looking back now, I realize how lucky I was.

I was equally fortunate to receive incisive guidance from my committee at each major stage of the PhD.

Professor Marta González is always warm, energetic, and direct. After one particularly blunt critique, she laughed and said she spoke that way because she considered herself my “academic aunt”: since I was at Berkeley, I should aim for the very best research. Scott and Marta gave me complementary research tastes. One taught me to use elegant, rigorous algorithms to design the best possible system; the other taught me to let complex real-world data tell its own story. Together they shaped my basic view of systems engineering: seek structure, embrace complexity.

Professor Joan Walker has always cared for our department as a community, not merely as an academic unit. She cares about our studies, but even more about our sense of belonging. Intellectually, she has always pushed me toward the real world. Following her advice, I recorded every EV charging stop and experience on a 1,400-mile road trip over one week. It made me less impressed by layers of technical sophistication built on conventional but weakly examined assumptions, and more attentive to real-world problems that still demanded theorizing. After my Preliminary Exam, Scott told me that Joan said to him, “Yi should be working on more important problems.” I have carried that expectation with me ever since.

Professor Alexandre Bayen always seems impeccably dressed and in motion. He supported me twice in applying to the Master of Science in Computer Science and generously shared what he had learned from working across the two departments. I also remember that he was the first to speak during my Qualifying Exam. At his usual rapid pace, he went through my weaknesses one by one, clearly and sincerely. I remember thinking: perhaps I am going to fail. After the committee finished deliberating, Alex, seated by the door, opened it for me. He was the first to reach out his hand and say, “Congratulations!”

I am grateful to Professor Jinhua Zhao for giving me the chance to spend six months at MIT. Jinhua has the sharpest instinct for research questions of anyone I know. He can hear a problem once—whether tangled in history or technically complex—and, as I like to put it, make “three cuts across and three cuts down,” reorganizing it into a small set of distinct but connected research questions. The “sparse matrix” near the end of this dissertation is one idea I borrowed from him. Yet, honestly, the real gift of those six months at MIT was not filling, but making room. I had long stretches with no one interrupting me. I rode along the Charles River, watched snow in the courtyard outside my dorm, and, with the distance of a visitor, had space to reflect on my academic work and my life.

I also thank my master’s program advisor, Professor Stefano Schiavon. When I told him

that I planned to leave the building field and move toward systems engineering, he said to me seriously, “The best thing we can do as teachers is help students figure out who they are and what they want to become.” I thank Dr. Hui Zhang, who made every effort to help me come to Berkeley in both 2018 and 2021. Her warmth, sincerity, focus, and rigor formed my first picture of what a scholar could be. She also took care of me in countless practical ways. I also want to thank Professor Emeritus Edward Arens, now in his eighties. Many people have told me about Ed’s scholarship and vision, and about the three decades in which he helped build CBE from the ground up. I arrived too late to witness that history. What I remember is a small scene from the summer of 2018, when I was a visiting student about to leave Berkeley. I went to his office to ask for a photo. His long table was covered with devices and tools of different sizes. “Boy, wait a second,” he said, as he finished screwing in a light bulb he needed for an experiment.

During these five years, the route I flew most often was SFO-BOS. Once, taking off from Boston, I was reading Virginia Woolf’s *To the Lighthouse*. As the plane banked, the blue-gray roofs of the houses below flashed like fish scales, and then gave way to the open sea. I reached the passage where Mrs. Ramsay, for a moment, creates an island of beauty outside the flux of life. It made me think of these teachers:

In the midst of chaos there was shape;

This eternal passing and flowing ... was struck into stability.

I also thank Mohamad Hallal and Daniel Arnold for their guidance and trust when I served as a Graduate Student Instructor (GSI) for their courses. They helped me turn a childhood dream of standing in front of a classroom into a craft I could keep practicing and refining. The way Jonathan Shewchuk and Anant Sahai at Berkeley, and Gabriele Farina at MIT, organized their course materials and explained difficult ideas in class profoundly shaped how I think about teaching.

I thank Omar Asensio, Elaine Buckberg, and Jing Li for organizing the Economics of EV Charging Workshop for three consecutive years. Early versions of three original chapters of this dissertation were presented at the three workshops, and each received a wide range of thoughtful feedback.

It was also there that I first met my future postdoctoral advisor, Professor Le Xie. I remember the date: October 2024. In a room full of economists, he and I were two of the few engineers. A year later, again during the workshop, I sent him a cold email from an airplane. He took me to HouseZero, a zero-carbon smart building I had often heard my professors discuss in undergraduate classes, and introduced me to Na Li and Ali Malkawi, whose work I had read before. My colleagues and I once joked that there is something both “so American” and “so Chinese” about Le: the willingness to dream big, and the unity of knowledge and action (*zhixing heyi*). I look forward to spending the next few years making some concrete contribution to a more sustainable future.

I thank all the scholars and practitioners who generously shared their research insights with me, including Duncan Callaway, Raja Sengupta, Daniel Chatman, Chiwei Yan, and Manxi Wu at Berkeley; Jessika Trancik, Cathy Wu, and Bhuvan Atluri at MIT; Junjie Qin at Purdue University; and Zaid Allybokus and Wenten Zeng at TotalEnergies. I also thank the mentors at Tsinghua who have continued to follow and support my growth, including my undergraduate research advisor, Professor Bin Cao, as well as Professors Yingxin Zhu, Borong Lin, Xiaohua Liu, Da Yan, and others, and Professor Zhe Wang at the Hong Kong University of Science and Technology. I thank Ram Rajagopal and Marco Pavone at Stanford University, Jan Kleissl and Yuanyuan Shi at UC San Diego, and Henry Liu, Jiayu Zhou, and Qiaozhu Mei at the University of Michigan for their nominations and advice during my postdoctoral fellowship applications.

I want to thank the two most important collaborators of my PhD: Lunlong Li and Jingchun Wang. When the three of us first formed a team, we lived in three different time zones. What brought us together was an idea that, in hindsight, was still far from mature. We had very different backgrounds and ways of thinking, yet somehow they produced unexpected chemistry. We once worked in relay across all three time zones to meet a deadline, ending each daily meeting by scheduling the next. They were also always my first two listeners. Their puzzled faces became my feedback signal, and I would keep iterating until the explanation converged. And they repeatedly accepted my “demanding” challenges, turning abstract and complicated ideas, through iteration, into clear and elegant figures. I also thank my other collaborators during the PhD: Teng, Jiaman, Ruiting, Xinwei, Pan-Yang, Lejun, Zhihan, Linfeng, Xinyi, and Chonghe.

I thank Ruiting and Zihe, who shared an office with me at different times; Shida, who put Spring Festival couplets on our office door; and Jaewoong, who was always poking his head into our office. I also thank the rest of my eCal colleagues: Tugba, Preet, Joyce, Linda, Michael, Thibaud, Court, Sam, Bhumi, Shengyu, and many others. I thank everyone I met in CBE and JTL, and my new friends in Xie’s Lab, as well as many more friends who came from far and wide and have since scattered in every direction. I thank all 21 eMERGE speakers and everyone who took part. Thank you for keeping a small flame alive for so long. I thank the wonderful students in E7 and CE 295, who continually inspired and energized me. Nothing has made me prouder than becoming someone they could trust. I thank my old friends Hao and Yuhua for treating me to good meals every time I returned to Beijing, and Zhuofan, Xiaoyin, and Xuancheng for giving me a place to stay when I visited them. I thank Le’an for taking my parents and me on road trips to so many places, and for constantly reminding me to be sincere and brave, in research and in life.

I want to express my deepest gratitude to my parents and family, including my maternal grandmother and paternal grandfather, who did not live to see me formally become Dr. Ju. Looking back, our five years feel like a film with frames missing, the memories jumping forward. Thank you for always encouraging me to step into the world with courage and keep

moving forward, even as you worried about me from afar. My grandmother used to tell me on the phone that she watched news reports about the United States on Chinese television every day, looking at the supermarkets on screen to see whether she could spot me — while also hoping that I would stay away from those crowded, “dangerous” places.

I also owe something to the literary and historical tradition in which I grew up. During my doctoral years, I often found myself returning to these words of the Han historian Sima Qian, writing about his own youth:¹

遷生龍門，耕牧河山之陽。年十歲則誦古文。二十而南游江、淮，上會稽，探禹穴，闕九疑，浮於沅、湘；北涉汶、泗，講業齊、魯之都，觀孔子之遺風，鄉射鄒、嶧；庀困鄆、薛、彭城，過梁、楚以歸。

¹Sima Qian, *Shiji* 130, “Taishigong zixu” 太史公自序 (The Grand Historian’s Self-Preface). English rendering: Qian was born at Longmen, where he farmed and tended livestock in the sunward country between the Yellow River and the mountains. At ten, he could recite the ancient writings. At twenty, he journeyed south to the Yangtze and Huai Rivers, ascended Kuaiji, explored the Cave of Yu, looked upon Mount Jiuyi, and traveled on the Yuan and Xiang; turning north, he crossed the Wen and Si, pursued his studies in the old capitals of Qi and Lu, observed the lingering traditions of Confucius, and joined the local archery rites at Zou and Mount Yi. He met with hardship at Po, Xue, and Pengcheng, and returned by way of Liang and Chu.