

Acknowledgements

Foremost, I would like to thank my advisor and mentor Moshe Vardi for his unwavering support, constant guidance, and encouragement to pursue my ideas. He took me under his wings during the most difficult times I have faced, both academic and personal. Needless to say, there has been no looking back since. Thank you for giving me the freedom for ample exploration while also nudging me towards the right path. Most importantly, thank you for believing in me. I hope to be the advisor you have been to me to another dreamer someday.

I am fortunate to have worked with an excellent thesis committee: Rajeev Alur, Konstantinos Mamouras, and Peter Varman. Their suggestions, feedback, and thorough evaluations of this thesis have led to numerous improvements and pursuits for future work. Thanks go to Krishnendu Chatterjee and Swarat Chaudhuri, collaborators on parts of this thesis. Their feedback on my doctoral research from the very beginning has been crucial in shaping the course.

I am grateful to have found mentors in Swarat and Kedar Namjoshi. Right from building my foundations in Computer Science, Swarat has helped me navigate through the bigger career decisions. Incidentally, it was upon his advice that I took up the internship offer from Bell Labs to work with Kedar, which has turned out to be one of my best collaborative experiences. The daily, intense brainstorming sessions with Kedar were tiring yet immensely fulfilling. That said, a respite from the sweltering Houston weather takes the cherry on the cake for both of my summers at Bell Labs.

During the Ph.D., I had the opportunity to collaborate with several brilliant researchers from around the globe: Rajeev Alur, Shaull Almagor, Swarat Chaudhuri, Krishnendu Chatterjee, Dror Fried, Yong Li, Kuldeep Meel, Kedar Namjoshi, Yaniv

Sa'ar, Lucas Tabajara, Moshe Vardi, Andrew Wells. I am, perhaps, most partial to collaborations with my peers at Rice - Yong Li and Lucas Tabajara - where discussions would begin in our offices but end in Valhalla (*Viva Valhalla!*).

The fact that there is a large overlap between my friends and (extended) research group LAPIS is a testament to how instrumental they have been in this journey. Dror Fried has been so much more than a friend to me. I am eternally grateful to his wife Sagit, him, and their three little kids (not so little anymore) for giving me an abode in their hearts. In a discipline that suffers from a dearth of women, I have been very lucky to have Afsaneh Rahbar and Shufang Zhu by my side. These women have truly made my successes and failures their own, as we continue to inspire each other with our "*We can do it*" chant. Because Aditya and I share a history of borrowing each other's sentences, I'll paraphrase him here - Thank you to Yong Li and Aditya Shrotri for keeping me company during the late nights and weekends in the office, the car rides home, coffee breaks, lunches, and dinners. I am humbled to share a special siblings-like bond with Vu Phan. I have relied on Jeffery Dudek, Antonio Di Stasio, my officemate Lucas Tabajara, Kevin Smith, Abhinav Verma, and Zhiwei Zhang for cerebral discussions and simple reasons for laughter.

My life outside the colorful walls of Duncan Hall would have been so lack-luster had it not been for the friendships of Priyadarsini (Priya) Dasari, Vaideesh Logan, Rakesh Malladi, Sushma Sri Pamulapati, and the *folks@IMT*. In addition to keeping our apartment in pristine condition, my flatmate Priya has made me a better cook, and counseled me through personal and work-related turmoils; all of this over a steaming cup of *chai*. The *folks@IMT* have been a source of strength in the times of social-distancing/isolation during the ongoing Covid-19 pandemic. In these uncertain times, their small gestures have gone a long way to ease the anxiety around the global upheaval. Thank you all for making Houston my home.

My friends from undergraduate and school have been available in moments of despair and self-doubt. I cannot thank Saheli, Siddharth, Siddhesh, and Visu enough

for having been just a phone call away for almost a decade.

Of all the things I had imagined graduate school would entail, meeting the love of my life was not on the agenda. Yet, here we are. Whether we are ten centimeters or ten thousand miles apart, Kuldeep can always make me smile. Thank you, *ghano saaro*, for brightening my day, every day.

Finally but most importantly, I owe my deepest gratitude to my parents, Anita Bansal and Rajeev Kumar, and brother Sanchit Bansal. Right since I can remember, they filled me with curiosity, creativity, and imagination, and have shunned societal norms so that I could run, stumble, and chase after my dreams. Their love and support have been unconditional. It is to them that I dedicate this thesis.

Yet there is a pit in my stomach. We lost my mother, Anita, four years ago. She was my loudest champion and strictest critic. Never had I imagined crossing this milestone without her cheering from the stands. But I am not upset, because I know that wherever she is, she is very proud of her *guriya*. *We miss you every day, Mummy!*