As transistors are approaching a physical limit on miniaturization, it will be necessary to use innovative computer architectures to continue to improve the processing power of machines. Biologically-inspired parallel architectures will be the key to unlocking a wide variety of tomorrow's technologies, such as radiation-tolerant deep space computers and low-power rapid image and audio processors. Today's technology provides us with the necessary tools for building and simulating large neural networks to gain insight on the hidden layers as well as understand how to effectively encode and process information. Although it has been demonstrated with custom FPGA systems that massively parallel neural networks are superior to traditional computer architectures such as GPGPUs and CPUs for certain tasks, massively scalable systems have yet to been built successfully. I have worked with Altera FPGAs throughout my undergraduate career undergraduate on top of real-world industry experience in designing, testing, and building electronic hardware and low-level software. By introducing novel ways of simulating the thermodynamics and behavior of neurons on Altera hardware in the Computer Laboratory, it will be possible to solve the scalability issue. This increase in scalability will inevitably cause simulations to run into the memory wall, as fetching data out of RAM will become the bottleneck rather than the processing speed of the network. Therefore, it would be advantageous to have a large input layer to the neural network that comes from a device such as a silicon retina, rather than RAM. The entire data vector from this kind of sensor would be readily available to the network immediately, similar to how the brain processes sensory input, eliminating the issue of the memory wall. I would study integrating alternative data vector sources to the currently existing hardware for the BIMPA project.

My largest non-academic activity as an undergraduate has been the University of Florida Juggling Club. While the organization has taught me marketable skills, such as performing on stage and international networking, it has also been an outlet for abstracting my knowledge of mathematics and physics. Being an engineer, I am perpetually curious about the equations behind a system. "Siteswap" is a set of rules that dictate and describe juggling, and new patterns can be discovered on paper before they are ever imagined in real life. Furthermore, trajectory equations can be applied to juggling patterns to uncover surprising phenomena, such as how there are instances when a five-club pattern has all clobs anti-parallel with one another. My passion for engineering is not bounded by lab and academic projects, but is a tool that I use in my daily life.

Although studying Electrical Engineering as an undergraduate has given me a deep understanding of modern electronics at all scales, from the solid state physics of devices to the architecture of global networks, I believe that neuromorphic engineering will be a huge player in the future of computing. The digital design and software concepts I learned as an undergraduate will not necessarily translate when developing on neuromorphic systems. My studies in the University of Cambridge’s Department of Engineering would give me the most rigorous understanding of neuromorphic technology and allow me to work ahead of the trajectory of the field, rather than behind it. As stated by the computer pioneer, Alan Kay, "those who are serious about software build their own hardware." Software can only be optimized when the designer has a profound understanding of the underlying hardware and architecture. Ultimately, I hope to leverage neuromorphic systems to solve the two problems that are most important to me; advanced personalized education, as it is one of the Grand Engineering Challenges of the 21st century, and radiation-resistant computing for deep space applications, as spending time working at SpaceX has only galvanized me in my goal of making humans a multiplanetary species.

"Joggling" is the sport of running and juggling simultaneously, and it has become an inseparable part of my identity. Not only has it been a way of challenging my body physically and mentally, it has been a vehicle for targeting specific issues that are important to me. When I first heard about Rhotia Valley, Tanzania, my engineering side was inspired by the community’s mission to incorporate One-Laptop-Per-Child devices into the primary school, as it applies low-cost, robust technology to proliferate education and bring more of the world into the 21st century. I successfully broke two joggling world records to raise support and donations for this project, and although it was satisfying to break 22-year-old records, the partnership with the community in Rhotia Valley made the feat truly fulfilling.

One year after breaking these records, I travelled to Japan and met victims of the Tohoku Earthquake in Minamisanriku. The most memorable part of the trip was when one of the elder men in the town told us, “when you return to the big cities in America, do not forget about us. The media forgot about us but we are still struggling.” This moment galvanized me into taking action while conducting summer research on nanomaterials at Rice University. I decided to attempt a third record to raise awareness and support for this Japanese community and spent countless hours training and assembling a team of coaches, media, and supporters. Though I was successful in breaking the record and raising support, this journey was sprinkled with unusual challenges, such as being invited to do a live interview for a Minnesota radio station whose premise turned out to be humiliating their guests. The experience of candidly responding to their malicious banter and demeaning of the situation in Minamisanriku with composure and eloquence was a turning point in my personal growth. It was the most piercing antagonism I have ever received in my decade-long joggling career, but taught me the importance of strong commitment and leadership.

My passion for joggling is a reflection of my passion for engineering. Although my research and industry experience has been an eclectic mix of nanomaterials, space electronics, and photonics, these experiences have driven me towards my true interests. They have instilled me with the mindset to have a creative and interdisciplinary approach to neuromorphic engineering, which will be necessary as the paradigm of computing changes. Graduating Summa Cum Laude in Electrical Engineering has allowed me to master the basic tools to build complex electronic systems, which I could apply to the BIMPA project in the Computer Laboratory at the University of Cambridge, allowing me to help pave the future for the next generation of computing. Ultimately, I hope this new technology will enable my two long-term goals; making humans a multiplanetary species and advancing personalized education. Although I have already taken steps in working towards these goals, through my experience working at SpaceX and my partnership with Rhotia Valley, there is still much work to be done.