As transistors are approaching a physical limit on miniaturization, it will be necessary to use alternative computer architectures to continue to improve the processing power of machines. I believe that biologically inspired massive parallel architectures will be the key to unlocking a wide variety of tomorrow's technologies, such as radiation-tolerant deep space computers, low-power rapid image and audio processors, and advanced personalized education. 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, massively scalable systems have yet to been built successfully. This is because the neuroscience community focuses on building the tools for making small networks in order to bring studies through the proof-of-concept stage. Because I have gained significant experience using Altera FPGAs as an undergraduate, as well as real-world industry experience in designing, testing, and building electronic hardware and low-level software. By introducing novel innovative ways of simulating the thermodynamics of neurons on FPGAs, it may 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 vector of data 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.

"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, but it has allowed me to begin tackling one of my long term goals; providing personalized education globally. Though training and setting three Guinness World Records in the sport proved to be difficult on its own, using the publicity to raise support for Rhotia Valley, Tanzania was what made the feats truly fulfilling. The primary school in this village was trying to introduce One-Laptop-Per-Child computers into the curriculum to give young students the opportunity to use technology to pursue their interests and become members of the 21st century. Furthermore, this progressive application of low-power, sophisticated electronics appealed to my background as an Electrical Engineer and inspired me to get involved.

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, regardless of whether traditional CPUs are still used or not. Therefore, the digital design and software concepts I learned as an undergraduate will not necessarily translate well when developing on neuromorphic systems. My studies in the Department of Engineering will 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," because it is only possible to build fully optimized software 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 in deep space, as spending time working at SpaceX has only galvanized me in my goal of making humans a multiplanetary species.

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