Statement of Purpose
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In the Fall of 2014, I sought out advice regarding graduate studies from a PhD student named Jimmy Ba who was under the supervision of Professor Brendan Frey. Prior to meeting with Jimmy, I did not know of Deep Learning, or the breakthroughs that have been made through its use. Jimmy inspired me when he told me about his recent papers and his work at Google DeepMind. I was driven to join Jimmy and take part in shaping the Artificial Intelligence revolution. Since then, I have been eager to tackle research problems in Deep Learning as a career.

During my first research experience in May 2014, I worked on extending and implementing a constraint propagation algorithm from a paper written by Pierre Schaus for Professor Christopher Beck's research in Constraint Satisfaction Problems, a branch of Artificial Intelligence (AI). Schaus's paper contained unproven mathematical claims. Corner cases were not directly addressed by the author, which made it difficult for a robust implementation of the algorithm. I stopped coding, and instead spent two full days mathematically validating the paper's claims. I discovered a contradiction for a prominent claim. Schaus's proposed algorithm relied on the continuity property of a key function. However, I mathematically proved that this function may be piecewise discontinuous, meaning that his suggested algorithm in the literature is unsound. I emailed him to confirm my findings and later published a paper in the academic journal *Constraints*, proposing a modification to his constraint propagation algorithm.

The excitement of applying fundamental theories to real life has always motivated me. Back in 2013, a survey by the First Year Engineering Chair, Professor Micah Stickel indicated that first-year engineering students did not understand how to apply their knowledge to real life. To address this, I co-founded a club, called Multidisciplinary Analytical Kinesthetic Education (MAKE). This club allows upper-year engineering students to teach club members how to kinesthetically apply their first-year engineering knowledge by understanding and building working prototypes. I discovered my love for teaching when I gave lectures to approximately 30 club members to help them practice their first-year calculus knowledge in programming ray tracers and robot controllers. To illustrate, I explained how parametric functions, polar coordinates, implicit equations and vectors were used in Ray Tracers and demonstrated the use of derivatives, integrals and matrices in controlling a robot simulator.

I enjoy transforming innovative ideas into concrete applications. Piazza's single day hackathon for education was held at Silicon Valley in the Summer of 2015. This was where I pitched and implemented my original idea of a Lecture Recording device in Android that allows confused students to catch up during lectures. The device would sample audio waves of the lecture in real-time but playback these samples at a faster rate than it was being sampled. The samples would be stored and retrieved in a circular buffer in-memory, which would enable the device to run in real-time without running out of memory. This way, a lost student would be able to catch

up during the lecture itself. However, we encountered an obstacle with this approach. Playing back samples at a higher rate resulted in an increased audio pitch, which was undesirable. This was where I applied the Nyquist Sampling theorem. This meant that we could skip a number of samples while maintaining the audio quality. Thus, instead of playing back samples at a quicker rate, we skipped samples to implement the fast-forward functionality, allowing lectures to be played at an increased rate without any changes in pitch. Piazza's Chief Executive Officer, Pooja Sankar liked our prototype. We won 2nd place out of 20 teams.

My undergraduate curriculum and independent projects were inadequate for me. I faced difficulty in writing scalable programs and working with existing large code bases. To overcome this, I applied for opportunities to implement scalable fault-tolerant systems in a professional setting. In retrospect, my industry experiences at Intel, Salesforce and Google have taught me to employ test-driven development to produce efficient and robust programs that were pushed to production.

Programming abilities that I developed from my internships have aided my current research with Professor Sanja Fidler in using Machine Learning to approach Question Answering problems. I replicated their paper's algorithm for training word vectors, which ran 15 times faster while maintaining the paper's stated 47.5% accuracy for tackling Question-Answering problems. This allowed me to efficiently experiment with the various configurations of the machine learning model.

I am applying to pursue a Master's Degree in the Mechanical and Industrial Engineering at the University of Toronto. I find that my research interests are aligned with Professor Scott Sanner's work, which uses various Machine Learning techniques to approach industrial engineering problems in his Data-Driven Decision Making Lab.

During my undergraduate studies, I have developed mathematical skills, innovative thinking and ability to apply theory to solve practical problems. In addition, I have learnt to work with large code bases and implement scalable fault-tolerant systems. I feel that my academic, industry and research experience enable me to effectively contribute to future graduate research work in Mechanical and Industrial Engineering at the University of Toronto. Thank you for considering my application.