John Li: Personal Statement

It has always been a difficult philosophical question to answer, "Who am I?" If I attempt to answer this question, I will make an analogy of my life to an array of bits. Instead of restricting each bit to 1 or 0, I let the bits record every decision I make—time-sequentially starting from the moment of my birth. It is well known that any form of information can be stored in this manner; so can my life.

This array I currently have is just one realization of many branches representing all my possible life paths. Life is chaotic; a small change in one bit may influence the future bits exponentially. One may ask, which bit of decision would influence me the most? The most common answer would be the decision to pursue higher education, but this bit does not matter on my array. In every parallel universe, this Boolean bit stays constant: true. The bit I consider to most determine my life is the decision at age 15 to study calculus on my own—with only a book. As a high school freshman, I was very eager and could not wait to explore the frontier theory of physics, but I could never expect this would cause a *Butterfly Effect* to the rest of my life. This decision not only motivated me to study the equivalent of six years of math courses within three years of high school, but my early touch to calculus fundamentally rooted my intuition to visualize *limits*; this therefore made *calculus* my second nature.

This butterfly effect exponentially rolls over to the academic excellence of my undergraduate studies. While some students were just starting with calculus, I was able to enroll in upper division *Analytical Mechanics* as a freshman. Because calculus was already intuitive to me, my fast learning speed granted me the confidence to challenge a double major in Physics and Math within four years. Having this double major does not mean I am unsure about my future goal; rather, to become a theoretical physicist, it is essential to have a solid mathematical foundation, which I now have.

I can prove that this butterfly effect will further benefit my graduate studies at MIT and my further scientific career. My first step is already in advance; my maximum effort ensures every next step will still be in advance. By induction proof, my first step and my maximum effort proves I will always be in advance.

The array of bits determines my life—but not uniquely. To uniquely define my life, my full model requires an array of decisions as well as an array of decision-independent environmental influences. As the analogy of my whole life, my array of bits inevitably will come to an ending, but I do not want my significance to stop there; my significance can continue to exist in other people's lives as their environmental influence in the form of theories and technological products. For example, my life is influenced by scientists who are no longer alive. If Newton and Cauchy never invented calculus and limits, my critical decision to self-study calculus would not be possible regardless of my choice. Without Schrödinger, Maxwell, Einstein, and all other great physicists, I would not have the ability to clearly and elegantly see how the universe operates, and no modern technology would be possible. Every time I come across these names, I always feel an excitement–especially every night at 3 A.M. and I was still doing homework; I tell myself, one day I will be like them to leave some great impact to the rest of the world.

I don't need to wait until "one day"; I am already making some impact on the world. My passion in Physics drove me to co-found the Society of Physics Students at UC Merced, and I served as the first president. This provided a club to discuss and exchange ideas for undergraduate students like myself, who have a passion for physics. I have hosted several LaTeX and Matlab workshops for club members, and I often present my research in the club and encourage other members to present their research because these

are some common skills we need regardless of specific discipline. These presentations also helped other students broaden their view of physics and inspired their research interests.

The ultimate purpose of science is to benefit the world and this has inspired me to be involved in non-scientific activities that help the world. I was very fortunate to receive $10,000 in funding from the Strauss Foundation. With that funding I established an international non-profit organization, magic4hope.org, to help educate and encourage disadvantaged children. I led a small team of volunteers spending one month *educating*, entertaining, and encouraging more than one hundred earthquake orphans, disabled children and disadvantaged children. My organization made the news in the Sacramento Bee, the Modesto Bee, and the front page of the Merced Sun Star newspaper. As the founder of magic4hope.org, it is also my honor to have been named the Good Will Ambassador of the City of Merced by Mayor Thurston.

I have the will, I have good ideas, and most importantly I have the action to improve the world—with necessary funding. Thus, I believe I am an ideal candidate to receive an NSF fellowship.

Assume I receive an NSF fellowship, I plan to use partial funding to actualize my idea of software *Natural-Math* to improve mathematical interaction for scientific, educational, and everyday purposes. It is my belief that the repetition of automatable calculation has become insignificant since the invention of computer. The value of calculation is in the non-automatable portion that requires human involvement. Although we already have powerful mathematical software like Matlab, Mathematica, and Maple, they all require a certain programming background due to their user interface. Computation speed and algorithm have improved with time, but the user interface has not kept pace. The idea of *Natural-Math* initially came from my habit of solving math in the air, where I can create, drag, cancel anything using my imagination–as long as I can keep track previous results. *Natural-Math* will be designed to transform the interaction with math in this manner and let the computer keep track of results, mathematical rules, and do the calculations. It is intended to make mathematical calculation faster and without human mistakes. Inspired by the iPad multi-touch interface, we now have the technology to make possible this natural and efficient interface using all of our ten fingers. The motion of each finger is in a 4D continuous phase space of $x, y, \dot{x}, \dot{y}$; together it made possible a maximum 40D continuous phase space information input (to achieve this full effect, the screen requires the technology to distinguish different fingers). Although this software is designed for advance scientific purpose, its interface is equivalent to a game–and can be easily modified specifically for children. By promoting this software in schools, it can increase the mathematical interest of children at early ages. I hope to see that in the next generation math will no longer be seen as a common monster–in contrast to now. On the higher level, it makes scientific derivation faster and therefore more productive–which eventually benefits me as a theoretical physicist. I was honored to be selected by the Dean of the School of Natural Science to present this idea and some feasible algorithms at the 10th annual Founders Day event of UC Merced. All my audience was excited about the prospect of this software coming true.

At last, as a first-generation, underrepresented, English as the second language, low income student, I clearly understand the additional number of obstacles I needed to overcome beyond other students. In the future when I have the financial power to do so, I plan to start a foundation to help disadvantageous students like me, just as the Strauss Foundation helped me.