My potential for success in the Ph.D. in Applied Mathematics program at the University of Colorado Boulder is defined by my research experience from my Master's thesis, foundational knowledge from 10 graduate courses, two semesters of teaching experience, and my strong ambition toward a career in math research.

My intended field of study and research is broadly applied mathematics. My interest in this branch of math stems in part from my ongoing study at the Courant Institute of Mathematical Sciences at NYU, where I am currently on track to earn a Master of Science in Mathematics in May 2016. I will be graduating this intensive program after completing all requirements in just three semesters instead of the typical four that most students need.

Among other areas of applied math, I am most interested in computational mathematics. My interest in this field began this past summer when registering for fall courses at Courant. I was curious about an Advanced Topics course on Fast Analysis-Based Algorithms after reading the seminal research paper on the fast multipole method (FMM). The FMM is an algorithm that seeks to accelerate computations of pairwise interactions in a system of particles governed by mathematical physics, such as in the n-body problem. I was lacking an appropriate background in numerical analysis to take the course, but over the summer I corrected that gap by independently reading and completing problems in *Numerical Mathematics* by Quarteroni et al. This behavior is consistent with my modus operandi when I need to reconcile deficiencies in my background.

At the beginning of the course, I approached Professor Michael O'Neil about potential research projects in the area of fast algorithms. He outlined several projects applying the FMM to different scenarios requiring three dimensional cylindrical coordinates. I diligently researched each problem and ultimately found an appropriate project. Under his supervision, I am writing my Master's thesis, in which I will detail a new kernel-independent FMM algorithm applicable to scattering problems for

axisymmetric surfaces of revolution. One of the challenges of this project is that in 3D cylindrical coordinates, kernels involving the distance between sources and targets (like the 3D Laplace equation Green's function) are translation *variant* relative to the radial axis. To account for this, I am looking for systematic proportionality between translation operators at different positions in the plane since it would be very costly to precompute every possible operator. For detailed information on this project, please visit http:// victorchurchill.net/research.html. In addition to the mathematical workload, the project will involve a significant undertaking in programming in Python using the NumPy and SciPy packages to obtain numerical estimates to accompany the theory. My thesis will be completed for evaluation by May 2016. I know that my experience organizing, researching, and writing this thesis will help me conduct research during my Ph.D study.

Boulder clearly values the fast algorithms research area, making it a great mutual fit for me to continue working in this field. In particular, I would like to work with Gunnar Martinsson. He is an authority on fast methods, and his research papers, notes, and videos have been very useful to me as I continue to research for my thesis.

In addition to this research experience, my coursework in preparation for the challenge of a Ph.D. has been rigorous and broad. By Fall 2016, I will have taken 10 graduate courses forming an advanced groundwork in linear algebra, analysis, partial differential equations, complex analysis, and probability theory. These building blocks will allow me to understand and contribute to modern research topics. One particular example of this is how my coursework in probability and financial econometrics led to my interest in financial mathematics. After reading several books about the intersection of physics, probability theory, gambling, and the 2007 financial crisis, I began reading research papers about Zipf's law, the Pareto distribution, and the King effect in mathematical statistics. Pioneered by Didier Sornette, these distributions can be used to analyze time-series data and predict burst-like events in everything from earthquakes to the stock market. My extensive coursework has fostered my curiosity in myriad topics and always leads me to read and learn independent of my assigned work.

In addition to my research potential, I have teaching experience that will help me be a successful Ph.D. student. This past semester I took on the extra workload of being a recitation leader in the math department at Courant. Analogous to a teaching assistant, my duties include leading weekly 75-minute problem-solving and material review sessions for two sections of 30 Algebra and Calculus students each. I also create and grade weekly quizzes and worksheets, proctor exams, and hold office hours to help struggling students. This is an assignment that I will take on next semester as well. I know that a career in math research may very well coincide with a career in teaching, and I am very excited about and committed to both opportunities. I know that with my experience, ability, and personality, I am an effective math teacher.

Despite my current status as a serious math student, my path to a Ph.D. has not been traditional. I was an undergraduate math major at Boston College, but I wasn't always sold on a career in math research. In fact, I started in the business school and explored a major in Classics. I also minored in economics, studied abroad in Morocco for an entire year, and accepted business and law internships over math REUs. Still I was one of the top students in the math department, graduating magna cum laude and standing out amongst my peers by being inducted into the Pi Mu Epsilon National Mathematics Honor Society. After graduation I was offered several jobs and took a technical role at a software company, Code Systems Corporation.

I took advantage of my time there to upgrade my technical skills beyond my prior math- and statistics-related programming experience. I prototyped several of the company's new projects in Python and Java, and was promoted to lead systematic investigations of issues experienced by our community of over a million users. But the investigations I found myself more interested in were more theoretical like using Markov chains to study networking or linear algebra for machine learning. I knew that I was categorically more interested in solving problems in math, and so I decided to apply to graduate school. I chose the Master's program at Courant to deepen my knowledge, discover my interests, and get some serious graduate-level research experience. After finishing this rigorous program, I know I will be prepared to pursue a Ph.D.

All of my experiences and achievements thus far have been motivated by my integral objective, a career in math research. I am passionately motivated toward this. It is my sole aspiration and this Ph.D. at Boulder is the clear path to this goal.