As an undergraduate at the University of Maryland, I have been exposed to a great variety and depth of mathematics in many forms. I have at times taken the role of math student, teacher, researcher, and hobbyist, each reinforcing my passion for math in its own way. Each of these has, in its way, prepared me to graduate school.

As a math and computer science student, I consumed as much knowledge of mathematics as I could manage, which led to advanced courses such as topology, set theory, cryptography, field theory, and algorithms. Learning from each of these courses has helped me see the big picture in math and understand how important theorems can have far-reaching consequences.

When I told my advisor I was on track to learn practically all of the undergraduate math offered at Maryland, he pointed me to the Budapest Semesters in Mathematics program. It was in Budapest that I found my passion for discrete mathematics. Separate courses in combinatorics and in graph theory, supplemented with combinatorial approaches to other classes, helped me to respect the significance and elegance of the subject. Learning the techniques of Paul Erdös and Laszlo Lovász in their home land from their colleagues surely helped to solidify my appreciation. My most compelling course in Budapest was called "Conjecture and Proof," in which we were led to solve more and more interesting problems by surprising applications of previous theorems.

Back at the University of Maryland, I am currently taking three graduate courses: real analysis and abstract algebra in math, and complexity theory in computer science. These have given me a taste of what to expect from future coursework, and my success in them is encouraging to my graduate career. Particularly helpful are the assignments of complexity theory, which often require me to read through research papers and present the results to the professor.

Outside of the classroom, I have worked on a few interesting problems in my free time. A friend and I developed a nontrivial way to put a topology on the power set of an arbitrary set, by declaring sequentially closed sets to be closed. That definition, of course, required a robust meaning of convergence of a sequence of sets. After a few failed definitions, we found a very natural one which worked wonderfully. From there we were able to prove properties of the topology, characterize continuous functions, and even provide a notion of differentiation. The struggles to find the "right" definition of limits and the reward for finding it taught us a lot about what research was all about. Our ideas were vindicated when we found a paper ["The Sequential Topology on Complete Boolean Algebras" by Balcar, Glowczynski, and Jech] which defined essentially the same topology.

Having enjoyed my fix of recreational topology, I decided to work on some more structured research. Since I was undecided between a future in computer science and in math, I found some Computer Science professors who enjoy math – Bill Gasarch and Clyde Kruskal – and began working on a project with them. They had me work out the details of the three-person duel (or "truel" for short) in which three players with fixed accuracies take turns shooting at one another. I found formulas for each player's probability of winning, and verified them by programming a simulation. I also analyzed some of the quirks of the game, including when the poorest shot is the likely winner.

Dr. Gasarch introduced also his current fascination to me – Ramsey theory. He proved Van der Waerden's theorem to me, which states that any finite coloring of the natural numbers induces large monochromatic arithmetic progressions. When the topic came up in my combinatorics class in Hungary, I realized how beautiful a theorem it was, and knew that I wanted to learn more. I emailed Dr. Gasarch and asked if we could continue working together, but on this instead of the truel problem. For the past year, we have worked to write an exposition paper, covering Van der Waerden's theorem, the Hales-Jewett theorem, more general versions of each, and their applications. Working on this topic has helped me identify interesting questions to ask about a structure, along the lines of "what happens if we add this requirement?" or "could we relax this to make a more general theorem?"

Outside of combinatorics, I researched on cryptography this summer at the Johns Hopkins University Applied Physics Laboratory (APL). I worked with Jonathan Trostle to investigate Private Information Retrieval (PIR) – learning an entry from a database without revealing which entry it was. For example, suppose there is a database of compromised passwords. Searching for a particular password compromises it, making the query counterproductive. The trivial approach to PIR is to download the entire database of passwords, and searching through it for the requested entry. However, for a large database, the communication cost is too high, so more sophisticated protocols must be used. A paper by Sion ["On the Computational Practicality of Private Information Retrieval"] challenged that these protocols would never be faster than transferring an entire database, because of high computation costs. Our goal was to prove that a particular fast protocol devised by Trostle was actually secure. We managed to show that it was secure in a weak sense, but actually found an attack which could leak information. I wrote up our findings, which we submitted to cryptography conference: CT-RSA 2008. While working at APL, I spent a lot of time sorting through previous journals to find relevant work and possible approaches to the problem, as well as refereeing several papers for the AMC conference on Computer and Communications Security. Together, my time at APL gave me experience reading technical papers.

In addition to coursework and research, I made efforts to help others learn and appreciate mathematics. For the past two years I have worked as a math tutor for the Math Success program at the University of Maryland providing free math help for struggling students, often in introductory algebra, calculus, and statistics. I was also a teaching assistant for a discrete math course in the Computer Science department. Each of these has been very rewarding, but these experiences also gave me an understanding for how to teach math, determining which methods clarify a concept and which make it more confusing. Because I see the beauty of math, I feel it is my responsibility to portray that beauty to all. As I also enjoy research, my current career goal is to be a math professor at a college or university.

On the path to professorship, I am most interested in researching discrete mathematics, specifically graph theory and enumerative combinatorics. This makes San Diego, with its renowned combinatorics program, an ideal choice for my graduate study. Simply being in the same department as so many others who are passionate about the topic will surely help guide me toward important, interesting research. Since my experience has focused on both discrete math and theoretical computer science, there are any number of professors with whom I could work well. For example, I have been exposed to unavoidable graphs in my coursework in Budapest, and I think I would be happy to work with Professor Graham in that area. Failing that, the depth of the combinatorics faculty will surely give me flexibility to find other specific topics I would like to work on, and professors who can help direct me within that topic. As San Diego will help me succeed in my goals, I will also work my hardest to reflect best qualities of the Mathematics department.