I am applying for Cornell's Summer Program for Undergraduate Research (SPUR). I want to work on Analysis on Fractals because I'm fascinated by ordinary and partial differential equations and what analysis tells us about them. I'm excited to extend the theorems and intuitions I have about PDEs into fractal PDE's and seeingwhat happens. I can offer experience learning independently from books, using my knowledge to find new problems, and implementing algorithms and numerical solutions. I hope that working with atrained and experienced mathematician will help me to seek out problems and find novel interpretations. I would like assistance in finding interesting problems and guidance in how best to get results and extend them to find new interesting questions and answers. Since I'd like to attendgraduate school in mathematics, I will benefit from getting a taste of what being a math researcher is like. This program will help me find interesting problems and become a better mathematician.

I have experience with numerical complex analysis, which I hope will benefit me in research this summer. I am doing a research project with John Hubbard on finding numerical Schwartz-Christoffel mappings. I started the project because Hubbard challenged anyone in our complex analysis class to construct a conformal mapping from the upper half-plane to any domain. Currently, I'm doing independent researchwith Hubbard to determine the preimages of the polygon's vertices which will allow us to quickly and efficiently construct conformal mappings from and to any polygons we choose. I'm excited to see whether we can prove that we'll always be able to construct a conformal mapping.

Not all of my math projects start with a challenge;I usually start a project because I'm confused by an idea or want to get a picture. After I learned the extension of Newton's method to complex functions, I wanted to make my own program to draw Fatou domains and color them by attractor. I was able to get beautiful fractal images from this program. At first, I was most excited by the convergence image of f(z) = z^3 – 1, since it was one that I'd seen before. Then I tried out higher order polynomials, to see what happens when the roots weren't symmetrical. After that I tried applying the same program to draw and label the Fatou domains of f(z) = sin(z), which showed me a fractal structure which I had never seen before. This problem taught me how to use known solutions to extend a problem to get interesting results.

I've also learned a lot just from reading and then applying the concepts from books. I read Farlow's *Partial Differential Equations for Scientists and Engineers.* In his book, Farlow uses the Fourier transform to solve the heat equation. As soon as I saw the solution, I realized that I could use the same method to solve the wave equation. I was thrilled when I found the solution, and even more thrilled when I used the solution to show that though waves propagate with finite speed, there's no upper limit on how fast particles can diffuse. After using Fourier analysis analytically to solve the wave equation, I then began to explore its numerical uses. I had learned how to implement the Fast Fourier Transform in Numerical Analysis, so I set to work on a program which numerically solved arbitrary linear PDE's using the fourier transform. I used it to make videos of heat diffusing and waves spreading in one and two dimensions.

I love working on problems, and I love finding solutions and representations of solutions. I want the guidance of a professional mathematician so that I can seek out significant and interesting problems, make conjectures, and extend solutions. I want to work with a professional mathematician and get experience writing papers and giving talks about my research. I'm also excited by the prospect of interesting material to give talks about! I can offer experience finding new problems and showing how new systems behave. I'm interested in trying to extend theorems and intuition to fractal PDE's. I would be excited to work with SPUR on the Analysis on Fractals project this summer.