Department of Mathematics
University of Minnesota Duluth
Duluth, MN 55812

January 28, 2019

Dear Professor Gallian,

My name is Kenneth DeMason, and I am a third-year undergraduate at UF majoring in mathematics. I am applying to Duluth's REU and am very interested in attending. By attending this program, I would both gain valuable knowledge from a top institution, which would aid me in graduate school, and build relationships with other like-minded individuals.

I first became interested in mathematics in high school. As a student in the IB program, I wrote a mathematics paper on a way to approximate the inverse of $y=x^x$. It turned out that this was just Newton's method in disguise, but the process of finding what I thought to be my own method was fascinating. Indeed, it was a creative approach that ultimately lead me to a known solution. I continue to enjoy studying a variety of small problems and independent learning. I have competed in the Putnam (in 2018, due to conflicts in past years). Though I was unable to finish most of the problems during the allotted time, I continued to work on them during the following winter break. This past August, I began my first mathematics research project on Minimal surfaces. I investigated the catenoid, the only minimal surface of revolution. As part of this, I worked out a simple proof of this property, and another unique property of the catenoid concerning a relation between its surface area and volume (which neither my advisor nor I have seen discussed before). Afterwards, I extended a formula given by do Carmo (on the initial rate of change of surface area when a surface undergoes a normal variation) to general smooth vector fields. I enjoyed these topics because they were both questions I proposed myself and was later able to solve, and they provided an important foundation for working with surfaces. I have since transitioned to investigating Delaunay surfaces under the Ricci Flow and am currently familiarizing myself with the properties of Delaunay surfaces. I changed topics so that I can eventually make my way to the more abstract areas of differential geometry. These projects motivated me to complete the graduate analysis sequence, take a course in Curves and Surfaces, and study from do Carmo and Montiel & Ros on my own. I plan to attend graduate school to obtain a Ph. D in differential geometry or geometric analysis. Afterwards, I plan to become a professor at a distinguished university and conduct research in the same field.

Though I work in differential geometry, I also take interest in other areas of math. I read on the REU webpage that you select problems and try to match students to them. These problems are selected, as you say, from papers collected throughout the year. I cannot imagine that you set aside differential geometry problems for use at Duluth, in the off chance that you choose someone like me who enjoys that the most. In the end, one of my goals for attending this REU would be to familiarize myself more with the research process, and that can be achieved independently of the research area.
In fact, my Sets and Logic class first demonstrated this to me. My professor, Dr. King, would assign take-home exams and put us into groups. The goal was to present a challenging problem and see if your group could come up with a creative solution. These problems ended up being combinatorial or from graph theory. My professor also has a problem list (URL: http://squash.1gainesville.com/PDF/induction-SELO-jk.pdf) that we would work on throughout the semester. We had a database where we would upload proofs or critique those that others submitted, which I extensively used throughout the semester. If a proof of a problem was complete, our name would be added to the "Solved by:" list underneath the problem. I currently

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hold the record for the most problems solved (10), whose areas include combinatorics, number theory, and graph theory. Throughout the semester, I would spend anywhere from an hour to weeks on a given problem, approaching it from every angle I could. I thoroughly enjoyed those projects and feel that I would find a similar atmosphere at Duluth.

Ultimately, I believe research to be a creative process. It seems that a lot of the proofs presented in my classes are "routine" or rely on the same repeated tricks and methods. I do not think that abusing these will continue to lead to good research. I find it much more valuable to be able to generate unique, creative solutions to problems. I specifically do not write "known problems" in the last sentence because an essential part of research is being able to ask the right question. To this end, I believe this method of thinking falls in line with most participants at Duluth, given the success of its past participants.

There are a multitude of reasons why I am interested in Duluth in particular. The photos presented on your website help illustrate this point. For example, there is an album containing pictures from a biking excursion. It even looks like one of the advisors brought their family along to join in the fun! Knowing that both the students and advisors are committed to making this an enjoyable and lively experience motivated me to apply. Also, having the students live together in the same apartment building enhances the camaraderie and forms a social atmosphere conducive to not only collaborative work but also play. As shown, the students will sometimes play ultimate frisbee together on the field. I am a member of an ultimate frisbee group and can see myself enjoying a game with my fellow students in the program. There are also the weekly lunches and field trips, which help to not only bring the group closer together but also provide a nice contrast to the work-intensive research environment. Finally, I would love to attend Beatles night. Not only am I a fan of the Beatles[1], but I think it's cool to see past participants on a game show and feel connected to them knowing that they attended the same program I would.
I have also had the pleasure of talking to Colin (Defant) about his experience at Duluth. He mentioned Alpine sliding and The Malte Shoppe as some of his most memorable parts of the REU. Knowing this, it appears that the leisure side of Duluth is just as important as the research, which I love!
In addition, attending will diversify the interests of the group members. Having someone in the group whose current primary work is in differential geometry would expand the knowledge of the group, allowing for more opportunities to learn from one another. I am looking forward to learning from the unique interests and experiences of my peers in a research program such as this.

I hope for your sincerest consideration of my application. I believe I have the required background knowledge and motivation to conduct research. I am applying to, above all, a research *experience* for undergraduates. And here, I feel I will find an amazing experience!

Regards,
Kenneth DeMason

[1] My dad grew up with the Beatles and other rock groups from the 60s/70s. He always listens to them whenever he can, so I grew up with them in a way too!