

My Experience at Mathfest

by Brandon Gibson

I was the winner of the 2011-2012 Undergraduate Problem Solving Competition by the Math department at the University of Utah. As such I was granted a trip to MAA's 2012 Mathfest held in Madison, Wisconsin. I was supposed to compete in the National Problem Solving Competition, but due to health issues on the part of the competition's director, it was canceled. There were plenty of other interesting things to do.



I flew in on Wednesday and met two other Mathfest attendees at the airport. We were all headed for the University of Wisconsin at Madison's dormitories. One was a student who was presenting research, the other was a younger middle-aged man back for grad school who was also presenting his research. Though the dormitories were largely empty, many students were still there from summer semester, or already there for fall. This gave a brief glimpse into college life at this university, and opportunities to interact with the locals at various restaurants. The local cuisine was also readily available to sample.

After situating myself, I headed over to the convention center. I was able to catch the end of the Undergraduate Reception where some delicious treats were served. I had previously signed up for the Undergraduate Face-Off. This was essentially a jeopardy-styled game where 10 teams competed for points with questions based off of math. Some questions were to solve a mathematical problems (how many zeroes at the end of 2012!, the answer is 501), while others involved math vocabulary based off of hints (1. What is the thing a golfer puts his ball on? 2. What is a popular drink in England? 3. What is the English equivalent of the Greek letter Tau? The answer "T-test"), and others were references to popular culture (What is the song from a musical set in WWII Austria that talks about two numbers from an arithmetically increasing sequence? The answer "17 going on 18" from the Sound of Music. The teams were composed of 3-4 people. They had a few teams with members all from one school, and a few "Franken- teams" that were a mixture of various schools. I was on a team with students from across the US (Texas, Oklahoma, and Maryland if I remember correctly). We had 3 rounds that were jeopardy-styled. Then we had a written round where each correct response was worth a large amount of points. This was so that the winner could be announced at the Undergraduate Awards ceremony. My team was ahead on points by a large margin, such that if we didn't win any points in the written round, we still had a good chance at winning. We did get several questions right, so we already knew that we would take 1st place. It was me and a young man from Maryland who scored all the points for our team, roughly evenly divided.

Thursday I went to various talks. The undergraduate research papers were rather boring in my opinion. They were mostly simple mathematics applied to some field. I therefore decided to mostly attend the lectures meant for grads and professors. Many of these ended up being a bit above my head, but I still was able to learn some concepts from them. In particular, I remember one from Thursday that described the sorting problem and the travelling salesman problem in terms of linear algebra. In fact they were both of the form maximize $(\sigma \times w) \cdot v$. For sorting, v was any increasing sequence of the same dimension as w . w was the unsorted vector, and σ a permutation matrix. We need to find the permutation matrix that maximized the dot product, and by doing so, we knew how to permute w into an ascending sorted order. The travelling salesman problem had the same form, except that w was a matrix of costs to travel from one location to another, which made σ have to be a tensor permutation. The geometric interpretations of the two were then shown and the difference became even clearer. This offered an interesting algebraic/geometric insight into the computational differences between the travelling salesman problem (which is NP-hard or intractable) and the sorting problem (which is polynomial, or tractable). Later I attended the graduate student reception since I officially became a grad student in Fall 2012.

Friday there were more presentations of various worth. I remember a talk on the catalan numbers. Actually, it was a series of talks from several professors who researched the catalan numbers and their many applications/properties. It was interesting to see the presenters during their colleagues'

presentations. They were asking questions and getting insights, and ultimately sharing and collaborating what they had found. To me this represented exactly what a research conference should do: allow professionals to openly share and discuss their findings on a common research field. There were a few presentations specifically for undergraduates that were presented by professors. One in particular was Mathematical Intuitions. It focused on problems where it was difficult to use mathematical intuitions to find or estimate the answer, as these generally pointed to the wrong answer. We had the Undergraduate awards ceremony, which included an ice cream sundae bar. My team won for the Face-Off, as expected, and received books loaded with mathematical problems/brain teasers. At night, they had a viewing of the new "Flatland 2: Sphereland" movie. I happened to meet the grad student that I met at the airport, and discussed the first movie with him as well as speculate on the new movie. The theater was packed as we watched the movie, and many people brought their kids with them. Afterwards, we met the makers and discussed the movie and the concepts presented.

Saturday I got up early and participated in the 5k run. I had been training, but hurt my knees two weeks before, and so ceased to train in order to heal. Despite being relatively out of shape, I did fairly well. However, the others were in great shape, so overall I ranked in the last 10% or so. The competition was much steeper than what I would have expected from a math group. To make the event more math based, at the starting line they gave us a math problem to solve while running. At the finish line we were to give the answer, and if correct, get 3 minutes and 14 seconds cut from our time. The problem given was to find the prime factorization of our running number. Mine was 327 which factored into $3 \cdot 109$. Few others had 3 digit prime numbers to deal with, and instead had various powers of 2, 3 and 5 mostly. Much of the fest was wrapping up by Saturday. I went to a talk about how to establish a math circle for undergraduate students. The idea was to have weekly meetings and discuss and explore various mathematical processes and their properties. He gave examples of games of folding papers to previous fold marks, or the pouring of water from variously volumed containers. We then explored how some processes could generate any rational number, while other similar ones could get only from the cantor set. I also bought a cool math shirt from the gift shop. The National Problem Solving Contest was supposed to be Saturday, but was canceled. We were invited for next year. Some of us joked at how weird it would be competing in an undergraduate contest as grad students, or in my case as a graduated master. I instead attended presentation by the mathematical philosophers on what role pictures played in proofs. As a case study, we looked at the geometric interpretation of $1+2+3+\dots+n=n \cdot (n+1)/2$ as well as a proof for the pythagorean theorem that involves the cartesian square. It was interesting to hear some philosophical concepts and insights into the matter. Particularly since most philosophers I talk to refuse to admit even the basics such as $2+2=4$.

Eventually, I did have to leave. On the bus ride, I sat near two relatively young professors. One was a post-doc, and the other had recently received a tenure track position. They discussed the pro's and con's of their academic careers in Mathematics and ultimately encouraged me to pursue one in a field of Mathematics that I liked. It was good to network and get their insights into options and opportunities for me. I also met a local who worked for a large software company. I spoke with him and he asked me to send him my resume and ultimately have an interview for a full-time job with that company (Epic). At the airport, I met several other employees from that company and they also had good things to say about my opportunities there.

Overall, it was a really good experience. Travel, networking, cool math, awards, and souvenirs. I'll be back in 2013 to win that problem solving contest.