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# The BIG Notebook

A Newsletter of the MAA Special Interest Group for Mathematics in Business, Industry & Government

**Mathematics and Running**

Professor Adam Childers,
Roanoke College, Salem, Virginia

I like to run and I like mathematics. By almost any standard metric that makes me pretty crazy, but somehow I really enjoy these things that torture so many others around me. For me, running and mathematics go hand in hand and have become the two things that define most of my days.

One of my favorite things about both mathematics and running is their striking simplicity. The tools necessary to get started in either are modest. There is something beautiful about being able to lace up a pair of shoes or pull out a pen and paper no matter where I am or what the weather is like. It is this simplicity that has allowed both of these disciplines to remain practically unchanged over the past two thousand plus years. I know my work is not as strong as Euclid's and my runs are not as urgent as the journey of Pheidippides to Marathon, but not much has changed in our technique.

I have found that having a strong base in mathematics and running to be great preparation for most of the other things l like to do. It has been easier to pick up new sports and get back into ones that I haven't played in a while, for being in good running shape has often let me compensate for a lack of technical skills. Similarly, in academia I have been able to have meaningful conversations and opportunities for collaboration because of my experience in mathematics. It is rare that one of my friends or colleagues doesn't

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Dr. Adam Childers, on a hiking trip on Kauai in the Hawaiian islands.

**Inside:**

**Editor's Note**

It may seem strange to feature items by two academics in a single issue of the BIG newsletter. However, there is some method in this madness.

Joseph Fehribach is involved in the Mathematical Problems in Industry (MPI) workshops, a fascinating corner of our world of BIG. Each summer, the workshops set teams of young mathematicians to work on problems brought to the workshop by problem proposers from business or industry. While these teams often find solutions or new directions of attack to these problems, this is not where the value of these workshops end. The MPI workshops came to America from Europe, where they developed traditions and a community of passionate problem solvers. A week at the MPI workshops can be fun, intense, and a chance to form new friendships. For problem proposers, there may be the added bonus of a solution.

The theme of Mathematics Awareness Month this year was Mathematics and Sports. Once you start looking, the applications of mathematics to sports, and practitioners seeking solutions to sports questions using Mathematics, seem to be everywhere. Adam Childers, a project NeXt fellow at Roanoke College, has a passion for applying Mathematics to sports problems. Being a cross-country runner, his first loves are running sports. But he is interested in all sports, which becomes clear after one or two minutes talking with him. When Adam and I met while sharing a table at the MathFest Opening Banquet in Pittsburgh last month, I mentioned that two of my cousins were involved in the sport of Ride and Tie. This involves a team of two athletes, one on horseback and one on foot. The idea is for the teammates to alternate running and riding; the pair of team-mates across the line first wins. Can Mathematics be applied to this sport? We might find out soon, because Adam has one of his undergraduates analyzing winning strategies.

have an interesting math problem that is a part of the work that they are doing.

The research that I do is in the design of experiments for continuous nonlinear dynamical system. One of the areas that I focus on is trying to make sense out of small data sets by combining mathematical and statistical theory. In addition to this research, I like to investigate the connections between mathematics, statistics, and sports. In fall semester 2010, I am teaching an inquiry based introductory statistics course with a sports industry theme.

When I am actively doing mathematics research and training for an event, I feel healthy and satisfied. These two activities seem to form a good balance in my life. Mathematics keeps my mind stimulated, and running gets rid of enough energy to sit down and do some work. On most of my runs I find myself working through problems I have been thinking about during the day, and often times I develop new solutions or additional problems. I haven't found another activity that clears my head as fast as going for a run.

Part of me hates to admit it, but I believe a big part of why I became interested in running and mathematics was because they both came naturally to me. In high school I took math courses and ran cross country/ track, but I don't think you could have gotten me to admit those were two of my defining characteristics. I thought of myself in more general terms as a scientist and an athlete.

My introduction into marathon running and graduate school were much the same. I entered both endeavors with excitement while completely underestimating the difficulty of the tasks. At 17, with three solid years of cross country experience, I thought that the most logical next step was to go from the standard 3.1 mile cross country race to the full 26.2 mile marathon. Why not sign up to run the Mayor's Midnight Sun Mara-

thon in Anchorage, AK as a member of the Leukemia Team in Training? Going into the event my longest run was close to a half marathon. A marathon is only twice that far, right? All the confidence I had about the ease of running the race began to shatter around the half-way point as my body began to feel my miscalculation.

Similarly, in the fall of 2003, I entered graduate school after declaring a mathematics major during the second semester of my junior year. When I entered graduate school I did not fully grasp the meaning of a graduate degree. Actually, an understanding of the nature of mathematics research eluded me for years to come. I could see the problems I wanted to solve but not the path to get there. Again, I had jumped right in, enthusiastic but underprepared.

Since then I have completed over ten marathons and received a PhD from Virginia Tech in Mathematics. None of this was easy, but it is amazing how painful certain moments of both were at the time and how quickly I brush the bad memories away, convincing myself that they were fun. I am thankful for a selective memory. I'm done with school, but doing research is going to be a constant in my life for a long time, and I'm sure there are many more marathons in my future.

I am a mathematician and a runner. As a mathematician I'm proud to now be able to say I am a professional. In the fall of 2009 I started as an Assistant Professor at Roanoke College in Salem, VA, and quickly realized that I was exactly where I wanted to be. Working at a small liberal arts college has provided just the right combination of flexibility, student interaction, and independence. I'm not a professional runner and never will be, but I know that running has helped me become the mathematician I am.

**Noteworthy Upcoming BIG Events**
by Carla D. Martin

BIG SIGMAA invites you to present papers or discuss projects involving the application of mathematics to BIG problems at the BIG paper session at the Joint Meetings in New Orleans January 5-8, 2011. Mathematicians, including those in academia, with BIG experience are invited to submit an abstract for the paper session held the morning of January 7.

To submit an abstract for this session,visit http://www.ams.org/meetings/national/jmm/2125_intro.html and choose the MAA Session on Mathematics in Business, Industry, and Government. Abstracts are due by **September 22**.

The goal of this contributed paper session is to provide a venue for mathematicians with experiences in business, industry, and government to share projects and mathematical ideas. Anyone interested in learning about BIG practitioners, projects, and issues will find the session valuable.

BIG SIGMAA also invites you to attend our guest lecture and reception the evening of January 7. Tony DeRose, Senior Scientist and lead of the Research Group at Pixar Animation Studios, will give the guest lecture. The title of his talk is "How Mathematics is Changing Hollywood" and he will provide a behind-the-scenes look at the role that mathematics plays in the revolution using numerous examples from Pixar films.

**Mathematical Problems in Industry (MPI) Workshops**

by Joseph Fehribach
Worcester Polytechnic Institute

Many people, I suspect, think that having mathematicians heavily involved in studying problems important to industry is a relatively new thing---something that started only in the last five or ten years. This is in fact far from the case. Applied mathematicians have been interacting with various industries for many, many years. And one of the important American forums for these interactions for the past quarter century is the Mathematical Problems in Industry (MPI) workshop, held annually each June since 1986.

The MPI workshops are a part of an international collection of "study groups" which are held in many parts of the world. Each of these study groups has its own flavor, but all have the roots in what began as the Oxford Study Group with Industry (OSGI) at Oxford University in England back in 1969. Today the OSGI has become the ESGI (European Study Group with Industry), and ESGI and MPI are two of about a dozen or so study groups.

Fundamentally, MPI is a problem-solving workshop. Some of the top applied mathematicians from America, Britain, Canada and elsewhere work with scientists and engineers from industry on problems of interest to industry that seem to have some sort of novel mathematical issues. Sometimes these mathematical issues are identified before the workshop, and other times identifying them is a part of what we need to accomplish during the workshop. But in all cases, we try to achieve a clearer fundamental understanding of the industrial problem.

The workshop always begins on a Monday with presentations from the industrial problem sponsors to the entire workshop, reviewing what is already known and framing what at least initially the open questions seem to be. Then sometime on Monday afternoon, we break into working groups, one group per problem, and continue questioning the presenters and each other. On Tuesday, Wednesday and Thursday, we continue in our working groups, sorting out ideas, making calculations, trying to make sense of the issues, and in general, trying to understand. On Friday morning, there are roughly half-hour presentations by each working group summarizing all of the work that was done during the week. MPI typically ends with lunch on Friday.

Part of what makes MPI and other study groups unusual is that inside the working groups ideas for attacking the problems are welcomed from

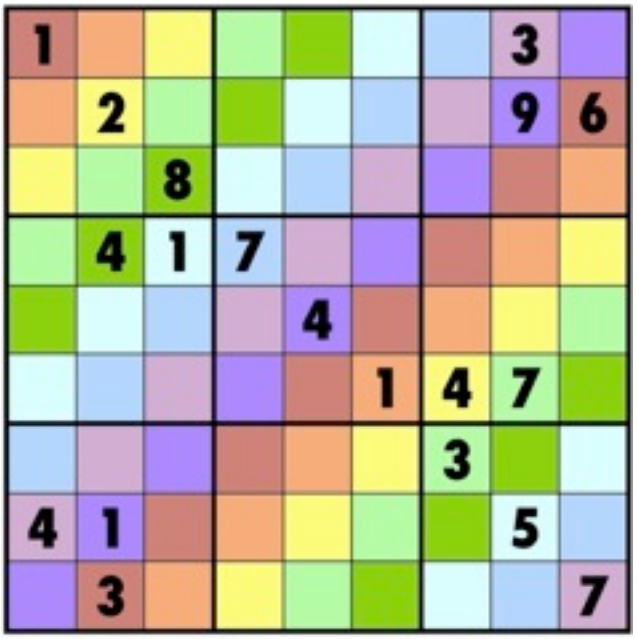
all participants -- undergraduates through senior faculty. While it is certainly true that many of the ideas for understanding the problems come from faculty and graduate students who have attended previous workshops, it is also true that useful insights have sometimes come from surprising places. I still remember when an undergraduate math major attending MPI 2003 pointed out a counterexample that showed that one claim that had been made for one problem could not be correct as it was stated.

Another unusual aspect of MPI and other study groups is the tendency for participants to say bizarre things as they try to sort out the issues. At MPI, you will have the opportunity to see a prominent mathematician or engineer say things like "If the wire is bent, does that mean it isn't straight?" or "Let's get rid of the pluses and do some actual math." The only "awards" given out during the workshop are for these "Coleman Balls", named after British sportscaster David Coleman, reputed for saying "unintentionally funny" things. The awards occur at the closing of the workshop around noon on Friday.

Today, part of the challenge facing industry is to prosper as technology changes rapidly. Meeting this challenge requires improving productivity, resource management, and innovation, both to refine existing products and processes and to create new ones. The MPI workshop offers industry an opportunity to examine issues at a basic, fundamental level using new sets of eyes. To be fair, we can rarely completely solve any problem in three and a half days. What comes out of MPI is not likely to be fully-functional, ready-to-market product (though patentable concepts have been developed at some workshops). But ideas coming out of MPI continue to have real impact on how industry deals with the questions that are discussed at the workshop.

**A New Sudoku Puzzle Variation from Dr. Laura Taalman (JMU Mathematics Department and brainfreezepuzzles.com)**

Rainbow Wrap Sudoku




brainfreezepuzzles.com

Rules: Fill in the grid so that each row, column, and 3x3 block contains 1–9 exactly once, and each number appears exactly once in each color.

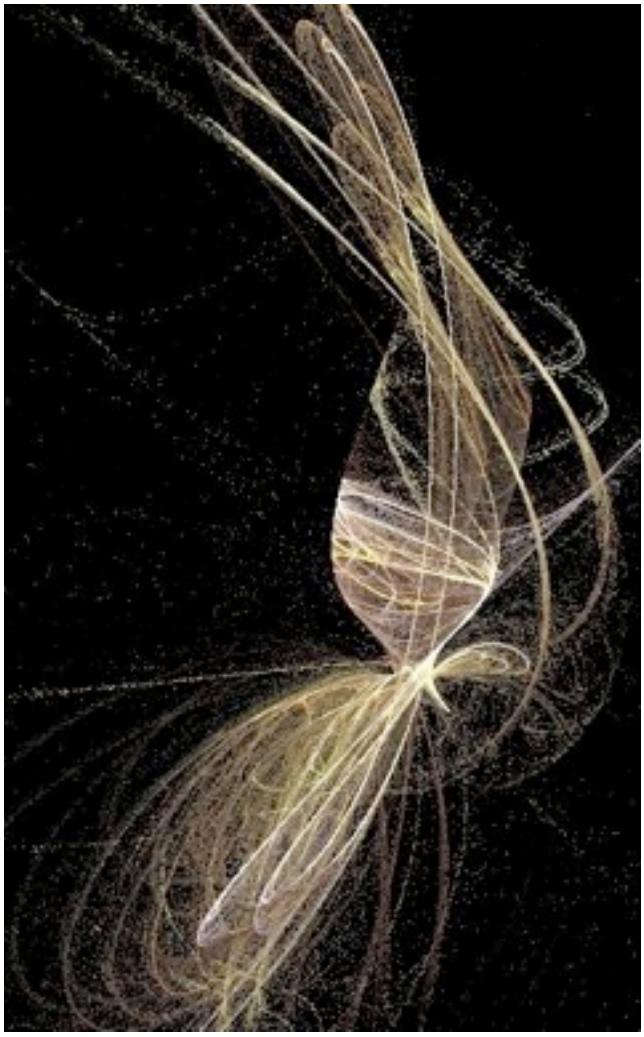
MPI began in 1986 with all but one of its annual workshops being held at RPI (Rensselaer Polytechnic Institute) until 1998 when the University of Delaware hosted its first meeting. WPI (Worcester Polytechnic Institute) joined the set of hosts in 2003, and NJIT (New Jersey Institute of Technology) will host the next MPI in June, 2011. A complete set of web pages for all the workshops since 2000 can be seen on the web at http://www.math.wpi.edu/MPI Anyone interested in more information or considering bringing a problem to a workshop can contact the author: bach@wpi.edu

**A Visit to Hood College**
by Greg Coxson

In college and graduate school, I often felt a need for a connection to the "real world," to motivate the Mathematics and Physics I was studying. I was woefully lacking in role models, too, to show me what a mathematician does. It was so bad for me at times that I remember imagining I would create my own business sign (much like those I would see outside lawyers' offices in my college town of Charlottesville, Virginia) saying "For Hire: Function Differentiator."

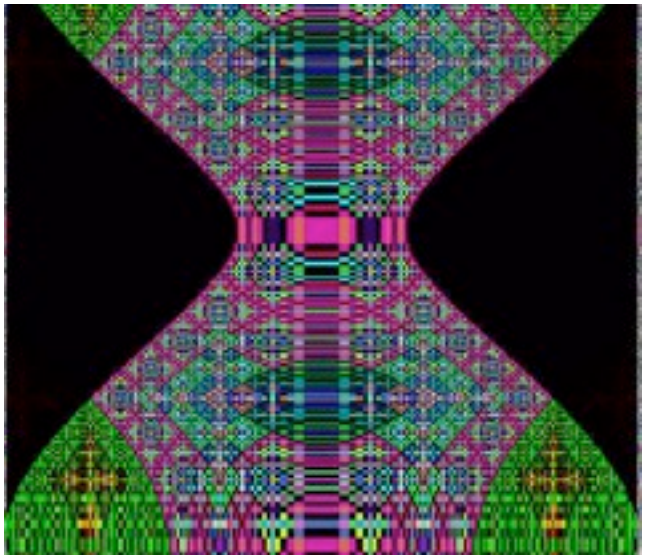
I have not forgotten those days or those feelings. So when Betty Mayfield, the head of the Mathematics department at Hood College, asked me if I would like to come give a talk to undergraduates on a topic related to my work in radar engineering, I did not have to think much before accepting. I chose to speak about the challenge of searching for low-sidelobe binary pulse compression codes and properties of binary complementary code matrices. I titled the talk "There is Mathematics in Radar," which understates things even to the point of humor (at least in my mind). The visit proved to be a very good experience, one I would recommend to others like myself who have discovered mathematics while working in industry and might like to share the experience with college undergraduates.

Hood College is a small private liberal arts college serving about 1430 undergraduates, located on a 50-acre campus in Frederick, Maryland. Historically a college for women associated with the German Reformed Church, today Hood is co-educational. When I was young, my family would travel between the DC area and my mother's home town in Pennsylvania. I watched Frederick grow by a strobe-effect timed to holiday visits. Once a small town, it is now the third-largest encorporated area in Maryland (behind Baltimore and Rockville). While I knew of Hood College from an interesting adoption connection



(more on that later), I knew nothing about the Mathematics department until I met Betty Mayfield at an MAA Board of Governors meeting. Her friendly welcome to the Board of Governors quickly extended to a visit to Hood to give a talk.

Hence, on the 19th of November 2009, I found myself headed up highway 270, and making my way to Hood's pretty campus and to the nice modern building that the Mathematics department moved to not long ago and proudly calls home. Upon arrival, I met Jill Tysse, the professor who arranged the visit, and most of Hood's Mathematics faculty of 4 or 5 professors. After talking for a while in the Math faculty lounge, we all walked over to the cafeteria for lunch before the 1 pm talk.



Allen Flora, the new dean of the graduate school at Hood, also stopped by our table. Dr. Flora has experience studying sonar waveforms, an area not distant from radar, providing common ground for conversation. This bit of serendipity was not the last -- I was stopped in the hall after lunch by a physics professor with an interest in radar; he promised to attend my talk.

The talk was attended by a mix of faculty and students. During the talk, I received several questions, mostly from the mathematics professors in the room. Two students stayed after to ask me questions about the topic and about my company. Another attendee was the head of the Human Resources Department at Hood, who told me her interest in attending was to learn about local companies that hire mathematics undergraduates. She dropped by after the talk to trade business cards.

I always find a visit to a college or university an interesting change from the normal routine. But Hood College has something truly unique -- the Latgalean Research Institute. Latgale is a province of Latvia, and said to be the most beautiful, blessed with lakes and forests. It also happens that one of my adopted children comes from a sliver of land in Russia that was Latgalean until the end of World War II. Not only that, but by coincidence, my talk was scheduled on Latvian Independence Day. So as a last event during my visit, Betty Mayfield walked me over to the LRI to see their exhibits for Independence Day.

Two weeks after my talk, I received an email from a student named Christina who had attended my talk. She told me she had gone to her professor to ask if she could work on some of the open problems cited in my talk. Hearing of her interest was the crowning touch on what was already a memorable trip.

The obvious benefit of giving such a talk is to give students hints of mathematical work and opportunities outside of academia. But there is always something more. Every week the Mathematics department holds a social event on Thursdays. Who knows, maybe one week I will find myself headed up 270 for tea and cookies.

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