Notes From
HILBERT SPACE

Vol. 15, No. 1 **Fall, 2005**

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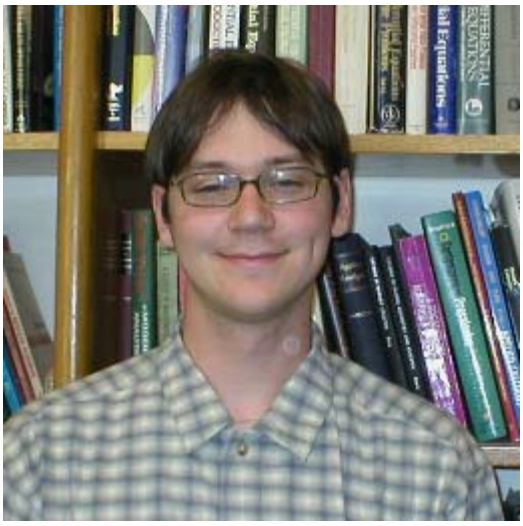
MATH PEERS HERE



Welcome to the latter half of your Fall 2005 term! If you are seeking math classes for next term or just want a comfortable place to lounge between classes, then come find a friendly face in the Hilbert Space (Deady 108). We hope to see all of you soon.

Whether you need help registering for Winter term courses, you have questions about what a class covers or even if you have questions about professors, we are ready to assist. As a math major here at the University of Oregon, there are many resources you should be aware of including job opportunities through the Mathematics Department or Academic Learning Services, math study abroad programs, internships, the Math Club, and the Math Department's Honors program. Many of us have taken advantage of these resources and would be happy to point you in the correct direction. If we aren't around you'll find our office hours, but more than likely if it is between 10 and 3, we'll be around.

Also needing an introduction are the Teacher Assistants. These folks assist professors in teaching the 105 /106 /107 math sequence. They are also fellow math majors that might have insight worth asking about.

Best of luck finishing off your classes this term and registering for the winter term. Also, make sure to stop by soon.

DEAD MATHEMATICIAN

by Bethany Parkyn

Dead Person of the Term: Ernst Leonard Lindelöf

I know you've all been waiting something like 6 months to read about another dead mathematician, and who can blame you? This guy intrigued me because I accidentally said his last name out loud, and then I couldn't stop. Try it. It just rolls off the tongue!

Ernst was born March 7, 1870 in a town called Helsingfors, Russian Empire, which is now Helsinki (another fun word), Finland. He studied mathematics at Helsingfors University, where his father was a former mathematics professor, and became a full professor himself in 1903. Most of Ernst's studies focused on differential equations (in 1890 he published his first work), analytic functions, and conformal mappings, whatever those are*. Eventually he got sick of doing research all day long, and realized his deeply-embedded love of teaching the uneducated, although he continued to write and publish textbooks.

Besides the specific breakthroughs listed above, Ernst is also recognized for encouraging the Scandinavians to embrace the history of mathematics, and for this success he was honored by several Finnish universities. I've just spent 200 words doing the same thing, but I'm betting I won't get any university honors for it. I guess my name's just not as fun to say.

*For interested parties: "A *conformal mapping* is a map from the plane (which can be regarded as $\mathbf{R}^2$ or $\mathbf{C}$) to itself which *preserves angles*. That is, the angle between any two curves is the same as the angle between their images. Any analytic map from $\mathbf{C}$ to $\mathbf{C}$ is conformal at a point where the derivative is non-zero"
(From http://www-groups.dcs.st-and.ac.uk/~history/Mathematicians/Lindelof.html

MATH SOCCER?

by Jeffry Lamb

Since I had trouble finding an article to write about, Scott recommended that I write about the math soccer team. Who would have thought we had a math soccer team. The team was started by Max Wakefield, a graduate student. They call themselves the Gauss's and are made up of Professors, Instructors, staff members and graduate students. The full roster consists of 18 people, but Max would guess that there are about 20 people on the team of which 10 usually show up since the team is usually busy doing math at home. Max says that Mark Walsch is their best player, but that there are also 3 other players with lots of soccer experience who are extremely competitive from Ireland and Spain.

The league is an indoor rec league played at the Student Rec Center, and the games were on Thursdays. There are five people on the court, and since it is a co-ed league two of those must be women during one half, and three must be women during the other half. The team usually doesn't have any women for substitutes, so the girls can get really tired. Max says the games are extremely tiring, more so than outdoor games, because the court is smaller and you have to move faster and run harder since you are always near the ball.

I've been told the team is also very competitive, even though they have a heartbreaking record of 0 and 3. Each game has been close, with their biggest defeat being a 0 to 3 loss. Rumor has it that the team hasn't taken lightly to this less than spectacular record and have taken it out on the other team. I can't guarantee this, but I think if they get one more red card they will be banned from the league.

Even though they didn't win a game in the season, they still qualified for the playoffs. (everybody does as long as their team isn't kicked out of the league) There first playoff game was on Thursday November 12th, but as this article was written before then, I cannot tell you the outcome of the game. Let's hope that during the season they were resting their stars and that they can turn it on in the playoffs and make the math department proud.

Editor's note: While playing tough in the playoffs, the Gauss's were eventually eliminated.

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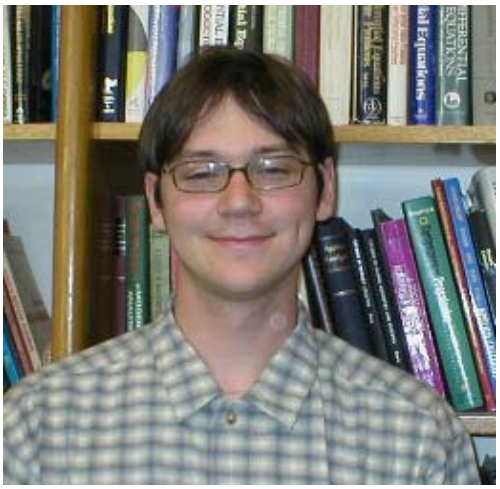
Sure, this class sucks. It bores you, is tedious, and utterly useless. "I'm a pure math major when will I ever use this crap?" Some thoughts along these lines have probably ran through your head. However, even though you could not care less about the rate of salt water mixation from several tanks, the techniques used in this class are unfortunately ever too applicable to a lot of fields. Not properly learning these techniques proved to be somewhat painful in our case.

8. There is Life After Math

It may seem unthinkable now, but you can have a rewarding and fulfilling existence outside of the math department. Much of the happiness you get in the math world derives from solving interesting problems, which can be found in many other fields. Staying purely with math is certainly best for some, but you should at least give some consideration to other fields after you graduate. You might be suprised by what you find. Especially impressive is how much better prepared you are for solving analytical problems than are your peers with non-math backgrounds.

We hope you find these insights to be helpful, and that you enjoy the Hilbert Space while it lasts.

SUMMER COMPUTER SCIENCE



What can one do after taking lots of math classes here at the University of Oregon? Lots of interesting things! Find Hal Sadofsky near the Hilbert Space and he might give you a handy handout.

Back to my story... so last spring I decided it was due time to start working. (While it was a sad day, it has a happy ending... I hope.) With the patience of the UO Career Center (highly recommenced by me) I was able to survive (kicking and screaming) the wonderful process known as "seeking employment" without losing to much of my voice.

This past summer I worked for a company called Instantiations, a Software Engineering organization in Portland. Instantiations builds plug-ins (enhancements) for an open-source program known as Eclipse (http://www.eclipse.org/). Eclipse is probably best known as a Java IDE, that is, a program to speed up the writing of Java (a computer programming language).

Specifically, Instantiations writes these plug-ins for Eclipse which further speeds up Java programming by writing software which checks that the Java code complies with a set of "Audit Rules." For the code being evaluated, each Audit Rule looks through the code and returns a set of violations or comments on the code that suggests ways to enhance the Java program.

The interesting part of the work however lies in how such rules are programmed: within the Eclipse project, there is an Abstract Syntax Tree (AST) structure that can be grown for a given Java program. That is, given Java source, a unique tree is generated which can then be traversed and searched. After such a tree has been generated an Audit Rule is simply a set of of instructions over such an arbitrary tree... making for some interesting problems.

Extra Puzzle for you:

Try to beat 2 minutes for this Sudoku — Note that you should really only play this puzzle once for your time. Playing multiple times is good practice, but for comparison purposes, only use your first time. If you enjoy this, let the editor know and there may be more to follow!

		1				8		
	7		3	1			9	
3				4	5			7
	9		7			5		
	4	2		5		1	3	
		3			9		4	
2			5	7				4
	3			9	1		6	
		4				3		

HILBERT SPACE... WHAT IS IT, AND WHY IS IT HERE?

I decided to write this article as a call to all undergraduate math majors to come check out Deady 108B, codename Hilbert Space. Hilbert Space was established by former department head Frank Anderson as a place for students to gather to work on homework, share ideas, play cards and chess, and learn math the way it is supposed to be learned: in a social environment (It also serves as the center for "peer advising," i.e. advice about which classes to take, and office hours for undergrad TA's). I had a favorite professor once who studied math in the Soviet Union, back when it was the Soviet Union. The math department was on, like, the fifteenth floor of some building, and every day he had to ride the elevator up to get to his classes. He told me that he learned more about real mathematics talking to people on that elevator than he ever did in class. I mean look at what math is; it's giving talks, it's teaching, its writing papers – basically it's communication combined with learning. Without that social element, not only is studying math harder, its less fun.

I am now a senior here at the U of O, and have seen the room and its "scene" go through many phases, but the current phase could best be described as desolate. I don't even really think I've met more than a handful of freshman or sophomore majors (though the ones I have met are really awesome), and really you all are the ones this space best serves. Homework doesn't have to be a drag that you leave until 8pm the night before it's due, and then frantically scramble to complete. I find that the atmosphere in Hilbert Space is pretty much perfect; you can come in with your problem set on your mind, think about it, maybe talk to some of the upperclassmen about the "bigger picture," that can be missed in lecture, meet some classmates, and actually find you learn a lot without working hard at all. I should say that there's also internet, Anna will usually play you in "set" (a card game) when you want a break, and all the chalk and slate you could ever want.

I have several friends in the graduate school, and I think the biggest advantage of being a graduate student is having that office, having a space that's yours, where your classmates are working right beside you, where your professor's office is just down the hall. Well, look; Hilbert Space can *be* that office environment for you, if you choose to take advantage. Why should it be that the bright undergraduate taking his or her first 400 class should pound through it alone, when the graduate students collaborate, and learn from one another? This is exactly why the department set up this place – to give us as undergraduates that opportunity.

Alright, I realize that I sound like I'm selling something here. I am. I love this place, and I love that while the U of O could be just another state university with just another so-so undergraduate math program, instead we have something special, something that has made my time here so much more pleasant, and given me such a feeling of community. Do yourself a favor. Come to the talks, come to the teas. Learn about how you can travel as a math major (I know of four great programs). Learn about all the money the NSF wants to give you for studying math. Learn how to play set. Make friends, and make your math major something fun.

SUMMER INTERNSHIPS

by Blair Moore

Most people assume that math majors will simply be number crunching for the rest of their lives. However, this view is obviously flawed because math majors have the chance to work in many diverse occupations. One such example was my internship this past summer at DST Systems, one of the largest computerized billing companies. Numerous cell phone companies, cable providers, banks and other businesses contract through DST to send out those lovely monthly payment requests.

My job consisted of networking with personnel in the Project Management Office in Hartford, Kansas City and Bangkok. Then using newly programmed reports, I was responsible for cross checking data and documentation for several development projects. In addition to these duties, I became an integral part of the Business Continuity Team after Hurricane Katrina occurred. All of the companies contracting through DST wanted a simulation of the events that would take place if such a disaster struck at one of our main locations. I collected the data and created a report to be sent out to all of our liaisons.

Many of these tasks do require a math background that can be applied to diverse fields. Though there seems to be a lot of number based data utilized in this internship, it was focused more upon comparison and problem solving than anything else. Furthermore, there are a large number of internship opportunities for math majors in all fields every year and I encourage everyone to look into something that my interest them and applies to their math major.

MOVIE REVIEW:

The movie Proof is about the relationship between a mathematical genius, Robert, and his daughter,Catherine, who is also a mathematical genius. In the last years of his life, Robert has become mentally unstable. Catherine has been caring for him instead of going to school. During a year while he was lucid he sketched a proof about prime numbers. After Robert dies, Hal, a Ph.D. student that he had been advising, goes through Robert's notebooks to see if there were any insights made while Robert was mentally unstable. The notebook with the proof on prime numbers is found. The story then turns to whether or not Catherine wrote it, which she says she did, or if her father wrote it. Catherine's sister, Claire, also comes after her father dies. I took her to be overbearing and in general controlling. Over all I was not that impressed with the movie. Of course there was not much in the way of mathematics in it other than the basis for the story line. The subject is talked about all of the time but never gone into, mainly because most people would not understand it. I was not satisfied with the ending. When the credits started rolling, I was surprised; I was expecting more to the story. I did like the song "i" played by the band. I personally will not see it again but it is okay to watch once.

TIPS FOR GETTING INTO GRADUATE SCHOOL

by Nathan Collins

First, I have to point out that I am not in graduate school and that I have not yet been accepted into, let alone applied to, any graduate programs. In fact, I haven't even taken the math GRE yet. Now that we have established that I am not in the position to be giving this advice we can proceed with said giving of said advice.

Don't worry, I am not going to tell you to get straight A's, participate in a few REU's, present a solution to Fermat's penultimate problem in the Really Prestigious Journal of Really Important Mathematics, or even to win a Fields medal. Sure, all these things would probably help, but they would also, in varying degrees, be more difficult than what I am going to suggest. All I am going to do is tell not to be a slacker. In fact, I will suggest when and how to not be a slacker, and hopefully it will make your final fall term a little less stressful.

Now, I only really have two pieces of advice, but they alone wouldn't fill much paper, so I had to put you through the first part. The technique may be reminiscent from the papers you had to peer review in your writing 121 class. The first piece of advice concerns GRE's (http://www.ets.org, or something like that) and the second concerns deciding where to apply.

You will be taking two GRE's, a general and a mathematics subject test. In both cases I am suggesting you take them earlier rather than later. The general GRE is kind of like the SAT, except the vocabulary words probably got harder. You should take this early so you don't have to think about it when you have more important things going on, like actually applying to schools during the fall of your last year. I studied for the general GRE a few hours each of two or three evenings before I took the test and did fine, and one who walks among you didn't study at all, as far as I know, and did better than ninety fifth percentile on the verbal. Your mileage may vary, and you may be in trouble if you have never read a book, but I would suggest you take it during your sophomore year, or earlier. If you do poorly you can always take it again; if you do fine you can forget about it.

The subject test is harder. It is another silly multiple choice test, so they aren't going to ask you to do anything very interesting, but you will be expected to be able to integrate and differentiate like a certain tree dwelling mammal, and know basic linear algebra and differential equations. Sure, there is a little analysis and combinatorics, and even some abstract algebra and topology, but if you take honors calculus and attend Professor Vaintrob's Putnam seminar (both of which you should do) you will learn enough of the first two, and you can probably get by without the second two, as far as the test is concerned. What I am getting at, of course, is that you should take the test soon after your second year, assuming that is when you take 28x, 34x, and 256. Maybe I am wrong, maybe I have gotten the wrong impression of the test, or maybe I don't realize that some of the techniques I use to solve the problems are ones I learned in algebra or topology. In any case the potential losses and benefits of taking the test early are the same as with the general.

This brings us to deciding where to apply. Okay, so now it is the summer before your last year and

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you already took your GRE's, and did fine of course. What are you going to do? Yes, that's right. You are going to figure out where you are going to apply in the fall. This is probably pretty obvious, but some people, such as the author, decide to put this off until the fall, since the deadlines are oh so far away, mid December at the earliest. If you already know what area you want to focus in, this probably won't change during the fall term, and if you don't know, you probably won't figure it out in the next 2 months. So, do yourself a favor and get started early. It couldn't hurt to crank out a personal statement or two and a resume either.

MY SUMMER AT PENN STATE

by Lauren Weiner

This summer I attended the Penn State REU (Research Experience for Undergraduates) in State College, PA with 10 other undergrads. The National Science Foundation funds these research programs in mathematics and science and REU's are held every summer at campuses all over the country. We spent seven weeks attending an algebra class, taught by Professor Yuri Zarhi, and working on our research projects. In the algebra class we focused mainly on polynomials – the interpolation problem, algebraic numbers, etc. For the research projects we split into pairs or groups of three and each group was assigned a different topic. Some were problems that related to what professors at Penn State were working on, some were extensions of problems from the previous REU and some were just interesting questions.

The project my group worked on dealt with Alexandrov's conjecture, which states that the ratio of the surface area to the square of the geodesic diameter of a convex surface embedded in Euclidean 3-space and homomorphic to the 2-sphere is always less than or equal to half of pi. We focused on two aspects of this conjecture: we attempted to prove that this ratio holds for tetrahedra and we also investigated a possible counterexample. For certain tetrahedra, proving that this ratio is less than or equal to pi was no problem (ie on regular tetrahedra and other nice shapes). We ran into problems with the not so nice tetrahedra because we couldn't always easily construct the geodesic diameter. We tried to come up with a function that took area and geodesic diameter into consideration and would allow us to find the maximum of the ratio over tetrahedra, but we were unable to. As a counterexample, we considered a degenerate surface. We ran experiments on Maple but were unable to determine whether or not the degenerate cases we studied were indeed counterexamples.

As far as math goes, it was an unsuccessful summer (that's how research is though, right?), but I still had a great time. Even though State College makes Eugene look like a big city, we found lots to occupy our time (mainly movies, pizza, and poker), I visited Washington D.C. for the first time, and I got to see Ben

LIFE AFTER HILBERT SPACE

by Jonathan Lafky and Jared Lunsford

Clearly life outside Hilbert Space exists, and is not unique. We should know. We left the Hilbert Space in June of 2003, eager to apply our freshly acquired mathematical abilities. Jared went straight to the University of Pittsburgh economics PhD program, while Jonathan first took a year of introspection in Sweden before being swayed by Jared into also joining the dark side of economics. After leaving, we learned several nonobvious things about studying math.

1. Listen to Cathie (and Probably That New Guy as Well)

She knows what she's talking about. As undergraduates we recieved a lot of advice from her on subjects ranging from scheduling courses, to finding work, applying to graduate school, romance, and teaching. Looking back it's clear that her advice was always on target.

2. Talk to Professors Every Chance You Get

In addition to learning neat stuff from them, conversing with professors is valuable in many ways. The most direct is that you will need strong letters of reccomendation from them when applying to graduate school as well as for non-academic jobs. Additionally, it can be beneficial to cultivate the ability to talk to professors. In graduate school being able to work and communicate with professors is very important. You'll have to find an advisor, for example. Having the ability to discuss research topics with them will clearly help you in this regard. As undergrads you should take advantage of opportunities to meet and talk with professors whenever you can.

3. You're Smarter Than You Think You Are

Sure, when the classes are kicking your ass you feel pretty dumb. The good news for you is that you are still surviving. There are very few students in the university who could get through them, and even fewer who would choose to. Always keep in mind with whom you are comparing yourself. In these classes you learn a lot mathematical tools which might be useful to you in the future, but probably won't be. More importantly, you are learning how to think analytically. Identifying that two problems have the same structure is a skill which you may take for granted even while it eludes many others. This ability to analytically think is hugely beneficial in both the academic and civilian world.

4. Math Is Good for Grad School Applications

Because of 3. above, having a lot of math coursework is very beneficial when applying to graduate school. Completion of a math degree speaks well of you, and employers and admissions committees will look very favorably upon you for it. This is true even if your area of interest is not mathematically oriented. In our case it helped a lot because economics is a math heavy field at the graduate level and most undergraduates avoid math courses even if they plan on going to grad school.

5. Enjoy Oregon - It Probably Won't Last

You don't know what you have until it's gone. If, like us, you grew up in Oregon you probably don't realize how great it really is. From the climate, to the people it is a uniquely special place to live. Go hiking, go to the coast, go the mountains, go to football and basketball games, go to Crater Lake, go to the Pre Classic (talk to Cathie about this we hear she's been before), go to Savoure, go to Allen Brothers, go to the Country Fair. Enjoy it while it lasts.

6. The boring Classes Continue

Not to depress you but you will always have to take the bad with the good. In graduate school you will still have to take classes that bore you, are tedious, and utterly useless. Learning how to deal with these classes when you are an undergrad will soften the blow when you get to grad school.

7. Pay Attention in Differential Equations.

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DEPARTMENT: PUZZLE TIME

PUZZLE TIME

The Problem Solving Competition uses problems submitted by professors and students from different campuses throughout the United States and abroad. Each month the competition sends out problems to participating institutions.

To submit your solutions to the current or past problems, give them to Scott Fallstrom in 108 Deady. Your solutions should be clearly written and should show all of your work and contain some mathematics. A correct solution for each problem will qualify for a drawing. You don't have to solve all of the problems. Just submit the ones you can solve. The person with the winning draw will receive a gift at the end of the school year. Of course, this competition is for undergrads only, but graduate students may enter their solutions just for fun.

Problem # 1: Ten poker chips have numbers written on them so that one chip is numbered "1," two chips are numbered "2," three chips are numbered "3," and so on. The chips are placed in a bag and three chips are drawn at random without replacement. What is the probability that the sum of the numbers on the chips drawn is divisible by 5?

Problem #2: There are 137 red dots and 137 blue dots on a chalkboard, no three of which are colinear. Is it possible to pair the dots into 137 pairs, each pair having one dot of each color, such that if you draw a line segment connecting each pair, the lines don't intersect?

Problem #3:

$$\text{Given } f(0)=0,\ f'(0)=1,\ f'(2)=3,\ \text{and } f''(2)=5,$$

$$\text{find } \int_0^1 x\cdot f'''(2x)\,dx.$$

Problem #4: Find any and all real solutions to the following system of equations. Show your work and explain your solution.

$$x + y = z$$

$$\frac{1}{x} + \frac{1}{y} = \frac{1}{z}$$

Editor's Note:

Cathy Triguiero has retired from the Hilbert Space Newsletter and the new editor is Scott Fallstrom. The Hilbert Space Newsletter will be published at least once each term, and any comments or suggestions may be directed to Scott Fallstrom at fallstro@uoregon.edu.

Mr. Fallstrom was hired to serve as the Mathematics Education Coordinator as well as the Assistant Director of Undergraduate Studies. He will be teaching the seminar during spring term for prospective undergraduate TA's. Those interested may contact him about the opportunity.