The Quaternion

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Transitions

Ken Pothoven has retired after 35 years at USF.

He got his bachelor's degree from Calvin College in Michigan, and his Ph.D. in functional analysis and category theory from Western Michigan University in Kalamazoo in 1969. In 1970, he came to the USF Department of Mathematics and was immediately appointed Assistant Chair. As Assistant – later Associate – Chair, he helped lead the department as it launched its new Ph.D. program, and then he served as Chair from 1984 to 1992 as the department expanded its research program.

Although he remained active in research, in real analysis and differential equations, he is best known for his service to mathematics education. He was very active in the MAA, helping organize Suncoast meetings at USF since 1978, and helped with a vast number of community programs and educational initiatives, ultimately becoming Secretary-Treasurer of the Florida MAA Section from 1999 to 2003. Meanwhile, closer to home, he took over the Center for Mathematical Services in 1994 (from which he recently retired) and was very active in the calculus reform movement.

We are grateful for his contributions, and we wish him well on his further adventures.

If Size Matters, then how Large are the Primes?

by Boris Shekhtman

Counting primes is not like counting ballots in an election: if we wanted to know what proportion (or "density") of the integers are prime, we learn little by counting them. There are countably many primes and countably many non-primes. To find the density, one must do what the exit pollsters attempt: measure the density itself. We do this by estimating how many of the first n integers are prime, and let n go to infinity.

Applying this sampling logic to the size of the primes gives the "The Prime Number Theorem": in 1896, Hadamard and de la Valle Poussin in 1896 independently verified a formula for the asymptotic density of primes that are less than some given number:

$$(\#\text{primes} < n)/n \approx 1/(\log n).$$

But then, the density of Primes, $\lim 1/(\log n)$, goes to zero. To bad for primes, but on the positive side, this is as large a zero as there is.

In nature, small animals are, relatively speaking, faster then the giants. One could consider size as a quantity inversely proportional to speed. The slower a sequence speeds to infinity, the slower the reciprocals tend to zero, and the better the chances that the sum

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The Quaternion is an annual publication of the USF Department of Mathematics, which can be visited on the web at <http://www.math.usf.edu/>. Our e-mail address is <mathdept@math.usf.edu>, our snail-mail address is Department of Mathematics, University of South Florida, 4202 E. Fowler Ave., PHY114, Tampa, FL 33620. Our phone number is (813) 974-2643, and our fax number is (813) 974-2700.

The Nagle Lecture: Andrew Odlyzko on Cybersecurity

Andrew Odlyzko gave the 13th R. Kent Nagle Lecture on *Cybersecurity, Mathematics, and the Limits of Technology* to an audience of about 170 people on February 24. Professor Odlyzko, Director of the Digital Technology Center at the University of Minnesota, told us that humans and computers think very differently.

Humans are good at coming up with cumbersome security systems that humans then finesse in order to get things done. Secretaries routinely forge and fax signatures, while lawyers write laws and contracts with deliberately ambiguous wording to preserve slack. The point is that humans are supposed to use their "common sense." Odlyzko's example is of someone who asks a neighbor to "let the plumber in to fix the leaky faucet": a sensible neighbor would be presumed to know that something was wrong if the plumber started removing furniture.

Until recently, security problems were the usual embezzlement, bad checks, hold-ups, etc. Even now, most scams rely on tricking users to reveal credit card numbers for phony security checks, or sending money to cover handling costs for Nigerian lotteries. There are some technical security problems, such as the "buffer overruns" that have facilitated most virus and worm invasions in the last three decades; yet it was humans that have known about this problem and done little about it.

Odlyzko's point is that the problem is *us* goes beyond security. For example, poorly written software may be an irritant for users, but the necessity for endless upgrades provides job security for the code writers. And so, as long as humans are involved, there will be security issues...

Center / Mathematical Services

The Center continues to be involved in outreach and service activities to the Suncoast Region.

In the summer of 2005, the Center conducted two programs for gifted and high-ability secondary students. Both programs ran concurrently from June 6 through July 8, from 9 a.m. to 3 p.m. weekdays. This was the 27th year that the Center has conducted such programs. The programs had a total of 32 students who were taught courses in mathematics, computer science, and environmental science. All students were taught these courses in formal class settings, but they also participated in laboratory exercises in computer science. A grant from the Academy of Applied Sciences helped provide scholarships for three of the high school students to do research in mathematics with the help of their mentors: Professors Jonoska, Rakhmanov, and Ramachandran. The Center is planning on conducting similar programs during the summer of 2006.

The Math Club

The Math Club – the joint USF Student Chapter of the Mathematical Association of America (MAA) and the Florida Epsilon Chapter of Pi Mu Epsilon (PME) – met fourteen times during the academic year. The meetings are mostly attended by math undergraduate students. There was free pizza and sodas and a speaker at every meeting. The talks were given by both faculty and undergraduate and graduate students and topics ranged from applications of mathematics to biology and chemistry to proofs in mathematics, interesting geometry problems and math games among others.

In additional news:

PME again hosted the Spring and Fall Hillsborough County Math Bowls with all 23 county high schools sending team and individual student competitors; top honors went to **H. B. Plant High School** winning top honors in the overall competition.

At the MAA Suncoast Regional Meeting in December 2004 at St. Pete College, **Matt Williamson**, one of four USF math undergraduate students attending, delivered the student presentation *Inversion and Geometry: An Interesting Technique Not Usually Taught in Geometry Class*. And at the 2005 Joint meetings of the MAA and the FTYCMA in February 2005 at Manatee Community College, Mr. Williamson spoke again, while three other USF math undergraduate students also attended the meeting.

Two USF undergraduate students attended the 2005 Joint Meetings of the MAA and the AMS in January 2005 in Atlanta.

At the 2005 St. Pete College Mathematics Awareness Conference, undergraduate students **Keith Grizzell** and **Nicole Hooper** won a prize for solving a math problem posed by one of the speakers at the conference.

Our PME chapter inducted eleven new members this year. The induction ceremony

was attended by several inductees' parents and relatives as well as mathematics faculty members. The keynote speaker was Dr. Gordon Fox of the biology department.

The 2005 PME Outstanding Scholar was **Anand Bhat**. After finishing his math major last December, he has already started graduate studies in our department. Upon being named for this award, he delivered a well-received math club talk titled "Magic Squares- Some Math and Some Magic," and he received a plaque at the PME banquet.

Darshit J. Patel won the 2005 USF Council of Honor Societies Academic Achievement Award for the second year in a row. As president of the PME chapter, he represented the chapter at the joint MAA Math / PME national meeting in August.

Student News

Four students were awarded doctorates during the 2004-'05 academic year: Djiby Fall (under Y. You; *Longtime Dynamics of Hyperbolic Evolutionary Equations in Unbounded Domains and Lattice Systems*), David Edwin Kephart (under N. Jonoska; *Topology, Morphism, and Randomness on the Space of Formal Languages*), Ferenc Tookos (under V. Totik; *Hölder Continuity of Green's Functions*), and Norbert Noupeyou Youmbi (under A. Mukherjea; *Contributions to Harmonic Analysis and Probability Theory on Semihypergroups*).

Thirteen students were awarded Master degrees: Angela Angeleska, Jodi Louise Barlow, Lisa Marie Stephenson Borzewski, David Jeffrey Bueller, Stacey Lynn Cummins, Rajesh Ganesan, George W. Kimber, Jr., Gayathri Mahalingam, Meagan Nicole McNamee, Robert David Mitchell, Ena Lynette Salter, Janet Hester Samuels, and Anupama Tippabhotla.

Twenty-five received Bachelor's degrees: Hashim Ahmed (Cum Laude),
Richard Arriaga, Anand Bhat (Magna Cum Laude), Scotty Boutte, Judi Charley-Sale, Natalie Davis (Magna Cum Laude), Jennifer Ezell, Justin Feller, Joshua Felton, Brian Frasier, Fred Gore (Magna Cum Laude), Keith Grizzell, Alex Guevara (Cum Laude), Jessica Halsell, Princess Harris, Christopher Hollander, Tanya Jones
Thomas Joyce, Avni Kardani, Jason Karol, John Knisley, E'Leon Mills, Robert Rienzi, Gregory Thole (Cum Laude), and Daryl Williams.

Primes, *continued from page 1*

of the reciprocals diverges.

The sum of reciprocals of primes is infinite: the primes tend to infinity slow enough to be LARGE.

So the density of primes is both zero and large. We need a tiebreaker.

In 1927, B. L. van der Waerden published his famous theorem: In any finite partition of integers, one of the sets of the partition contains arithmetic sequence of arbitrary large finite length. He thought of a large set as a set that contains arithmetic sequences of arbitrary length.

An arithmetic sequence (of length n), is of the form $a, a + d, a + 2d, a + 3d, \ldots, a + nd$. For instance, the set of natural numbers is an infinite arithmetic sequence with $a = d = 1$. Delete every millionth number and you have a set, almost as large as naturals, but not an arithmetic sequence. Nevertheless, it contains arithmetic sequences of arbitrary length. To further elaborate on the relationship between size and arithmetic sequences, in 1936, Erdös and Turan conjectured that every set with positive ("upper") density contains arithmetic sequences of arbitrary length. E. Szemeredi proved the conjecture in 1975. So, the sets that are large in terms of density are large in terms of arithmetic. Where does it leave the Primes? In limbo for thirty years. Well, 3,5,7 is a sequence of three primes of constant difference two. The primes 5, 11, 17, 23, 29 form an arithmetic sequence with constant difference 6. The world record is an arithmetic sequence of TEN primes discovered by Manfred Toplic in 1998: Start with the prime 100,996,972, 469,714,247,637,786,655,587,969,840,329,509, 324,689,190,041,803,603,417,758,904,341,703, 348,882,159,067,229,719, and use a constant difference of 210. Finally, last year, Ben Green and Terence Tao used the Semeredi's theorem in combination with a "transference principle" and 48 pages of technical mathematics to establish that the primes *do* contain arbitrarily long arithmetic progressions. Joy to the world, the Primes are BIG! This macho melodrama is not over.

Erdös conjectured that if a set of integers has an infinite sum of its reciprocals, then the set contains arithmetic sequences of arbitrary length. Try it. Maybe you will get lucky.

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The Newsletter of the USF Department of Mathematics
In this issue:

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We'd Like to Hear from YOU!

The Department of Mathematics would like to hear from alumni, friends, collaborators, members of the community, and fellow explorers of and guides to the world of mathematics.

Contact us at: 974-2643, or fax 974-2700. E-mail <mathdept@math.usf.edu>. We have a web-page at <http://www.math.usf.edu/>. Snail-mail address is Department of Mathematics, University of South Florida, 4202 E. Fowler Ave., PHY114, Tampa, FL 33620.

The Continuing Crisis

The budget crisis – which may be a bit chronic to call a crisis – continues to constrict the department's operations. There will be no Nagle Lecture again this year, and the Institute for Constructive Mathematics remains dormant. Meanwhile, the Associate Chair is scrambling to find graders for undergraduate courses, and (as usual) many lower division sections are being taught by adjuncts.

USF in general, and the Mathematics Department in particular, can use all the help it can get. Contact the USF Alumni Association or the Department of Mathematics if you have any stray change.