

# QUEEN'S MATHEMATICAL COMMUNICATOR

SPRING 2008

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A Sudoku puzzle with exactly two solutions

An open problem received by the

Department of Mathematics

QUEEN'S UNIVERSITY

QUEEN'S MATHEMATICAL COMMUNICATOR  
SPRING 2008



# The Mathematics of Sudoku Squares

**M. Ram Murty**



*Research.* I won't say much here, except that Queen's, while continuing to value and support high quality undergraduate teaching, puts most of its de facto emphasis on research and graduate education. The big grant money, the big awards and the big reputation certainly seem to come, on many levels, mostly from research and while most of us enjoy our teaching and take care with it, the struggle for most of us is to carve out enough time and resources to do our research. And so a big question I have often encountered is how to give my colleagues this research time and still maintain (or recover?) Queen's reputation for top quality undergraduate teaching.

*Teaching.* On the teaching side, things are often not quite what they seem, and I believe that this is the case here. Certainly over the past 25 years the number of students has doubled and the number of faculty in the department has been cut by a third (from a high of 47 to the current 31). So classes are much bigger and many more of them are taught by sessional lecturers, post-docs and graduate students. Actually there a lot of richness in all that, and the advantages outweigh the disadvantages. I will make two closely related comments (along the lines of things not being quite what they seem), and these are about class size and expectations (student and faculty).

There's a lot of talk in the teaching world about student engagement (the importance of that for effective learning) and there's an idea that large class sizes are the enemy of engagement. I do not believe this. In my own life I have found myself engaged and absorbed in what was happening more often in a large crowded room than in a small more intimate setting. Engagement has to do with what is happening in the learner's mind and that is determined by the problems and challenges that are being posed, by the story (or narrative) that is unfolding. It is fashionable to

ran 4 sections of this for a total of 50 students using 8 undergraduates. At the end of this experience, students talk glowingly about it, both the first-year students and the undergraduate teachers. It is a program we definitely want to keep going but funding for it will continue to be a challenge. If anyone wants to endow a named tutorship, let me know!

Speaking of which, we do have a couple of these already, the Gill tutors and the Norman Miller Fellows. The latter were endowed by a gift from one of Norman Miller's former students, Oswald Hall, whom I used to visit whenever I was in Ottawa to keep him abreast of the program, but who, sadly, died earlier this year at the fine age of 99. [An article on Professor Miller was featured in a Communicator some years ago.]

Speaking of endowments, I mention teaching by post-doctoral students and that is one way the department has seen a major change over the past decade—the number of post-doctoral fellows in residence (about a dozen each year). Our flagship program for this, the Coleman Fellows program, was started 6-7 years ago by Eddy Campbell and Bob Erdahl and we have obtained a few wonderfully generous gifts from former students of John Coleman to support this. [By the way we are half-way to our goal for this program so are still looking for contributions!]

*Seice.* This component also has challenges that have arrived with changes over the past decades, mainly the increase in student/faculty ratio and along with that, what is a huge increase in the amount of work required to get resources (new positions, research chairs, strategic grants) and to justify our programs (various forms of accountability). There are good examples of that in all four of our key administrative officers, the Associate Head, the Chair of Undergraduate Studies, the Chair of Mathematics and Engineering, and the Graduate Chair.

The Associate Head is **Leslie Roberts** and he handles the appointment procedures (for hiring new faculty) and the tenure and promotion procedures. This is a much bigger job than it used to be, partly because of the collective agreement which mandates a comprehensive set of procedures for personnel decisions, and partly because of the huge number of applicants we typically get for mathematics positions. Over the past few years we have made a number of appointments, and this coming year we are attempting to fill two positions, one in Statistics and one in Statistics and Probability. We need to work hard to get good applicants as statisticians are everywhere in demand and can command high salaries. [If you have a son or daughter who is looking for an important area of

study with a great and flexible future, suggest statistics.]

The Chair of Undergraduate Studies is **Ole Nielsen** and his big challenges are in staffing all our courses and keeping tabs on the quality of our large instructional machine. Students follow a huge variety of paths and they are often seen in Ole's office needing special attention. **Alan Ableson** is a new adjunct faculty member who has been appointed Assistant Chair of Undergraduate Studies and relieves Ole of some of this workload. In addition, Alan teaches and coordinates some of our large service courses, and has become a crucial member of our teaching staff.

The Chair of our Mathematics and Engineering program is **Fady Alajaji**. This is an awesome program, virtually unique in Canada, and it equips students with a formidable array of skills and experience all the way from financial mathematics to information technology. It's an accredited professional program and that is what has required such enormous work in reporting and accountability over the past years. Thus we have created a position of Curriculum Chair in the program to take some of the load off of Fady and Navin Kashyap has stepped into that.

The Graduate Chair is **Andrew Lewis** and his job has been made much more interesting (Andrew might have chosen a different word) by the recent policy of the Ontario Government to put special funding into graduate expansion, particularly of domestic PhD students. This has created huge competition among Ontario universities for this limited pool of applicants and we have had to work hard, and will have to continue to do so, to recruit good students.

Finally, it is great for the department that **Ram Murty**

## News Items

Peter Taylor

AMS

Photo by David Tyner

Mathematics & Statistics Prof. David Thomson (second from right) with Queen's solar radio telescope and team members: Lindsay Smith (now at University of California), Robert Carkner (BSc Mechanical & Materials Eng) and Ben Gardner (MSc Math & Eng)

**David Thomson's** statistical study of the radiation coming from the sun continues to receive active interest from the press. David's analysis of data from the Ulysses spacecraft mission has shown that sounds generated deep inside the Sun cause the Earth to shake and vibrate in sympathy. It appears that Earth's magnetic field, atmosphere and terrestrial systems, all take part in this cosmic sing-along.

David's co-authors include **Lindsay Smith**, a recent Math&Eng graduate. To demonstrate the effect, they use highly sophisticated statistical techniques. Their most dramatic and surprising finding has been to discover these resonances in the seismic data here on Earth. In short, earthquakes even respond to the sun.

Interestingly enough, although these tones are all around us, they are too low for the human ear, being some 12 octaves below the lowest audible note. David figures that the effect is caused by a type of resonance generated by the interaction between the magnetic fields of the two bodies.

AMS

**Agnes Herzberg** and **M. Ram Murty** are in the news because of their article ["Sudoku Squares and Chromatic Polynomials"](#), (see cover and lead article of this issue) which appeared in the June/July 2007 issue of the *Notices of the AMS*. In the article they pose some mathematical questions about Sudoku and

*Pi* Day events culminated at 1:59 (that's at 03 14 159 to be precise) with the annual *pi*-recital contest. The winner was **Jenica Baulk-Smith** with a flawless execution of 101 digits. In talking to her afterwards she confessed that her trade secret was to use songs.

Jenica reciting Pi

## Significant Events in the Department of Mathematics and Statistics

M. Ram Murty

### PROMOTION AND TENURE

*Spring 2006*: **Fady Alajaji** and **Tamás Linder** promoted to Full Professor.

*Spring 2007*: **Mike Roth** and **Greg Smith** promoted to Associate Professor.

### APPOINTMENTS

**Serdar Yüksel** (July 1, 2007) received his PhD in 2006 from the University of Illinois, Urbana-Champaign, with a thesis on information transmission in control systems. Following this, he worked as a post-doctoral associate at Yale University (New Haven, CT), working mostly on information theory. Serdar also has some industrial research experience, having worked as a summer research intern in 2004 at Xerox-PARC (Palo Alto, CA), applying some of his research concepts to large-scale printer design. He currently works primarily on understanding the value of information in multiple-agent control and communication systems. Serdar adds strength to both our control theory and communications theory groups.

It is a pleasure to announce the appointments of two new members of the department.



## **AWARDS AND RECOGNITION**

### **FACULTY AWARDS 2005**

**Andrew Lewis** was one of two Queen's winners in the Round 1 competition of a new Ontario research support program, the

ciated with Indian scientists as evidenced by collaborative programmes with the Indian scientists, training of Indian scientists by the nominee, participation in Indian scientific programmes, visits to India for participation in conferences, consultancy, programmes, etc. Founded in the year 1930, the National Academy of Sciences, India is the oldest Science Academy of the country. The main objective of the Academy is to provide a national forum for the publication of research work carried out by Indian scientists and to provide opportunities for exchange of views among them.

#### **FACULTY AWARDS 2008**

An expert in modeling the transmission and evolution of infectious diseases such as SARS and avian flu, **Troy Day** is one of six outstanding Canadian university researchers to receive a 2008 **E.W.R. Steacie Memorial Fellowship** from the Natural Sciences and Engineering Research Council (NSERC). Troy studies the evolution and causes of infectious diseases through the use of mathematical models. His research examines how and why diseases appear when they do, as well as the reasons some diseases become deadly while others remain relatively benign. Dr. Day will receive funding enabling him to pursue his research full-time. The universities receive a salary contribution to fund a replacement for the Fellows' teaching and administrative duties for two years.

was motivated by a study of how to reduce back pain in industrial workers.

#### **TEACHING DISTINCTIONS**

**Patrick Reynolds**

Hwashin Shin (Health Canada), **Glen Takahara** and Duncan Murdoch  
(University of Western Ontario)

**Glen Takahara**, his former student **Hwashin Shin** and our former member of department, **Duncan Murdoch** have been awarded the Canadian Journal of Statistics Award for their paper "Optimal designs for calibration of orientations" published in that journal in Volume 35, pp. 365-380. Orientations describe rotations of three-dimensional objects. These are used in virtual reality systems in connection with 3D animation, and in motion-tracking devices studying human motion. In order to calibrate these tools, a statistical model must be used. The winning article discusses efficient ways of conducting experiments to estimate the parameters in such models. This work



**Sumit Oberai** (Apple Math 95) writes: I'm the Vice President of Customer Solutions at Indigo Books & Music, where I manage the team that delivers all of the front office technology for Indigo, including the Online eCommerce Site, the POS (cash registers), Loyalty program (iRewards), and in-store technologies. I enjoy my job because of the variety driven by the difference in managing for both an online environment and a physical store, as well the mix of day-to-day operational challenges, projects to address business challenges, and work on the technology direction for future stores. It is also interesting to be part of a well-known consumer brand in Canada as it explores growth options for the future. And as a shameless plug, I am most excited about the recently launched Canadian Booklovers Community at <http://community.indigo.ca>.

**Erica Blom**

Students also develop communications (written and oral) skills by receiving instruction on effective technical writing and reporting from a Queen's Writing Centre instructor at the beginning of the term, producing typed essays on four seminars, and presenting a 15-minute talk on an engineering topic.

**If you are a Math&Eng alumnus with an interesting career story to share**, and you are interested in participating in this Fall's seminar, contact Johana Ng <[johana@mast.queensu.ca](mailto:johana@mast.queensu.ca)> or 613-533-6000 x74469.

Thanks to our **Alumni** who participated in the Fall 2007 Seminar:

**Mr. Timothy Evans**, Genum Corporation, Burlington, Ont. (B.Sc. Math&Eng '05, M9 option): *Video Posing Sgms*

**Dr. Ron Kerr**, Communications Research Centre, Ottawa (B.Sc. Math&Eng '87, M7 option; M.Sc.,

E.E., Queen's; Ph.D., Univ. of Victoria): *Resach at Commuication Resach Cent*

**Prof. Kevin Deluzio**, Mech. and Materials Eng., Queen's (B.Sc. Math&Eng '88, M6 option; M.Sc., Ph.D., Mech. Eng., Queen's): *What Can EigenctbsTell YouAbotKnee Ahit?*

**Ms. Cynthia Thomas**, Alcatel-Lucent, Ottawa (B.Sc. Math&Eng '02, M9 option; M.Sc., Math & Eng '05): *IPTV: Coming b A Phone NearYou*

**Mr. Nicholas Whalen**, Stikeman Elliott LLP, Toronto (B.Sc. Math&Eng '96 M7 option; M.Sc. Math&Eng '98; LL.B.'01, McGill): *LawAferEngi- neeing: Applicatons of Y onSkillsin Intellectal Popep& Copoat Law*

**Ms. Meghan Patterson**, Cobalt Engineering, Toronto (B.Sc., Math&Eng '04 M6 option): *A Geen Apple: Designing Sainable Bildings*

## Celebrating Marge Lambert

Peter Taylor

This year, **Marge Lambert** became a member of that awesome 40-year club at Queen's University, and was celebrated as such by the Principal. The great mystery for us is how, at her current age of 52, she has managed to do that. But then mathematicians are well known for their inability to add or subtract.

A number of us date back to

# Gifts to the Department of Math & Stats

Peter Taylor

You might consider directing your alumni giving to the Department. We have two fine programs that would profit greatly from your support.

## **The Coleman Fellows Program**

Our drive to build this program started 5 years ago at the initiative of the Head, Bob Erdahl. The fund celebrates the pioneering work of John Coleman, who shaped the Department during his 20 years as Head (1960 to 1980), and who in fact celebrated his 90<sup>th</sup> birthday this May at a departmental conference held in his honour at which he delivered a 1-hour talk comparing Whitehead's and Einstein's General Theory of Relativity. When we decided we wanted a permanent memorial to recognize John's passion for teaching, his ardent pursuit of research at the borders of Algebra and of Quantum Theory, and his conviction that Canadians have a duty to bring intelligence and good will to bear on international affairs, he was clear that he wanted it to support young mathematicians who could come and add vitality to the research and teaching life of the Department. And that is exactly what has happened. Our overall goal is to establish eight Coleman Fellowships, requiring a total endowment of 2.4 million dollars and thanks to the extraordinary generosity of a number of John's former students, we are halfway there (and as a consequence are now supporting four Fellows). The second half is always harder than the first, but this is a great

program, great for us and great for the wonderful young men and women who come.

## **The Trust Fund**

Built up largely from royalties and alumni donations, it is an essential component of the work of the Department. Just to give you an inside peek at departmental resource allocation (this will surprise most of you as it did me), the Trust Fund finances:

- x Orientation evenings for both Arts & Science and Math & Engineering;
- x Convocation receptions;
- x Homecoming reception (that's you!);
- x Refreshments for Math Club and High School Enrichment sessions;
- x Travel grants to Undergraduates (e.g., Undergrad Math Conference);
- x The Departmental December Holiday Party;
- x Special celebrations during the year (e.g. John Coleman's 90<sup>th</sup> conference).

Over the past few years the demands on the Fund have increased (more activities and Faculty cut-backs) and the income has decreased (a possible reason is the stronger push from the university as a whole for alumni funds). So this is an excellent place to target your gifts. The "gift ticket" on the next page can be sent to Alumni Affairs with your donation.



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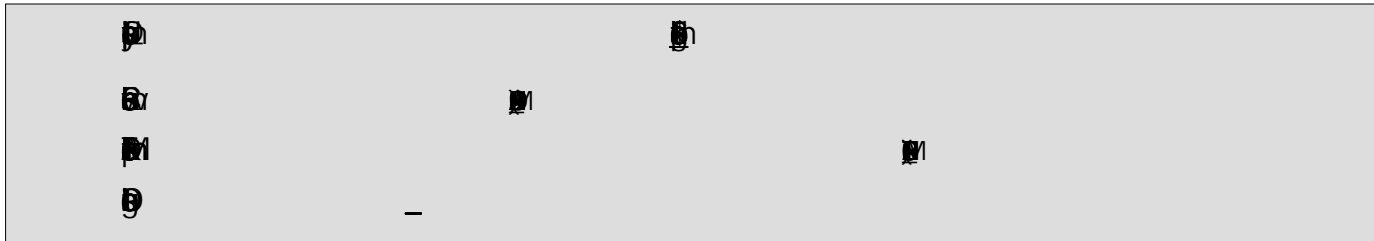
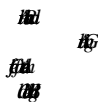
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## **New Problem**