Student

Mathematical

Communicator

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About the *Student Mathematical Communicator*

The *Student Mathematical Communicator* was created in 2000 and is published by the Canadian Mathematical Society (CMS) Student Committee in order to serve the community of Canadian mathematics students. This includes assisting the current president of the Canadian Undergraduate Mathematics Conference (CUMC) and fostering a community of mathematics students through other events, a website, and this newsletter. Detailed information about the Committee (including it's terms of reference, duties, responsibilities, and guidelines for membership) can be found on the Committee's website http://www.cms.math.ca/Students.

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Contents

News

Math Millionaires?

This past September, mathematics student Shannon Patrick Sullivan of Memorial University of Newfoundland made it into the hot seat on *Who Wants To Be a Millionaire-Canadian Edition*. We asked him 20 questions.

1. **What are you studying at MUN?**

Applied Mathematics. Specifically, numerical analysis and dynamical systems.

2. **Where are you from originally?**

St John's, Newfoundland. Lived here basically all my life.

3. **What did you do to qualify for Millionaire?**

Sacrificed several small animals. No, actually, there were a bunch of steps involved. First, there was a two-week period (or something like that) where you could call in, once a day, and try to qualify. Qualifying involved answering five "Fastest Finger" questions correctly, in a row. If you did that, your name went into a draw which was broken down by region. I was lucky enough to qualify on my second try.

Newfoundland was part of the Atlantic region (with the three Maritime provinces) and they were only taking one contestant from that region. Fortunately, out of the 180 or so people who qualified from Atlantic Canada, my name was the one that got picked. Once they confirmed that I was actually eligible, I was in the show.

4. **The taping was held in New York. What was your agenda for the trip?**

Pretty hectic. We arrived around lunchtime on a Wednesday and most of that afternoon was taken up with media interviews. Then we had a production meeting with the producers and the other contestants and their guests, and the big press call with Pamela Wallin after that.

Thursday was almost entirely taken up with the recording of the shows themselves. We went to the studio at around 8:00 am, and the entire morning was spent doing rehearsals, getting make-up and hair done, that kind of thing. We taped one episode, had lunch, then taped the second episode, and after that had another short press scrum. Finally, in the evening we went to the Canadian Consulate General for a reception.

Friday was pretty quiet. We finally had a chance to take in some of New York in the morning, and our flight home left that afternoon.

5. **Who did you bring with you, and why? (Sorry if this is two questions.)**

I brought my father, Desmond. He's been to New York City before, so I was glad to have someone who knew a bit about the place along with me.

6. **Did you meet Regis Philbin?**

Ah, the question everybody wants to know! Actually, Regis was on vacation at the time (the American episodes airing around then had all been taped a few weeks earlier) so nope, didn't see hide nor hair of him.

7. **What was Pamela Wallin like?**

Off set, very nice, very friendly. During the actual recording, I think she was as nervous as any of the contestants. She was in a pretty tough situation, trying to fill Regis' shoes! I know she's taken a lot of flak for her performance, but I thought she did pretty well, under the circumstances, and certainly warmed up throughout the two shows.

8. **What were the other contestants like?**

Really great for the most part, we all bonded pretty quickly. Some people were pretty intense. They had really been studying hard, or felt a lot of pressure to do well. But most of us were just there to have a good time, have an interesting experience and meet some new people. Well, and win some money, of course.

9. **How was the hot seat?**

Interesting. When I first made it into the Hot Seat, right at the end of the episode, it was pretty strange. I mean, I knew I had as much time as I wanted to the answer the questions, but you still feel that you should be answering them rapid-fire. So I was in a really weird sort of zone then, and in fact when the break came, I had to ask people just how many questions I'd answered. I couldn't remember!

With the hour break in between the two tapings, it gave me time to catch my breath and refocus, so I was a lot more comfortable for the second show.

10. **You were the "carry-over" person, appearing on both shows. How was the wait?**

Wonderful! Like I said, it gave me a chance to just sit back and calm down (and eat). Some of the other contestants said they would have hated to be in that situation, but in all honesty I think it was to my benefit.

11. **How much did you win?**

$1000. Which, in the grand scheme of things, isn't a lot. But it's still $1000 more than I went in with. So I'm not complaining.

12. **Which question did you answer incorrectly, and what was it?**

The $16,000 question. It went something like "In Nova Scotia, the term *Digby chicken* is used to refer to what?" The choices were cured herring, rubber duck, smoked lobster and cornish hen. The 50–50 lifeline narrowed it down to cured herring and smoked lobster. I went with the latter, and unfortunately that was wrong.

13. **Did you use all of your lifelines?**

I used the Ask the Audience on a baseball question that I really should have known the answer to, except that I had the two [World Series] appearances by the Toronto Blue Jays switched around in my head. The thing about Ask the Audience is that it becomes progressively less useful as the game wears on (this was the $4000 question) so I figured it was as good a time as any to use it. I don't think it would have helped me with the Digby chicken question.

Like I said, I used 50–50 on the Digby chicken one. I didn't use Phone a Friend. I was pretty sure no one on my list knew the answer to that one (turns out I was right) so I didn't want to waste it in case I guessed correctly.

14. **What did you spend your winnings on?**

Absolutely nothing yet! It's safely stored away in my bank account, collecting interest. I'm very tempted to splurge on a DVD player, but the last thing I need is something else to distract me from my studies. So I might just hang on to it for now.

15. **Did you have much publicity?**

Quite a bit, yeah. Several TV, radio and newspaper interviews in Newfoundland. Some radio stations in Nova Scotia and New Brunswick as well, since I was acting as their representative too. On the national scene there was Canada AM and the CTV National News, the Globe and Mail, the National Post, and the Canadian Press.

It was pretty constant right from the moment my name was announced until the two episodes actually aired, for a total of about two weeks.

16. **What has it been like since?**

In the immediate aftermath, people were coming up to me constantly. Fortunately, I enjoy that sort of thing so it never really got annoying. I guess I must be a bit of a glory hound!

I still get noticed every now and then, but I'm sure that before too long, everyone will have forgotten about it. But it's nice while it lasts.

17. **What are you doing now?**

Well, I'm starting my Masters this semester and teaching an undergrad course. That is, I would be, if the term hadn't been interrupted by a faculty strike. So while that's going on, I've been working pretty much non-stop on a movie screenplay that's been percolating in the back of my brain for a while now. Plus I'm maintaining my website, writing movie reviews, and I'm on the Board of Directors for the MUN

Graduates Students Union, so it all keeps me pretty busy.

18. **Do you have any hobbies, other than these?**

I've gotten into movies and movie reviewing in a big way the past two or three years, so I watch a lot of those. I collect comic books which I have done since I was about four or five years old. And I'm a big fan of the old BBC science-fiction TV series "Doctor Who", so I keep up to date on the latest news about that and write articles about its history for my website.

19. **On the show, Pamela Wallin said you were "reluctantly single". How's that going?**

Well, I got a lot of very flattering e-mails after the shows aired, and still correspond with a couple of those people. But I'm not all that keen on an electronic relationship, so I guess from that point of view, things haven't changed too much.

20. **If you had to use one word to describe your Millionaire experience, what would it be?**

Memorable.

I thank David Isaac Morgan of Memorial University for contributing this article. David is a member of the Student Committee and was one of Shannon's Phone a Friend! -*Ed.*

Awards: NSERC for Undergrads

NSERC stands for the National Science and Engineering Research Council of Canada. The following is an excerpt from the *Frequently Asked Questions* of
http://www.nserc.ca/programs/schol1_e.htm

Questions from Students

1. **How do I apply for an award?**

You must complete Form 202, Application for an Undergraduate Student Research Award, which is available from USRA liaison officers at Canadian universities or from NSERC (select *Application Forms* on the above NSERC page). You should send the application along with your official transcripts to the proposed supervisor at the university at which you would like to hold the award.

2. **What is the application deadline for USRA in University applications?**

Each university establishes its own internal deadline for submission of USRA applications.

3. **What are the selection procedures for these awards?**

Each university selects students for USRAs according to its own selection criteria and within broad guidelines that NSERC provides. Once the university has selected its awardees, the information is sent to NSERC.

4. **When will I find out if I have received an award?**

The university will inform you of its award decisions after it has completed its selection procedure.

5. **When can I hold my award?**

You may hold your award at any time during the year as permitted by your academic program.

6. **When do I receive my award?**

NSERC pays the award directly to the university at which you are carrying out the research. The university will issue you payments during the period in which you are carrying out your research project; you will not receive any payments directly from NSERC. You will, however, receive an official letter of award from NSERC during the tenure of your USRA.

Some Math Links

1. Institutes:

   (a) The Fields Institute

   http://www.fields.utoronto.ca

   (b) Pacific Institute for the Mathematical Sciences

   http://www.pims.math.ca

   (c) Centre de recherches mathématiques

   http://www.crm.umontreal.ca

   (d) Institut des sciences mathématiques

   http://www.math.uqam.ca/ISM

   (e) The Mathematics of Information Technology and Complex Systems

   http://www.mitacs.math.ca

2. Canadian Mathematical Society

   http://www.cms.math.ca

3. American Mathematical Society

   http://www.ams.org

4. World wide listing of math departments

http://www.ams.org/mathweb/mi-depts.html

5. The Math Forum Internet Mathematics Library

   http://forum.swarthmore.edu/library

6. The Mathematical Atlas: A Gateway to Modern Mathematics

   http://www.math.niu.edu/~rusin/known-math/welcome.html

7. The Universal Currency Converter

   http://www.xe.net/ucc

8. Merriam-Webster's Collegiate Dictionary

   http://www.m-w.com/dictionary

For more links see

- http://www.cms.math.ca/Students/en/Links

Vision of newsletter project

On Mon, 1 May 2000 21:07:56 -0400 (EDT), I sent the following e-mail to all mathematics departments across Canada. I received 3 replies.

`Dear Members of the Canadian Mathematics Community:`
`I am writing your department to first inform you that our Canadian Mathematical Society Student Committee has completed a Web page to serve students across Canada. The CMS Student Web page is available on the CMS site under` *Activities* `under` *Students*`. Second, we need your help in realizing one of our visions of creating a national mathematics student newsletter. Our idea is to have university mathematics departments across Canada select a student webmaster to download the template page at:`
`http://www.dms.umontreal.ca/~girouard/journal`
`This page contains subsections titled News, Women in Mathematics, Men in Mathematics, Canadian Mathematicians, Opinions, Papers, Book review, Fun with Math, and Links, which we intend to use as a framework for a hard copy. We expect in some cases there might not always be a willing student to keep up a Web page, but who would be willing to be a contact and to serve as a link with the other students of your university. In that case this student will be`

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considered a webmaster anyway.  Initially, your webmaster may be
a student working for the department over the spring and summer
months.  The student webmaster's task would be to modify the page
with relevant local information pertaining to your university (with
a template page all that is left to do is fill in the blanks!).
These regional newsletters will be linked to our Student Center
Web page available on the CMS site under Activities under Students at:
http://www.cms.math.ca
Of course student webmasters graduate.  So, for the sake of
continuity, we suggest that the department selects the student
webmaster from the departmental student council, or the like.
[...].  We intend to inform each university webmaster in advance
that their newsletter is next to be linked to our Student Center
page.  Of course, in order to do this we need to be able to contact
your student webmaster.  Once you have recruited a student webmaster
please have them drop me (or Alexandre) a line at
juricev@cicma.concordia.ca (or girouard@dms.umontreal.ca)
Sincerely,
Robert Juricevic
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Notice Alexandre is no longer working on the newsletter project and my contact address is now *student-editor@cms.math.ca*. I would be more than happy to work with many people. If your are interested in working with me, drop me a line. The ability to translate this newsletter into French is an asset and it is my intention to do that for the next issue.

Now that the wave has started out West with Web pages at UNBC, UCAL, and UBC, thanks to Dan, Raymond, and Adrien respectively (see In Your Area), I would like it to continue through central Canada and splash into the Atlantic! That means that for the next issue I would like to establish contacts with the universities of Saskatchewan, Waterloo, and Carleton say (of course any of the 34 universities listed on our website in our links section may establish contact at any time), and for the following issue with UQAM, DAL, and Memorial say. Moreover, I would like the next newsletter to be two column; French à la droit, English à la gauche. This is consistent with other national magazines such as VIA magazine[1].

[1] Unfortunately VIA has ceased publication as of October 2000.

Irongirl

I would like to explain the title Irongirl and Ironboy.

An *Ironman Triathlon* consists of a 4km swim, a 180km bikeride, and a marathon run. It is a grand test of physical and mental endurance. On Saturday, September 16th, 7pm, the Canadian Broadcasting Corporation (CBC) broadcast the Olympic triathlon (1.5 km swim, 40km bike, 10km run) live. A 25 year old Canadian by the name of Simon Whitfield[2] shocked the world by outsprinting Vucković of Germany for Olympic gold! Simon showed grit, determination, patience, discipline, heart, courage, and a harmony between physical and mental endurance in his win.

In order to play in an Olympic triathlon (and win the gold medal like Simon), you need the intuition of a kid and the courage of a kid of steel[3].

The point is that mathematics is also a grand test of physical and mental endurance. Canadian mathematicians have the same traits as Simon but don't have the forum of the Olympics to show them off.

Hence, *Irongirl* and *Ironboy* is a spin on *Ironman*.

My vision is to use the Irongirl and Ironboy section in order to profile a Canadian mathematician (student or professional). Letters welcome.

In order to play with mathematics (and solve open problems), you have to have the intuition of a kid and the courage of a kid of steel.

Profile: Wai Ling Yee, University of Waterloo

Profile by Ken Davidson (KRD), *University of Waterloo.*

Wai Ling Yee graduated from the University of Waterloo this past August, and was one of our top students. As well as being a student in my second year group theory class, I knew her from two summers she spent working here on summer NSERC grants where we had a number of students working in analysis. Part of their time was spent running a learning seminar (on convexity one year, and on continuous optimization the other).

She worked on a research project with Kathryn Hare[4] on some questions about harmonic analysis on Lie groups, a subject Wai Ling knew nothing about when she started. This was a very successful project that resulted in a publication each summer. The first has appearred:

> K.E. Hare, D.C. Wilson and W.L. Yee, *Pointwise estimates of the size of characters of compact Lie groups*, J. Austral. Math. Soc. **69** (2000), 61–84.

[2]For a great profile on Simon check out the December 2000 issue of Triathlete magazine.
[3]Simon trained and raced in the *Kids of Steel Triathlon Series* in Ontario, Canada.
[4]Website: http://www.math.uwaterloo.ca/PM_Dept/Hare

As a result, Wai Ling Yee was nominated for the AMS–MAA–SIAM Frank and Brennie Morgan Prize[5] for Outstanding Research in Mathematics by an Undergraduate Student. She was a very close runner up for this award.

Wai Ling Yee also did extremely well on the Putnam[6], getting an Honorable Mention in the 1999 competition. She was the highest ranking women last year, and so won the Elizabeth Putnam prize[7]. That was a good year for Waterloo, which won the team competition by virtue of a stirling performance by many students including two Putnam fellows (top 6 overall) and two Honorable Mentions (top 30 overall).

Wai Ling is now a graduate student at MIT (http://www-math.mit.edu). I recently had a conversation with her, and she answered the following questions by e-mail. The other comments were from our unrecorded conversation.

1. **Where are you from originally?**

I was born in Toronto and grew up in Mississauga.

2. **What program did you study at U. Waterloo?**

I completed a double honours degree in computer science and pure mathematics at the University of Waterloo.

3. **What parts of your studies did you like best?**

I most enjoyed courses in which the professor gave interesting problems. I would have to say that the students and professors at Waterloo were what made my undergraduate experience so extraordinary. Not only was I constantly astounded by the abilities of my classmates, I was fortunate to find that they were extremely supportive people. The pure mathematics professors always took a personal interest in their students. Even though I have graduated, some of them still check up on me intermittently to see how I'm doing.

KRD: She also mentioned that she appreciated the emphasis on problem solving in and out of courses. Apparently other graduate students from places like Harvard had not learned how to give complete proofs, and still believed that it was enough to present the rough idea. Wai Ling felt that she had learned how to give complete arguments.

4. **Tell us a bit about your summer NSERC project with Kathryn Hare.**

During my first summer working as a research assistant, Prof. Hare gave me the problem of finding pointwise bounds for the trace of a representation applied to

[5] See http://www.maa.org/awards/morgan_nom.html

[6] To find out more about the William Lowell Putnam competition, see http://math.scu.edu/putnam

[7] See http://math.scu.edu/putnam and click on *Prizes and Scholarships* for a description of the prize. Furthermore, see http://www.maa.org/awards/putnam.html for an alphabetical list of individual winners.

a non-central element of a Lie group in terms of the degree of the representation. From these bounds, we determined the minimal integer k such that any continuous orbital measure convolved with itself k times belongs to L^2. The following summer, we found the minimal number k for which the Fourier transform of any continuous, orbital measure belongs to l^2.

5. **What are you studying now at MIT?**

I'm taking courses in Lie theory, differential geometry, and partial differential equations. I have yet to choose an area of specialization.

KRD: She tells me that she really likes Lie groups, which was one of the reasons for choosing MIT in the first place. She did not much enjoy PDEs. The differential geometry was hard, perhaps because of the next answer.

6. **How well prepared were you for grad school?**

In the areas of algebra and analysis, Waterloo had prepared me well. However, I would have appreciated more knowledge in the areas of topology and geometry. Certainly, this would have been a smaller problem had I chosen to major in applied mathematics instead of computer science.

KRD: I was also a graduate student in the US after a Canadian undergraduate degree (many years ago), and my experience was similar. Canadian programs are more intensive in the major subject, but no program does everything. I also felt that my background in analysis and algebra was outstanding, but I was missing the differential geometry background that American students from top schools had. I imagine that Wai Ling's knowledge of computer science will come in handy, and that she will overcome the deficit in geometry.

7. **What are your interests outside of mathematics?**

Of my hobbies, I spend the most time playing classical music and jazz and swing dancing. I find that they provide a relaxing contrast to mathematics. The athletic facilities at Waterloo and MIT have enabled me to take up new sports such as cross-country skiing and hockey, which I enjoy immensely.

I thank Ken Davidson (Pure Mathematics Department, University of Waterloo) for contributing this article. His website address is

http://www.math.uwaterloo.ca/∼krdavids

-Ed.

Ironboy

Profile: Robert E. Woodrow, University of Calgary
Profile by -Ed.

Mathematicians don't have the forum of the Olympics to show off their grit, determination, patience, discipline, heart, courage and harmony between physical and mental endurance. In fact, this is not entirely right. There are aspiring mathematics students who participate in local contests leading up to national mathematical olympiads. A small number of them take part in national training programs. Six students are sent each year to the International Mathematical Olympiad (IMO)[8].

Robert Woodrow is the Olympiad Corner Editor of *Crux Mathematicorum with Mathematical Mayhem*, a Canadian problem–solving journal at the senior secondary and university undergraduate levels with an international following of those who practice or teach mathematics. For more on CRUX with MAYHEM see

http://journals.cms.math.ca/CRUX

Professor Woodrow is a Canadian logician who works in a branch of Model Theory called the Theory of Relations. One of his interests is in the study of homogeneous structures such as the Random Graph (the graph almost surely obtained on the natural numbers when the existence of an edge between two vertices is decided (independently) by flipping a coin).

Woodrow took over writing the Olympiad Corner from Murray Klamkin a decade ago. While Klamkin is well known as a problem poser, problem solver, and coach of winning Olympiad teams, (and a member of one of the first winning teams of the Putnam competition), Woodrow came to the Editorship without having made any great splash on the contest scene. His interest is in fostering student interest in problem solving and in mathematics, with the major international contests being only the tip of the iceberg.

Of course contests are not the only way that students come to mathematics–some of the best mathematicians approach the subject entirely differently. Over the years Woodrow has been involved in other work of the Canadian Mathematical Society[9].

[8] IMO 2001, will take place between July 1–14, 2001, Washington, DC, USA. In Canada, Professor Chris Small (University of Waterloo Statistics Department) is the 2001 IMO team leader, and was deputy leader this past year. For more information see http://imo2001.usa.unl.edu and Professor Chris Small's website http://www.stats.uwaterloo.ca/∼cgsmall/homepage.html

[9] He served for a number of years as a member, and for a term as Chair of the Education Committee, and currently is the faculty member on the Student Committee.

Math talk

Editorial

Time to show initiative

What do research mathematicians do? Most Canadian high school students do not know. What is even more troubling is that most Canadian high school mathematics teachers do not know either.

The answer needs to come directly from research mathematicians. Research mathematicians understandably are concerned with their research. Nevertheless, without the Gretzky's of math directly participating in answering the question it will always remain an open question to Canadian high school students.

One suggestion is to form a travelling team of research mathematicians analogous to the *Legends of Hockey* tour. They would travel Canada inspiring high school students directly by giving public lectures at public schools and establishing contacts with high school mathematics teachers in person.

One problem is that this will take a lot of work and travel energy on their part and I don't think the mathematicians still researching will be keen participants. So, what can be done?

Many high school students watch TV. The Discovery channel

http://exn.ca/@discovery.ca

is giving nice profiles on biologists, chemists, physicists, astronomers, anthropologists, archaeologists, and so on. The point is that they have reduced mathematics to a *Numbers Game* past time. Personally, I would love to be updated on new mathematical discoveries and more importantly, how such discoveries were made.

I would like to see research mathematicians interviewed on the Discovery channel.
-Ed.

Opinions/Commentary

On the UNBC Math Department by Dan Wolczuk wolczu0@unbc.ca.

Despite the fact that the UNBC Math Department is underfunded, understaffed and shows no signs of improving in these areas, I believe I could not have received a better undergraduate education anywhere else.

The shortage of staff is a definite problem, which is added to by the high turnover. In my view, there are not enough professors to teach the required courses, and the professors generally end up teaching a wide variety of different courses. This is difficult on both students and faculty. I was fortunate that we had a number theorist, Dr. Chris Pinner, for two years, as this is the field of mathematics I intend to pursue. I believe many students do not gain as much as they could due to the lack of a professor in their field of interest.

It is not hard to argue however, that the faculty we do have make up for any problem the department has. Many of the professors are very dedicated to their students and give them opportunities they would not have elsewhere. I have been a TA since the beginning of my second year (undergrad), as well as having the opportunity to assist Dr. Pinner in his research. (See my Lagrange Spectrum Calculator http://ctl.unbc.ca/CMS/LSC). This kind of experience is invaluable as I intend to become a university professor myself one day. Many other students have had this same opportunity with a variety of professors. On top of this, all of the professors I have had are excellent teachers and really demonstrate their love for mathematics. The UNBC math professors do not just give notes and tests, they give their students support, encouragement, experience, and an appreciation for the wonderful world of math.

Overall, I think the UNBC Math Department definitely has room for improvement, which is not so surprising since it is such a young university. The faults of the department, however, are greatly overshadowed by the staff and faculty in it. I am very fortunate to have been a part of this department and when I leave for graduate school I will be very proud to say that I received my undergraduate degree from UNBC.

Book Review

Lang, S. Linear Algebra–3rd edition. Springer-Verlag, 1989.

Reviewed by Andy Culham, ajculham@ucalgary.ca.

This book is designed to serve as a text for a senior undergraduate linear algebra course. The first three chapters (vector spaces, matrices, and liner mappings) briefly cover material that should have become second nature to any senior undergraduate student. The book then proceeds to very quickly cover much more advanced topics such as scalar products, determinants, and eigenvalues/eigenvectors. While these topics are covered in a junior course, they are approached much more rigorously here. The proofs of theorems are often brief and lack in detail. While there are exercises provided at the end of each section, there are no solutions or hints provided anywhere in the text, nor is there a solution manual available for purchase. Many undergraduates will find this quite frustrating and may have to resort to purchasing a supplementary text which includes problems with solutions. While this book is efficient and moderately priced, the content and presentation is less than sufficient for most undergraduates.

O'Neill, B. Elementary Differential Geometry–2nd edition. Academic Press, San Diego, CA, 1997.

Reviewed by Dan Wolczuk, wolczu0@unbc.ca.

To be to the point, I am not very impressed by this text book. The two main problems I have with this book are that some definitions and formulas are hidden amongst regular text, and that there is a major lack of descriptive examples. If it were not for the former problem I would believe that this would make a good reference book, but unfortunately you cannot find all of the necessary definitions and theorems by merely scanning the pages. The lack of examples makes the textbook fairly difficult to learn from as the explanations of concepts and proofs of theorems are not always complete. The questions at the end of each chapter are the only part of the book I have to commend. They do an excellent job of ensuring an understanding of the material from the previous chapters. For example, in doing questions from Chapter 4, if you do not have a good grasp of the previous three chapters you will find the questions quite difficult. However, with a good understanding of the necessary material many of the questions are quite trivial.

Overall I am not at all a fan of this book, although I have definitely learned the necessary material from it, so it cannot be all that bad.

Ross, Kenneth A. Elementary Analysis: The Theory of Calculus. Springer–Verlag, 1980.

Reviewed by Raymond Cheng, kwrcheng@ucalgary.ca.

The book is rigorously written and is extremely good for math majors. I don't think this book is very suitable for non-math majors however, since they might think it's too dull. The book does not go on and on like some math textbooks with non-essential talk. It gets into the material right away. The proofs have been carefully chosen so that they're as simple and as elegant as possible. Topology is treated in optional sections, and the focus of the book is sequences. Indeed, the treatment of sequences is very thorough. Also, many notions are also defined in terms of sequences. However, proof that this definition and the usual delta-epsilon definition are equivalent is given. The style of writing is clear, concise, and avoids unnecessary discussion. Proofs are given out in full and are seldom left to the readers as an exercise. In keeping with the style of this book, historical facts and references are not provided. I think this book should be a must-have for all math undergrads.

Pi in the Sky. The Pacific Institute for the Mathematical Sciences, June 2000. Available at (opens in new window): http://www.pims.math.ca/pi

Reviewed by Raymond Cheng, kwrcheng@ucalgary.ca.

Pi in the Sky is a semiannual mathematical magazine targeted at junior and senior high school students and educators. However, I find that some of the content might be too advanced and the magazine as a whole might be more appropriate for undergraduates. There are nearly ten articles in this periodic publication along with jokes, comics and other interesting materials. As stated in the publication, "This journal is devoted to cultivating mathematical reasoning and problem-solving skills, to prepare students for the challenges of the high-technology era." The magazine is professionally produced and if you plan to read it from cover to cover, it will set you back a couple of hours. There are some interesting math questions at the end of the magazine, and the reader is invited to submit solutions. Overall, I think this journal is a good read for all math undergraduate students as well as advanced high school students.

In Your Area

UNBC website

Dan Wolczuk at the University of Northern British Columbia (UNBC) was the first to reply to our e-mail and the first to complete a website. His website can be reached via our website *http://www.cms.math.ca/Students* by following the links *in your area, mathematics at UNBC*. Great job Dan!

UCAL website

Raymond Cheng at the University of Calgary (UCAL) has also completed a website. His website can be reached via our website by following the links *in your area, Calgary*. Great job Raymond!

UBC website

In process. Adrien Desjardins at the University of British Columbia (UBC) is the webmaster.

Calender

Here we intend to list mathematical events and deadlines throughout the year which appear on our website http://www.cms.math.ca/Students under *Calender*.

If you have an event or deadline which you would like to include, visit our website and drop our webmaster Andrew Irwin a line.

The Land of the Lounge Mathematician

Jokes

- Q: What sound does a drowning analytic number theorist make?

  A: $\log\log\log\log\cdots$. *This is attributed to Ram Murty.*

- There are three kinds of mathematician, those who can count, and those who cannot. *This is attributed to John Conway.*

- One day a group of scientists got together and decided that man had come a long way and no longer needed God, so they picked one scientist to go tell him. “God,” the appointee said, “we’ve decided we no longer need you. We can cure diseases, clone people, and create life, so why don’t you just go on your way.”
  God listened patiently to the man, then said, “Very well. But first let’s have a man–making contest, doing it just like I did back in the old days with Adam.”
  “Sure, no problem,” the scientist said, bending down to scoop up a handful of dirt.
  “No, no, no,” God admonished, “Get your own dirt.”
  This is attributed to Playboy’s Party Jokes, March 2000.

- A mathematician is showing a new proof to a large group of peers. After going through most of it, one of the mathematicians says, “Wait! That’s not true. I have a counter-example!” She replies, “That’s okay. I have two proofs.” *This is attributed to Stefan Chakerian via Raymond Cheng.*

- I believe that people would be alive today if there were a death penalty. *This is attributed to Nancy Reagan.*

- In Italy for thirty years under the Borgias, they had warfare, terror, murder, bloodshed. They produced Michelangelo, Leonardo da Vinci, and the Renaissance. In Switzerland, they had brotherly love, five hundred years of democracy and peace, and what did they produce? The Cuckoo clock. *This is attributed to Orson Welles.*

- Q: What has points closed and comes from Formosa?

  A: A Taiwan space. *This is attributed to Bob Quackenbush.*

For more math jokes click on the link *mathfun* at Dan's UNBC page
http://ctl.unbc.ca/CMS
and click on the link *Jokes* at Raymond's UCAL page
http://studentnews.math.ucalgary.ca

Poems

The Red Wheelbarrow by William Carlos Williams[10].

so much depends
upon

a red wheel
barrow

glazed with rain
water

beside the white
chickens.

you fit into me by Margaret Atwood[11].

you fit into me
like a hook into an eye

a fish hook
an open eye

A limerick by Cyril Kornbluth[12].

A burleycue dancer, a pip
Named Virginia, could peel in a zip;
But she read science fiction
And died of constriction
Attempting a Möbius strip.

An equation limerick by Jon Saxton (an author of math textbooks)[13].

$((12 + 144 + 20 + (3 \times \sqrt{4}))/7) + (5 \times 11) = 9^2 + 0$

[10]Extracted from the *Broadview Anthology of Poetry.*

[11]Extracted from *Math and Poetry class notes*, Queen's University.

[12]Extracted from *Impossibility: The Science of Limits and the Limit of Science by John Barrow.*

[13]Extracted from Dan Wolczuk's web page http://ctl.unbc.ca/CMS under *Mathfun, Poems'n things, Poem 3.*

Or for those who have trouble with the poem:
A Dozen, a Gross and a Score,
plus three times the square root of four,
divided by seven,
plus five times eleven,
equals nine squared and not a bit more.

The Popcorn Gallery ©2000 **Shannon Patrick Sullivan**

You may recall that Shannon Patrick Sullivan of Canadian Millionaire fame is an amateur movie critic.

website: http://www.physics.mun.ca/∼sps

Click on *The Popcorn Gallery*. We hope to inspire Shannon to contribute a movie column regularly. His rating scale is 4 stars–outstanding, 3 stars–very good, 2 stars–average, 1 star–poor, and No stars–terrible. Shannon has 68 total reviews. Here is an excerpt from Shannon's review on Magnolia, which he rated 4 stars.

Magnolia (1999) / ****

Directed by Paul Thomas Anderson. Screenplay by Anderson. Starring Philip Baker Hall, Jason Robards, Tom Cruise. Running time: 188 minutes. Rated R for offensive language by the Maritime Film Classification Board (MFCB). Reviewed on March 20th, 2000.

I am almost surprised to find myself reviewing "Magnolia", two months after viewing the film. But although I have seen several movies in the intervening weeks, the images of "Magnolia" have remained strong in my mind, and so here I sit at my keyboard. This is not to say that "Magnolia" is a perfect film; in some respects, it is deeply flawed. But it is one of those movies which demands to be viewed, contemplated, remembered, even if the verdict is not entirely positive.

"Magnolia" is the brainchild of Paul Thomas Anderson, and is a sequel of sorts to his "Boogie Nights", featuring many of the same cast and crew. Some critics have reviewed "Magnolia" on this basis, but I have not seen "Boogie Nights" (yet) and would prefer to discuss "Magnolia" on its own merits anyhow.

For a complete review of Magnolia see http://www.physics.mun.ca/∼sps under *The Popcorn Gallery* under *Magnolia*.

Homeplay

Let $S(p)$ be the length of the curve $y = x^p$ for $0 \leq x \leq 1$. Show that S is an increasing function of p for $p \geq 1$.[14]

[14]Proposed by Ken Davidson (Pure Mathematics Department, University of Waterloo). "I gave this as a (very hard) bonus question to my calculus class." Solutions should be sent to the proposer krdavids@uwaterloo.ca. We will consider the best solution for publication.

Problems

"I think it's very important that people are encouraged to work on very hard problems. The tendency today is to work on short and immediate problems." *This is attributed to Andrew Wiles.*

The Pomerance 10

On Saturday, June 10th, 2000, Carl Pomerance gave a plenary lecture at the Canadian Mathematical Society summer meeting at McMaster University, Hamilton, Ontario, Canada. He listed his top 10 unsolved problems in number theory.[15] *I formulated the problems and so I am accountable for any mistakes. The numbering of my list does not necessarily agree with the numbering of Carl's list. -Ed.*

1. *Goldbach Conjecture.* In a letter to Euler in 1742, Goldbach formulated the following conjecture.

   Conjecture (Goldbach) *Every even integer $A \geqslant 4$ is the sum of two primes.*

2. *Riemann Conjecture.* For a complex number $s = \sigma + it$, and $\chi(n)$ a non–trivial Dirichlet character, let
$$\zeta(s) = \sum_{n \geqslant 1} \frac{1}{n^s},$$
   and
$$L(s, \chi) = \sum_{n \geqslant 1} \frac{\chi(n)}{n^s}.$$

   Conjecture (Riemann Hypothesis–RH) *All non–trivial zeros of $\zeta(s)$ lie on the line $\sigma = \frac{1}{2}$.*

   Conjecture (Extended Riemann Hypothesis–ERH) *All non–trivial zeros of $L(s, \chi)$ lie on the line $\sigma = \frac{1}{2}$.*

   Let K be an algebraic number field, $\mathcal{O}_K$ its ring of integers, a an ideal of $\mathcal{O}_K$, and
$$\zeta_K(s) = \sum_{a} \frac{1}{(\mathrm{N}a)^s},$$

[15]See Richard Crandall and Carl Pomerance *Prime Numbers, A Computational Perspective*, Springer 2000, ISBN 0387947779.

where the sum is over all ideals a of $\mathcal{O}_K$, and $\mathrm{N}a$ is the norm of a, defined to be the index of a in $\mathcal{O}_K$.

Conjecture (Generalised Riemann Hypothesis–GRH) *All non–trivial zeros of $\zeta_K(s)$ lie on the line $\sigma = \frac{1}{2}$.*

3. *Hardy–Littlewood Conjecture.* For integers $A \neq 0$, B, and C, let

$$q(n) = An^2 + Bn + C, \text{ for some } n,$$

and

$$Q(x) = \#\{\, p \leqslant x \,:\, p = q(n) \text{ for some } n \,\}.$$

Conjecture (Hardy–Littlewood, 1923). *There exists a constant $K > 0$ such that*

$$Q(x) \sim K \frac{\sqrt{x}}{\log x}.$$

4. *Artin's Conjecture.* Let A be a non–zero integer other than $1, -1$, or a perfect square, and let $N_A(x)$ denote the number of primes $p \leqslant x$ for which A generates the cyclic group $\mathbb{F}_p^* = \{\, 1, 2, 3, ..., p-1 \,\}$.

Conjecture (Artin, 1927) *There exists a constant $K(A) > 0$ such that,*

$$N_A(x) \sim K(A) \frac{\sqrt{x}}{\log x}.$$

5. *ABC Conjecture.* In 1980, Masser and Oesterlé formulated the following conjecture.

Conjecture (Masser–Oesterlé, 1980) *Let $n = p_1^{\alpha_1} p_2^{\alpha_2} \cdots p_k^{\alpha_k}$, and $rad(n) \stackrel{\text{def}}{=} p_1 p_2 \cdots p_k$. Suppose we have 3 integers A, B, C satisfying $(A, B) = (A, C) = (B, C) = 1$, and $A + B = C$. Given $\epsilon > 0$, it is conjectured that there is a constant $K(\epsilon)$ such that*

$$\max(|A|, |B|, |C|) \leqslant K(\epsilon) \{rad(ABC)\}^{1+\epsilon}.$$

6. *Discrete Log Problem.* Let G be a finite group with group operation $\circ$, $\alpha \in G$, $H = \{\, \alpha^i \,:\, i \geqslant 0 \,\}$ the subgroup generated by α, and $\beta \in H$.

Discrete Log Problem *Find the unique integer A such that $0 \leqslant A \leqslant \#H - 1$ and $\alpha^A = \beta$, where α^A means $\alpha \circ \alpha \circ \cdots \circ \alpha \circ \alpha$, A times.*

7. *Wieferich Primes.* An odd prime p is called a Wieferich prime if p^2 divides $2^{p-1} - 1$. The only known Wieferich primes are 1093 and 3511.

Wieferich Prime Problem *Do there exist infinitely many primes p such that p^2 divides $2^{p-1} - 1$?*

8. *Mersenne Primes*. A Mersenne prime number is a prime of the form $2^p - 1$. Notice every even *perfect number*; equal to the sum of its proper divisors, is of the form $2^{p-1}(2^p - 1)$; $6 = 2(2^2 - 1), 28 = 2^2(2^3 - 1), 496 = 2^4(2^5 - 1), \ldots$

   Mersenne Prime Problem *Do there exist infinitely many primes p such that $2^p - 1$ is a prime? That is, do there exist infinitely many even perfect numbers?*

   Conjecture (Wagstaff, 1983) *There exists a constant $K > 0$ such that*

$$\#\{\, p \leqslant x \;:\; 2^p - 1 \textit{ is prime}\,\} \sim K \log\log x.$$

9. *Prime Gaps*. Let p_n denote the nth prime, and let $d_n = p_{n+1} - p_n$.

   Prime Gap Problem *For $p_{n+1} \leqslant x$, how big can d_n be?*

10. *Multiplication vs. Factoring*. Modern cryptography is based on our inability to factor large numbers fast.

    Arithemetic Problem *Prove or disprove the following assertion which is at the base of the RSA cryposystem: It is harder to factor a given number than to multiply given numbers together.*

Remarks

- On the Riemann Hypothesis. Show that

$$\sum_{d|n} \frac{1}{d} < e^{\gamma} \log\log n,$$

  for all n sufficiently large ($n \geqslant 5041$), where γ is Euler's constant.

  Theorem (Robin, G, 1984): This is equivalent to RH.

  A. Ivić[16] has shown for $n \geqslant 7$, $\sum_{d|n} \frac{1}{d} < 2.59 \log\log n$.

  Let

$$\theta_{n,m} = \sum_{k_1 < \cdots < k_n} \prod_{\ell=1}^{n} [\rho_{k_\ell}(1 - \rho_{k_\ell})]^{-m},$$

  where $\rho_1, \rho_2, \cdots$ is the list of all nontrivial zeros of $\zeta(s)$.

  Theorem (Matijašević, 1988): For all n, m, $\theta_{n,m} > 0$ is equivalent to RH.

- On the Extended Riemann Hypothesis.

  Theorem (Miller, G, 1975): ERH implies that primality testing can be done in polynomial time P.

  Is primality testing NP complete? If so, ERH implies P=NP.

[16] Two inequalities for the sum of divisor function. Uviv. u Novom Sadu Zb. Rad. Prirod. -Mat. Fak. 7 (1977), 17-22.

- On the Generalized Riemann Hypothesis.

  Theorem (Hooley, C, 1967): GRH implies Artin's conjecture.

- Hilbert's problem 8 (in 3 parts and concerned with RH, Goldbach's conjecture and twin primes) is still unresolved since its announcement as part of Hilbert's famous list of 23 problems. Notice that Hilbert's list of 23 problems appears in the Bulletin (New Series) of the American Mathematical Society (AMS) volume 37, #4, October 2000, pg. 407.

The Riemann Hypothesis has been supported by extensive numerical calculations (the first 1.5 billion zeros satisfy RH) and various heuristics, but such partial evidence is not convincing enough for all mathematicians, including A. Ivić. He points out[17] a heuristic connected with moments of the zeta-functions: this would imply the falsity of the Lindelöf hypothesis, and a fortiori that of the Riemann hypothesis! In the same paper he discusses other "conditional disproofs" of RH. Furthermore, in personal correspondence, he writes "I don't think there is much hope in working through Robin's equivalent."

CMI Millennium Prize Problems

The Clay Mathematics Institute (CMI) of Cambridge, Massachusetts has named seven Millennium Prize Problems. The Scientific Advisory Board of CMI selected these problems, focusing on important classic questions that have resisted solution over the years. The Board of Directors of CMI designated a 7 million prize fund for the solution to these problems, with 1 million allocated to each. The problems were announced on Wednesday, May 24, 2000, at the Collège de France. One hundred years earlier, on August 8, 1900, David Hilbert delivered his famous 23 open problems. A mathematical description *(a leading specialist in the domain in question has formulated each problem)* as well as the rules for the CMI millennium prize problems can be found via our website (http://www.cms.math.ca/Students) by following the links *In your area*, *mathematics at UNBC*, *news*, *Clay Mathematics*. The 7 problems are:

P versus NP
The Hodge Conjecture
The Poincaré Conjecture
The Riemann Hypothesis
Yang-Mills Existence and Mass Gap
Navier-Stokes Existence and Smoothness
The Birch and Swinnerton-Dyer Conjecture

[17] On some results concerning the Riemann hypothesis, Analytic number theory (Kyoto, 1996), 139-167, London Math. Soc. Lecture Note Ser., 247, Cambridge Univ. Press, Cambridge, 1997.