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MAA FOCUS

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Inside

On the cover: At Colby College, one of the goals of "Calculus After Hours" is to encourage students to study actively and cooperatively. Several articles in this issue discuss ways to encourage active learning. See pages 11-19. Photograph courtesy Fernando Gouvêa.

MAA FOCUS Deadlines

	August/September	October	November
Editorial Copy	July 8	July 20	September 16
Display Ads	July 10	August 20	September 24
Employment Ads	June 11	August 13	September 10

John Thompson and Jacques Tits Share the 2008 Abel Prize

The Norwegian Academy of Science and Letters announced that John Thompson of the University of Florida and Jacques Tits of Collège de France will share the 2008 Abel Prize "for their profound achievements in algebra, and in particular for shaping modern group theory." The prize of six million NOK (about US $1.2 million) will be presented by His Majesty King Harald of Norway at the Abel Prize Award Ceremony in Oslo on May 20.

Both Thompson and Tits have made fundamental contributions to group theory. Thompson "revolutionized the theory of finite groups by proving extraordinarily deep theorems that laid the foundation for the complete classification of finite simple groups." Tits "created a new and highly influential vision of groups as geometric objects." Their work has, in different ways, become foundational in modern group theory, playing an important role, in particular, in the classification of finite simple groups. Thompson discovered one of the sporadic simple groups and made the connection between Lie Groups and finite groups, while Tits' buildings proved to be the key to the classification of simple groups of Lie type.

John Griggs Thompson and Jacques Tits are the 2008 Abel Laureates. (Photo: University of Florida and Jean-François Dars/CNRS Images)

John Griggs Thompson is Graduate Research Professor at the University of Florida. Born in 1932 in Ottawa, Kansas, Thompson received his PhD from the University of Chicago in 1959. He became a professor at the University of Chicago, then moved to England in 1970 to become the Rouse Ball Professor of Mathematics at the University of Cambridge. He retired from Cambridge in 1993 and moved to the University of Florida.

Thompson's work includes many important results on finite groups, including the famous theorem, proved in collaboration with Walter Feit, that every finite group of odd order is solvable, a result that many consider the starting point for the classification of all finite simple groups. In 1970, Thompson received the Fields Medal for this and other results. For more on Thompson and his work, see http://www.math.ufl.edu/dept_news_events/news-items/abel-prize-2008.html.

Jacques Tits is Professor Emeritus at the Collège de France, in Paris. Born in Belgium in 1930, Tits received his doctorate in Brussels when he was 20 years old. Now a French citizen, he has held professorships at the Free University of Brussels, at the University of Bonn, and, since 1973, at the Collège de France, where he became Emeritus in 2000.

Tits is best known for his creation of the theory of "buildings," which are combinatorial structures associated to algebraic groups. The theory of buildings which "can be thought of as a vast generalization of projective geometry," has become an essential tool for studying algebraic groups, including, in particular, finite groups and p-adic Lie groups. For more on Tits and his work, visit http://www.college-de-france.fr/default/EN/all/ins_pro/p1000206292273.htm.

Since there is no Nobel Prize for mathematics, the Abel Prize is intended to be its equivalent in both prestige and monetary value. It is awarded by the Norwegian Academy of Science and Letters. Their choice of Abel Laureate is based on a recommendation by the Abel Committee consisting of five internationally recognized mathematicians. The Niels Henrik Abel Memorial Fund was established in 2002, to award the Abel Prize for outstanding scientific work in the field of mathematics. The prize was awarded for the first time in 2003. For more information on the Abel Prize and on this year's winners, visit http://www.abelprisen.no/en/.

Past Abel Prize Winners

2003: Jean-Pierre Serre

2004: Sir Michael Francis Atiyah and Isadore M. Singer

2005: Peter D. Lax

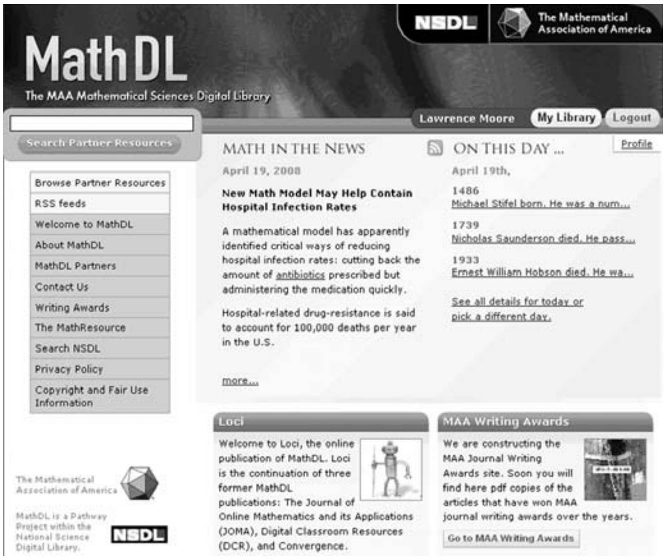
2006: Lennart Carleson

2007: Srinivasa S.R. Varadhan

New MathDL To Debut This Summer

By Lang Moore

A new Mathematical Sciences Digital Library (MathDL) will appear on MAA Online this summer. This new MathDL will have a new format, a new mission, and will feature a new publication, *Loci*.

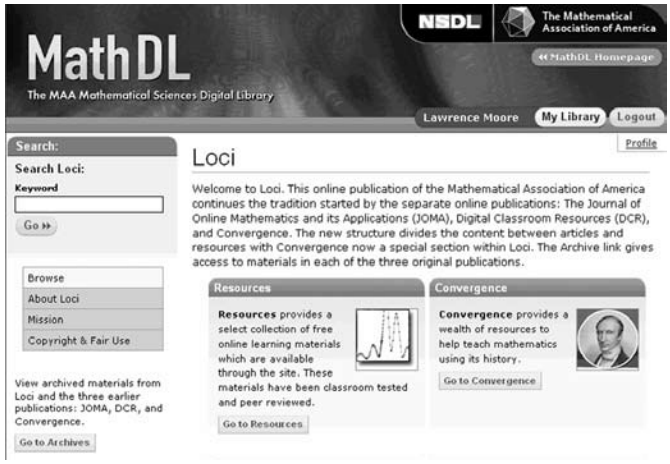


The New MathDL Homepage

About the New MathDL

Within MathDL you will be able to read the daily Math in the News feature (with RSS and FeedBurner notification options), check *On This Day* in math, and search for online materials in mathematics at partner sites. (One new partner is MathResources Inc.; MathDL search will feature mathematical definitions from their *The MathResource*.) If you are registered with the site and login, you will have access to the My Library functionality including a list of your favorite MathDL materials and an opportunity to share links to resources and discussions with those you invite.

The new online publication, *Loci*, will combine and extend three old MathDL publications: *Journal of Online Mathematics and its Applications* (JOMA), *Digital Classroom Resources* (DCR), and *Convergence*. *Loci* will be directed by a new editorial board consisting initially of Kyle Siegrist (currently Editor of JOMA), Doug Ensley (currently Editor of DCR), Victor Katz (currently co-Editor of *Convergence*), and Lang Moore (Executive Editor of MathDL). The new publication will support both searching and browsing over materials published in *Loci* as well as over materials archived from the three earlier online publications. While *Loci* will have many new features, special sections for *Resources* and *Convergence* will maintain continuity with the earlier publications.



The MAA Writing Awards site within MathDL will continue to make available online pdf copies of award-winning articles from the three MAA print journals.

The two members-only-or-by-subscription components of the current MathDL, *MAA Reviews* and *Classroom Capsules and Notes*, will no longer be accessed from the MathDL home page. Instead, they will be available through MAA Online. However, they will still be supported by the MathDL content management system, and the functioning of these two sites will be essentially the same as before. Under the editorial direction of Fernando Gouvêa, *MAA Reviews* now contains listings of over 4100 mathematics-related books, about 40% with reviews (and many still being reviewed). With the help of JSTOR, Wayne Roberts and his associate editors have identified and posted over 550 classroom articles from the MAA print journals. Both these projects will continue to grow in their new setting.

While anyone may register with MathDL, MAA members will be automatically registered at MathDL with the same username and password they use in the rest of the MAA site, Moreover, once logged in on either MAA Online or MathDL, members will be able to move from one site to the other without logging in again.

The development of the new MathDL has been supported by NSF Grant DUE-0435198 within the program supporting the National Science Digital Library (NSDL). When the new MathDL comes online, Math Gateway will cease operation, and MathDL will become the MAA's pathway project in the NSDL.

The merger of Math Gateway and the existing MathDL is being carried out by MathResources Inc. (MRI) in Halifax with the assistance on MAA's end of Sam Hathaway. In addition to contributing definitions from *The Math Resource*, MRI has documented the existing code, made the combined system more reliable, and greatly improved the administrative "back end."

Since early 2001, MathDL has published the *Journal of Online Mathematics and its Applications* (JOMA) and provided an array of classroom tools in *Digital Classroom Resources* (DCR). In 2004, the online magazine *Convergence* joined the two original publications. *MAA Reviews* and *Classroom Capsules and Notes* followed in 2005 as resources for MAA members and subscribers.

The original MathDL was created by Don Albers, Doug Ensley, Gene Klotz, Lang Moore, Jerry Porter, David Smith, and Tina Straley with the extensive support of staff at Math Forum, particularly Lee Smith. The site was housed at Math Forum in Swarthmore from 2001-2003. Shortly after Math Forum moved to Drexel University, MathDL was moved to a content management system located at MAA Headquarters in Dupont Circle. The original MathDL was made possible by NSF grant DUE 0085861, awarded to MAA in 2000 — in the first year of the NSDL program.

Online resources evolve more quickly than do print ones, and MathDL is no exception to this rule. Keep an eye out for the latest version of MathDL — online at MAA.org early this summer. The URL will remain the same.

http://mathdl.maa.org

Irina Mitrea Wins Ruth I. Michler Memorial Prize

The Association for Women in Mathematics and Cornell University have announced that Irina Mitrea of the University of Virginia will receive the second annual Ruth I. Michler Memorial Prize. The Michler Prize grants a mid-career woman in academe a residential fellowship in the Cornell University mathematics department without teaching obligations. This pioneering venture was established through a very generous donation from the Michler family and the efforts of many people at AWM and Cornell.

Irina Mitrea was selected to receive the Michler Prize because of her past achievements and future promise. After earning an M.S. in Mathematics from the University of Bucharest in 1993, Mitrea carried out her doctoral work at the University of Minnesota, where she investigated the spectral properties of elliptic layer potentials under the direction of Carlos Kenig and Mikhail Safonov. A postdoctoral membership at the Insitute for Advanced Study in 2000–2001 was followed by her appointment as an H. C. Wang Assistant Professor at Cornell University. In 2004, Mitrea began a tenure track appointment in the mathematics department at the University of Virginia, where she was tenured and promoted to Associate Professor in 2007.

Mitrea's area of expertise is at the interface between Real and Harmonic Analysis and Partial Differential Equations. In particular, combining harmonic analysis techniques and partial differential equations methods, she studies second and higher order elliptic boundary value problems in non-smooth domains. At Cornell, Mitrea plans to collaborate with Camil Muscalu on the connection between integral operators for higher order elliptic PDEs and multilinear theory. With Bob Strichartz, she will study Triebel-Lizorkin spaces on certain selfsimilar fractals. She also intends to continue her work with Subrata Mukherjee studying higher order elliptic boundary value problems in two and three dimensional Lipchitz domains.

Ruth Michler's parents, Gerhard and Waltraud Michler of Essen, Germany, established the memorial prize with the Association for Women in Mathematics because Ruth was deeply committed to its mission of supporting women mathematicians. Cornell University was chosen as the host institution because of its distinctive research atmosphere and because Ithaca was Ruth's birthplace. At the time of her death, Ruth was in Boston as an NSF visiting scholar at Northeastern University. A recently promoted associate professor of mathematics at the University of North Texas, she was killed on November 1, 2000 at the age of 33 in a tragic accident, cutting short the career of an excellent mathematician.

Found Math

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(Thanks to Mark Sand, Dana College)

Ask Not What Your MAA Can Do For You...

By Robert W. Vallin

The MAA has two extremely large meetings each year, MathFest and the Joint Mathematics Meetings. The MAA applies for, receives, and administers dozens of grants each year. The MAA has 11 SIGMAAs (Special Interest Groups of the MAA). For 2007, the MAA commitment to professional development included running 14 Professional Enhancement Programs, assisting 17 Regional Undergraduate Mathematics Conferences with funding and materials, and running the Putnam Exam and American Mathematics Competition (AMC). In addition there are the three journals and two magazines published by the MAA, and let's not forget Project NExT (New Experiences in Teaching).

What's the point of this (partial) list? Not to brag, although with so many things done so well, the MAA would be justified in a little hubris. What if it's also pointed out that this is done with 32 staff members at the Washington, DC headquarters and nine at the AMC headquarters? Let's get to the point. What we do cannot be done by 41 people alone. It can only be done with the help of hundreds of member-volunteers.

It sounds like a cliché, but the volunteers are the backbone of the MAA. Without their help the MAA could not hope to do a tenth of what it does each and every year. For those who pursue jobs in academia, helping the MAA is a great way to fulfill some of your obligation in the Scholarship and Service categories. Outside academia, companies like to see well-rounded employees with a commitment to their discipline. For those who are still students, getting involved now will make you part of the vibrant culture of mathematics. Faculty, graduate and undergraduate students, mathematicians in business, industry, and government can all contribute.

Committees/Liaisons

A large part of the MAA is committee work. Currently there are over 125 committees listed on the the MAA web site. Examples include the MathFest Site Selection Committee, the Committee on the Undergraduate Program in Mathematics, the Committee on Two-Year Colleges, the Science Policy Committee, and the Committee on SIGMAAs. The interests and activities of the various groups cover a large spectrum of subjects. Check and see which one could use your talents. Many committees meet once a year at either MathFest or the Joint Meetings, although there is work to be done throughout the year.

Given everything the MAA does, both on the national and on the local levels, there needs to be an effective way to communicate information to the members. Currently MAA Liaisons fill this role. Every department should have a faculty member as a liaison (check and see if yours does). When the MAA announces new programs, grant opportunities, or workshops, it contacts the liaisons and asks them to spread the word to the faculty members. When there is information on travel grants and programs for students, the MAA uses the liaisons to spread the word. If you become a liaison, let us know so we can update our records.

Journals and Books

The MAA publishes three journals (*The American Mathematical Monthly, The College Math Journal, Mathematics Magazine*), a news magazine (MAA FOCUS), an undergraduate magazine (*Math Horizons*). The MAA also has a very active book publication program. Plus there are many online articles and other items, such as the columns on the MAA web page, *Digital Classroom Resources, MAA Reviews, Convergence*, and *Classroom Capsules and Notes*.

One way to get involved is, of course, to put your time and energy into writing for one of these. If you know a great way to show Newton's Law of Cooling in your Differential Equations class, write it up for *Classroom Capsules*. If you have a neat little exercise, submit it for the Problems Section. In addition, referees are always in demand to look at submissions and determine whether they are appropriate for the journal's audience. Journals and book series also have Advisory Boards. Maybe working on one of these is a match for you. Undergraduates also have a place in all this: *Math Horizons* has a fifteen-member Student Advisory Group.

The Joint Mathematics Meetings and MathFest

Behind every big meeting there is a big group of people who make it work. Without them, it would be like throwing a big party, yet having no music, no games, and no food. These meetings have mini-courses, short courses, invited paper sessions, contributed paper sessions, panel discussions, poster sessions, and much more.

The people who put all this together are not just the staff of the MAA, they are the members who want to contribute to the mathematical community. If you have a great idea for a mini-course, submit it. If there is a topic for a contributed paper session that you wish to see done, don't wait for someone else to run it, petition the committee on contributed paper sessions to approve it for the next JMM or MathFest. No, you are not thrown out there alone and told, "OK, you wanted it, you put it all together." There are staff and volunteers ready with advice and answers to assist you.

Once again, opportunities exist for undergraduates. At the January 2008 JMM, a panel discussion on navigating the meeting had a student sharing his experiences at the 2007 meeting in New Orleans. Two students at the 2007 meeting wrote up their adventures for the Chapter Advisor's Newsletter put out by the Committee on Undergraduate Students and Chapters (see http://www.maa.org/students/chapter_news/index.html). Don't let the size of the meetings intimidate you out of helping.

MAA Sections

We would be remiss not to talk about Sections and their need for member-volunteers. Each regional Section of the MAA has at least one meeting per year. There are talks (so volunteer to speak) and possibly short courses, panels, games, and more. Each Section does things a little differently and, if you have belonged to more than one Section, you can bring these different ideas to your new Section's attention. One Section has a Puzzle Czar who makes a handout of "Puzzlers and Prizers" for students and faculty to work on during the meeting. Another makes some of the lunch tables themed. At registration, you can sign up to be part of a group discussing math for elementary education majors or using PowerPoint in the classroom.

Of course, one way to volunteer in a section is to be part of running the show. That could be in the form of volunteering for committee work (someone has to help with choosing the Teaching Award winner), hosting a sectional meeting at your school, or running for office. You don't have to wait for the section to come to you for help, go to them and ask what they need. Students, if the sectional meeting is held at your school, you can help. People are needed to check participants in and give them their information packets, rooms must be set up, and signs posted. It's a great opportunity to meet people and see what goes on outside the classroom. Graduate students: this is a good place to practice your expository job talk.

So why volunteer? On one level, there is the self-indulgent answer: it looks good on a resume and will help in finding a job/obtaining tenure/earning promotion. All of those are true and none of them are bad reasons. But there is much more. We want our discipline to continue to flourish and grow. This can only be accomplished through a continuing influx of new ideas and new people. Enthusiastic individuals who can help keep things going and bring innovation to the table are needed. You can be one of these people.

Robert Vallin is Associate Director for Student Programs at the MAA.

Outsourcing Mathematics: Is a News Story Like This Possible?

A nightmare from Michael Henle, Oberlin College.

Dystopia Times

Mathematics Department Shuts Down

Monday, May 3, 2010. Nemesis College announced today the dissolution of its mathematics department. No details were given, only the statement that the future mathematical needs of its students would be met outside the traditional Department of Mathematics setting.

We wondered what this meant. Could it really be true that students at Nemesis would no longer be subjected to the universally unpopular subject of mathematics? To find out, we interviewed Professor Earnest, the former chair of the mathematics department.

He met us in his old office, surrounded by half-packed boxes of books. We asked first if this action on the part of the College administration had come as a surprise to him or to other members of the mathematics department.

"Not at all," Professor Earnest said. "This has been in the works for some time. For example, we haven't taught statistics for at least a year. It's outsourced to economics, psychology and other client departments. They prefer it like that. The last statistician left the Department of Mathematics several years ago."

We were curious about the calculus, that most dreaded of mathematics courses. How would Nemesis students be taught calculus?

"Not a problem," Professor Earnest told us. "Most of our students get their calculus in high school now. The few that don't will be given workshops. They'll be shown how to do calculus using a computer algebra system. The Engineering Department will handle this. That's what they want. Likewise, students who need remedial work in algebra and trigonometry will be trained on software."

What about current members of the Department of Mathematics? Where would they end up?

"Well, a few *will* retire," Professor Earnest said, "but most of us will be right here. Let's see. A few colleagues are joining the Computer Science Department and some others will be in Engineering. They'll teach the workshops I mentioned. Then a few more will work in Information Technology. They will update software, trouble-shoot email problems, replace spent print cartridges, and the like. Oh, and a few lucky chaps are joining Environmental Studies. They'll teach modeling software. Maybe even a course or two."

All this seemed very well planned to us. Our last question concerned Professor Earnest himself. Where would he be?

"I'm fortunate," he said. "I'll be in the Physics Department. I get to teach transform theory and advanced analytical methods." He paused. "There's only one problem." For the first time in the interview he looked a little sad. "What was the problem?" we asked.

Professor Earnest sighed. "No proofs," he said. "I have strict instructions. There must be no proofs in my classes."

New JSTOR Platform Launches

By Ryan Miller

Frequent users of the scholarly journal archive JSTOR may have noticed a few changes to its interface beginning on Friday, April 4. Besides a renovated homepage, new search capabilities and features such as "MyJSTOR" make the new platform easier to use.

"MyJSTOR" is the first step in providing greater personal customization for users throughout the site. Users can now manage citations over time by saving them to an account where they can be stored indefinitely. Users can also accept JSTOR's terms and conditions of use once, rather than being prompted to respond with each article print or download.

JSTOR basic searches, which search the full-text of all journals, can now be entered directly from the homepage by authorized users and limited by discipline. Advanced searches can be limited by selecting disciplines or specific journal titles, or by directly entering a specific title into the form. Also, proximity search is now available in the advanced search form, using near 5, near 10, or near 25 operators in the pull-down menus. Searches from an individual session will now be saved, and they can be rerun from a dropdown menu at the bottom of each of the search forms. Users are also able to search for both the singular and plural versions of a word by adding an ampersand (&) to the end of the singular form of the word.

JSTOR now offers articles in a single, improved PDF format for printing. The PDF versions of articles provide bookmarks for easier navigation, both throughout the article and the entire issue.

The JSTOR database is an archive of important scholarly journals, offering researchers high-resolution, scanned images of journal issues and pages. It now includes more than 37,000 articles from *The American Mathematical Monthly,* from 1894 to 2003.

Access to the JSTOR archive is provided by many colleges, university, and other libraries. If your library is a subscriber, look for a nearby library that does have JSTOR access and is open to the public. Members of the MAA have the option of purchasing an individual subscription to JSTOR that gives them access to the archives of *The American Mathematical Monthly, Mathematics Magazine,* and *The College Mathematics Journal*. For complete details on the improved JSTOR platform, visit http://www.jstor.org/page/info/about/archives/newFeatures.jsp.

Quantitative Literacy Conferences

Three related events addressing Quantitative Literacy (QL) will take place between May 15-17 at Colby-Sawyer College in New London, NH, offering opportunities to meet colleagues from across the country involved in promoting QL, to hear presentations on teaching QL, funding QL initiatives, and QL assessment, and to contribute to a web site on "writing with numbers" assignments. Participants are invited to all of the three, or to individual events if they choose. Travel support is available for the workshop event to individuals lacking institutional or grant support.

Annual Meeting of the National Numeracy Network, Thursday, May 15.
The NNN is a broad-based organization, largely rooted in higher education, promoting quantitative literacy for all citizens.

Workshop on Writing with Numbers, Thursday evening, May 15-Friday, May 16.
This workshop is designed to generate materials for a web site providing examples of assignments that involve students in writing with numbers. Workshop features a keynote address by Mya Poe, MIT.

Annual Meeting of the Northeast Consortium on Quantitative Literacy, Saturday, May 17.
NECQL annually brings together faculty from the northeast states interested in teaching quantitative literacy. Open to all.

All three links are available at the National Numeracy Network home page at: http://serc.carleton.edu/nnn/.

Some Observations on Teaching Induction

Mary E. Flahive and John W. Lee

We have taught mathematical induction in various courses over many years. The observations given here stem from an analysis of our experience, and especially from listening to math majors in recent discrete mathematics classes that we have recently taught using guided discovery.

Mathematical induction is often illustrated by an analogy to long rows of falling dominoes or to steps on infinite ladders. After listening to students, as they worked in groups and reading their subsequent written work, we've identified some subtleties of the technique that we now are more careful to emphasize with our classes.

Most students easily learn to apply the induction template to prove formulaic results. Indeed, Gauss' formula for the sum of the first n positive integers is a typical first problem in many textbooks. In that example, after verifying the base case, a student or a textbook might continue the induction argument as follows:

Assume inductively that:

$$1+2+\cdots+n=\frac{n(n+1)}{2} \qquad (*)$$

Then

$$1+2+\cdots+n+(n+1)=$$
$$\frac{n(n+1)}{2}+(n+1)=\frac{(n+1)(n+2)}{2}$$

With these two sentences the induction step is advanced and the proof is completed. When we explicitly asked our students why these steps constitute a proof, most students were unable to explain. In fact, as we probed further most of them displayed a marked uncertainty with the correctness of their proofs. One reason for their ambivalence is the use of the word "assume" in the inductive hypothesis: many students find it difficult to distinguish between assuming something is true and knowing that it is true. This distinction requires a precision of language and thought that presses their mathematical experience and provides an opportunity for growth.

This example also illustrates one of the problems with restricting the first examples on induction to such formulas. Students seem to regard (*) *as the statement being proved by induction*; that is, the context obscures the fact that a sequence of statements S(n) must be proved where the nth statement S(n) is (*). Another reason for student uncertainty with these arguments is the inherent chameleon role of the variable n: sometimes it is a fixed variable and sometimes it is a free variable.

When mathematicians read the above proof we mentally insert "Assume inductively for an arbitrarily fixed positive integer n that…" For us, the use of the variable in the principle of mathematical induction is clear. In the original statement n is a free variable. In the induction assumption and the subsequent algebra it is a fixed variable that is otherwise arbitrary. In the inductive conclusion it is again a free variable.

From the perspective of many of our students the situation is much less clear. For them, n usually denotes a free integer variable, in which case the inductive assumption is assuming what they are asked to prove. Nevertheless, they have been asked to prove something and so they continue. As evidence of this, we offer the following rather common phrasing of an induction argument that we see frequently in homework. (Students include more algebra for "justification").

Assume that:

$$1+2+\cdots+n=\frac{n(n+1)}{2} \text{ for all } n.$$

Then

$$1+2+\cdots+n+(n+1)=$$
$$\frac{n(n+1)}{2}+(n+1)=\frac{(n+1)(n+2)}{2} \text{ for all } n.$$

Thus, by the principle of mathematical induction the formula holds for all positive integers n.

In an effort to correct their understanding, we now ask our students to explicitly identify the sequence of statements to be proved and to use a different label to distinguish the free from the fixed roles of the variable. For example, the generic statement to be proved is identified as S(n) and in the inductive step they assume S(N) for a fixed but arbitrarily chosen positive integer N and then prove S(N+1) follows.

In addition, we encourage them to summarize in words what they have just proved; namely, to write explicitly that the truth of S(N) implies the truth of S(N+1) before they invoke the principle of mathematical induction. When our students organize their proofs in this way, they typically say that N is fixed but they rarely mention that it is fixed arbitrarily. We take this to mean that they have an understanding of the importance of the fixed nature of N in the inductive hypothesis but do not yet fully appreciate the fact that the inductive argument must work from an arbitrary positive integer to the next one.

After listening to students in this course, we now see little advantage to beginning with problems that are as prescriptive as Gauss' formula and now prefer problems that allow students to work on the subtle aspects of induction in a less artificial setting. Elementary discrete mathematics has a wealth of such problems, and two we find especially informative follow. The informative aspects of these problems include:

(A) Induction can be applied in many situations, not just to formulas involving n.

(B) The sequence of statements to be proved and the inductive proof benefit significantly from an essentially verbal statement of the sequence S(n).

Example One *(The Sum Principle) If a finite set is partitioned into a finite number of blocks, then the sum of the sizes of the blocks in the partition is the size of the set.*

As students work on this problem, it usually helps to point out that the base case is the partition into two blocks, and the result is true by definition of addition. In order to carry out a reasonable proof by induction, a student must recognize to induct on the number of blocks in a partition (rather than the size of the set) and to express the general statement as:

S(n): For any finite set and for any partition of the set into n blocks, the size of the set is the sum of the sizes of the blocks in the partition.

The proof of the inductive step must begin with an arbitrary partition of a set X into $N + 1$ blocks that is then related to an N-block partition of the same set X to which the induction hypothesis can be applied. Two essential features of this problem are realizing why the second "any" of the statement is critical to a correct induction argument and carefully invoking the base case during the induction step.

Our experience is that too many symbols get in the way. Some students formulate the general statement roughly as:

$$\mathrm{S}(n): \text{If } X = \bigcup_{k=1}^{n} B_k, \text{ then } |X| = \sum_{k=1}^{n} |B_k|.$$

Since this notation seems to force them to think in terms of one set and one partition, they cannot get started. This is an example of a common problem that can be corrected by using words rather than symbols.

Example Two *(Vertices and Edges of a Tree) In a finite tree with at least two vertices, the number of vertices is one greater than the number of edges.*

We ask our students to prove this statement by induction using two facts that they have already established: (1) every tree with at least two vertices has at least one vertex of degree one; (2) if a vertex of degree one and the incident edge (but not its other endpoint) are removed from a tree, the resulting graph is a tree. With these two pieces of information, a natural induction argument proves the sequence of statements:

S(n): Any tree with n vertices has $n - 1$ edges.

There is only one tree with two vertices and S(2) is therefore true. In order to advance the induction step, take any tree T with N+1 vertices. Using the two earlier results, T can be pruned to a tree T_0 with N vertices; by the induction hypothesis T_0 has N−1 edges. Reattaching the removed edge and vertex to T_0 reconstructs T and proves that T has N+1 vertices and N edges. An appeal to the principle of mathematical induction completes the proof.

This example reinforces aspects (A) and (B) for most students. It also uncovered an interesting student preference (possibly encouraged by the falling domino analogy) that made carrying out the proof more challenging than we had expected.

In their proofs of the inductive step, students instinctively began with a tree with N vertices to which they added an edge and a vertex of degree one and they then invariably asserted that the induction step had been advanced! They missed the subtle point that such an argument brings with it the obligation to show that all trees with N+1 vertices can be obtained in this way. (This can be justified from the two facts established earlier.) Even the best students missed this point.

Although with later classes we mentioned in a general context the extra obligation incurred by this use of induction, most students again ignored the gap in the reasoning noted above. This uncovers another subtlety in inductive arguments that requires more time and experience to appreciate. For the most part, this problem didn't occur in carefully written solutions to example one. That is, students don't build up partitions of N+1 blocks from ones with N blocks since most students who initially consider this approach realize that adding a block changes the underlying set. We have occasionally seen students construct the argument in this way, but usually the confusion comes from their using the same label for what are in fact two different sets.

Our teaching has benefited from our discussions, and we hope others who teach induction find some value in these observations from our recent experiences in teaching mathematical induction to math majors.

Acknowledgments: This material is based upon work by Mary Flahive supported by the National Science Foundation under Grant No. 0410641. Our guided discovery courses were based on Ken Bogart's notes, found at http://www.math.dartmouth.edu/archive/kpbogart/public_html/ComboNotes3-20-05.pdf. *The version used in our classes can be found at* http://www.math.oregonstate.edu/~flahive/PDFolder/DMFolder/currentadapt.pdf.

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Teaching Time Savers: The Study Challenge

Christopher K. Storm

Aren't office hours wonderful? They provide an excellent forum for the professor to connect directly with their students to discuss course materials and provide enrichment. However, students do not get the most benefit out of this time if they do not know how to study the material in a mathematics course. All too frequently, a student will arrive at my office, often quite frustrated and worn down, and say they just don't understand the material on the midterm even though they've studied for countless hours. I usually ask *how* they have "studied" and receive a blank look followed by some comment about reading over notes again and again.

This is when I inwardly cringe, for the student has taken a completely passive role in preparing and has not *done* any mathematics, wasting valuable preparation time. At this point, in the past, I would start to talk in detail about the major areas on the exam and then get the student started on working problems in my office with instructions for continuing at home. I would try to nudge the student in a more active direction.

This semester, I decided to be proactive and see if I could fix the problem before my students had spent hours "studying" instead of doing math. Before the midterms in my Calculus II and Ordinary Differential Equations classes, I instituted the Storm Study Challenge.

The challenge is simple: you are not allowed to use the word "study" in the lead up to the exam. Instead, you must phrase your plans in an active, concrete way. Asked what you are planning to do that evening, you might respond "I am going to work ten chain rule problems from the review section of my textbook and then look over some more problems to be sure I can always identify how I should break the functions up." By providing active goals, I hoped that students would be able to structure their time effectively. In addition, with such clear goals, they could better judge where they were in terms of preparedness.

Before I gave out the Study Challenge, I remarked that from time to time, I come up with ideas to help students become better learners. I did this to emphasize that this idea was meant to be something students could apply to all of their courses, not just my own. Then, I gave out the challenge. I even provided a whole string of recommended things to say instead of "I am going to study." I also mentioned that these might be some good lines to describe an exciting Friday night. I got some laughs, and the students seemed amused but willing to try it out.

The effect was great. I had students coming to my office with specific questions on specific topics. We spent our time much more effectively, and I felt that at last my students were taking control and doing the "right" things to master the content in my courses.

On the midterms, I offered a bonus point for an honest answer to whether a student had accepted the challenge or not. In both courses, over half of the students did accept it or made an effort at it (although some students said yes, but their further comments suggested that they had missed the point of active studying). Out of curiosity, I compared how students who had accepted the challenge measured up to those who had not: there was a 10 percent gap in achievement in both classes.

While I cannot claim the Study Challenge really accounted for the difference, I suspect the Challenge provided motivated students with a better understanding of how to "study" for a math exam. All in all, I considered it a great success. The Study Challenge turned my pre- and post exam office hours into more productive sessions for myself and my students.

In past courses, I created fairly comprehensive review sheets and practice exams to provide a framework for students to become active studiers. While I feel this takes some of the responsibility of studying away from the students, it has been important if I wanted good things to happen on the exams. Practice exams and review sheets implicitly direct the student to active studying, but with the Study Challenge we can make this explicit. By the end of the semester, we can just issue the Study Challenge, complete with some active studying suggestions, and then let the students create their own review sheets and search out their own review problems. Not only do students take charge of their education, but we pick up some time during a busy part of the semester for ourselves. A double bonus!

Time spent: Ten minutes making the handout and photocopying it. Three minutes giving it out and explaining the Challenge in class.

Time saved: Any time that would have been spent on making a review sheet. In addition, student studying and office hours become much more efficient, making the time spent in those activities feel far more productive and enjoyable!

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Teaching Time Savers are articles designed to share easy-to-implement activities for streamlining the day-to-day tasks of faculty members everywhere. If you would like to share your favorite time savers with the readers of FOCUS, then send a separate email description of each activity to Michael Orrison at orrison@hmc.edu. Make sure to include a comment on "time spent" and "time saved" for each activity, and to include pictures and/or figures if at all possible.

How Do Students Study?

Carmen M. Latterell

Many of us have told our students that "Mathematics is not a spectator sport" and have tried to make our lectures more interactive. But what are students doing with mathematics outside of class?

Every fall, I teach Calculus I, which is a large lecture course. At the end of the semester, I ask my students to write a one-page paper describing what they did on a daily basis in order to learn calculus. I have my graduate assistant record which students write the essay and award extra credit points. I only read the essays after the final letter grades are assigned. Students are, of course, aware of this process. To analyze the data, I write down every different strategy mentioned (usually about 75 percent of the students write). I then go through each essay again and make a tally of each strategy mentioned.

I think it is likely that my students are a lot like your students. My university is a medium-sized university, with students who were above average in their high schools. There is nothing particularly unique about them. There are various options of universities in the area, and we are able to be somewhere between selective and highly selective.

Through the years, I have learned some surprising lessons. They can be summarized in a thought, an implication, and a lingering philosophical question. The thought: *Students do what is expedient, and not necessarily what professors think they ought to do*. The implication: *Professors need to teach students how to learn*. The philosophical question: *To what degree should professors force students to work?*

Let me illustrate with a few things I've learned.

Lesson One: Students Do Not Read the Textbook, But They Do Attend Lectures.

I've never had more than 20 percent of the students say that they even look at the textbook other than for exercises. I have never had less than 80 percent of the students say they attend almost all lectures. Students have limited time. One student wrote, "I work, I have fun, I study, in that order. I am often out of time by the time I study." Another student wrote, "Reading the textbook is a waste of time." And another: "It is the job of the professor to summarize and explain the textbook. Why should I read it?" Thus, attending lectures is expedient, but reading the textbook is not.

Since I think reading the textbook is important, I've tried various strategies to encourage students to do so. I've even used class time to demonstrate how to read a mathematics textbook and I've used some book examples on tests. However, I've never seen the percentage of students who read the textbook increase. In fact, even the A students don't read the textbook. I may give up on this one. Calculus textbooks are very expensive, and all my students use are the exercises. I wonder if calculus textbooks should just be exercises.

Lesson Two: Students Do Not Work Problems That Are Viewed as "Extra."

Because this is a large lecture course, with typically 150 students in the class, I usually assign a large number of odd-numbered problems (with answers in the back of the book) and a very small set of even-numbered problems. I only collect and grade the latter. I have never had as many as one third of the students say they do the odd-numbered problems, while nearly all students did the even-numbered problems. Again, students are doing what they see as expedient. One student wrote, "I don't have time to do the extra problems."

Truly believing that students must do problems, I decided not to assign any even-numbered problems anymore, only odd-numbered problems that are neither collected nor graded. I tell students to work the problems and check their answers in the back or in the student solution manual. I then tell students that I will take problems from the odd-numbered problems to place on quizzes, and at least a few to put on tests. Would students now do the odd-numbered problems?

In fact, this significantly raised the percent of students who worked the odd-numbered problems (only a quarter of the students now say they seldom or never work the problems). When I separate the responses by grade, it shows clearly that as the grade went down, so did the percent of students who worked the odd-numbered problems. It seems that I have stumbled on a method to make doing the odd-numbered problems expedient.

Lesson Three: Students Think They Are Doing Better Than They Are.

I have also asked students what letter grade they thought they would earn in the class and what they could have done to earn a higher grade. The students were told (and it was on the syllabus) that their grade would be based on the percent of points earned, following the usual rule that 90% is at least an A–, 80% is at least a B–, etc. A total of 500 points were possible, with 400 coming from four exams and 100 points worth of weekly quizzes. At the time students were asked to predict their grade for the course, they had taken and received back all three tests and they had a summary quiz score. Only one exam was yet to come.

I count a prediction as correct unless it was at least a full letter grade off. Thus, if a student states that he/she would receive a B, and he/she received a C+, I count that as correct. I have never had more than a third of the students correctly predict their grades. Further, a vast majority of those who are incorrect overestimate their grade. Finally, the majority of students *could not think of something more that they could have done* to help themselves do better.

I'm sure I'm not the only professor who has received an email like the following.

"Professor. I'm shocked that I got a D. I had an F on the first test, a C on the second, and a D on the third. I did really well on the quizzes, and the final felt like it went really well." Of course, the student did not do all that well on either the quizzes or the final.

Back to the Thought, Implication, and Question.

Students do what is expedient, and not necessarily what professors think they should. Further, students think this strategy will lead to high grades and that they cannot do anything further. As professors, we can try to manipulate things to change how students study (I succeeded on getting them to do more problems, but have not yet succeeded on getting them to read the textbook). But, should we do this?

What do we really want students to learn? What does a grade in a course like calculus really represent? I've often struggled with these questions when our department agrees to "calculus in the high schools" (high school students taking calculus in their high school from their high school teacher but earning college credit from us). Is an A in calculus taught under these conditions the same as an A taught under the conditions of a large lecture at our university?

I think the answer to this is no: an A in college, under much more difficult conditions, represents more than an A in high school, even if we assume the content is identical. In other words, I don't think the A is only for learning content.

I do think that it is an important skill to learn how to learn, and as far as I can help students learn how to learn, I probably should. And yet, don't students have a right to make stupid decisions if they want to? And haven't we all learned a lot from our past stupid decisions? Do we really learn how to learn if we are tricked into doing certain things? Maybe we ought to tell students what we think they ought to do and then leave it up to them. Is that where we draw the line?

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Portfolios and Scoring Rubrics in Technology-Aided Instruction

By David Yopp

Mathematical software systems, such as *Maple, Mathematica,* and MATLAB, offer attractive graphical and computational packages that can enhance students' exploration of mathematics. Used appropriately, such software can help students develop rich conceptual understanding of course content. However, if you are like me, you have had difficulty getting students to use mathematics software effectively. My students have often used this software solely as a computational crutch, avoiding work they could have (and possibly *should* have) done in the traditional, paper-and-pencil way. This article shows how a portfolio-based assignment and corresponding scoring rubric can be used to increase students' "high-level" use of these technologies.

I first began using *Maple* in third semester calculus about ten years ago. Third semester calculus seemed like a good fit for this software because of the course's required spatial reasoning skills. I wanted my students to use the software to build concept images (defined to be the total cognitive structure associated with a concept, including all mental pictures, properties, connections, etc). I wanted my students to connect the computation they were performing to the corresponding graphical representations.

I asked my students to use *Maple* to explore class content and to hand in printouts of their *Maple* sessions, in portfolio form, at the end of the semester. I hoped to see evidence of concept development. I also hoped to find a lot of new and nifty *Maple* commands. Instead, I received portfolios containing almost verbatim regurgitations of *Maple* sessions I had presented in class. There was no evidence of concept development, and I didn't see a single new command. The students seemed to have done little on their own and had used this high-powered software as a calculator.

Maple Portfolio Scoring Rubric

To receive a grade in the range on the left, your portfolio must exhibit the corresponding characteristics on the right.

90-100 **A**	• I included printouts of Maple work-sessions using **all** of the commands given to me in class; plus I demonstrated that I learned **several** useful, nontrivial Maple commands different from those given to me in class. • I used Maple to explore Calculus III numerically and graphically, and the comments included with my printouts made it clear that my conceptual understanding of Calculus III applications or theory was significantly **deepened** by my use of Maple. • I used Maple to make new discoveries about Calculus III. • My portfolio is clear, concise, and well organized.
80-89 **B**	• I included printouts of Maple work-sessions using **most** of the commands given to me in class; plus I demonstrated that I learned **at least one** useful, nontrivial Maple command different from those given to me in class. • I used Maple to explore Calculus III numerically and graphically, and the comments included with my printouts made it clear that my conceptual understanding of Calculus III applications or theory was **somewhat deepened** by my use of Maple. • My portfolio is clear, concise, and well organized.
70-79 **C**	• I included printouts of Maple work-sessions using **roughly 3/4** of the commands given to me in class. I included **no or few** maple commands that I learned **on my own**, and those included were not sufficient to make up for the other commands absent from my portfolio. • I presented **little evidence** to suggest I gained conceptual understanding about Calculus III from my Maple sessions. • My portfolio **could be improved** in terms of clarity and organization.
60-69 **D**	• The printouts in my portfolio were **incomplete**. Many of the commands given to me in class were absent. I included **no or few** Maple commands I learned on my own, and those I did include were not sufficient to make-up for the other commands absent from my portfolio. • I presented **very little evidence** to suggest I gained conceptual understanding about Calculus III from my Maple sessions. • My portfolio could be **improved considerably** in terms of clarity and organization.
0-59 **F**	• A **significant number** of the Maple commands given to me in class are missing from my portfolio. • I presented **no evidence** to suggest I gained conceptual understanding about Calculus III from my Maple sessions. • My portfolio is **minimally or not at all** clear or organized.

About five years ago, I stumbled onto some mathematics education literature that discussed scoring rubrics. To many mathematics educators, portfolios and scoring rubrics go hand-in-hand. According to the literature, the power of a scoring rubric goes beyond its value as a grading and feedback tool. Rubrics also help educators communicate their expectations better and help students understand those expectations prior to beginning the assignment. With a better understanding of the instructor's objectives, students are more likely to meet or exceed the instructor's expectations.

Consequently, I created the *Maple* Portfolio Scoring Rubric shown on page 14. All of my *Maple* objectives were delineated into itemized rows with corresponding grades. Specific wording was included about each assessment criterion, e.g. *the portfolio contains all commands given to me in class; most of the commands; ¾ of the commands; or few or none of the commands*. The students were given the rubric at the beginning of the semester, and the rubric was used to provide feedback at midterm and on the final product at the end of the semester. The improvement in student outcomes was striking.

The use of *Maple* commands not presented in class improved strikingly. While new commands were almost always absent from the pre-rubric portfolios, the post-rubric portfolios were rich with them. In fact, students began teaching me commands. Examples include: textplot3d, TNBFrame, RadiusOfCurvature, potential, tubeplot, animate, densityplot, DirectionalDiff, ApproximateInt.

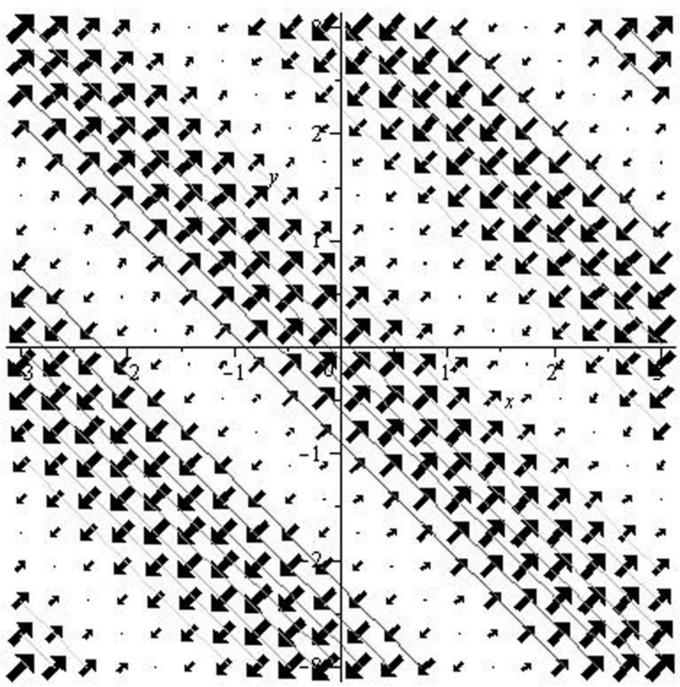
Also improved was the students' use of *Maple* text lines to explain their thinking. These text lines were used to narrate *Maple* sessions, and it was this prose that helped me evaluate whether students had used the software to increase their understanding of important mathematical ideas. (See Student Work 1 & 2 for examples of actual student work with my comments.)

Using the scoring rubric also aided me during the grading and feedback process. As we all know, it can be daunting to grade an open-ended task such as a portfolio. The process can be time consuming, and giving feedback can be challenging. Finding the right words to explain how and why a grade was assigned can be particularly difficult. Fortunately, the rubric offers a quick, clear, and consistent process for grade assignment. By circling the corresponding bullets, each scoring criterion is assessed individually in a manner that allows for easy student reflection. The total percentage score can be calculated by considering the aggregate of the individual criterion scores or by considering which category the majority of the circled items appear.

The feedback benefits of the rubric are best realized if the instructor evaluates the portfolio before the final due date. This "progress assessment" allows the student to reference the bulleted items and self-assess by determining exactly which criteria are deficient and need to be improved.

Student Work Example 1
(Student comments are in italics)

> T := *gradplot* (*sin*($x + y$), $x = -3..3$, $y = -3..3$, *arrows* = (*thick*) :
> Y : = *contourplot* (*sin*($x + y$), $x = -3...3$, $y = -3...3$) :
> *display* (T,Y) :



This graph shows where the steepest slopes are in the function sin(x+y). The relationship between the gradient vector field and the contour map is that the gradient vectors are perpendicular to the level curves. Also the gradient vectors are long where the level curves are close to each other and short where they're farther apart. This is because the length of the gradient vector is the value to the directional derivative of f and close level curves indicate a steep graph.

Author's notes: It is this student's rich dialogue that convinces me that the student is using *Maple* as an exploratory learning tool. While many of these terms, concepts, and relationships were discussed in the text and in the class, the *Maple* session appears to have helped the student put these concepts together to form a strong concept image.

The use of a portfolio and corresponding scoring rubric can greatly increase students' use of mathematics software to investigate and explore important mathematical concepts. Advantages include:

1. Clear communication of instructor expectations.

2. Clear and concise criterion-based feedback.

3. Quick and consistent grading.

It should also be noted that the rubric is not *Maple*-specific. The terms can be changed to accommodate any computer algebra system.

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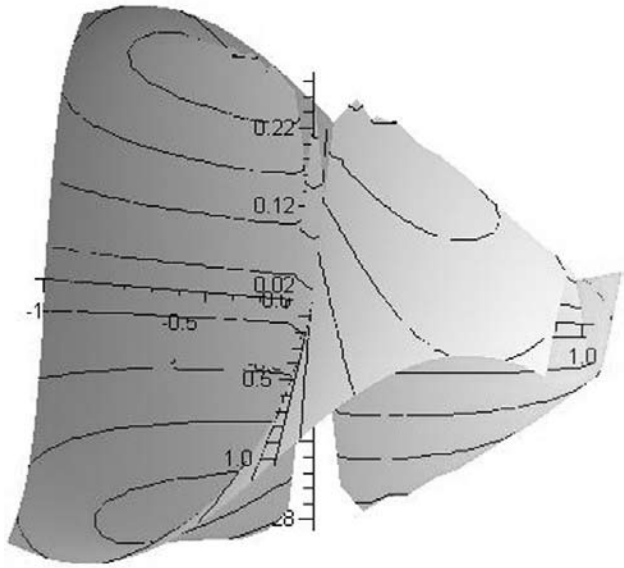
A Calculus Exercise?

Poland Springs claims that its new bottles (on the left) are "greener" than its old bottles because they hold the same amount while using less plastic. Can this be true?

Student Work Example 2

$> with(plots):$

$> plot3d\left(\dfrac{x \cdot y \cdot \cos(y)}{3 \cdot x^2 + y^2}, x = -10..10, y = -10..10, axes = normal\right);$



Doesn't look like this graph has a limit at the origin because different paths in the domain converge on two different z values. To prove this let one path be y = x.

$> limit\left(\dfrac{x^2 \cdot \cos(x)}{4 \cdot x^2}, x = 0\right);$

$$\frac{1}{4}$$

Let another path be $y = x^2$

$> limit\left(\dfrac{x^3 \cdot \cos(x^2)}{3 \cdot x^2 + x^4}, x = 0\right);$

$$0$$

Two different paths lead to two different limits which means the limit of this function as x and y approach zero does not exist.

Author's notes: Again, it is the student's prose that convinces me that the student is using *Maple* for more than a computational tool. The three-dimensional graph has allowed the students to visually discover paths where the limits do not agree. Again, this type of activity can help the student to create a rich concept image.

Student Collaboration Using a LaTeX Wiki

By W. Ethan Duckworth

How can you get your students working together? How can you get them involved in the creation of important class material, from lecture notes to worksheet solutions? How can you have them practice writing beautiful mathematics? One answer to all of the above is to use a LaTeX wiki. In this article I will describe how I've used such a system for the past few semesters at Loyola College.

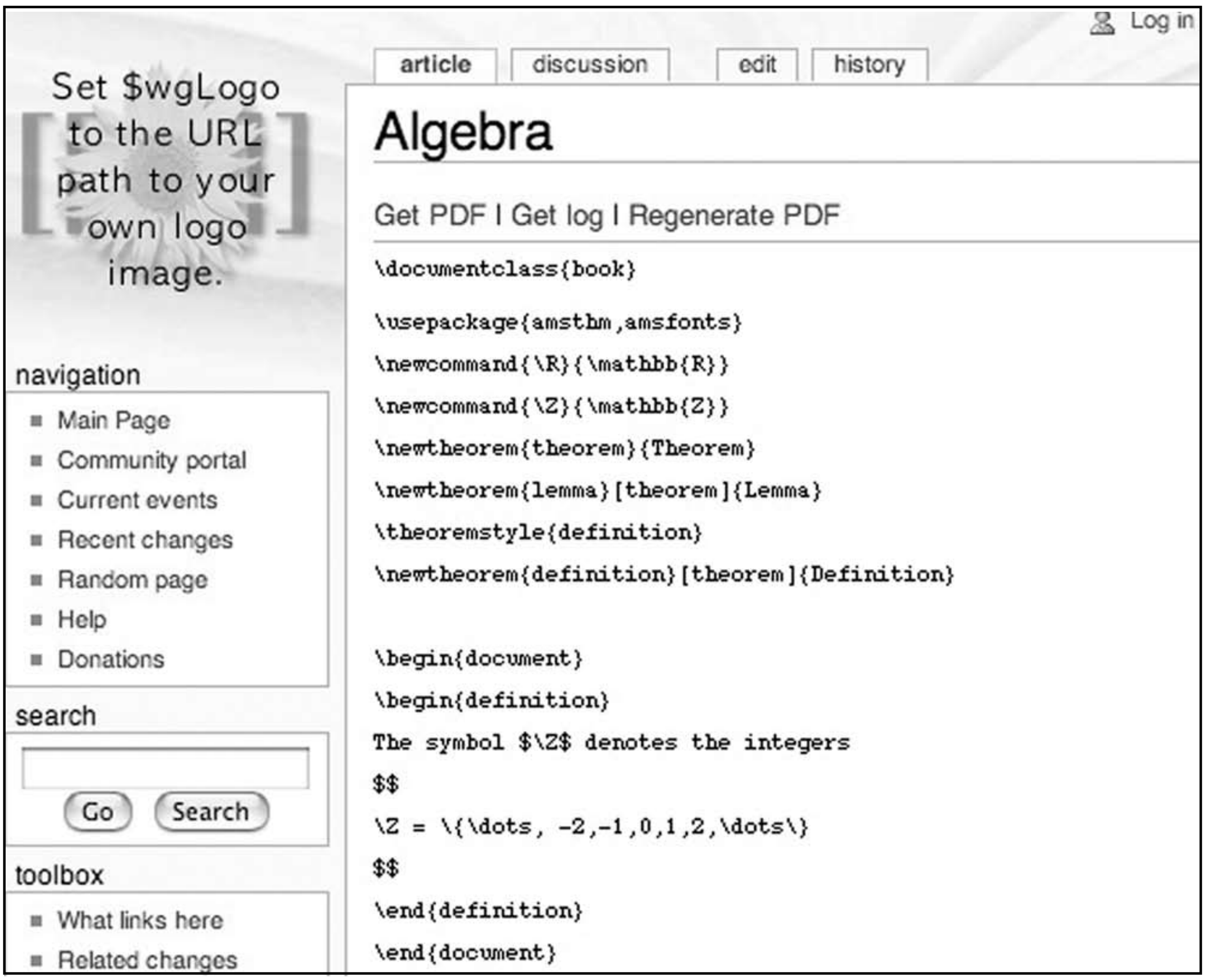
Wikis are web pages like *Wikipedia* that anyone can edit using their web browser as the interface. Usually, the editing is done to create text on the webpage itself. While there is some debate about how trustworthy *Wikipedia* is, there is no doubt that in the right circumstances a wiki can be a useful tool for collaborative work.

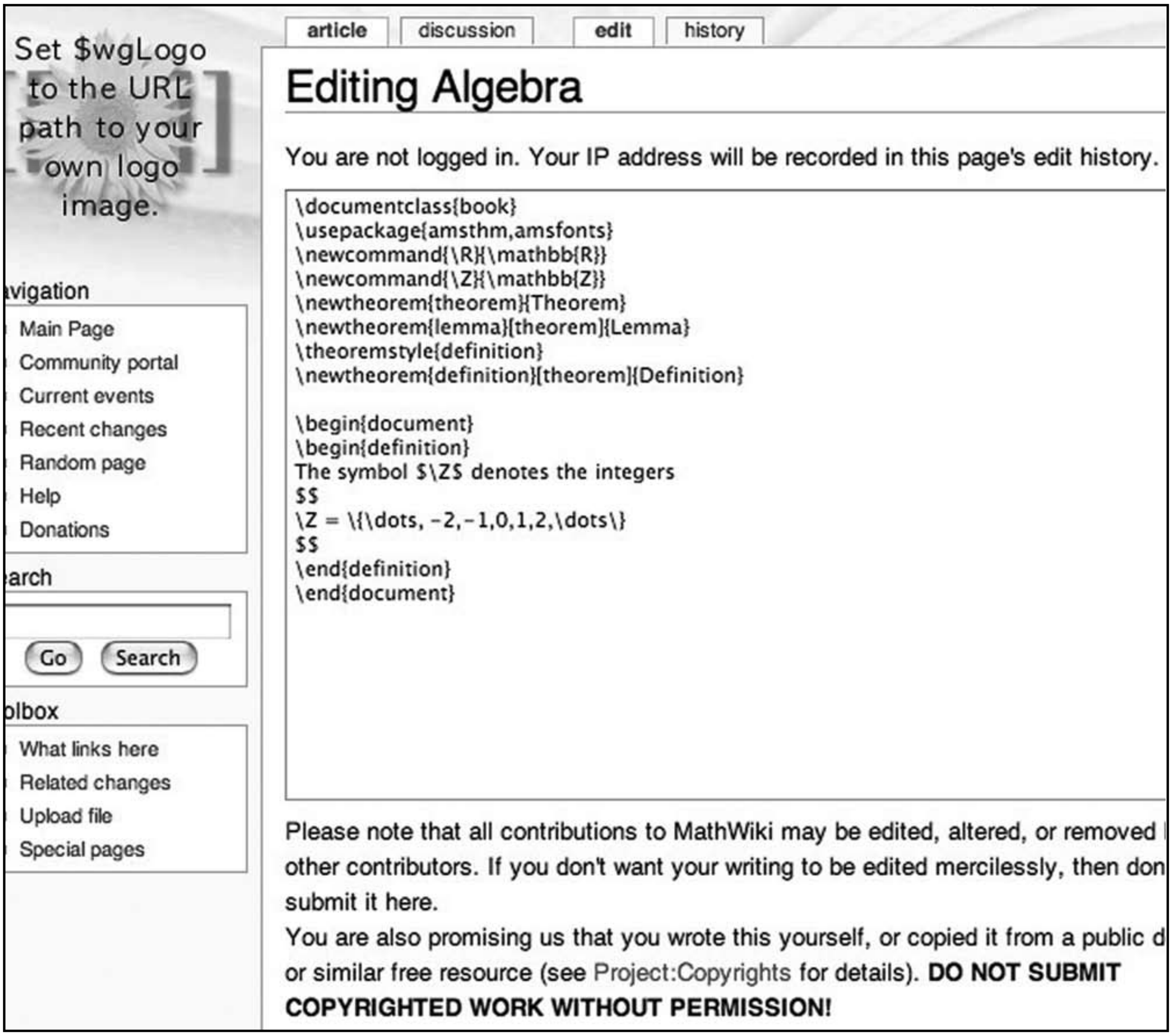
How it Works

In the Fall of 2006, I started having my abstract algebra students work on a wiki which processes LaTeX documents. This wiki isn't used to produce a web page, although the interface is through a web browser. Rather, when a student looks at the web page, they see the LaTeX code itself (see below). The web page we use at Loyola College uses the format and template of Mediawiki, the same package that powers Wikipedia, so it looks somewhat like Wikipedia right now (at some point we'll create our own format). But for the students, the relevant interaction at this stage is to hit either the **edit** tab at the top, or the **Get PDF** link, below the algebra heading.

If the student hits **edit** then they see the page shown on page 18. This page lets one type directly into the LaTeX code, deleting, inserting or making other changes. Now the student would hit the save button to return to the main page, and then **Get PDF** to see the output. In the background the wiki runs LaTeX, the web browser downloads the resulting PDF, and Adobe Acrobat opens the result on the student's computer.

The main reason I chose such a system is that it allows all the students to work on a single common document that is automatically up-to-date with the latest changes. I don't need to merge contributions from different students or update anything on my web page. In addition, the wiki stores the previous versions of each





page, so anyone can hit the history link to undo mistakes or track changes.

In my class, I have the students use the LaTeX wiki to produce a collaborative set of lecture notes. During class, at the beginning of each new result, I identify a student who will type up the result and enter it into the wiki. (I've found that it works best to just pick students in a predetermined order rather than asking for volunteers.) During a typical class there will be two to seven results assigned, so each student will be responsible for a fair number of results by the end of the semester.

I have also used the LaTeX wiki to have the students complete a collaborative worksheet, where each problem is assigned to one or two students.

Installation and Troubleshooting

Here's a description of how we set up and run the LaTeX wiki system at Loyola College. We have:

(1) a computer running Linux, with an administrator,
(2) an installation of LaTeX,
(3) an Apache webserver, with PHP and MySQL,
(4) an installation of Mediawiki,
(5) the LaTeXDoc config file (see the URL below), which causes the webpage to display the LaTeX source and provides the **edit** and **Get PDF** links.

In this setup there are two administrators: the Linux computer administrator, who knows how to set up Apache, Mediawiki etc.; and me, the wiki page administrator who sets up the LaTeX template, interacts with the students, etc.

Once the installation is done, I set up a new web page by typing in a URL such as http://mathwiki.cs.loyola.edu/index.php/Algebra into the address bar of my web browser. The first time someone types in a new URL, the page doesn't yet exist, and the wiki asks if you would like to create a page with this name ("algebra" in this case). I enter "yes," and then paste in my LaTeX code for the template file. From this point forward, any student who visits the algebra page can edit it and create PDF as described above.

Mostly this set-up has worked fine, but I should mention one potential pitfall. About nine months after we first set up this wiki, the pages got filled with "wiki spam." Wiki spam consists of advertisements for questionable products, just like email spam. It was simple to delete the spam by hitting the history link and recovering a previous version of the page.

There are (at least) two ways to prevent this kind of spam from reappearing. The wiki page administrator (me in this case) can create an account for each student, and set things up so that edits can only be done by having the user login. I chose not to follow this path because I didn't want to add any more steps than absolutely necessary to each student's task.

Instead, the Linux computer administrator blocked all internet addresses from off-campus. This had the effect of blocking the wiki spam without adding any additional steps for my students. The only downside is that the students needed to be on campus to work on the LaTeX wiki.

There are a couple of other administrative issues that I should mention in making a LaTeX wiki part of your class. You have to teach the students LaTeX, but the LaTeX wiki offers some advantages in doing this. The web browser interface is familiar to students, you can start the page with a template file, and they can copy and paste from other parts of the document. In any case, I recommend keeping requirements as simple as possible. I start the students with what appears in the file on page 17, a 10 minute presentation about LaTeX and the wiki, and some short hand outs (see the list below).

There are also some ongoing tasks in keeping the LaTeX wiki running. I set up a new template page for each new document (for example each chapter of the lecture notes). In addition, I debug the student submissions every few days. I fix minor mistakes directly in the wiki edit window shown on page 18, but for larger changes I paste all of the LaTeX code into my own text editor (emacs), fix it there, and paste the result back into the wiki page. Finally, when a chapter is done, I edit the whole thing for consistency, removing hard line breaks and **\vspace** commands, adding **enumerate** environments, etc. I try to limit this sort of rewriting: too much editing creates extra work for me and erases the students' style.

I have had good results using the LaTeX wiki in my class. The lecture notes were nice, the students enjoyed producing them, working together, and learning LaTeX.

References and URLs

Wikipedia: http://en.wikipedia.org

LaTeXDoc config file: http://openwetware.org/wiki/User:Austin_J._Che/Extensions

LaTeX at a liberal arts college: http://www.tug.org/pracjourn/2005-3/breitenbucher/

Handouts:

The one page guide to LaTeX: http://www.evergreen.loyola.edu/~educkworth/one_page_latex.pdf

LaTeX for novices: http://theoval.cmp.uea.ac.uk/~nlct/latex/novices/novices_a4.pdf

Acknowledgements: I'd like to thank George Hall for helping set up and run the LaTeX wiki, and Austin Che for writing the LaTeXDoc wiki plugin that makes this project possible.

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Mathematical Art at the Heckscher Museum

"To Infinity and Beyond: Mathematics in Contemporary Art" is the title of an exhibition at the Heckscher Museum of Art in Huntington, NY. The exhibit, which began on on April 19 and ends on June 22, highlights "the ideas that drive mathematics — numbers, geometry, pattern, and so on — and demonstrates how artists have expressed these topics." More information, and a small sampler of the images from the exhibition, can be found at the Hecksher Museum web site at http://www.heckscher.org/pages.php?which_page=exhibition_detail&which_exhibition=8.

Sections Elect New Governors

Several MAA Sections have recently elected new governors. Congratulations to all!

Allegheny Mountain: James Sellers, Penn State University

Indiana: David Housman, Goshen College

Kentucky: Bill Fenton, Bellarmine University

Metro New York: Henry Ricardo, Medgar Evers College (CUNY)

Nebraska-SE South Dakota: Mark Sand, Dana College

Northern California-Nevada-Hawaii: Frank Farris, Santa Clara University

Oklahoma/Arkansas: Charles Cooper, University of Central Oklahoma

Rocky Mountain: Kyle Riley, South Dakota School of Mines

Wisconsin: Jonathan Kane, UW–Whitewater

Improving Success Rates in Calculus

By P. K. Subramanian, Marshall Cates, Borislava Gutarts

How many of us are familiar with the following scenario? We are tirelessly trying to improve our calculus lectures, looking for better and more exciting ways to engage our students, all to no avail: the pass rates are dismal. If this sounds familiar, let us share with you our story of looking for, and finding, the solution to our "calculus problem."

At the Cal State LA Mathematics Department, we have known for some years that our students' calculus pass rates needed improvement, as they were about 50 percent. Marshall Cates decided to investigate this very unflattering phenomenon. What he uncovered, though not totally unexpected, was still quite shocking.

As students moved through our calculus sequence, the modal grade in nearly every class was one or more grades lower than the grade they had earned in the prerequisite. The results of the study are summarized in the charts in Figure 1. In these bar graphs, the vertical axis represents the number of students. The horizontal axis represents the grades in the prerequisite course, and each block in the horizontal axis gives a distribution of the final grades obtained in the current course. For example, for Math 206 (the first quarter of the calculus sequence) in the graph below, there were 109 students with a C as their prerequisite grade. Of them: two completed the course with an A, 14 received Bs, 29 maintained their incoming grade of a C, 20 got a D, 32 failed (!), and 12 withdrew.

Once our department digested these staggering statistics, we set out to find a solution. For a start, P. K. Subramanian suggested changing the then prevalent two day a week schedule to four days a week, since everyone agreed that the former was pedagogically unsound. Based on the studies of Uri Triesman (and Subramanian's own successful experiences elsewhere), he suggested a supplementary workshop meeting twice a week to augment the calculus sequence.

We quickly learned that offering just few workshops to cover several calculus sections (a model tried unsuccessfully at several other universities) could not be coordinated very well.

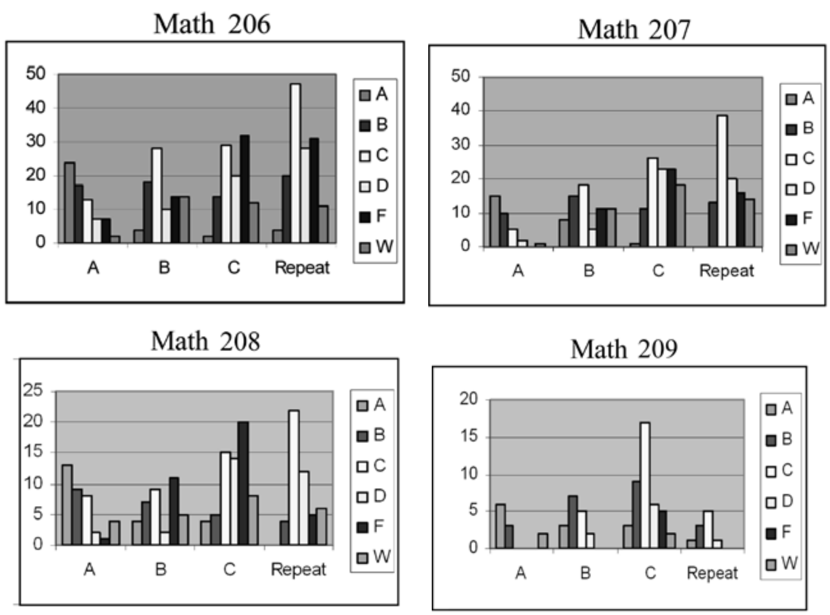


Figure 1

We then decided to add a separate workshop to each calculus section (except the last quarter calculus), which would meet twice a week. This was piloted for a year and the results were very encouraging.

With the hard data in our hands and enthusiasm and hope in our hearts, we set out to convince all affected departments to increase the total unit requirements in their program accordingly. We proposed to augment our calculus courses with workshops designed to improve our students speed and success in passing through the calculus sequence. In the beginning most departments agreed that our workshops were a great idea. When the time came to increase their required units, however, all feigned inability. The problem was that no department wanted to add even one (let alone four) units to their already full programs. All our explanations that in the current state of events students already take much longer than an extra quarter to graduate (since they often have to repeat courses) fell on deaf ears. We had hit an impasse.

Having seen students take years to complete our calculus sequence and believing that we had a way of speeding up the process, we were not about to give up. So we started trying to figure out ways of convincing our client departments of the importance of these workshops. Cates then proposed an excellent solution, which broke the impasse: mandate the workshops only for the so called "at risk" students, those that are either repeating a given course or those that have a C in the previous course. For the others, we would make the workshops optional. Since no additional units would be added to any discipline (and the workshops would be mandated only for students not likely to succeed on their own), all departments supported our move, and we won the administration's approval for the new plan.

The workshops became a reality and have been in place since Winter Quarter of 2006 and immediately became a great hit among our students. Though only "at risk" students were required to enroll, students with Bs and As were just as willing, even eager, to enroll in and attend the workshops. The resulting pass rates in Math 206–208 required us to open more sections of Math 208, 209, and 215 (Differential Equations). Many of our students took these workshops a level further: not only did they work in groups during the workshops, but they also continued to do it on their own outside the classroom. We have observed many students finding their study groups in the workshops and beginning to have weekly study sessions. The workshops have also built camaraderie among them. In figure 2 we give some data on the results, collected over the past two years after the workshops were implemented.

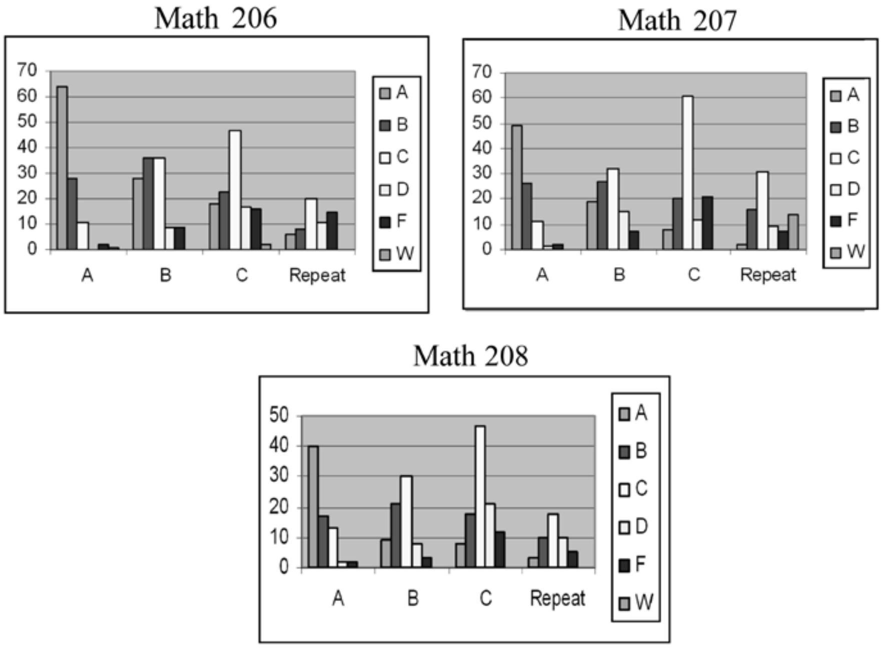


Figure 2

At this point, you are probably wondering what those magical workshops are. In essence the workshops, designed by Subramanian, provide an active learning experience for the students. Each workshop is directed by an experienced TA. The students are divided randomly into groups of two or three students working on problems. They take turns writing on the blackboard as the TA goes around the room monitoring the progress of each group, occasionally giving a hint or two. In a 50 minute session the students get to do about six to eight problems. The hope is that students will gain sufficient confidence to attempt and solve homework problems by themselves. Our results show that this is indeed the case. The workshops are scheduled very carefully: either right before or right after the class meeting they are keyed to, in the same classroom, to ensure that students can attend easily and conveniently.

We are currently writing an extended review of our experiment and its results, which we will submit to a mathematics education journal. Meanwhile, we would be happy to help any readers who would like to learn more about our journey and try to implement something similar.

P. K. Subramanian and Marshall Cates are professors, and Borislava Gutarts is an assistant professor at California State University, Los Angeles.

A Carnival of Calculus

By Dan Margalit

How do you get upwards of 180 calculus students to hang out in the math department after hours on a Tuesday night, giggling in the hallways, and playing mathematically themed party games? Was it the candy corn? The balloons? Well, most likely it was the promise of that sweetest of pedagogical nectars: extra credit.

Our department at the University of Utah has long had a tradition of holding calculus contests. Over time the format has run the gamut from straightforward calculus exams to "Who Wants To Be A Mathionnaire?" In recent years, though, interest had been waning to the point where only a handful of math majors were showing up. This year, Angie Gardiner, Julien Paupert, and I set out to improve attendance for this event. Also, in the spirit of the NSF VIGRE program, we wanted to attract more first year calculus students.

We came up with 3 guiding principles:

(1) There should be extra credit.
(2) First year calculus students should be able to win.
(3) The games should be fun.

We quickly settled on the philosophy of imitating party games, and, because of lack of space, decided to have the different games in different rooms, or "booths". With these ideas, the Calculus Carnival was born.

I timidly mentioned the idea of a Calculus Carnival to my Calculus I class, and I was amazed when about half of the students expressed interest (actually, at first only one student was interested, but then I mentioned Guiding Principle #1). Before long we had a small army of calculus teachers in the department who were recruiting students to participate. A key idea that helped win the teachers over was to have a "carnival currency": at the Carnival itself, students would only win smiley face stickers, and each teacher could then devise his or her own scheme for awarding extra credit based (or not based) on the number of stickers each student won.

The next step was coming up with the actual games. After collecting input from many department members, we came up with the following smorgasbord. There were three individually played games:

(1) *Pin the Nose on Isaac Newton*. At the start of the game, a calculus problem was announced; for instance, "find the derivative of $f(x) = 7\sin(5x)$." Each student wrote his or her answer on a cutout of Newton's nose, put on a blindfold, spun around, walked a few feet, and stuck their answer on a picture of a noseless Isaac Newton. The most anatomically correct nose with a mathematically correct answer won a sticker.

Pin the Nose on Isaac Newton. (Photo by Andrejs Treibergs)

(2) *Puzzler.* See the photo. How do you arrange those pieces to get a correct mathematical statement (if the shapes of pieces are irrelevant)? We had five such puzzles drawn on the board. The largest number of correct answers (with no incorrect answers) won a sticker.

Puzzler (Photo by Andrejs Treibergs).

(3) *Basket Toss*. When students entered the room, we handed them each a packet of seven problems, one per page. The idea was to solve each problem, crumple up the piece of paper, and toss it into one of the recycle bins in the corner of the room. At the end of a few minutes, the facilitators picked randomly from each bin, and each correct answer won a sticker.

Then there were three team games (students were told they had ten seconds to make teams of four or five):

(4) *Pictionary*. At the start, each team chose an "artist." Then, at four different whiteboards, the artists simultaneously tried to get their teammates to say as many words on their list as possible, by drawing pictorial hints. Sample words included "function," "limit," "pi," "Leibniz," and "antiderivative." The greatest number of correct answers won a sticker for each team member.

Pictionary (Photo by Andrejs Treibergs).

(5) *Distraction*. For this game, teams were paired up, and took turns: one team solving problems from a list (one student writing, teammates giving verbal help), the other team doing their best to throw off their opponents by singing, listing random numbers, telling jokes, etc. In each pair, the team with the most correct answers won a sticker (so half the students were winners at this booth).

(6) *Telephone*. Teams lined up in rows. The student in the front of each team solved a problem, and handed her numerical answer to the teammate behind her, who then plugged that number into the empty space in his problem. The first team with the correct answer at the end of the line won a sticker.

We also gave one challenge problem that students could work on individually during any free time between games:

(7) *The Demoralizer*. What is the largest rectangle that can be inscribed in a 3-4-5 right triangle? Which of the two inscribed squares is bigger?

On the day of the Carnival, students arrived in droves to a math department decked out in balloons, streamers, animal crackers, and candy corn. Each student got a colored index card on the way in, as proof of attendance, and as a way to collect stickers. After a quick pep rally, we sent the students to the different booths, depending on the color of their card. They then rotated through the booths in cyclic order. Somehow, the timing of it all was magically coherent.

We had many graduate students and faculty members helping to run the games. I got to spend the evening running around the two buildings of our department, checking out all the action. I was overjoyed — and a little shocked — to see how much fun the students, as well as the faculty members, were having. For at least a couple of hours, math was cool.

After the six rounds of games, we all gathered in the same room where we started. We handed out donuts and juice, and we awarded $25 gift certificates for most stickers in the Calculus I, Calculus II, and Beyond Calculus categories, and also for best solution to the Demoralizer.

In the end, what was most rewarding about the Calculus Carnival was that our students had real fun — not lack-of-excruciating-pain fun, but real, uncontrollable-laughter fun. A great barrier for many calculus students is that mathematics seems esoteric and inaccessible. While most students came to the Carnival for the extra credit, quite a few of them left with good feelings about mathematics, and that is a big first step towards eventual calculus success.

Dan Margalit is assistant professor of mathematics at the University of Utah. His web site is at http://www.math.utah.edu/~margalit/.

Letters to the Editor

More Homework Helpers

This comment is motivated by Judith Morrel's "Duo of Homework Helpers" in the February MAA FOCUS.

In a course such as calculus, where many of the homework problems are similar, I assign problems in groups. An example would be "Do section 3.1, problems [1-10], [11-28], [29-36], [37-40]." Odd answers are in the back of the book, even answers are not. The next day, at the beginning of class, I give each student a sheet of paper and ask for his/her choice of one even problem from a problem group that I specify. For example, "Choose any even problem from Section 3.1, #11-28. Write the problem number, the answer, and any supporting work." Also at the bottom of the paper, I ask, "Did you have trouble with any problems from the homework? Which ones?"

This takes the students one or two minutes, assuming they bring a problem prepared to copy from their notes onto the paper. The smart student will do enough odd problems from each group to be sure he/she has the technique, and then do at least one even problem from each group so there will be something to turn in. When I collect the papers, I glance through the questions at the bottom, and choose a couple to respond to in class.

When I grade the problems, I respond to students' questions individually if I have not done those problems in class. I also write out one or two illustrative examples and copy those onto the backs of the student papers before I return them.

Margie Hale
Stetson University

Homework and Quizzes as Teaching Tools

Homework and quizzes always generate much discussion. Having more grades makes you more certain of a student's overall grade. Furthermore, it is part of the job of instructors to find good practice exercises so that students can assess if they have mastered a topic lectured on. All this is counterbalanced, however, by the time demands of homework and quizzes — demands on both students and instructors.

I was therefore intrigued to learn that educators have begun once again to emphasize the importance of doing either daily homework and/or daily quizzes. David Glenn, in a recent issue of *The Chronicle of Higher Education* (53.40, June 8 2007, pp A15-A17), summarizes in several articles some recent research as well as their current applicability to middle schools. Here is a punchy experiment from the article with a surprising point:

Experiment: Three groups of students were asked to read some articles. They were each given 20 minutes to "study" them. One group studied the articles in four five-minute sessions. A second group studied the article in three five-minute sessions with one quiz at the end. A third group studied the article in one five-minute session with three five-minute quizzes. The students were then tested that day and a week later. The results: Short term: the students studying a full 20 minutes did better. But long term: the students studying with three five-minute quizzes did better.

The Point: This experiment highlights that homework and quizzes are not only about assessment; but rather are themselves another vehicle of pedagogy. You give homework and quizzes to teach, not to assess. The assessment function of homework and quizzes is just fringe benefit.

These results should change our attitude to what we do. They also provide us with arguments to use with both colleagues and students as to why we assign homework and give quizzes: tell them that homework and quizzes are tools to cement the learning experience and make it more productive.

Russell Jay Hendel
Towson University

Mathematicians and Climate Change

The very title of the article "Mathematicians Recruited for Climate Change Research" (MAA FOCUS, March '08) suggests that "climate change," a euphemism for global warming caused by humans, is an indisputable fact. This claim is made explicitly in the white paper "Mathematics of Climate Change" accessible at the Mathematical Sciences Research Institute (MSRI) link provided in the article. The basis for this claim is the report issued by the Intergovernmental Panel on Climate Change (IPCC) of the United Nations, envisioned eventually to be the overseer of a multi-billion dollar "climate change" program.

Recently, over 400 prominent scientists have spoken out against the claim. The MAA FOCUS article made no mention of them, but perhaps their view should be given consideration as well. Even if there are more mathematical research opportunities available for supporting "climate change" than for debunking it, I hope we as mathematicians will take a careful, objective look at the evidence before reaching a conclusion.

Elliott Weinstein
Baltimore, MD

What I Didn't Learn from My Daughter

Recently, my daughter Dahlia Neeman, who is in the eight grade, told me: "Dad, I found a way to check my addition and subtraction." And she explained: "you take the operands and the answer and for each you do the following: you add the digits and if the result is more than a single digit, you add again the digits of the results until you get a single digit. So now you have three digits corresponding to the two operands and the result. Then you add the two digits corresponding to the operands and if the result is more than a single digit you add the digits to get a single digit. This single digit should equal to the single digit you got for the result."

Initially I thought the proof for this is simple, then gradually I realized I could not find a simple proof. Can someone help? I promised my daughter a proof without using abstract algebra.

Sol Neeman
Johnson & Wales University
Providence, RI

MAA Contributed Paper Sessions Washington, D.C. Joint Mathematics Meeting, January 5–9, 2009

The MAA Committee on Contributed Paper Sessions solicits contributed papers pertinent to the sessions listed below. Contributed paper session organizers generally limit presentations to 15 minutes. Each session room contains a computer projector, an overhead projector, and a screen. Please note that the dates and times scheduled for these sessions remain tentative.

Assessment of Student Learning in Undergraduate Mathematics
William O. Martin, North Dakota State University and Bernie Madison, University of Arkansas
Wednesday afternoon

Building Diversity in Advanced Mathematics: Models the Work
Patricia Hale, California State Polytechnic University, Pomona and Abbe Herzig, University at Albany
Monday afternoon

College Algebra: Focusing on Conceptual Understanding, Real-World Data, and Mathematical Modeling
Florence S. Gordon, NYIT; Laurette Foster, Prairie View A&M University; Yajun Yang, Farmingdale State College; and Ray Collings, Georgia Perimeter College
Thursday morning

Cryptology for Undergraduates
Chris Christensen, Northern Kentucky University and Robert Lewand, Goucher College
Monday afternoon

Demos and Strategies with Technology that Enhance Teaching and Learning Mathematics
David R. Hill, Temple University; Scott Greenleaf, University of New England; Mary L. Platt, Salem State College; and Lila F. Roberts, Georgia College & State University
Tuesday morning and afternoon

Developmental Mathematics Education: Helping Under-Prepared Students Transition to College-Level Mathematics
J. Winston Crawley and Kimberly Presser, Shippensburg University
Thursday morning

Environmental Mathematics
Karen Bolinger, Clarion University and Ben Fusaro, Florida State University
Monday afternoon

Guided Discovery in Mathematics Education
Jerome Epstein, Polytechnic University
Thursday afternoon

Innovative and Effective Ways to Teach Linear Algebra
David Strong, Pepperdine University; Gil Strang, Massachusetts Institute of Technology; and David C. Lay
Tuesday morning and afternoon

MAA Session on Research on the Teaching and Learning of Undergraduate Mathematics
Keith Weber, Rutgers University; Michelle Zandieh, Arizona State University; and Karen Marrongelle, Portland State University
Tuesday afternoon

Mathematics and the Arts
Douglas E. Norton, Villanova University
Thursday morning and afternoon

Mathematics of Chemistry
George Rublein, College of William and Mary and Thomas R. Hagedorn, The College of New Jersey
Monday afternoon

Mathematics Experiences in Business, Industry and Government
Phil Gustafson, Mesa State College and Michael Monticino, University of North Texas
Wednesday morning

The Mathematics of Games and Puzzles
Laura Taalman, James Madison University
Tuesday morning

Mathematics and Sports
Howard Penn, United States Naval Academy
Tuesday morning

Mathlets for Teaching and Learning Mathematics
Thomas E. Leathrum, Jacksonville State University; David Strong, Pepperdine University; and Joe Yanik, Emporia University
Wednesday morning and afternoon

Operations Research in the Undergraduate Classroom
Gerald Kobylski and Josh Helms, United States Military Academy and William Fox, Naval Post Graduate School
Monday afternoon

Performing Mathematics
Timothy P. Chartier, Davidson College and Karl Schaffer, De Anza College
Monday afternoon

Productive Roles for Math Faculty in the Professional Development of K-12 Teachers
Dale Oliver, Humboldt State University and Elizabeth Bur-

roughs, Montana State University
Wednesday morning

Promoting Deep Learning for Mathematics Majors Through Experiential Learning, Writing and Reflection
Murphy Waggoner, Simpson College and Chuck Straley, Wheaton College
Thursday morning and afternoon

Quantitative Literacy Across the Curriculum
Kimberly M. Vincent, Washington State University and Cinnamon Hillyard, University of Washington, Bothell
Wednesday morning

Statistics in K-12 Education: How Will it Affect Statistics at the College Level?
Patricia Humphrey, Georgia Southern University and Robin Lock, St. Lawrence University
Wednesday morning

Statistics Resources on the Web
Dorothy Anway, University of Wisconsin, Superior; Patricia Humphrey, Georgia Southern University, and Chris Lacke, Rowan University
Wednesday afternoon

Teaching Calculus in High School: Ideas that Work
Dan Teague, NC School of Science and Mathematics and John F. Mahoney, Benjamin Banneker Academic High School
Tuesday morning

Undergraduate Mathematical Biology
Timothy D. Comar, Benedictine University; Raina Robeva, Sweet Briar College; and Eric S. Marland, Appalachian State University
Tuesday morning and afternoon

General Session
Sarah Mabrouk, Framingham State University
Monday, Tuesday, Wednesday, and Thursday mornings and afternoons

For complete descriptions of each session and additional information on the Contributed Paper Sessions please visit the MAA online at: http://www.maa.org/meetings/cps_jmm09.html.

Short Takes

Putnam 2007: The Results Are In

The 68th annual Putnam competition, held in December 2007, had 3753 participants from 516 institutions and 413 teams, all record highs. Harvard won the team competition for the 26th time while Princeton, which won its first team competition in 2006, finished second for the tenth time. The next three teams were MIT, Stanford and Duke. Because of a two-way tie for fifth place, there were six Putnam Fellows. The top fives scores on the 120 point exam ranged from 110 to 82; a score of 21 was enough to rank in the top 500. The median score was two. This is only the second time in the past nine years that the median was greater than one.

In keeping with recent trends, five of the six winners and 12 of the top 16 finishers were Gold medal winners in the International Mathematics Olympiad for high school students. Aaron Pixton of Princeton, who won for the third time, was the only repeat winner. Three of the six winners, Jason Bland and Brian Lawrence of Caltech and Arnav Tripathy of Harvard, were freshmen. Alison Miller won the Elizabeth Lowell Putnam Prize for outstanding performance by a woman for the third time; she was a member of Harvard's winning team. Among the top ten teams, only Harvey Mudd is not a PhD granting institution. Harvard increased its total number of Putnam Fellows in the 68 competitions by one to 96 and MIT, which has the second highest number of Putnam Fellows over the years, increased its total by two to 47. The number of participants in the 68 Putnam competitions is now at 111,205.

A Journal on the History of Mathematics Education

The International Journal for the History of Mathematics Education is "the only journal in the world that is entirely devoted to the world history of mathematics education." Edited by Gert Schubring, the journal hopes to provide those interested in mathematics education with some historical memory, making the successes (and failures) of the past available to today's educators. Published by the Teachers College at Columbia University in cooperation with COMAP, the journal makes tables of contents and abstracts available online. See http://journals.tc-library.org/index.php/hist_math_ed/ for more information.

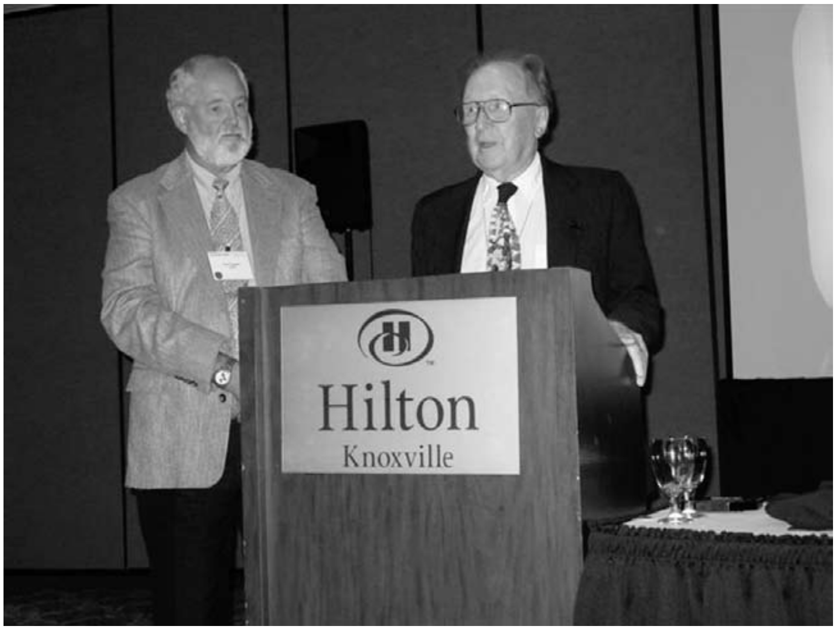
AMS Recognizes Programs for Efforts to Increase Diversity

This April, the American Mathematical Society (AMS) announced the 2008 winners of two awards that recognize the achievements of whole programs.The first award, for "an Exemplary Program or Achievement in a Mathematics Department," went to the Mathematics Department of the University of Iowa. The second award, for "Mathematics Programs that Make a Difference," went to SUMSRI and Math SPIRAL, two programs that aim to increase diversity in the mathematics profession. SUMSRI is the Summer Undergraduate Mathematical Science Research Institute at Miami University in Ohio. Math SPIRAL is the Mathematics Summer Program in Research and Learning at the University of Maryland, College Park. For more on these AMS awards and on the programs receiving them, visit the AMS web site at http://www.ams.org.

Remembering Richard Anderson

By Tina Straley and Friends

Former MAA President Richard Davis Anderson died on March 4, 2008, at age 86. Dick was the complete mathematician: highly regarded scholar, teacher, and leader. Throughout his career he led both by example and through the offices he held. Dick served as MAA President in 1981 and 1982, and as Vice- President of the American Mathematical Society, from 1972–1973. He received the Distinguished Service Award, the MAA's highest award for service to mathematics, in 1978.



Richard Anderson, with Carl Cowen, at his induction into the Icosdahedron Society at MathFest 2006.

Several people wrote to me with their remembrances of Dick. I present excerpts here because I could not do these memories justice by paraphrasing them.

Former President Ken Ross interviewed his fellow former President, Dick Anderson, on August 11, 2006 in Knoxville, Tennessee, and on January 5, 2007 in New Orleans, Louisiana.

KR: Tell me about your early years.

RA: I was born in Hamden, Connecticut, on February 17, 1922, just a few minutes after my identical twin brother, Jack. I went to public schools in Minneapolis and graduated from high school in 1939. I was an undergraduate at the University of Minnesota and graduated in two years. I studied mathematics and I was in Naval ROTC. I took heavy loads and took 24.5 credit hours one term. A fellow student was Ed Spanier. I managed to beat him on one of nine finals.

KR: When did you join the MAA?

RA: While I was an undergraduate at Minnesota, John Olmsted took me to a section meeting where I joined the MAA. After I graduated, Olmsted took me to an AMS–MAA summer meeting in Chicago. Fortunately, this was at the same time that my father attended a psychological association meeting at Northwestern, so I traveled with my father. At this meeting, I met R. L. Moore who showed an interest in me and offered me a half-time instructorship at the University of Texas. I had applied to several schools in the spring of 1941, but I didn't get any responses because they didn't expect me to finish my undergraduate work so quickly.

In my first year, I was one of four students in R. L. Moore's class. The others were Ed Burgess, Bob Adams, and Harry Cates. Joe Diaz and Ed Moise were second-year students, and Gail Young was a fourth-year student. Of these people, three served as MAA president, two served as AMS vice-presidents, and Joe Diaz became an Einstein Professor at RPI.

I had been in Naval ROTC as an undergraduate, but I didn't complete the program because I finished my other undergraduate work too quickly. On December 8, 1941, I volunteered for the Navy, but I wasn't called up until April 15, 1942. I met my wife, Jeanette Olliver, at a dance on June 12, 1942. We were married in Nashville on April 12, 1943.

I served in the Pacific and I was discharged on December 21, 1945, but I was already back at the University of Texas by then. I obtained my PhD in 1948 and my advisor was R. L. Moore. I then went to the University of Pennsylvania. In 1956, I took a position at Louisiana State University. I spent two years at the Institute for Advanced Study, 1951–1952 and 1955–1956. I met Einstein, as did my oldest son. Einstein was more interested in my son than my son was in him, because my son was about 15 months old.

KR: Did you ever consider fields other than mathematics as a vocation?

RA: I thought I would be a lawyer, but it was easy and quick for me to graduate in two years if I studied mathematics… it's not certain whether I would have pursued mathematics were it not for Moore's intervention.

KR: What did your parents do?

RA: My father was a child psychologist in Minneapolis. At one time, he was president of the American Psychological Association. My mother's father was an author in Chattanooga. He obtained an honorary degree at the University of the South at Sewanee. Much later I also obtained an honorary degree at the same university.

KR: Tell me a little about LaSIP and LaCEPT.

RA: LaSIP (Louisiana Systemic Initiatives Program) was an effort that began around 1990 to improve math and science education at the school level. I helped to organize this effort, but my role was unofficial because I was already retired. Four of us wrote the first proposal for this program. Later, LaCEPT (Louisiana Collaboratives for Excellence in Preparing Teachers) was an effort to reform the preparation of math and science teachers in college which was organized by Lynne Tullos.

KR: What accomplishments in the MAA are you especially proud of?

RA: During my leadership, the MAA broadened its responsibilities in precollege education and, in particular, strengthened its relationship with NCTM. Thanks to Shirley (Hill), the NCTM and MAA were better linked. One advantage that I probably had was that I'd been very active in professional organizations before I was MAA president. I was active in NRC, NSF, and the National Academy of Sciences.

KR: During your career, what personalities have stood out in the mathematics community?

RA: I had the accidental great fortune of knowing the first four winners of the Abel Prize: J. P. Serre, Sir Michael Atiyah and I. Singer, and Peter Lax. I have fond memories of playing tennis and chess with Serre, playing touch football with Singer, and of playing tennis with Peter Lax.

Former MAA President Lida Barrett:

"I met Dick in the summer of 1948 when I arrived at Texas for graduate study and he was leaving to go to Penn. When John completed his PhD in 1951 we moved to the University of Delaware. I continued the graduate work I had begun with Moore under the direction of J. R. Kline, who was Moore's first student and department head at Penn. I had given Kline a draft of my thesis when he had a heart attack. Dick took over and directed the editing of the thesis. He always claimed me as his first PhD student.

"During the summers while we were all in the East, John and I often visited Dick and Jeannette. The guys would play golf, neither a very good player, and I would visit with Jeannette and the children. We also continued to see them regularly after they moved to Baton Rouge."

From "A Tribute to Richard D. Anderson" (upon his retirement from LaSIP), February, 2004, by Richard Schori:

"When I was in graduate school in the early 1960's I heard of the famous topologist R. D. Anderson. I accepted a position at LSU largely because my PhD advisor Steve Armentrout had such a high esteem for you."

Professor Schori arrived at LSU shortly after Dick Anderson had proved that the countable infinite product of triods was the Hilbert Cube. "This result was a stepping stone to a new area, even a new paradigm, of topology research that you started… you proved that separable Hilbert space was homeomorphic to the countable infinite product of lines, finishing a major research project spear-headed by the Polish topologists and analysts. This result is thought of as the beginning of Infinite Dimensional topology, of which you are the father."

"During my first three years at LSU I… worked on the "2 to the I" problem. After watching me struggle for three years… you came to me with the idea that if I were bogged down… then perhaps I would be willing to join you on a conjecture concerning infinite-dimensional manifolds. We spent many an hour pacing the halls. What a unique problem solving procedure, pacing and using your hands to help visualize the evolving proofs. I went back to the "2 to the I" problem and with Jim West, one of your previous PhD students, we solved that 40 year old problem. When I went back to that problem, it was exactly the techniques and philosophy that I learned from you that solved it. It truly represented a new paradigm in topology research and I'm still convinced to this day that the old techniques would never have worked.

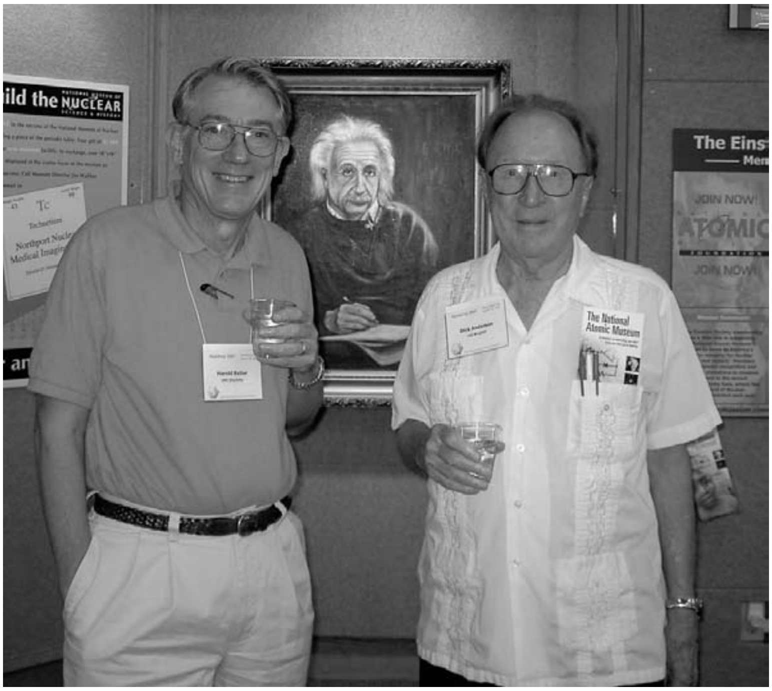
"It seems to me that you said you wrestled in school at some point, but tennis has been a life-long activity. Charlie Curtis, retired from the University of Oregon, volunteered that he had often played you but had probably never won. You and I played every day in Warwick during the summer of 1970 and I won only one set, but never at match…your tennis (is) similar to your mathematics. Largely self taught and somewhat unconventional but honed to a sharp cutting edge. You also joined the younger faculty and graduate students at LSU in touch football as our quarterback and punter."

"Your evolving career over nearly 60 years has been a model of success, while being modest, caring, and supporting of your colleagues and students. Your support and mentoring has provided me with a life and career far beyond what it would have been otherwise."

Hendrik W. Lenstra:

"Dick visited Amsterdam for a semester, maybe even for a year, as a guest of my uncle J. de Groot, who was a professor in point set topology. It must have been in the 1970s. Our offices were on the same floor, with a hallway that was topologically a circle; the actual shape was a rectangle. I would do my work in my office, with my door open, and he would do his work by walking around the hallway. Every few minutes he would pass by my office door, and I still hear the regular rhythm of his footsteps, first becoming louder and then dying out: the steps of a thinker! They had something soothing, and also stimulated my own work.

"No word was exchanged, until lunch time of course, when I found him to be a gentle person with whom it was a pleasure to interact. He was one of my early role models, maybe before the word was invented. Although later I found similarly usable hallways both at Berkeley and now at Leiden, I never imitated Dick's habits. Most of my mathematical thinking occurs when I am showering or swimming, in places where I am safe from computers but unlikely to serve as a role model for students."



Harold Reiter and Dick Anderson.

Michael Atiyah:

"I clearly remember (Dick) and his large family from our time at the IAS in Princeton in 1955. We were newly married and the Andersons, if I remember right, had five children. They were very helpful to us and eased our entry into the Princeton scene. We met a few times later, especially when we were in Oxford where one of their daughters was studying. Dick always had such vitality and enthusiasm for life. This no doubt enabled him to undertake so many roles. Our neighbours on the other side were Jim and Nan Eells and by coincidence Jim also died quite recently. At the time I suppose we thought Dick and Jim were just typical Americans, but I later realized that they were rather special."

Robert Perlis, LSU:

"I knew [Dick Anderson] since 1980, the year I came to LSU and the year Dick retired. He got me heavily involved with issues of school reform, in-service teacher training, and summer programs for teachers. Below are a few of the many things I recall with love and respect.

"Dick often referred to "my older twin brother" and to "my younger twin brother," smiling broadly at the consternation this utterance caused in the listener. It turns out that Dick was one of a set of identical twins, his twin being born first. His mother later gave birth to a second set of twins, one boy, one girl, allowing Dick to refer to his "younger twin brother."

"Dick was one of the people who set the New Math into motion. Although he recognized the program's failures, he was never defensive about it. He remarked that when you start a trend, it often ends up differently than anticipated. In his words, the New Math was intended to develop a sense of "precision of language" in early math classes.

"Dick had a way about him that got people involved. At my request, he twice lectured to my first-semester freshman calculus class on everywhere continuous nowhere differentiable functions. This advanced topic usually follows a study of infinite series, which my students hadn't had.

Dick… walked into class, spent ten minutes telling the freshman about great American mathematicians, then introduced writing real numbers base 3. He drew a 3-by-3 grid on the board and asked students to name some pairs of points, each point written base 3. The class, usually reticent, began calling out numbers, and became really fascinated when he explained a scheme for mapping the interval [0,1] — with numbers written base 3 — onto the 3-by-3 grid.

Without using the words, he had created a space-filling curve. The map from [0,1] to the grid, followed by projection to the y-axis, is the everywhere continuous nowhere differentiable function. The class was excited and amazed both times. Of course the students didn't remember details, but they were convinced they had been involved with something deep, and it left an impression.

"Dick loved jokes. He particularly liked one about a snail who requested that a silver "S" be affixed to the back of his new car. He wanted people he passed to say "Look at that S-car go!" Another favorite involved flashing the peace sign and saying it started with a Roman Centurion, ordering five beers!"

Martha Siegel, MAA Secretary:

"[Dick] was a pleasure to be with, as he had a knack for sharing — his humor and his warmth were so much a part of him. He had terrific jokes and wonderful yarns. When I was at the LA/MS Section, his name came up several times...several people were lamenting that he was unable (he was then in a nursing home) to continue his vigilance with regard to state standards and curriculum. I had the pleasure of working with Dick on several projects. He was welcoming and generous with his time and his knowledge."

Dick Anderson will be greatly missed by many more than those quoted here. He has left his mark on mathematics, mathematics education, and on all of us who had the pleasure to know him.

Tina Straley is Executive Director of the MAA.

William L. Duren, Jr. (1905-2008)

William Larkin Duren, Jr., former President of the MAA who was for many years professor of mathematics at the University of Virginia, died on April 4 at the age of 102. Born in 1905 in Macon, MS, Duren was the eldest of three children. He attended Tulane University, where he excelled both as a student and as an athlete, winning the Southeastern Conference championship in the high hurdles. He did his graduate work at the University of Chicago, where he worked with G. A. Bliss. While at Chicago, he met Mary Hardesty, a graduate student in zoology. They obtained their PhDs in 1930, and were married in 1931.

After graduation the couple moved to New Orleans, where Duren taught at Tulane. There they raised three children. They spent the year 1936-37 at the Institute for Advanced Study in Princeton, New Jersey, where he was assistant to Marston Morse, working on what Morse called "the calculus of variations in the large."

During the Second World War, Duren served the Army Air Corps as a civilian scientist, working in an operations analysis group based in Colorado Springs. In collaboration with military personnel at various locations, he devised and implemented improved strategies for flexible gunnery and bombing. In later years he would view that experience as the turning point of his career. From the success of his war work he discovered that his talents lay more in general science and administrative skills than in mathematics alone.

Appointed Chairman of the Tulane Mathematics Department in 1947, he obtained a grant from the U.S. Office of Naval Research to establish a PhD program that became a model for other such programs in the South. Seeing a need for curriculum reform at the undergraduate level, he worked through the MAA to form the Committee on the Undergraduate Program in Mathematics (CUPM), which over the next ten years brought about substantial improvements in curricula throughout the country. CUPM still exists and is still active.

In 1952-53, Duren was in Washington as the first Program Director in Mathematics at the National Science Foundation. Under his leadership, the NSF made grants to establish new PhD programs and funded a series of national summer institutes to help faculty members improve their mathematical skills.

Two years later, Duren was elected President of the MAA. In 1955 he left Tulane to become Dean of the College of Arts and Sciences at the University of Virginia. As Dean he worked closely with President Colgate Darden, a former Governor of Virginia, to begin a transformation of the University to high academic standing. He was instrumental in negotiating new admissions policies that led to a dramatic increase in graduation rate, creating the first undergraduate library (the Clemons Library, still in use), founding the Echols Scholars program to attract and nurture superior students, and bringing racial integration to the College. Upon leaving the Deanship in 1962, he was appointed the first University Professor, allowing him to move to the School of Engineering, where he formed a new Department of Applied Mathematics and Computer Science. As Dean and later, he fought for admission of women to the College, a battle that was finally won in 1970.

Duren was awarded an honorary degree by Tulane University in 1959, and in 1967 he received the annual MAA Award for Distinguished Service to Mathematics.

After retirement in 1976, and up to two months before his death, he continued to live in his home in Charlottesville, writing historical articles for mathematicians, humorous essays about his Mississippi boyhood and life in New Orleans, and more serious essays. One, written at age 97, proposed an interdisciplinary graduate degree in Arts and Sciences generally, as an antidote to the over-specialization he saw in today's PhD programs. Another, which he delivered as a Colloquium lecture to the UVA Mathematics Department on the occasion of his 100th birthday, surveyed his career as a scientific generalist based in mathematics, with observations on luminaries he had known and on the changes wrought by revolutionary scientific developments in his lifetime.

After the death of his wife Mary in 1998, he resumed overseas travel, regularly attended weekly seminars in operator theory presented by the Mathematics Department, and continued exercising three times a week at UVA's Cardiac Rehab and Wellness Center, a habit he maintained for the last 20 years of his life, past age 102. It was to his friends at Cardiac Rehab that he addressed most of his essays, which took the form of annual birthday letters from age 90 though 101.

Out of conviction that undergraduate education in American universities had become too specialized and compartmentalized, Duren made a substantial gift to Tulane University in 2000 to encourage creation of a broader curriculum of multidisciplinary courses in the College. This led Tulane to establish the Duren Professorship Program, in which faculty members are selected each year to offer such courses. The program has been quite popular.

A memorial celebration will be held in Charlottesville on June 21. Memorial contributions in Duren's name may be made to the MAA or to the AMS.

For more information on Duren's career please visit MAA Online at: http://www.maa.org/news/durenobit.html.

AMERICAN MATHEMATICAL SOCIETY

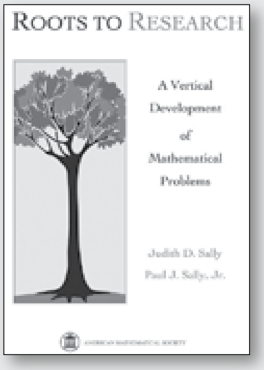
New from the AMS

Roots to Research

COURSE ADOPTION

A Vertical Development of Mathematical Problems

Judith D. Sally, *Northwestern University, Evanston, IL*, and **Paul J. Sally, Jr.**, *University of Chicago, IL*



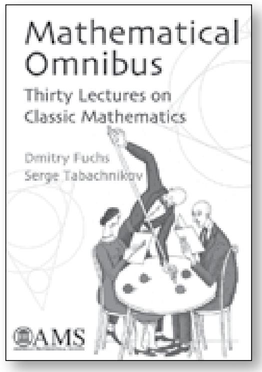
Certain contemporary mathematical problems have captivated the field because their study originates in the elementary school curriculum and proceeds through the high school, college and university levels. This book traces the full range of mathematics needed to understand the emergence of five such problems: The Four Numbers Problem, Rational Right Triangles, Lattice Point Geometry, Rational Approximation, and Dissection.

The five problems are discussed in five separate chapters, each beginning with the elementary mathematics involved at the source of the problem. For four of the problems, the discussion proceeds to an examination of important results in contemporary research. For example, the chapter on Lattice Point Geometry traces the path of study from the properties of lattice polygons in the early grades to the study of Minkowski's theorem on lattice points in convex regions and Ehrhart's theorem at the university level.

The discussion of the full range of mathematics for these five problems makes this book ideal for students and teachers at all levels, as well as for working mathematicians who are curious about results in fields other than their own. Students who begin reading the book in high school can return to it as their experience allows them to delve into more advanced aspects of the problems.

In its coverage of all levels of mathematics pertinent to the understanding of these five problems, this book offers unprecedented depth in its presentation of these important mathematical topics.

2007; 338 pages; Hardcover; ISBN: 978-0-8218-4403-8; List US$49; AMS members US$39; Order code MBK/48



Mathematical Omnibus

Thirty Lectures on Classic Mathematics

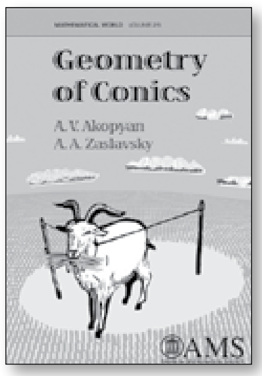
Dmitry Fuchs, *University of California, Davis, CA*, and **Serge Tabachnikov**, *Pennsylvania State University, University Park, PA*

This is an enjoyable book with suggested uses ranging from a text for an undergraduate Honors Mathematics Seminar to a coffee table book. It is appropriate for either. It could also be used as a starting point for undergraduate research topics or a place to find a short undergraduate seminar talk. This is a wonderful book that is not only fun to read, but gives the reader new ideas to think about.

—MAA Reviews

The book consists of thirty lectures on diverse topics, covering much of the mathematical landscape. The reader will learn numerous results and discover connections between classical and contemporary ideas in algebra, combinatorics, geometry, and topology. The common thread of the book is the unity and beauty of mathematics. Each lecture contains exercises to which solutions or answers are given. A special feature of the book is an abundance of illustrations and artwork by an accomplished artist. Almost every lecture contains surprises even for the seasoned researcher.

2007; 463 pages; Hardcover; ISBN: 978-0-8218-4316-1; List US$59; AMS members US$47; Order code MBK/46



Geometry of Conics

A. V. Akopyan, and **A. A. Zaslavsky**, *CEMI RAN, Moscow, Russia*

This book treats second order curves as geometric objects by purely geometric means, offering the most interesting facts about curves of order two. Topics include second order curves' optical properties as well as the projective geometry of curves and the Poncelet theorem. More than 50 exercises and problems and more than 100 figures enhance the reader's geometric intuition.

Mathematical World, Volume 26; 2007; 134 pages; Softcover; ISBN: 978-0-8218-4323-9; List US$26; AMS members US$21; Order code MAWRLD/26

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Los Angeles, CA 90095-1554

The applicants should arrange for three letters of recommendation to be sent to Professor De Leeuw. Until the file is complete with the requested information, the application cannot be given full consideration.

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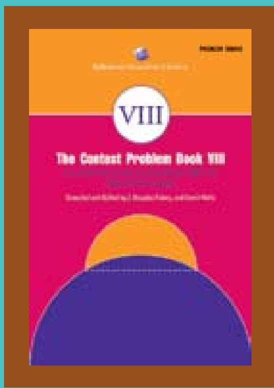

The Contest Problem Book VIII

American Mathematics Competitions (AMC 10)
2000-2007
J. Douglas Faires & David Wells

Catalog Code: CP8/FOC
ISBN: 978-0-88385-825-7
List: $49.95
MAA Member: $39.95

For more than 50 years, the Mathematical Association of America has been engaged in the construction and administration of challenging contests for students in American and Canadian high schools. The problems on these contests are constructed in the hope that all high school students interested in mathematics will have an opportunity to participate in the contests and will find the experience mathematically enriching. These contests are intended for students at all levels, from average students at typical schools who enjoy mathematics to the very best students at the most special schools.

In the year 2000, the Mathematical Association of America initiated the American Mathematics Competitions 10 (AMC 10) for students up to grade 10. *The Contest Problem Book VIII,* is the first collection of problems from that competition covering the years 2000-2007. There are 350 problems from the first 14 contests included in this collection. A Problem Index at the back of the book classifies the problems into the following major subject areas: Algebra and Arithmetic, Sequences and Series, Triangle Geometry, Circle Geometry, Quadrilateral Geometry, Polygon Geometry, Counting Coordinate Geometry, Solid Geometry, Discrete Probability, Statistics, Number Theory and Logic. The major subject areas are then broken down into subcategories for ease of reference. The problems are cross-referenced when they represent several subject areas.

A Guide to Complex Variables

Catalog Code: DOL-32/FOC
ISBN: 978-0-88385-338-2
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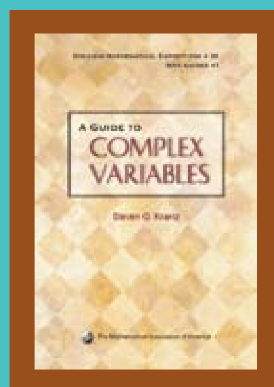
Steven G. Krantz

The first in a series of MAA GUIDES that will provide readers with an overview of a particular topic. The Guides are meant for students, especially graduate students, and faculty who would like an overview of the subject. They will be useful to those preparing for qualifying exams.

This is a book about complex variables that gives readers a quick and accessible introduction to the key topics. There are many figures and examples to illustrate the principle ideas, and the exposition is lively and inviting. An undergraduate wanting to have a first look at a subject, or a graduate student preparing for the qualifying exams, will find this book to be a useful resource.

In addition to important ideas from the Cauchy theory, the book also includes the Riemann mapping theorem, harmonic functions, the argument principle, general conformal mapping, and dozens of other central topics. Readers will find this book to be a useful companion to more exhaustive texts in the field.



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