1-1-2007

Teaching Time Savers: Is Homework Grading on Your Nerves?

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FOCUS is published by the Mathematical Association of America in January, February, March, April, May/June, August/September, October, November, and December.

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Periodicals postage paid at Washington, DC and additional mailing offices. Postmaster: Send address changes to FOCUS, Mathematical Association of America, P.O. Box 90973, Washington, DC 20090-0973.

ISSN: 0731-2040; Printed in the United States of America.

FOCUS

Volume 27 Issue 1

Inside

On the cover: Portrait of Leonhard Euler by Emanuel Handmann, 1753, pastels on paper, currently at the Kunstmuseum Basel. Photograph by Martin Bühler of the Kunstmuseum Basel. Used by permission.

FOCUS Deadlines

	April	May/June	August/September
Editorial Copy		March 9	June 15
Display Ads	February 23	March 23	June 22
Employment Ads	February 9	March 9	June 15

Leonhard Euler at 300

By Fernando Q. Gouvêa

On April 15, 2007, the mathematical world will celebrate the 300th anniversary of the birth of Leonhard Euler. Many events of all kinds are planned. It will be a unique opportunity to learn more about the life and work of one of the greatest mathematicians. The Euler Tercentenary web site, located at http://www.euler-2007.ch/en/index.htm describes the main events in Basel and includes many links to other Euler events to be held this year.

Euler was born in Basel, Switzerland; that town will be the site of many events. The activities, sponsored by the Swiss Confederation, the Cantons Basel-Stadt and Basel-Landschaft, the University of Basel, the Swiss Academy of Science, the Swiss Mathematical Society and the Basel Naturalist Society, will include "a public celebration with guests from the countries where Euler lived and taught, an interdisciplinary lecture course on Euler's life and works, an international symposium on the significance of Euler's research for modern mathematics," and several other events, including some aimed at high school students and at the general public. The annual congress of the Swiss Academy of Science will be held in Basel and will include many Euler events. English language editions of both a biography of Euler and a comic book about Euler will also be published for the event.

In the United States, the Euler Society, whose web page is at http://www.eulersociety.org/, is planning its own celebration. The Euler 2007 conference will be held in San José, CA, in parallel with the 2007 MAA MathFest. The Russian Academy of Science, the Berlin-Brandenburg Academy of Science, and the Hermann von Helmholtz-Zentrum für Kulturtechnik of the Humboldt University in Berlin are also planning special events. Links and more information can be found at the main Euler Tercentenary site.

The MAA will also be celebrating Euler. This year's MAA Study Tour will be an Euler tour, visiting the three main cities where he lived: Basel, St. Petersburg, and Berlin. (Details were published in the December issue of FOCUS and can also be found online.) In addition, the MAA will be publishing a series of volumes about Euler this year (see Don Albers' article on this page).

The 2007 Joint Mathematics Meetings in New Orleans will include many Euler-related events, including an MAA Short Course, an MAA special session on "Euler in the Classroom," and a lecture on "Euler and his Word Problems," by

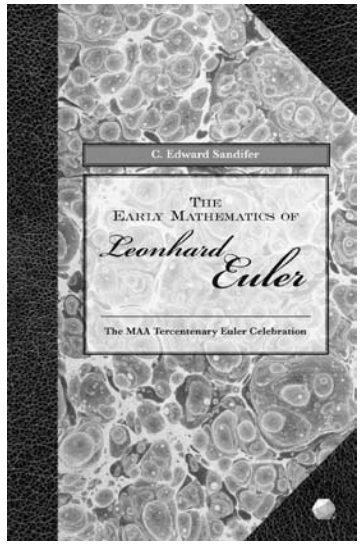
Logo for the Euler Jubilee year, by Elena Pini. Used with permission.

Ed Sandifer, at the annual meeting of the History of Mathematics SIGMAA. Later in the year, Patricia R. Allaire, Robert E. Bradley, and Lee J. Stemkoski will be organizing a special session on Euler for the meeting of the Eastern Section of the American Mathematical Society to be held in Hoboken, NJ, on April 14–15. And, of course, the MAA will be working closely with the Euler Society to hold many Euler-related events during the 2007 MathFest.

The MAA is Celebrating the Year of Euler

By Don Albers

The MAA is celebrating the 300th anniversary of Leonhard Euler's birth and his massive contributions to the world of mathematics by publishing five books about Euler and his work. We have recruited a distinguished cast of Euler scholars to prepare books that we believe are destined to become essential references for all who are interested in Euler and his mathematics. The first two volumes will be released in January 2007 — *The Early Mathematics of Leonhard Euler,* by Edward Sandifer, and *The Genius of Euler: Reflections on His Life and Work*, edited by William Dunham, author of the perennial bestseller *Euler: Master of Us All*. Appearing later in the year will be *The Development of Euler's Ideas and Modern Science*, edited by N. N. Bogdyubov and Yushkevich; *300 Years of Euler*, edited by Lawrence D'Antonio; and *How Euler Did It,* by Edward Sandifer.



Building the Euler Archive
An Interview with the Founders

By Don Albers

In 2001 Dominic Klyve and Lee Stemkoski began their graduate studies at Dartmouth. By the fall of 2002, they started building the Euler Archive, an online resource on the works of Leonhard Euler, currently at http://www.math.dartmouth.edu/~euler/. It has grown rapidly, and is now the largest online collection of Euler's papers and books in the world. The fascinating story of how these two enterprising students accomplished the construction of the Euler Archive with meager financial assistance is told in the interview that follows. No doubt Euler himself would have been greatly pleased by the creation of the Euler Archive, and very likely would have it found very useful in his own work.

Dominic Klyve

Lee Stemkoski

Lee completed his doctorate under Dorothy Wallace in the spring of 2006; he is now an assistant professor at Adelphi University. Dominic will finish his doctoral studies, under Carl Pomerance, in the spring of 2007.

Don: Today I'm talking with Dominic and Lee, founders of the Euler Archive. You two entered Dartmouth at the same time as graduate students.
Dominic: That's right.
Don: What sparked your deep interest in Euler? How did it happen that you ended up creating this archive?
Lee: Our initial spark came from two different sources. One was a talk given by Ed Sandifer at Dartmouth. He talked about Euler — his great passion. The other impetus for us was a large 10 x 10 Graeco-Latin square in the foyer of Bradley Hall, the former mathematics building at Dartmouth. Bradley Hall was built around the same time that the 10 x 10 square was discovered. Euler had conjectured (falsely) that there are no Graeco–Latin squares of an order congruent to 2 modulo 4.
Dominic: We were interested enough in the conjecture that during the summer after our first year of graduate school we decided to look into the problem. We found that it was really interesting, with a 200-year long history and lots of false starts. We eventually put together a little paper (see below) about it and went to the Euler Society's first annual conference that was held in August 2002.
Don: So you two guys had struck up a productive friendship during your first year.
Dominic: Yes, pretty early on. We have a good synergistic relationship. We got to the Euler conference, and when people heard we were from Dartmouth they were quite excited because Dartmouth has a copy of the *Opera Omnia*, which is a copy of Euler's works in several (I think the current number is 77) volumes. Most libraries don't have a copy, so at the meeting we got several requests to photocopy articles.
Lee: As young graduate students, we were more than happy to photocopy anything for anybody at that time.
Dominic: We got to thinking more about it a little bit after that. The Euler Society, as you may know, was formed in part because there's currently very little work done on Euler in English. There's no biography of him in English and there's no really full length biography in any language.
Don: Right, although Ronald Calinger of Catholic University is writing one.
Dominic: That's right, and from my conversations with him, it's going to be fantastic. There are several reasons a biography hasn't been written already. One is that Euler did so much that no single person is able to read and understand everything Euler did (except Euler himself, of course). Even the Euler Society as a whole has studied only a fraction of Euler's works over the last five years. Another big problem was simply that it was really hard to access his original works.

The Birth of the Euler Archive

Lee: Somewhere along the line we got the idea that rather than copying a lot of individual things for one individual person, let's just run them through our little magical scanning device in the math department copy room, and put them online — since the copyrights had expired on the original articles long ago and we happened to have the original articles in the Dartmouth library.
Don: That's a lot of scanning.
Lee: Not initially. We scanned maybe a few dozen papers, the ones that were most popular and easiest for us to access. We put the first pages together and scanned the first articles during April and

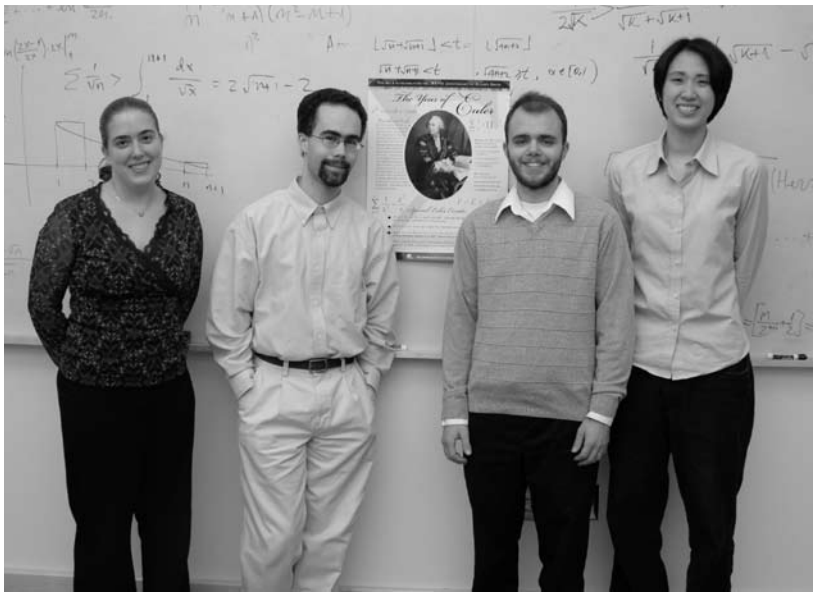
May of 2003.

Dominic: When the Euler Society first learned about it [in August 2003, at the Society's annual meeting], we had only a couple of dozen online. We had put together a big skeleton for the whole website. For Euler's work, there are identification numbers — the Eneström numbers. Eneström gave each of Euler's works a number. There are 866 of them. So we immediately had 866 web pages and each of them has information about the title of the work, and where it was published, and where it appeared in the *Opera Omnia*.

Lee: A lot of this was thanks to Ed Sandifer's preexisting work. He had done a lot of work on Euler, and had a spreadsheet with a lot of this information on it. We were able to use the information to create these web pages pretty quickly.

Dominic: We did start doing some of the scanning and, of course, it did end up being a lot. We now have over 20,000 scanned pages.

Don: Wow!



Graduate students who provided help are pictured from left to right, Rachel Esselstein, Erik Tou, Dominic Klyve, Alison Setyadi. Photo courtesy of Dartmouth Undergraduate Journal of Science. Photograph by Edward Chien.

Help from Undergraduates and the Swiss

Dominic: That is not only quite a bit, but it ended up taking longer than even our graduate student enthusiasm could carry us, and we realized we would need some help. The help came in two stages. First we put out an advertisement to undergraduates. We then met the interested students, and explained how terribly interesting and useful the project was, and convinced them to work for free doing our scanning for us.

Don: You must be very persuasive!

Lee: The most significant help came at a later Euler Society meeting, where we met Deputy Consul Marianne Gerber of the Swiss House for Advanced Research and Education. She was looking for ways to popularize science and build connections between the Swiss and people in the New England area, and the Euler Archive was a very viable and tangible idea that was ready to go.

Dominic: We spoke to her, and she invited us to come down to Boston and give a presentation to the Swiss consul and the staff, which we did in September of 2003. They liked the fledgling Euler Archive, and they gave us a grant of $5,000.

Lee: That enabled us to accelerate the development of the website quickly enough to have much more done by the 1st of January.

Dominic: Once we had $5,000, we could offer undergraduate students $10 an hour, after giving them a little bit of training in how the scanning process worked and how the documents got organized.

Lee: And how to be very careful with very old books.

Dominic: And from that point things did start moving a lot more quickly.

Don: At the same time presumably you two guys were busy with your own graduate work.

Lee: Yes, but if you really want to do something, you find the time to work on it. We spent late nights up in the copy room, and requested documents from other libraries across the country. We were able to fit it into our free time.

Dominic: Another way we really like to think about it is that nobody can do their work all the time. At some point you take a break, and you can take a break and play Solitaire on your computer, or you can take a break and go for a walk, or you can take a break and go work on the Euler Archive. That really became the thing to fill the time between the math work.

Don: During that period, do you have any rough idea of the actual amount of time you were spending on the project?

Lee: I think if we had really thought about the amount of time it would require to do it, it would have discouraged us.

Don: That seems to be true of many great projects.

Lee: Our enthusiasm carried us forward and not thinking about the actual time required helped motivate us to work on it. We never thought it would take forever to finish, but instead we thought about how within a given week we could copy two or three more documents and be that much closer.

Help From Other Graduate Students

Dominic: I would guess that Lee and I each were putting in 10 to 15 hours a week during the high point of it. We certainly had a lot of help, not only from the undergraduates that we hired, but also from three other graduate students from Dartmouth, all of whom are finishing their doctorates this year. Rachel Esselstein, Alison Setyadi, and Erik Tou signed up to do various components of the Archive, and over time, Alison has become "Chief Web Researcher," Erik "Chief Historian," and Rachel "Chief Archivist." The Euler Archive would never have been built up so quickly or so well without them.

Don: So you two succeeded in building up some real enthusiasm among first the

undergraduates, and then your fellow graduate students.

Dominic: Well, it's hard not to sound enthusiastic when you're talking about a project as interesting and exciting as this turned out to be.

Don: Apparently the department head or whoever is in charge of servers around there said, this is fine, go do it.

Lee: We did have to talk to the department chair and make sure we had permission to occupy one of those copy machines and copy room late at night every night. But they were very supportive. There was plenty of room on the servers, and the system administrator didn't mind the extra internet traffic at all.

Dominic: The whole Archive takes up about two gigabytes of space, which is quite a bit, but it doesn't fill up a really appreciable part of a server's hard drive these days. And Dartmouth was willing to let us have that, at least for a couple of years.

Don: Well, that's not bad. I would have guessed that it might have been bigger. It certainly will get bigger.

Dominic: It will get bigger, but it won't get a lot bigger. We currently have more than 95 percent of Euler's works online.

Don: That's close to all of it!

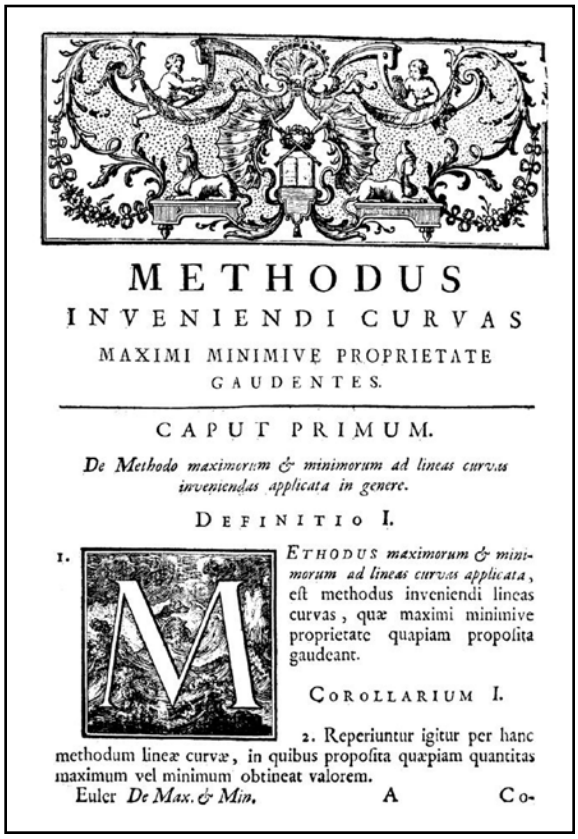
Dominic: I should have checked in the report before I talked to you, but I think it's 827 of Euler's papers and books. [As of December 1, the number was 840.]

Lee: Out of a grand total of 866.

Dominic: And of those that are not online, most are short works, which are lost or almost lost. Euler, for example, published an anonymous tract in 1744 explaining why the comet that was coming back was not signaling the end of the world and why God wouldn't destroy the planet. It was a 56-page tract, published anonymously in St. Petersburg. And there are still one or two copies in existence, but they're locked away in libraries, and I don't think we'll get them anytime soon.

Don: Have you had time to read much Euler as the Archive has grown?

Lee: Well, some. Much of it is hard to read because it's in Latin, French, or German. The two of us can read and speak French okay, we can parse some Latin, and we've been working on German for the past couple of months. But it's really hard to fully appreciate the articles unless you have the command of a number of different languages.



METHODUS
INVENIENDI CURVAS
MAXIMI MINIMIVE PROPRIETATE
GAUDENTES.

CAPUT PRIMUM.

De Methodo maximorum & minimorum ad lineas curvas inveniendas applicata in genere.

DEFINITIO I.

1. METHODUS *maximorum & minimorum ad lineas curvas applicata*, eſt methodus inveniendi lineas curvas, quæ maximi minimive proprietate quapiam propoſita gaudeant.

COROLLARIUM I.

2. Reperiuntur igitur per hanc methodum lineæ curvæ, in quibus propoſita quapiam quantitas maximum vel minimum obtineat valorem.

Euler *De Max. & Min.* A Co-

The first page of Euler's famous Methodus Inveniendi, the first book on the calculus of variations. Image provided by Euler Archive.

Dominic: At first when we would get a copy of one of the old rare journals that had 10 of Euler's works, it was tempting to look at them and try to see what he wrote. Eventually we simply wanted to get them on the Archive for the benefit of others, and we were happy to scan them and put them up without even really thinking about what was on them at the time.

Don: Fair enough.

Dominic: But, of course, doing this put us in touch with a lot of Euler scholars in the U.S. and around the world. We probably receive two or three e-mails a week from various people working on the Euler material. People from 20 countries have written to us. So we've really been put in touch with a lot of people, and therefore we've been able to think about and become aware of a lot of Euler studies without sitting down and reading them ourselves.

Don: Who's going to take care of the Archive once you have both departed from Dartmouth?

Lee: We have tentative plans for what we might do with it. First, since it's not very large, we may eventually create copies of the Euler Archive to take with us to whatever institutions we go.

All of Euler on a CD

Lee: We have further plans. Since the Archive isn't too large, we want to put it on a CD or a pair of CDs to make it completely portable for those people without a high speed connection.

Dominic: You're the first person to hear about this, since this is still very much a work in progress.

Don: That is really impressive. I'm sure that the MAA would be interested in hosting the Archive at some appropriate time.

Dominic: Yes, that's something we're definitely interested in a few years down the line. Right now we're making changes to it so often it's convenient to have it at hand.

Lee: One big change we're currently making and one of the reasons we haven't released it on CD yet is that we're trying to add a lot of Euler's correspondence to the Archive as well. We have a lot of Euler's collected works and we'd feel fine putting that on a CD, but we don't have enough correspondence yet to feel comfortable moving it too far out of our control.

Don: That's understandable.

Dominic: But at some point definitely being able to have a lasting permanent organization like the MAA, which could be responsible for it and have people there look after it and make sure it stays updated in an appropriate way would be wonderful.

Lee: Yes, we'd be very interested.

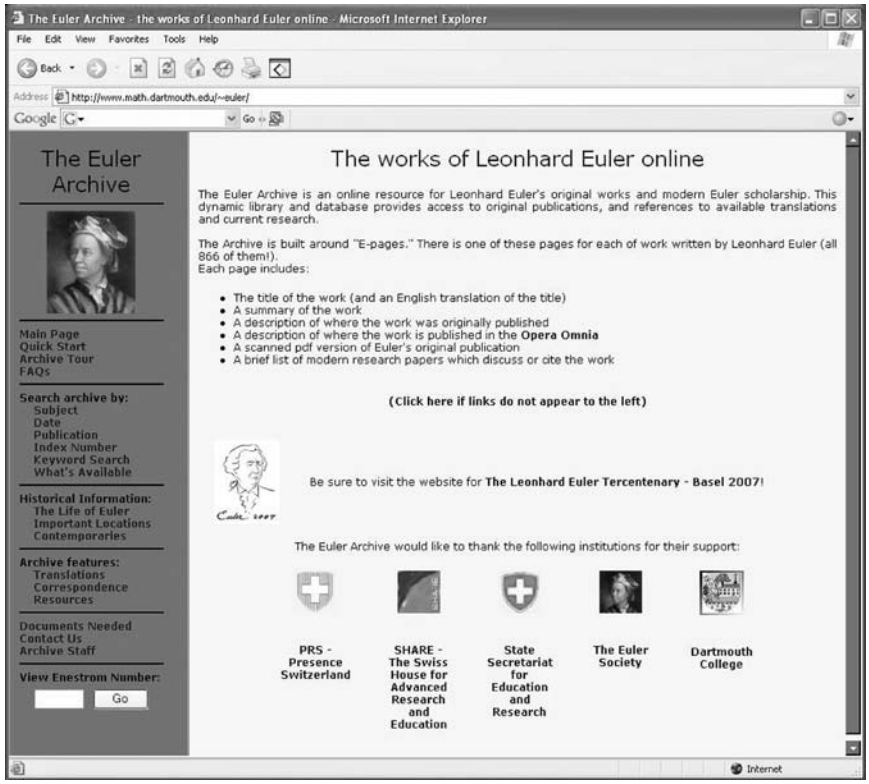
Don: We're agreed that the Euler Archive is a very important project that you've undertaken, and that it definitely needs to be continued. I hardly need to convince you two of that.

Dominic: As long as we're talking about some of the things that we've done on

the Archive, let me mention a bit more of what we have done recently. Lee mentioned adding the correspondence, and that has been a big success over the last year or so. Much less of Euler's correspondence has been published than his papers and books; many of his letters have never appeared at all. Some of them have been published, and a few have even been published in translation. But a lot of them did appear, especially in the late 19th and early 20th centuries in various journals. People would collect some of them and publish them in different pieces, and we think we have found many of them. We have, I think, 450 of his letters online now. A decent fraction of them have been translated into English online, and several people working with the Archive are translating more. As far as we've been able to tell, what's on the Archive now is the largest collection of Euler's correspondence anywhere in the world. It's certainly more than the *Opera Omnia* has published — though here I add the important caveat that the letters in the *Opera Omnia* are carefully checked, edited, and commented on; ours, in many cases, are simply presentations of the text.

Don: Very impressive.

Dominic: Euler's correspondence is something that we're really excited about, and I think that's really going to be useful for anyone interested in the history of mathematics, because a lot of people don't know that much of it has ever been published. There was one person we talked to who worked in the history of astronomy who knew about certain letters of Euler published in an astronomical journal in 1890, and another person that pointed us in another direction. But the fact that we've really been able to put these together and serve as a repository for people is something that we're really happy about.



The homepage for the Euler Archive

Translations

Don: What else have you been adding to the Archive?

Dominic: Another addition to the original works that has been great is the translations, and this is something that I hope we can really make people aware of. Like we said, it's hard to read Euler in the original, but many people who have been translating Euler have wanted to publish the translations with us. We're the most visible publication of Euler's work on the web. We have translations of 25 original publications that we've published online [As of December 1, the number is about 35.], so the number of Euler's works that have been translated into English has doubled over the last two or three years.

Don: That's terrific. That's really significant.

Dominic: Yes, it's fantastic. And some of them are things that we've directly solicited. We'll get e-mails from a professor at some college saying, "I have a student interested in an honors project, and I think a translation might be good. Can you recommend a work of Euler in this language about this subject?" Several others have just come in unsolicited again from all over the U.S. and the world.

Lee: We're hoping that with this increased attention to the Archive lots of people will become more excited and more aware about the need for translations, and will volunteer to take one of these articles and summarize it or translate it for us. It's really through word of mouth and many scholars doing a little bit in their spare time that the Archive has grown to this extent.

Don: You certainly have some strong selling points for getting more people involved with the Euler Archive.

Dominic: It's a really exciting time to be doing Euler scholarship. In some ways we're the first generation of Eulerian scholars, at least in America [there has been a tradition of Eulerian scholarship in Switzerland, Germany, and Russia for some time]. Many of Euler's papers have been read by something like three living people, and no one has taken the time to write about them, or think hard about them, much less translate them. There are hundreds and hundreds of papers out there that a mathematician or a mathematics student can really dive into and get something out of. And if this generation of scholars gets excited about this, and if 50, or even 100 people work on this project together, we could make enormous strides. We could have summaries and abstracts and hopefully translations of many more of Euler's work by the end of 2007.

Coordinating Communication

Don: That's a wonderful goal, and I believe that you'll succeed in getting lots of people involved. What's been the

toughest part of bringing the Archive as far as you have?

Lee: Well, one issue we have is not only collecting, but trying to coordinate Eulerian scholarship. There's the Euler Society which meets every summer, and that's really great. The rest of the time we've been trying to have the Euler Archive serve as a communications hub, and that's had varying degrees of success. At our high point we actually installed a forum where people could write about Euler; there were bulletin boards and guest books, so that people could share information instantaneously. That worked well for about a year until it was taken over by a series of hackers, who unfortunately shut down the math department's servers for a couple of days.

Dominic: So that was the end of the forum.

Lee: To set something up like that again would be nice. That's probably the hardest problem we've had so far: coordinating communications between everybody.

Don: With a little more help, I believe that problem can be addressed.

Lee: We really appreciate any help we can get. We get a lot of e-mails ourselves, but then sharing the relevant information in the e-mails with everybody who visits the site is a challenge.

Dominic: It's also been difficult to simply determine what's out there. Every so often we'll come across another section of Euler's correspondence or a published work that we hadn't been able to find before, so it's hard to determine what's there. For example, there are collections of some of Euler's unpublished correspondence in Switzerland and in Russia. There's a brief summary of each one of Euler's letters in the *Opera Omnia*, which is a fantastic set of books. It's really fun to flip through the *Opera Omnia* and see what Euler did. But what we'd like to be able to do is take these letters and make them available online. Even if they're just in the old handwritten form, they can be photographed and put online easily.

Euler's manuscripts — notebooks and handwritten drafts of books and papers — are in a similar position. There have been tentative plans by the Euler Commission in Switzerland to publish the manuscripts for, I think, about 25 years now, but they haven't appeared yet; they are very difficult to edit and publish. And, boy, if there was a way we could get permission to get in there with a digital camera, we could crack Euler scholarship wide open. We could make 5,000 letters and dozens of manuscripts available on the web.

Don: Have you inquired about the possibility?

Dominic: We have, but thus far no arrangement has been made. They raised questions about the technical feasibility, and there are serious concerns about rights and permissions. Some of the letters were originally in Moscow in the St. Petersburg Archives. The letters were photocopied or mimeographed a generation ago. Who has the rights to them? Understandably they're not eager to let their most valuable possession out.

Don: Of course.

Lee: One point we should stress is that our goal has never been to supplant the *Opera Omnia*. In fact, we're hoping to work more closely with them over the years. In the *Opera Omnia* you can find a lot of things that you can't find at the archives and won't find any time soon. For example they have large summaries and introductions to every volume, which give an overview of Euler's contributions to a specific discipline of mathematics. Our goal in the Euler Archive is just to provide access to the raw text, and to give a summary if possible. [Since the interview, Dominic and Lee have begun discussion with the Euler Commission and the people at the original Euler-Archive, and they are confident that they will find a way to work together.]

Don: So at this stage of the game, if somebody came along and said, here's $100,000, is that something you would be able to spend easily on the project or would that be just an obscene amount of money?

Lee: A hundred thousand dollars is far more than enough for what we currently have in mind. It's amazing what a couple of graduate students can do with, say, $5,000 or $10,000, which is what we got with the help of the Swiss Consulate. Mostly we have been hiring undergraduates to photocopy, which isn't too expensive. Hopefully, someday we will be able to travel to some of the other archives to build relationships and locate more original documents. A hundred thousand dollars would be more than adequate for these purposes.

Dominic: However, if there were a lot of money available, our ultimate dream for the Euler Archive is that all of Euler's works are available, in a fully searchable format, and that they all are translated into English. In addition we hope to someday save sufficient commentary and supplementary material for all of the items so that you could easily create links and go back and forth between them.

We've done some experimenting. We've tried to make the original publications fully searchable using various optical character recognition [OCR] technologies, and nothing has worked really at all. For example, the text might be in Latin, which few mathematicians know. The font is different. The old "S"s look like "F"s. Also there are a lot of math equations that OCR isn't equipped to do. There are a lot of significant difficulties. If someone came along and granted us enough money, one thing we'd love to do is hire somebody talented in this area. We don't even know what that would mean yet, but presumably it must be possible to automate the processes, and make the document text searchable. That would be the ultimate realization of everything we're trying to do. So, yes. We could certainly make good use of $100,000!

Don: The JSTOR folks seem to have solved the problem. You might want to talk with them.

The Joys

Don: Well, we have talked about the biggest problems. What have been the greatest joys associated with your work on the Archive?

Lee: The unprecedented level of enthusiasm when we first unveiled the Euler Archive at the Euler Society meeting in 2003 certainly was a joy.

Dominic: Standing there as a graduate student looking at these people who you look up to and respect, and having them so happy with us was a great feeling. And extending that, the correspondence that we get weekly through the Archive has been almost universally complimentary.

Lee: It makes it all worthwhile.

Talking With Euler

Don: You have been close to the work

of Euler for a while now. Do you feel a special closeness to Euler himself? Suppose it was possible for you either to be transported back in time or Euler forward in time so that you could talk with him. What are some of the first things you would ask Euler if this was possible?

Dominic: It's a hard question. Euler the man is a hard person to know. Even when you read his correspondence, it's in some ways quite guarded. Euler's correspondence with Johann Kaspar Wettstein is a good example. He grew up with Euler in Basel and ended up being a chaplain to the Royal Family in Britain. Euler's correspondence with him is probably the most personal of any because they were personal friends growing up. John Glaus of the Euler Society has catalogued and translated all of those letters, and his translations are now available on the Archive. They are probably the best place to start with Euler's correspondence because you really get a chance to know him, but even among those letters there isn't a whole lot of personal information. He didn't like to talk about himself. In one letter Euler mentions that two months ago he had been near death, but that he seems to have recovered and has no ill effects. He had suffered an increasing loss of sight, but at the time of his illness he never mentioned any of this to his friends. He was a very personal and private man.

Don: So you've essentially said that the correspondence really reveals very little about him or his personality, other than you come away with the impression that he was very guarded.

Dominic: I think that's a fair summary. One of the really amusing things from this Wettstein correspondence that you see is Euler's passion for tobacco. He must have smoked like a chimney.

Don: That certainly is not well known.

Dominic: In almost every letter to Wettstein, he's fretting because Wettstein apparently had access to the good tobacco that England was importing from the New World, and Euler did not. He asks Wettstein: "Send five pounds of tobacco… send 12 pounds of tobacco… send 13 more pounds of tobacco… I'll send you payment later." It's crazy.

Don: So there's very little discussion of the family members, his children. It's science and it's mathematics that he's discussing.

Dominic: It's almost completely science, though this may be a little bit unfair. Some of the correspondence hasn't been published. Also, one of the collections of Euler's correspondence was put together by a man named Paul Fuss in 1849, but Fuss purposefully cut out all the parts that weren't science under the assumption that you read the works in order to learn what Euler thought about science.

Don: That's a pity.

Dominic: So there are a few more snippets [about Euler's personal life] out there that we could possibly get access to, but in general I think that's a very fair statement. He talks very little about family and personal life, hopes, and goals.

Don: Well, Lee, if you got to meet Euler, what would you be most interested in asking him?

Lee: I'd probably ask him to think a little more about some of the things he started thinking about, but didn't bring to fruition. For example, he thought about the Bridges of Königsberg, a famous problem in graph theory, and there are a lot of interesting questions he could have plunged into more deeply. Who knows what else he would have developed? In addition, I certainly would have encouraged him to think even more about the (Riemann) zeta function, especially about the value of the zeta function at odd integers. Perhaps the biggest question that we would have for Euler is: "How did you find time to write so much?"

"Graeco-Latin Squares and a Mistaken Conjecture of Euler" by Dominic *Klyve* and Lee Stemkoski appeared in the January 2006 issue of the *College Mathematics Journal*.

Don Albers is MAA Books Editorial Director. The Euler Archive is located at http://www.math.dartmouth.edu/~euler/.

Euler's Convincing Non-Proofs

By Fernando Q. Gouvêa

Three hundred years can be a long time. When we read Euler's work, we are often surprised by the way he handles certain issues, such as divergent series. We have been carefully indoctrinated into the view that convergence is essential, and that an equation such as

$$\sum_{n=1}^{\infty}\frac{1}{n}=\prod_{p}\left(1-\frac{1}{p}\right)^{-1}$$

in which neither side converges, is meaningless. Euler didn't think so. In fact, this very equation is to be found in chapter XV of his Introduction to t*he Analysis of the Infinite*. (It also appears on the Euler poster that was distributed with our December issue.)

Discussing what Euler thought such an equation meant would require a longer article than this one. On one level, he seems to have believed that convergence is only one of many ways to attach a value to an infinite series or product. He was also perfectly prepared to work with "infinite numbers." Finally, one sometimes gets the feeling that Euler was working with some kind of formal equality, so that the equals sign meant something like "this can be manipulated so that it turns into that."

For us heirs of Weierstrass, running into such things is surprising. Even more surprising, however, is discovering that Euler's arguments can be convincing even when they are, at some level, not proofs. Or at least not proofs we would accept today. It is often said that a mathematical proof is, at heart, simply a convincing argument, one that would be accepted even by the most reluctant reader. But if so, how should we think about convincing non-proofs?

The point here isn't just that the standards of correctness have changed since Euler's time, though clearly they have. The point is that even today, when we read some of the arguments, we find that they work. We read and we believe, even as we also see that the arguments would not pass if we gave them in our real analysis homework or wrote them up in a paper for publication.

Consider the problem of determining the sum of the series $\sum_{n=1}^{\infty}\frac{1}{n^2}$, which Euler solved (to his satisfaction) in a paper written in 1734. (It is usually referred to as "E41," the number given to it in the Eneström index of Euler's works.) After introducing the series in question, Euler says:

> *Recently I showed that the sum of this series is approximately*
> 1.6449340668482264364…
> *When the square root of six times this number is taken we obtain the number*
> 3.1415926535897932 38…
> *which expresses the circumference of a circle with unit diameter.*

This seems immediately convincing. After all, taking the square root of six times the number is very simple to describe, but it is not something one could come up with in a random sort of way. And the resulting number certainly does look a lot like π. Should we doubt, then, that the sum of the series is $\pi^2/6$?

Well, Euler knows we might. For one thing, where did that wonderful 20-digit value come from? For another, did Euler really compute 20 terms of the square root? *By hand?*

So what one finds in the paper is that Euler piles argument upon argument. He introduces a way to express a function (in this case, something closely related to the sine function) as an infinite product. The idea is to start from the formula that expresses a polynomial in terms of its roots, in the form

$$1+a_1x+a_2x^2+a_3x^3+a_4x^4+\cdots+a_nx^n=\left(1-\frac{x}{r_1}\right)\left(1-\frac{x}{r_2}\right)\cdots\left(1-\frac{x}{r_n}\right),$$

and to apply it to power series. (If zero is a root, factor out a power of x on both sides first.) After all, isn't a power series just a *really long* polynomial?

Aware that we might be suspicious about that, he finds the product expansion for the function $1-\sin x$ and sets it equal to the well-known power series. (The reader attempting this at home should keep in mind that each of the roots of this equation is a *double* root!) Computing the coefficient of x the power series, he gets the expression

$$1-\frac{1}{3}+\frac{1}{5}-\frac{1}{7}+\frac{1}{9}-\cdots=\frac{\pi}{4},$$

a famous result that had been obtained by Leibniz. And he comments

> *From this result, if there were any doubts as to the method, the whole sky is lighted up, so that there can be no doubt as to the validity of the new results we are to derive from this method.*

In other words, "See? It works!"

Euler proceeds to use his method to find an infinite product expression for sin x, and then, by comparing the coefficient of x^3 on both sides, gets the formula he had announced early in the paper, namely,

$$1+\frac{1}{4}+\frac{1}{9}+\frac{1}{16}+\frac{1}{25}+\frac{1}{36}+\cdots=\frac{\pi^2}{6}$$

For good measure, he goes ahead and computes the sum of the reciprocals of the 4th powers, the 6th powers, and several more.

I suspect most of us would react the same way to this: we would concede that Euler probably (almost certainly!) has the right answer, but we might be a little dubious about the method. Several of Euler's contemporaries seem to have reacted that way too, which stimulated Euler to provide several other arguments for why the formula is correct. One of them was presented in a paper (E63) published in French in a rather obscure venue. The proof in this paper, using integrals, seems completely acceptable in modern terms. What is neat, however, is that Euler ends the paper by pointing out that his first method allowed him to find the sum of the reciprocals of the 4th powers, 6th powers, and so on, while this method does not generalize. It reads like a challenge: "See, my answer was right after all; and if you don't like the other proof, then find something better if you can."

But here's the rub: if we're dubious about the method in the 1734 paper, why does it leave us so convinced that the answer is right?

Maybe it's because the numerical computation comes out right. But if we look into that, it also seems to become uncertain. Euler certainly didn't find his long decimal by computing a partial sum; it's easy to estimate how many terms that would require, and even Euler couldn't add that many. What he did was use various methods for accelerating the convergence of the series to get better and better estimates of the sum. The 20-digit estimate that appears in his 1734 paper was most likely obtained by using what we now call the Euler-Maclaurin summation formula. And there we get in trouble again, because there divergent series are used.

One can multiply such examples from Euler's work. My favorite remains Euler's discovery of the functional equation of the zeta function, which in some ways is the natural continuation of the work I have just described. In that paper (E342), almost every equation seems to involve a divergent series… but one comes out of the reading utterly convinced that the functional equation must be true.

What shall we say, then? Are we wrong to insist on rigorous proofs? Is there a special category of argument, something less than full proofs, something more than blowing smoke? Or do truly great mathematicians get special dispensation?

Fernando Q. Gouvêa is the editor of FOCUS. This article is based on a colloquium talk exploring Euler's shenanigans, entitled "Mr. Euler, You Can't Do That!" All of the Euler articles mentioned in this article can be found in the Opera Omnia *and at the Euler Archives, where one can also find pointers to the abundant secondary literature discussing them. See also William Dunham's* Euler: The Master of Us All *and the articles on the Basel Problem published in Ed Sandifer's online column, "How Euler Did It."*

College Mathematics Journal: Search for a New Editor

The Mathematical Association of America (MAA) seeks to identify candidates to succeed Lowell Beineke as Editor of *The College Mathematics Journal* when his term expires in December 2008.

Applicants should submit a résumé, names of three references, and a statement of interest containing their ideas about the journal. Review of applications will begin on March 15, 2007 with appointment as Editor-Elect to commence on January 1, 2008. The five-year editorial term runs January 1, 2009 through December 31, 2013. Some support, largely in the form of release time and a part-time editorial assistant, is available. Nominations are also welcome. Send inquiries, nominations, and applications to Arthur Benjamin, Department of Mathematics, Harvey Mudd College, Claremont, CA 91711, benjamin@hmc.edu.

Student Paper Contest in the History of Mathematics

For the fourth year in a row, HOMSIGMAA, the History of Mathematics Special Interest Group within the MAA, will be running a paper contest open to all undergraduate students. The goal is to increase awareness of and interest in the history of mathematics and to give undergraduates a chance to delve deeply into a historical topic of their choice.

Undergraduate students are invited to submit papers to the competition. A grand prize winner and two runners-up will be chosen. Papers for the competition can deal with the history of any field of mathematics, and may address a single person or topic or be a historical survey of a topic or school of thought. They should include a full citation list and should not draw too heavily from online sources. Further details may be found at the HOMSIGMAA web site, at http://home.adelphi.edu/~bradley/HOMSIGMAA/. The deadline for submissions is March 31, 2007.

In Memoriam

Sylvan Burgstahler, Professor Emeritus of Mathematics at the University of Minnesota Duluth, passed away on Sept. 28, 2006 at the age of 77 after a 12 year battle with cancer. Sylvan was a faculty member at UMD for more than 40 years and a long time active member of the MAA. He was known for his sharp wit, lively conversation and his knowledge of many subjects. Burgstahler's most important professional paper describes an iterative method for solving polynomial equations that was the lead article in the *American Mathematical Monthly*. He remained active mathematically during his retirement but spent most of his time writing a 750 page story of the Burgstahler family that included information about 8000 relatives. His honors include a Fulbright Scholarship, President of the North Central Section of the MAA, membership on the MAA Board of Governors, and the MAA Certificate of Meritorious Service.

Mathematics Advanced Study Semesters (MASS)

Department of Mathematics of the Penn State University runs a yearly semester-long intensive program for undergraduate students seriously interested in pursuing career in mathematics. MASS is held during the fall semester of each year. For most of its participants, the program is a spring board to graduate schools in mathematics. The participants are usually juniors and seniors.

The MASS program consists of three core courses (4 credits each), Seminar (3 credits) and Colloquium (1 credit), fully transferable to the participants' home schools. The core courses offered in 2006 are:

- *Computability, unsolvability and randomness* (S. Simpson),
- *Surfaces: everything you wanted to know about them* (A. Katok),
- *Topics in probability theory* (O. Sarig).

Applications for fall semester of 2007 are accepted now.

Financial arrangements:

Successful applicants are awarded *Penn State MASS Fellowship* which reduces their tuition to the in-state level. Applicants who are US citizens or permanent residents receive *NSF MASS Fellowship* which covers room and board, travel to and from Penn State and provides additional stipend. Applicants with outstanding previous record are awarded additional *MASS Merit Fellowship*. Participants who significantly exceed expectations during the program will be awarded *MASS Performance Fellowships* at the end of the semester.

For complete information, see
http://www/math/psu.edu/mass
e-mail to mass@math.psu.edu
or call (814)865-8462

SUMMA Director William Hawkins Wins 2006 Banneker Legacy Award

William Anthony Hawkins, director of the MAA's SUMMA program and professor at the University of the District of Columbia, has been named one of this year's Banneker Legacy Award winners by the Banneker Institute for Science and Technology, Washington, D.C.

SUMMA, which stands for "Strengthening Underrepresented Minority Mathematics Achievement," was created in 1990 to "increase the representation of minorities in the fields of mathematics, science and engineering and improve the mathematics education of minorities." As director, Hawkins has raised more than $3 million to increase the representation of minorities in mathematics and to improve the mathematics education of minority students.

Bill Hawkins earned his PhD in mathematics from the University of Michigan under James Milne. He taught at the University of the District of Columbia until taking on the role of Director of SUMMA in 1990. He now divides his time between SUMMA and UDC.

Hawkins and 10 other esteemed awardees, including the well-known Baltimore surgeon Ben Carson, were honored at a gala ceremony at the National Academy of Sciences on November 17 for helping to advance the participation of African Americans in science, technology, engineering, and the mathematical sciences. The keynote speaker at the ceremony was Bill Cosby.

For more on the Banneker Institute and its awards, visit http://www.thebannekerinstitute.org. The main page for the MAA's SUMMA program can be reached from the main MAA page (use the "Programs" menu) or directly at http://www.maa.org/summa/archive/summa_wl.htm.

Teaching Time Savers: Is Homework Grading on Your Nerves?

By Lisette de Pillis and Michael E. Orrison

You have probably heard it said that we learn mathematics best when we do mathematics, or that mathematics is not a spectator sport. For most of our students, this means that their mathematics courses will involve a fair amount of homework. This homework is often used to evaluate individual student progress, but it can also be used, for example, as a catalyst for discussion, to emphasize a point made in class, and to identify common misunderstandings throughout the class as a whole. There is, however, the matter of *grading* homework.

In spite of the importance of providing meaningful and worthwhile feedback to students regarding their homework, we have a feeling that, for many of us, it would be a struggle to imagine "grading homework" in our "ten things I like most about my job" lists. A few years ago, however, it occurred to us that grading homework was probably farther down on our lists than it needed to be, not because of what our students were trying to communicate, but because of how they were trying to communicate it.

How many of us have felt that we (or our graders) spend too much time trying to navigate puzzle-like homework with sentences that wind their way through a maze of scratch work, or dealing with answers that seem to have magically appeared at the end (if you are lucky) of a solution? Do you spend so much time deciphering handwriting that you begin to empathize with the folks at the NSA?

Since we wanted our students to communicate clearly and effectively to us in their homework, we felt that, as instructors, we were obligated to clearly and effectively communicate our expectations. We needed to go beyond saying "make it neat" and "box your answers" to a point where we were sharing specific advice (or instructions) together with a template. In particular, we wanted to impress upon our students the idea that "how you present your work should enhance the ideas you are trying to communicate, not impede them."

Cartoon by Brad Fitzpatrick

With that in mind, in the summer of 2004, we developed a website that described what we felt were the most important structural elements for presenting homework in our classes, both introductory and advanced, regardless of course content. That website, which can now be found at http://www.math.hmc.edu/homework/, is currently being used by the majority of our colleagues in our department.

From reading solutions, to providing comments, to alphabetizing and returning homework, the website has helped us to streamline the homework grading process, for our benefit and for that of our students. And while we hardly expect "grading homework" to find itself in that top ten list any time soon, it is nice to know that there are simple things that we can do to make it less onerous. It is also nice to know that even small investments toward fine-tuning the communication skills of our students can lead to huge payoffs for everyone involved!

Time spent: 5 minutes to link directly to our page, or 60 minutes to construct your own page from scratch, including an example image.

Time saved: 15 to 30 seconds per homework assignment.

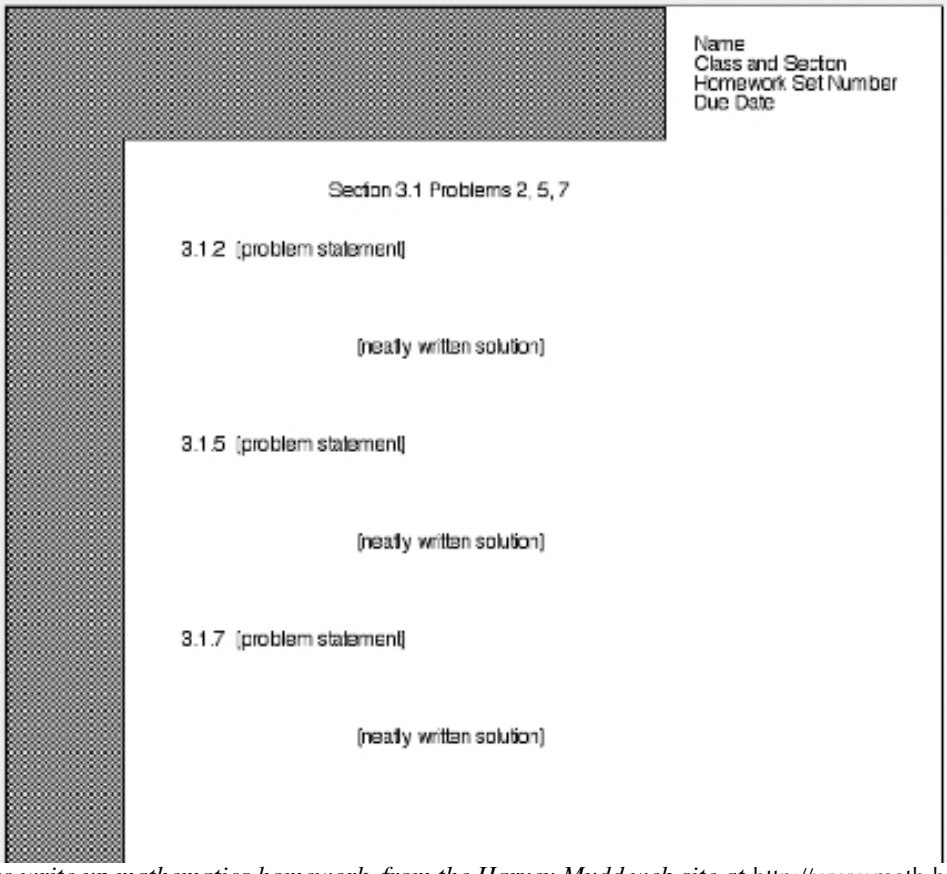
mathematics
harvey mudd college

Communicating Mathematics through Homework

Learning mathematics at Harvey Mudd College involves learning how to communicate your ideas effectively. As a student, much of this communication will be in the form of homework. Therefore, so that we may provide you with meaningful and worthwhile feedback, it is important that you put your homework in an easy to read, easy to navigate format. After all, how you present your work should enhance the ideas you are trying to communicate, not impede them. With that in mind, the following are some suggestions for submitting homework in your mathematics courses.

- Your handwriting should be legible.
- Homework with multiple pages should be stapled in the upper left-hand corner.
- In the upper right-hand corner you should write (in this order)
  - Your Name
  - Your Class and Section Number
  - The Homework Set Number
  - The Due Date of the Homework
- Problems should be clearly labeled and numbered on the left side of the page. There should also be a visible separation between problems.
- Each solution should begin with the original problem statement.
- You should leave the top left margin and the entire left margin blank so that graders may use this space for scoring and comments.
- To ensure that each problem is graded, problems should be written in the order they are assigned.
- It is good practice to first work out the solutions to homework problems on scratch paper, and to then neatly write up your solutions. This will help you to turn in a clean finished product.
- Some classes allow you to work jointly on assignments. You should write up your solutions by yourself, unless you are specifically told otherwise by your instructor. Also, you should always acknowledge any help received, at the top of the assignment or in the margin.

Easy to Read Homework Format



Instructions on how to write up mathematics homework, from the Harvey Mudd web site at http://www.math.hmc.edu/homework/.

Don Kreider, MAA President 1993-1994, Dies Suddenly

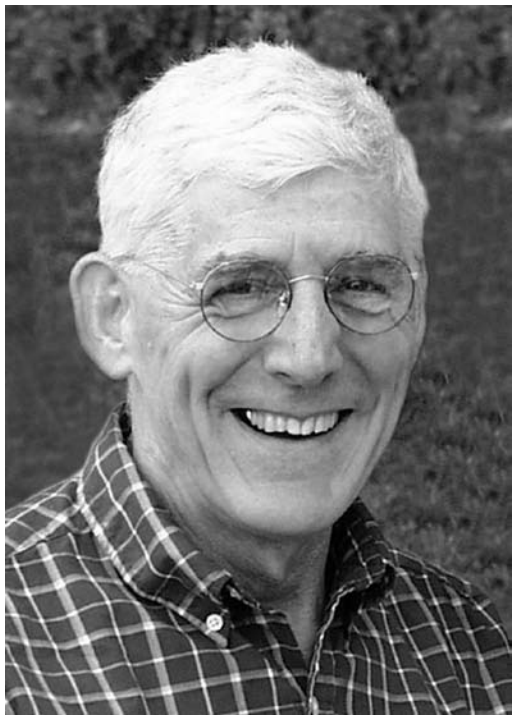
By Tina Straley

Donald L. Kreider, MAA Treasurer 1989-1991, President-elect, 1992, and President 1993-1994, passed away unexpectedly on December 7, he died of a massive heart attack. Don spent his academic career at Dartmouth College, starting in 1960 after receiving his doctoral degree in mathematical logic from MIT and spending a postdoctoral year there. At Dartmouth Don served twice as chair of the Department of Mathematics and as Vice-President of the College under the Presidency of John Kemeny, his friend and mentor. Don's passion was teaching, however. In an interview with Don Albers, FOCUS, June, 1993, he talked about the tempo of the academic year which drew him to the classroom.

Don Kreider's work in MAA also started in 1960. He was very active on a number of MAA committees, notably the Budget Committee and the Committee on the Undergraduate Program in Mathematics (CUPM), which publishes *Guidelines for the Mathematics Major*. In addition to his years in office, Don continued to serve on the Board of Governors in 1995-1999.

Don was a leader in the mathematics community in the advent of calculus reform and received one of the first grants in the then new Calculus Initiative launched by NSF in 1989. He was also a founding member of the Mathematical Sciences Education Board (MSEB), and in that capacity was influential in developing the Calculus for a New Century national colloquium.

Don Kreider authored several mathematics texts: *Linear Analysis,* with Kuller, Ostberg, and Perkins; *Differential Equations,* with Kuller and Ostberg; *Investigations in Mathematics,* with La Torre and Proctor; and, *Case Studies in Calculus* with Dwight Lahr. He also participated in the MAA CUPM reports on the undergraduate program in mathematics and the mathematical preparation of teachers.



Don Kreider is best remembered for his caring and gentle leadership. He handled many difficult situations while MAA Treasurer and President. He always did so quietly, tactfully, and decisively. Former President Lida Barrett said, "Don Kreider provided leadership to MAA in a wide variety of roles. He knew how to get things done in a quiet, gentle manner, often seeing what needed to be done before it became known, and taking care of things without seeking credit. I enjoyed working with him on the finance committee and as Treasurer when I was President. His many contributions to MAA activities have had long term effects."

Former President Ken Ross has similar impressions of Don, "He was a very thoughtful, tactful and caring guy, both when he was Treasurer and when he was President. He had those characteristics at other times, too, such as when he was on the Budget Committee. I was Secretary when he was Treasurer and I was President when he was Past President, and I often consulted him on issues, especially sensitive ones. I was elected President of the MAA to serve immediately after Don, and I really did not like having to follow him, because I felt he was an impossible act to follow."

Marcia Sward was Executive Director of MAA when Don was President. Marcia remembers first meeting Don. She was applying for the position of MAA Associate Executive Director and on the day of the interview decided to quietly slip a cover letter to go with her application into the mail slot early in the morning before anyone would be there. She was surprised to find a man sitting on the doorstep, all alone, in front of the still closed offices. She was even more surprised to learn that he was Don Kreider, the chair of the search committee. Marcia writes, "Wisdom, kindness, and humanity were Don's hallmarks throughout the twenty years of our professional relationship. Don could always be relied upon to provide thoughtful advice on any issue, to take the high road in any situation, and to cheerfully undertake any task."

"In 1990, when Don was elected to the presidency of the MAA, I was serving as MAA Executive Director. We worked closely together for the two years of his term on issues of particular concern to us both – strengthening the relationships between the MAA and its sibling organizations, and establishing a more welcoming environment for women, particularly in the American Mathematics Competitions. Don led the MAA during those years with statesmanship and diplomacy, approaching issues with unfailing vision and patience. As Treasurer, Don took very seriously the responsibility of insuring that the MAA would be passed on to the next generation in sound fiscal condition."

"The MAA has been greatly enriched in its programs, financial management, and culture through Don's involvement. It is a stronger, more open, welcoming, and col-

laborative organization because of him. We owe him a great debt of gratitude. He will be sorely missed."

John Kenelly, MAA Treasurer, credits Don Kreider for his leadership as Chair of the College Board Calculus Development Committee and member of the Mathematical Science Advisory Committee in the 1970s. "Don brought immense credibility to the program." John said that Don pushed the committee to incorporate the use of technology and to write questions that would reflect well on reform calculus today, thirty years later. "The rest of the committee sat in awe of Don Kreider and Winfred Kaplan. We wished we could do calculus one-half as fast as they could."

Tina Straley, MAA Executive Director, said the MAA is saddened and diminished by the passing of Don Kreider. He was a leader who made everyone feel welcome and important. "He was so exceptional, so dedicated, and so charming."

The last line of the FOCUS interview of 1993 expresses his motivation best in Don Kreider's own words, "We dare not waste one single person who has potential interest in mathematics or teaching."

Don is survived by his loving companion of more than twenty-six years, William F. White of Sugar Hill, NH. He is also survived by his former wife, Mary Ellen (Galebach) Kreider of Norwich, VT, and their three sons and daughters-in-law, seven grandchildren, and one great grandchild. He was predeceased by a brother, Richard Kreider, and two sisters, Rosanna Buch and Janet Knowles.

In lieu of flowers, Don's family and friends ask that donations be made to the Mathematical Association of America-Please make checks payable to 'MAA', write 'In memory of Don Kreider' on the memo line, and send to:

MAA Headquarters
ATTN: Lisa Kolbe
1529 18th Street, NW
Washington, DC 20036

IRS Regulation Regarding MAA Dues

Current IRS regulations do not allow the payment of professional dues to be taken as a charitable contribution for individual taxpayers but may still be deducted as business expenses. The 2007 dues notices still indicate that a proportion of your dues may be deducted as a charitable contribution to the MAA. This is no longer the case. Any added dues in the VDS (Voluntary Dues Supplement) or charitable contribution that you add to your payment, or donate at any other time, are fully tax deductible as charitable contributions.

We regret any inconvenience that this corrected interpretation of the relevant IRS code may cause. This statement supercedes any printed statement regarding the deductability of a portion of your dues as a charitable contribution that may be printed on your 2006 or 2007 dues invoice.

If you have further questions, Sharon Tryon, the Director of Finance, can answer general questions at 202 319-8485, or via email at stryon@maa.org. The MAA cannot be responsible for giving specific tax advice.

Found Math

Dr. Blind (pronounced "Blend") was about ninety years old and had taught, for the past fifty years, a course called "Invariant Subspaces" which was noted for its monotony and virtually absolute unintelligibility, as well as for the fact that the final exam, as long as anyone could remember, had consisted of the same single yes-or-no question. The question was three pages long but the answer was always "Yes." That was all you needed to know to pass Invariant Subspaces.

(From *The Secret History,* by Donna Tartt)

Have You Moved?

The MAA makes it easy to change your address. Please inform the MAA Service Center about your change of address by using the electronic combined membership list at MAA Online http://www.maa.org) or call (800) 331-1622, fax (301) 206-9789, email: maaservice@maa.org, or mail to the MAA, PO Box 90973, Washington, DC 20090.

MAA's Program for Continual Strategic Planning

By Nancy L. Hagelgans and Martha J. Siegel

In January 2005, on the advice of a strategic planning design committee led by Joan Leitzel, the Executive Committee proposed that the MAA begin a continual strategic planning process by choosing at most three areas each year for study and strategic planning. The Board of Governors enthusiastically approved the proposal.

The Process

The plan requires that MAA's President appoint a working group in each year's study areas by March; members of the working group have an initial term of two years. Each working group includes an Executive Committee member, usually as chair, as well as an MAA staff specialist in the study area. The Executive Committee, in consultation with the Executive Director and relevant Directors, will give each working group its charge.

Members of a working group meet at the Washington headquarters office for several days in late spring to initiate the study. They continue the work at national meetings, and they communicate by conference calls and email in between meetings. Within 12 to 18 months, the group is expected to prepare a report that recommends future actions in the target area. These recommendations are to be based on issues, opportunities, and obstacles described in the report.

The Current Working Groups and Areas of Study

Cycle I began in the Spring of 2005 with the Board of Governors endorsing working groups for the following areas: Professional Development, Revenue, and the American Mathematics Competitions (AMC). The groups conducted surveys, ran focus groups, and investigated what other organizations are doing and have available. They reported regularly to the Executive Committee and the Board during their deliberations. This January, they will present their final reports to the Board. The Board is expected to formally receive the reports and to discuss the recommendations of each of the working groups, to set priorities, and to decide on what should be implemented. When the Board acts on the final reports, the reports will be posted on MAA Online.

Cycle II groups, on Membership, Students, and Governance, started working this past spring. The Board will choose the new areas of concentration for the next year at their January meeting. The cycles are expected to continue for at least five years.

Cycle I Reports

The Revenue group (chaired by Barbara Faires and facilitator Tina Straley) strongly recommended that the MAA establish a process for evaluating new programs and activities. The group studied MAA's usual sources of revenue: membership, publications, programs, the Carriage House, and development.

The group's analysis of the Carriage House as a source of revenue from commercial rental of space addresses topics such as competition, cost benefit analysis, goals, and the decision making process. There is a helpful SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis for all recommendations. The usual missing pieces in an initial proposal are actual pricing and costs as well as estimated usage and revenue. These elements would give a more solid projection of revenues and profits. The working group viewed this analysis as a template of what should be considered for any new program.

The final aspect of this report addresses the establishment of criteria against which all programs can be measured, both on a financial and non-financial basis. The anticipation is that the recommended strategies and justification procedures will be adopted for use whenever MAA areas are included or proposed as additions to the business plan. Specific goals are enumerated in the report and the Board will consider them carefully as these ideas are developed further.

The Professional Development Group (chair Nancy Hagelgans and facilitator Michael Pearson) used focus groups and surveys to investigate satisfaction with our professional development programs. Here also there is a significant SWOT analysis of the MAA programs in professional development, including minicourses, short courses, PREP, and so on.

In general, the working group discovered widespread satisfaction with the programs of the MAA in this area. Its recommendations included increasing financial support to diversify and to insure sources of financial support designated for professional development; to offer a variety of programs in different formats that meet the needs of all whose careers involve the use of collegiate-level mathematics, and to better evaluate programs and actively and routinely collect data on participant demographics and satisfaction. The working group clearly supports the vision that the MAA will be the preeminent provider of professional development programs for those active in professional careers that use mathematics at the collegiate level.

The AMC Working Group (chair Frank Farris and facilitator Steve Dunbar) looked at many aspects of the American Mathematics Competitions. The group surveyed teachers and collegiate faculty and made many interesting suggestions. Ways to increase participation were discussed, suggestions for stronger affiliation with the sections and the colleges were presented, and investigation of the nature of the tests, their difficulty, their appeal, their mode of test delivery, and ways in which the program could enhance student attitudes toward further study of mathematics are all included in this report. Important aspects of the

report are suggestions of ways in which the MAA might give more support to teachers and increase the diversity of students taking the tests.

There will be a lot for the Board to dicuss on January 3.

Progress on the Cycle II Areas

Working Groups on MAA Governance, Students, and Membership are working on their studies. Some members of the Association have already participated in focus groups on governance and/or students. There will be other chances for the membership to add to the discussion at both the Joint Meetings and at the MathFest in 2007. With the arrival of our new Director of Membership, Robert Anastasio, the Membership group is beginning its work and we will be hearing more about their progress at MathFest.

Martha Siegel is the Secretary of the MAA. Nancy Hagelhans is Chair of the MAA Committee on Sections; she chaired the working group on the MAA's professional development activities.

Letters to the Editor

The Decline of Mathematical Learning

Many have observed that the learning of mathematics by students has declined over the last fifty years. As a professor of mathematics at mostly two year colleges since 1965, I have made the same observation. The point has also been made by letters and articles in FOCUS. A letter by Rich Kenefic in the November issue pointed out deficiencies of bright students due to overuse of the TI-89 calculator. An article by Susan Wildstrom in the August/September issue highlighted many deficiencies of college mathematics students and pointed out some reasons why. One question that was asked but not answered was why we teach calculus concepts in Algebra 1 and 2, but some problems caused by this practice were mentioned.

The operational answer to the question of why we teach calculus concepts in Algebra 1 and 2 is simple: The reason is that the National Council of Teachers of Mathematics says we should. The NCTM has developed over a number of years a near monopoly over what should be taught in American schools and how it should be taught. The principles behind the *Standards* of the NCTM are more psychological than academic. They are focused more on self-esteem, fun, excitement and interest than on actual academic learning. The justification is that these topics are aimed at a noble goal, conceptual understanding.

As a result of tutoring two fourth grade girls in Florida, I have become even more certain that so many of these topics are included that it is impossible for the students to learn the really important knowledge and skills that are necessary in both academics and life. The NCTM *Standards* mention computational fluency, but fill the curriculum with so many other topics that it is nearly impossible for students to obtain sufficient practice to gain any proficiency in the mechanics of mathematics. As a result, in future work they will spend so much time and effort performing the basic operations that they will have trouble learning more advanced concepts.

In addition to the over-inclusion of topics that seem to be designed to reach psychological goals is the trend of moving beginning ideas of advanced concepts into lower grades on the premise that this raises the standard. The real effect of this practice is to reduce the time available to really learn the basic ideas so they can be effectively used in later courses; thus, it actually lowers the standard of learning.

In our current educational environment, the monopoly of the NCTM on mathematics education allows the expansion of these erroneous concepts and will continue the downward trend in learning of mathematics. My suggestion is that the MAA produce its own standards for mathematics education that focus on learning rather than on psychological principles. I know the thrust of the MAA is on college teaching, but if this is not done the negative impact on college mathematics instruction will continue to worsen.

Warren J. Burch
Bluefield State College

So far, the MAA has preferred to leave the debate about the school mathematics curriculum to others, though of course many MAA members are deeply involved. The MAA's strength is, as you point out, at the collegiate level. Of course, neither MAA nor, for that matter, NCTM have any real "power" over mathematics education. All they can do is propose and attempt to persuade.

Curve-sketching: An Eternal Delight

In "Curve Sketching: A Disappearing Delight" (Nov. 2006 issue of FOCUS), S. C. Bhatnagar sounds rather nonchalant about the onslaught of graphing calculators and their effect on the teaching of curve-sketching.

Curve-sketching is taught because it motivates and achieves the very purpose of single-variable calculus, i.e., ascertaining behaviors of certain real-valued functions. It is the best vehicle for students to see how the derivative dictates the behavior of a function. That a calculator can do graphing in no way decreases the pedagogical value of teaching it. (A side note: the mechanism via which a calculator graphs a function is far more primitive than that used by a calculus-enlightened mind. Does that mean we may dismiss calculus as an unnecessary invention?)

Nowadays, while discussing $1/x$ in my calculus class, I can no longer rely on students' grasp of the fact that dividing 1 by a tiny fraction results in a huge number. To most, this arithmetic fact is just one of the dauntingly many confusingly disparate effects of button-pushing. Some would use the graph of $1/x$ as displayed on their calculators to explain this fact, not knowing that in reality it is that it explains the graph.

Is the use of technology putting students more in touch with, or is it alienating them from the underlying explanations for many fundamental facts? Have our students internalized some most basic mathematical phenomena and principles through the use of technology, or are they deprived of ownership of knowledge? Do disparate facts become better organized in students' minds?

Use of a calculator by an average student most often does not enhance the conceptual learning of mathematics; it most likely results in a less enlightened and more confused mind. Let's curb the abuse of calculators for a sounder mathematics

education and make curve-sketching an eternal delight.

Pisheng Ding
St. John's University
Queens, New York

"Disappearing" was an editorial choice; Bhatnagar's original word was "withering." Either way, no one is claiming that it's a good thing, necessarily, that curve sketching no longer excites students as long as it did… but the fact is that today's students don't seem to find it as delightful as we did when we were students. It's just not as much of a revelation anymore, given the ease with which one can graph on a calculator or computer. And one must teach the students one has.

Perhaps we should take this as a challenge. Can we come up with examples in which the calculator's graph is misleading in one way or another? Can we show students examples in which the calculus-enlightened mind has the advantage over brute force?

Short Takes

Compiled by Fernando Q. Gouvêa

A Greek Orrery?

In the November 30, 2006 issue of *Nature,* scientists reported on their progress in reconstructing the function of the "Antikythera mechanism," an ancient geared mechanism first discovered in 1900. Greek sponge divers found the mechanism in a ancient shipwreck near the islet of Antikythera. Scholars soon realized that this was some sort of astronomical machine, but were unable to reconstruct it convincingly.

The latest article, written by a team led by T. Freeth of Cardiff University, reports on work using X-ray tomography and surface imaging to reconstruct the original functions of the many gears found inside the mechanism and also to read some of the ancient inscriptions. The reconstruction confirms the usual assumption that the mechanism was an analog computer that displayed planetary positions, but reveals an unexpected level of sophistication. A pin-and-slot device connecting two wheels seems to have been used to realize the "first lunar anomaly," i.e., to reproduce some of the irregularities of the motion of the Moon.

The authors speculate that the mechanism is based on a model of lunar motion due to the Greek astronomer Hypparchus. The mechanism is remarkably sophisticated: "No earlier geared mechanism of any sort has ever been found. Nothing close to [this level of] technological sophisitication appears again for well over a millennium," writes Jo Marchant in *Nature*.

Another Explanation

We have just become aware of a report on *ABC Science Online*, dated 11 July 2003, that says that "getting married and having kids appears to dent creativity in men." The report is based on research published in the *Journal of Research in Personality* by Satoshi Kanazawa, a psychologist at the University of Canterbury in Christchurch, New Zealand. Kanazawa analyzed a database of scientists considered "great," looking for connections between biographical information and research productivity. He found the usual correlation between age and productivity: two-thirds of the scientists had made their most significant contribution before their mid-30s. But, says the report, "regardless of age, the great minds who married virtually kissed goodbye to making any further glorious additions to their CV. Within five years of making their nuptial vows, nearly a quarter of married scientists had made their last significant contribution to knowledge."

So *that's* why.

A Congressional Mathematician

Little noticed in the flurry of news about the 2006 midterm elections was the fact that one of the new members of Congress is a mathematician. Jerry McNerney, a Democrat from Pleasonton, CA, defeated Richard Pombo, the Republican incumbent. McNerney received his PhD in mathematics from the University of New Mexico in 1991. He is now the CEO of a startup firm that will manufacture wind turbines for energy generation. McNerney is a member of AMS; his campaign web site is at http://www.jerrymcnerney.org/.

Sources

Antikythera mechanism: *Nature,* November 30, 2006. Marriage and productivity: http://www.abc.net.au/science/news/stories/s900147.htm. Congressional mathematician: AMS "Headlines and Deadlines," McNerney campaign web site.

Employment Opportunities

NEW YORK

Farmingdale State University of New York
Applications are invited for one position in applied mathematics pending anticipated administrative approval. The department is looking for individuals with a minimum of three years of undergraduate teaching experience, preferably in the areas of mathematical finance or mathematical biology. Other areas of applied mathematics will also be considered. Responsibilities will include working with the department to develop a center of applied mathematics with a focus on financial mathematics, mathematical biology, or other areas connected to the local economy. Applicants should have a PhD or equivalent in mathematics or a related field. Strong evidence of interest in undergraduate education, demonstrated success in classroom instruction, and a commitment to teaching are essential. Applicants should send a letter of application, a curriculum vitae, three references (with contact information), and a personal statement providing the candidate's philosophy on teaching undergraduate mathematics and the role of applied mathematics in the undergraduate curriculum. Material should be sent to:
Dr. Irina Neymotin, Chair
Search Committee
Department of Mathematics
Farmingdale State University
of New York
2350 Broadhollow Road
Farmingdale,
New York 11735-1021
Applications must be received by March 1, 2007. Farmingdale State is an Affirmative Action/Equal Opportunity Employer.

PENNSYLVANIA

Robert Morris University
Position in Mathematics and Actuarial Science
Robert Morris University's Department of Mathematics invites applications for a permanent/full-time position at the rank of **Assistant or Associate Professor of Mathematics (and/or) Actuarial Science** beginning fall 2007. Our ideal candidate will possess a doctorate in actuarial science, mathematics, or statistics and whose teaching interests and individual research program are in Actuarial Science.

Qualified candidates will have (1) a demonstrated ability to teach undergraduate actuarial science courses, (2) the ability to extend our mission of providing a comprehensive actuarial education recognized throughout the industry for its quality, standards, and the achievements of its graduates, and (3) the capacity for leadership and entrepreneurship. Ideal candidates may possess a professional actuarial qualification, be working towards accreditation by the SOA or CAS, or have industry experience.

Robert Morris University, founded in 1921, is a private university with an enrollment of approximately 5,100 undergraduate and graduate students. RMU offers more than 30 undergraduate degree programs and 18 masters and doctoral degree programs across six academic schools. The university is located on an expansive rural campus 15 minutes from downtown Pittsburgh on 230 acres of rolling hills, a short drive from the Pittsburgh International Airport. The Department of Mathematics is housed in the School of Engineering, Mathematics and Science (SEMS). RMU is pleased to host the 42nd annual Actuarial Research Conference summer 2007.

The dynamic and thriving mathematics department boasts majors in mathematics education (25), applied mathematics (12), and actuarial science (80). The actuarial science major leads to a Bachelor of Science degree in Actuarial Science. The actuarial degree is the only "advanced undergraduate" program in western Pennsylvania. Although relatively new, the department currently possesses three full-time actuarial faculty with doctorates in mathematics and ASA credentials.

Qualified candidates should submit their applications using the standard AMS cover sheet (available at www.ams.org) together with a cover letter, teaching and research statement and vitae, and three letters of recommendation by email to: SEMS@rmu.edu or mail to: School of Engineering, Mathematics and Science, Robert Morris University, 6001 University Blvd., Moon Township, PA 15108.

Salaries are market-competitive and depend upon qualifications and experience. Screening begins immediately and applications will be accepted until the position is filled. Visit www.rmu.edu regarding this and other employment opportunities. EOE

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