Tangents

News from the Department of Mathematical Sciences
University of Massachusetts Lowell

Fall 2005

New UML Mathematics Faculty

Our department is delighted to welcome four new faculty members for the 2005-06 academic year. Tibor Beke, Ravi Montenegro, Victor Shubov and Alina Stancu all joined us this September. We profile Tibor and Alina in this issue, while Ravi and Victor will be featured in the spring issue of Tangents.

Tibor Beke

Tibor Beke. Prof. Beke was born and raised in Hungary. He received his bachelor's degree at Princeton University and his Ph.D. in mathematics in 1998 at the Massachusetts Institute of Technology, where his advisor was Michael Hopkins. His previous appointments include a two-year postdoctoral fellowship at Utrecht University in the Netherlands, and an assistant professorship at the University of Michigan, Ann Arbor. He also spent short-term sabbatical visits at the Centre de Recerca Matematica in Barcelona; at Masaryk University in Brno, Czech Republic; and at the Mathematical Institute of the Hungarian Academy of Sciences in his native Budapest.

His research interests include algebraic topology (especially homotopical algebra and sheaf cohomology), model theory, and certain aspects of applied mathematics (image processing). Most recently, he has been working on questions of enumerative combinatorics over finite fields, using techniques from algebraic geometry.

When he is not thinking about mathematics, most of his time is taken up by attempting to solve a two-body problem.

Alina Stancu

Alina Stancu. A native of Romania, Prof. Stancu came to United States to pursue a

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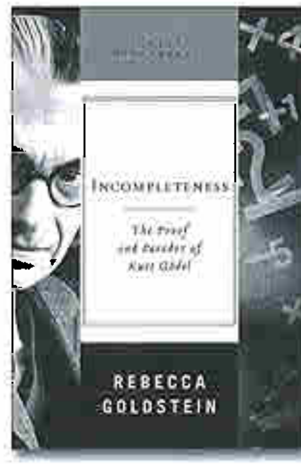
Incompleteness

by Rebecca Goldstein
296 pp. Norton and Co.
$22.95

Reviewed by Guntram Mueller



Incompleteness, relativity, uncertainty: these three early 20th century ideas have recast the fundamental notions of mathematics and physics and, not coincidentally, of truth and certainty. The recent little book by Rebecca Goldstein, a novelist and professor of philosophy of science, tells the story of Kurt Gödel and his remarkable incompleteness theorems, and of his touching friendship with Albert Einstein during their years at the Institute for Advanced Study at Princeton. One could hardly conceive of two more disparate figures: Einstein gregarious, disheveled, a little portly, and Gödel, 26 years younger, reserved, nattily dressed and ascetic. And yet, Goldstein points out, they had many things in common. Gödel made his grand discoveries at age 23, Einstein at 25. They had both fled the Nazi terror. And, astonishingly, both felt intellectually exiled from their professional colleagues, not least because they were Platonist in their views of their fields. They believed that they were discovering what was already out there, "objective mathematical and physical reality" as Goldstein terms it. Einstein was never reconciled to the probability clouds of quantum theory, and believed in an "out yonder," where "God does not throw dice."

> "One can even give examples of propositions which are really contextually true but not provable in the formal system of classical mathematics."

But I digress. What is this incompleteness? Goldstein begins 2500 years ago with Euclid's parallel postulate, or axiom, that, given a line and a point not on the line, exactly one line can be drawn through that point parallel to the given line. Because this axiom seemed not as basic as the others,

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Kiwi's Korner

What a year this has been... Quite unexpectedly, the administration authorized the hiring of four new full-time faculty in mathematics and, as you can imagine, the search dominated our activities for several months. With more than 400 applications from around the world it has been a mammoth task to pare the list down to a dozen or so candidates for interviews and then to decide on final offers. The process was completed in late April and we are excited to welcome four new faculty to the department—Tibor Beke, Ravi Montenegro, Victor Shubov and Alina Stancu. Tibor and Alina are profiled elsewhere in this edition, and Ravi and Victor will be featured next spring.

James Graham-Eagle

The department's undergraduate program continues to grow. Last year some 15 students graduated with mathematics as their principal major. This is close to a threefold increase over past years and is in no small part due to the overhaul undertaken by the department beginning four years ago, and to the ongoing efforts of Prof. Shelley Rasmussen, who never misses an opportunity to convert students from other fields.

On April 22, we held our annual Alumni Awards banquet at the Brewery Exchange in Lowell. Close to 50 people—among them the dean of the college, retired and current faculty, part-time teachers and students—saw us hand out some 15 awards to our outstanding undergraduate and graduate students. Among the awardees were the first ever Arthur Zamankaos Scholarship winners: Steven da Costa Ward and John McElroy. The Richardson Bedell Scholarship was awarded to Brian Intoccia and the Mary Hall prize to Paul Tishue. The Outstanding Graduate Student Award went to Mohammed Bhalla and other winners of awards for Outstanding Student were Brian Dukes, Jay McCarthy, Ryan Hill, Jason Percival, Barry Garside and Genovena Mateeva. This event has grown significantly over the past few years and we would like to see this trend continue. When the date for next year's banquet is set, it will be posted on the department web site under the Alumni section—please do visit the site and try to join us for a great evening of good company and good food.

Late in the spring semester, just in time for student advising, the University switched to a "new and improved" registration and scheduling system. The results so far have ranged from frustrating to comical. It's not that the previous system was better, in fact in many ways it was much more limited and cumbersome to use, but it had the benefit of familiarity and having to give it up cold turkey has proved difficult. Apparently the twenty-first century has arrived without our consent after all.

Once again, special thanks to Ken Levasseur for overseeing the production of this newsletter from layout to printing and, finally, distribution.

Kiwi

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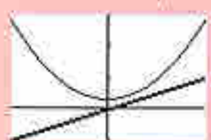
Calculators Across the Calculus Curriculum

An interesting application of the TI-84 is differential equations and graphing the solution to $y'=f(x)$ with the boundary condition $y(A)=B$. With the calculator, define $y_1=f(x)$ and $y_2=fnInt(y_1,x,A,x)+B$. As an example, let $y'=2x$ with $y(0)=3$. Values for the constants A and B can first be stored on the home screen with window settings Xmin=-5, Xmax=5, Ymin=-10, Ymax=30 and Xres=1. Then graph the functions y_1 and y_2. An option is to define the boundary condition constants as $y_2=fnInt(y_1,x,0,x)+3$. With Xres=2, plotting time will decrease. For the TI-83 Plus Silver Edition, plotting time was 17 seconds with Xres=1. Graphs of the differential equation and solution follow.



The TI-83/TI-84 family is a bit limited for multivariable applications. Programs for partial derivatives, double integrals over a rectangular region, dot products and cross products appear in [1]. No doubt, other applications can be downloaded. Computer Application Systems fill the void with 3D applications and graphing. In various Mathematics courses, many of us make use of Mathematica, Maple and MATLAB software. These applications are used at all levels of the Calculus curriculum and related courses.

For student discovery with Euclidean geometry, we use Geometer's Sketchpad software. While designed as a 2D tool, generated sketches can be modified to give a 3D appearance when dealing with surfaces and solids. Some of our students have pursued Maple's 3D geometry capability to supplement course requirements. TI now makes the Cabri Jr. geometry application available on the TI-84.

The *Tangents* Problem

A young man and woman plan to meet between 5 and 6 p.m., each agreeing not to wait more than 10 minutes for the other person. What is the probability that they will meet if they arrive independently at random times between 5 and 6?

Four correct solutions from among all that are submitted by Feb. 1, 2006 will earn a "Math Challenge" T-shirt.

Solution to the Winter 2005 Tangents problem.

The problem was

You are served a plate containing 100 spaghetti noodles. You randomly grab two ends from the pile and tie them together. Then you repeat this process until there are no ends left. What is the expected number of loops at the end?

Solution submitted by Donna Dietz (M.S. 1995, now assistant professor of Mathematics at Mansfield University), who won a UML Math Challenge T-shirt. The expected number of loops is approximately 3.28. Let L(n) be the expected number of loops formed by tying n strands of noodles.Then consider what happens when you select two ends at random from the 2n different ends. The two ends will form a loop with probability 1/(2n-1). Whether or not a loop is formed there will remain n-1 free strands left to tie together. Therefore, L(n) = 1/(2n-1) + L(n-1), which expands to L(n) = the sum of the reciprocals of the first n odd positive integers. For *n* =100, we get

$$1 + 1/3 + 1/5 + 1/7 + ... + 1/197 + 1/199,$$

or about 3.284342189.

It probably seems as though everyone in New England got their picture taken with the 2004 World Series trophy. Here is the first one we got from the faculty. Emeritus Professor Stan Spiegel had this photo taken as penance for wearing his Yankees cap to school for so many years.

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New UML Mathematics Faculty

Ph.D. in Mathematics at University of Rochester where she was later awarded a Dean's Teaching Fellowship. Prof. Stancu completed her doctoral dissertation in 1996 under the supervision of Michael Gage. Her work lies in the area of geometric analysis, particularly geometric evolution equations and applications to convexity.

After the completion of her graduate studies, Prof. Stancu received an NSF postdoctoral position at Case Western Reserve University, followed by a postdoctoral appointment at the Courant Institute. Prior to joining UMass Lowell, she spent two years at the University of Montreal.

Prof. Stancu's research interests include geometric properties of solutions to differential equations, curvature flows and differential geometry at large. She has recently focused on employing curvature flows to derive certain properties of convex bodies. A part of this work was presented this summer at the Erwin Schrodinger Institute in Vienna. Currently she is investigating new containment formulas for convex bodies in Euclidean space via geometric evolution equations.

In her spare time Prof. Stancu enjoys contemporary American literature, traveling, skiing and playing tennis. She is now considering learning karate at the UML Shotokan Karate Club.

Note: Dan Klain's "History of Math mod 100" couldn't be squeezed into this issue. It is posted on the department web page.

James Graham-Eagle, Chair

Writers: Ken Levasseur, Raj Prasad, Ann Marie Hurley, Dan Klain, Guntram Mueller, Marv Stick and Alex Olsen

Tangents is produced biannually by the Publications Office for the Department of Mathematical Sciences. Your comments are welcome.

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Incompleteness

Euclid tried to prove it from the other four axioms, in vain. For 2000 years others tried, also in vain, until it was discovered that it could not possibly be proved from the others because it was independent. In other words, one could assume Euclid's axiom, just as well as one could assume that there are no such lines, or that there are more than one such line. Phrased differently, if Euclid's geometry is consistent, then so are the non-Euclidean geometries, no matter how strange they might seem. But is Euclidean geometry consistent?

Goldstein continues with the story of Russell's paradox, which calls into question even the consistency of set theory and arithmetic. To try to address these concerns, it was decided to drain all actual meaning out of the objects and statements of arithmetic, to devise so-called formal systems of which arithmetic would be a model. (For instance, in the study of fields, one does not necessarily care what the field elements stand for, nor what the field operations represent. Fields stand on their own, in a purely formal way.) The hope was that in so-called finitary formal systems there would be no contextual intuitions that could lead us astray, and that thus the paradoxes and contradictions could be avoided. ("Finitary" indicates that at most a denumerable set of symbols, statements of finite length, and rules of inference involving only finitely many premises, are allowed.)

In 1900 David Hilbert, the leading mathematician of his time, laid out his program of the most significant mathematical problems to be solved. Listed second was the problem of proving the consistency of the formal systems of arithmetic, and to secure once and for all the certainty of mathematical truth. Goldstein quotes Hilbert: "Just think, the definitions and deductive methods which everyone learns, teaches, and uses in mathematics, lead to absurdities! If mathematical thinking is defective, where are we to find truth and certitude?"

Thirty years later, the young Kurt Gödel quietly mentioned at the end of a conference: "One can even give examples of propositions which are really contextually true but not provable in the formal system of classical mathematics." This is his incompleteness theorem. A corollary of Gödel's theorem is that the consistency of a finitary formal system that contains arithmetic cannot be formally proved. This corollary spells the end of Hilbert's idea of proving the consistency of arithmetic.

This is a fascinating story, extremely well told. Goldstein's style is informal, with lots of interesting quotes and personal anecdotes of Gödel and Einstein, such as the quote from Einstein (to Goldstein) that his own work no longer meant much, that he came to the Institute merely "to be allowed the privilege of walking home with Gödel." It's a delightful, breezy book to read, except that the explanation of the proof involves, alas, some tough sledding.

Calculators Across the Calculus Curriculum

By Marvin Stick

The following remarks are in response to an alumni question about the use of calculators. A graphing calculator can be a powerful tool, but it should be used to reinforce the analytic material and not used simply as a "black box." The verdict is still out regarding their use on exams, and instructors should be given the option to include their use. However, students are using them for homework and have used them for college preparatory examinations. The examples below represent a variety of applications across the Precalculus and Calculus curriculum. It is assumed that the TI-83/TI-84 family of calculators is used. More detail can be found at the Links under http://faculty.uml.edu/mstick. The three links are: Graphing Calculators Across the Calculus Curriculum [1] which provides detail on TI-83 commands and programs in Precalculus and Calculus courses; A Comparison of TI-83 and TI-89 Technology [2] which covers TI-89 3D features, Maclaurin and Taylor series and comparisons with TI-83 features to accomplish similar results; and TI-83, TI-86, TI-89 Systems of Equations and Least Squares [3] which contains information and examples to solve NxN systems of equations and least squares regression.

In an Algebra course, solution of radical equations can be examined by graphing an appropriate equation. For example, to solve $x=\sqrt{x+7}+5$, set $y_1=x-\sqrt{x+7}-5$, and look for zeroes. In all cases, the TI should be used as a tool to reinforce the analytic material.

In a Precalculus course, one can use the TI to graphically represent the solution of inequalities. For a straightforward problem $|ax=b|\leq c$, set $y_1=abs(ax+b)-c$, and examine where $y_1\leq 0$. When challenging students with a slightly different problem such as finding solutions for $|2/x|\leq 3$, set $y_1=abs(2/x)-3$. The graph should help explain the need to consider separate cases for $x>0$ and $x<0$.

Graphing derivatives in a Calculus I course can be done with $y_1=f(x)$ and $y_2=nDeriv(y_1,x,x)$. This approach can be extended to a point of diminishing return or inflection point by defining $y_3=nDeriv(y_2,x,x)$. Finding the zeroes of y_2 and y_3 helps confirm results when analytically setting the first and second derivatives equal to zero.

In a Calculus II course, the TI-84 family of calculators can solve arc length problems of the form $L=\int_a^b \sqrt{1+[f'(x)]^2}\,dx$ with $y_1=f(x)$, $y_2=nDeriv(y_2,x,x)$ and $fnInt(\sqrt{(1+(y_2)^2}, x,a,b)$ at the home screen. An example for this type of problem and one for a parametric equations case appear in [1]. Numerical evaluation of any definite integral can be enhanced with a visual display of approximating rectangles. Program MIDPT in [1] uses the midpoint rule to graph rectangles and evaluate a definite integral.

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What Are You Up To?

Want to keep your classmates up to date on what you're doing and where you are? Take a few moments to tell us where you are, and whatever else you might like to share. We'll add it to the UML Math Alumni page, http://www.uml.edu/dept/math/alumni.htm.

We can be contacted by mail at Department of Mathematical Sciences, North Campus, UMass Lowell, Lowell MA 01854. Telephone: (978) 934-2410. Email: Mathematics@uml.edu

You might also wish to contact our Office of Alumni Relations, One University Ave., Southwick 250, Lowell, MA 01854. Toll free telephone: (877) UML-ALUM. Email: Alumni_Office@uml.edu

Wanted: M. S. Computer Option Alumni

Through most of the 1980s the Mathematical Sciences Department ran a "retraining program" in computer science specifically targeted to students who did not major in computer science as undergraduates. That was a large market since undergraduate CS programs were rare prior to 1980. There were hundreds of students who earned a graduate degree though that program and we would like to highlight some of the success stories from that program in future issues of *Tangents*. If you have a story to contribute, send it to mathematics@uml.edu.

Thanks For the Contributions!

Our thanks to all who have contributed to the Department of Mathematical Sciences over the past few years. Your generosity has allowed us to make purchases, award scholarships, and engage in activities that would otherwise have been impossible.

Many of you have responded generously to UML phonathon and other fundraising contacts. These requests can benefit the Department of Mathematical Sciences directly if you specify that you wish to have your gift directed to Mathematics. Otherwise it will provide valuable assistance to the University at the College level.

The Mathematical Sciences Web Page

Have you visited the Mathematical Sciences web page lately? The address is www.uml.edu/dept/math. You don't need to remember the address—just Google "uml math" and the first link should be ours.

Have you lost your past issues of Tangents? Go to the alumni section of the UML Math web page links to find back issues.

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