

2011 Mathematics Programs That Make a Difference

Each year, the AMS Committee on the Profession (CoProf) selects outstanding programs to be designated as *Mathematics Programs That Make a Difference*. For 2011 the programs honored are the CENTER FOR WOMEN IN MATHEMATICS AT SMITH COLLEGE and the DEPARTMENT OF MATHEMATICS AT NORTH CAROLINA STATE UNIVERSITY.

CoProf created the Mathematics Programs That Make a Difference designation in 2005 as a way to bring recognition to outstanding programs that successfully address the issue of underrepresented groups in mathematics. Each year CoProf has identified two exemplary programs that:

1. aim to bring more individuals from underrepresented minority backgrounds into some portion of the pipeline beginning at the undergraduate level and leading to an advanced degree in mathematics or retain them in the pipeline;
2. have achieved documentable success in doing so; and
3. are replicable models.

Previously designated Mathematics Programs That Make a Difference are: the graduate program at the University of Iowa and the Summer Institute in Mathematics for Undergraduates/Research Experience for Undergraduates at Universidad de Puerto Rico, Humacao (2006); Enhancing Diversity in Graduate Education (EDGE) and the Mathematical Theoretical Biology Institute (2007); the Mathematics Summer Program in Research and Learning (Math SPIRAL) at the University of Maryland and the Summer Undergraduate Mathematical Science Research Institute at Miami University (Ohio) (2008); the Department of Statistics at North Carolina State University and the Department of Mathematics at the University of Mississippi (2009); the Department of Computational and Applied Mathematics at Rice University and the Summer Program in Quantitative Sciences, Harvard School of Public Health (2010).

The selection committee for the 2011 Mathematics Programs That Make a Difference consisted of: Matthias Heinkenschloss, Bryna Kra, Susan Loepf (chair), Rick Miranda, Richard Tapia, and Eric Tchetgen Tchetgen.

Below are CoProf's citations, followed by brief descriptions of the programs prepared by *Notices* staff.

Center for Women in Mathematics, Smith College

Citation

Be it resolved that the American Mathematical Society and its Committee on the Profession recognize the Center for Women in Mathematics and the Center's Postbaccalaureate Program, Smith College, for its significant efforts to encourage women to continue in the study of mathematics.

The program's supportive and encouraging environment has resulted in remarkable success. Talented undergraduate women, who have discovered their passion for mathematics late in their undergraduate careers or after they have obtained a degree in a field other than mathematics, are recruited for the program. The program's participants take courses, attend weekly colloquia, and participate in research projects, resulting in a valuable and effective community experience. Graduates of the program are accepted for and succeed in mathematics graduate programs at an astonishingly high rate. The program has made a remarkable contribution to the national effort to produce more women Ph.D.s in the mathematical sciences.

The AMS commends the members of the Department of Mathematics at Smith College for their high level of commitment and their successful efforts to improve the diversity of the profession of mathematics in the United States.

Program Description

After earning a bachelor's degree in theater, with a minor in mathematics, at Smith College in 2005, Samantha Oestreicher spent two years working in the costume shop in a college theater department and freelancing in costuming and backstage work in theaters in New England. Fast-forward to the fall of 2010, and she is starting her third year of graduate school in mathematics at the University of Minnesota. Her performance is outstanding: she passed her preliminary examinations early, participates actively in a research seminar, and is an exemplary teaching assistant. She held an internship at Los Alamos National Laboratory and now has a research assistantship on a grant from the National Science Foundation (NSF).

That Oestreicher made her way back to mathematics and then excelled so quickly is an indication of her talent and motivation. Helping that talent to flower and that motivation to strengthen was the postbaccalaureate program at the Center for Women in Mathematics at Smith College. Founded in 2007 with funding from the NSF, the center serves women who discover their desire to do mathematics only after having exited the traditional educational track and who need to build up or refresh their backgrounds to be able to enter graduate school. "If it wasn't for Smith's program and the NSF funding, then I would never have made it as far as I have," Oestreicher said. "Smith's program gave me a totally fresh start and the opportunity to do math for a living."

The center's postbaccalaureate program, the first in mathematics in the United States, attracts students from all over the country. In this one-year program, students take upper-level courses in the Smith mathematics department and also have the opportunity to take courses at Amherst, Hampshire, and Mount Holyoke colleges and the University of Massachusetts at Amherst. In addition, the center designed two special courses for the students. The first, *Dialogues in Mathematics*, introduces the students to the culture and profession of mathematics through various means: meetings with colloquium speakers to talk about mathematics and mathematical careers, preparation for the GRE examination, discussions of strategies for graduate school, and examination of issues pertinent to the mathematical community. In the other course, the *Advanced Mathematics Seminar*, the students work in small groups with faculty, generally on a research topic. The topics have included graph theory, combinatorics, and computational geometry, as well as biological and medical applications of mathematics. The center's NSF grant provides tuition and a living stipend for some of the postbaccalaureate students who are U.S. citizens or permanent residents.

Among the center's other activities is a Junior Program for undergraduate women from outside

Smith College who want to spend one or both semesters of their junior year in a mathematically intense environment. The NSF grant provides financial aid to participants who are U.S. citizens or permanent residents. In addition, the center hosts an annual conference called *Women in Mathematics in New England (WIMIN)*. In 2009 the conference was one of the *Regional Undergraduate Mathematics conferences* sponsored by the *Mathematical Association of America* and attracted 105 participants and twenty-four student talks. Most of the center's postbaccalaureate students attend the *Joint Mathematics Meetings*, the *Joint Statistical Meeting*, and/or the *Hudson River Undergraduate Mathematics Conference*.

The center is well integrated into the Smith College mathematics department and capitalizes on some of the department's assets, such as the *Math Forum*, a welcoming and comfortable space where students and teachers gather for conversation, study, and relaxation, as well as tea and cookies. At the same time, the center has had a positive, revitalizing influence on the department. By bringing together a group of active, serious, and motivated women, the center inspires Smith mathematics majors and increases the level of activity in the department. The center has fostered a vertically integrated community that is developing into a focal point for women mathematicians in New England. It is also having a national impact, as other departments around the country establish programs emulating those at the Smith center.

Data about the center's students demonstrate its success. By the fall of 2010, twenty-four women had completed the postbaccalaureate program. Of those, seventeen entered graduate school in the mathematical sciences immediately after completing the program, and five will have entered after brief deferrals; almost all of these students went to Group I or II departments. Only one student has dropped out of the graduate program. Ten new students joined the program in the fall of 2010.

The September 2007 issue of the *Notices* carried an Opinion column by the directors of the then newly created Center for Women in Mathematics. The final paragraph of their piece captures well the philosophy behind the center: "Yes, we marvel at the prodigies whose unwavering interest and aptitude in mathematics are evident from the start. But we must also open our minds to the vast numbers of students—women and minorities (and others from all walks of life)—who can be mathematicians but may not make that choice until late in their college careers or after."

Program directors: Ruth Haas and Jim Henle
Website: <http://www.math.smith.edu/center>

Department of Mathematics, North Carolina State University

Citation

Be it resolved that the American Mathematical Society and its Committee on the Profession recognize the Department of Mathematics, North Carolina State University, for its significant efforts to encourage students from underrepresented groups to continue in the study of mathematics.

The department's exceptional commitment to its students includes early research opportunities, financial support provided by grant funding, and extraordinary faculty mentoring. In addition, the department offers impressive undergraduate programs and postdoctoral opportunities. Since 1999 the department has produced almost 13 percent of all African-American Ph.D.s nationally. The department at North Carolina State University has made, and continues to make, a remarkable contribution to the national effort to produce more minority Ph.D.s in the mathematical sciences.

The AMS commends the members of the Department of Mathematics at North Carolina State University for their high level of commitment and their successful efforts to improve the diversity of the profession of mathematics in the United States.

Program Description

In how many different ways can a mathematics department succeed? Count the successes of the Mathematics Department at North Carolina State University, and you will have a good approximation. The recipient of last year's AMS Award for an Exemplary Program or Achievement in a Mathematics Department, NC State has excelled in just about everything mathematics departments do. This time, the department was chosen for the Programs That Make a Difference distinction for one particular achievement: its extraordinary record in serving students who have traditionally been underrepresented in mathematics, especially African-Americans.

The numbers speak for themselves. According to the Annual Survey of mathematics departments that the AMS and collaborating organizations prepare each year, Group I and II mathematics departments produced seventy-three African-American Ph.D.s during the academic years 1999-2000 to 2008-2009 (this counts U.S. citizens only). Nine of these seventy-three, or 12.3 percent, graduated from the NC State mathematics department. And NC State is not an enormous producer of mathematics Ph.D.s overall; in that period, it accounted for just 2 percent of the total number of Ph.D.s produced by Group I and II departments. NC State's impressive record has continued, with a total of four additional African-Americans receiving their Ph.D.s in the department in the 2009-2010 and 2010-2011 academic years. When it comes to female African-American Ph.D.s in mathematics,

NC State might very well be the top producer in the nation: In the same nine-year time period as above, twenty-six mathematics doctorates were awarded to female African-Americans by Group I and II departments, and six, or nearly a quarter, earned their degrees at NC State.

What accounts for this achievement? One factor is the department's commitment, starting more than a decade ago, to recruiting domestic students into its graduate program. Today 96 percent of its graduate students are U.S. citizens or permanent residents (and 49 percent are women). One of the strategies the department uses is an annual recruiting weekend, in which students are invited to the campus to learn about the graduate program. Through its long-standing contacts with historically black colleges and universities, the department identifies strong African-American applicants, encourages them to apply, and invites them to the recruiting weekend.

Another factor is the substantial support the department offers to students. An S-STEM grant from the National Science Foundation provides financial support for all of the department's African-American students during the first two years in graduate school. For students whose backgrounds need additional shoring up, extra mentoring is available. In addition, the department has a Research Experience for Early Graduate Students (REG) program, which provides stipends for first- and second-year graduate students to work with faculty on summer research projects. Unlike other graduate students, S-STEM students are eligible for two summers of REG participation.

A third factor in the department's success lies in the broad and flexible nature of its graduate program. Students have a wide variety of research areas to choose from, and many opportunities are available to work on interdisciplinary problems with researchers in other university departments, in industry, and in government laboratories. The mathematics department wanted the structure of its qualifying examinations to reflect the increasingly interdisciplinary nature of mathematical research, so it created a set of fifteen examinations, and each student must complete three of them.

The final, and perhaps most important, factor is the faculty's commitment to students. The department's success with students from underrepresented groups is not due to outsized efforts by a small number of faculty members. Indeed, the thirteen African-Americans who received their Ph.D.s in the department during the academic years 1999-2000 to 2010-2011 were spread among twelve different advisors.

The department's commitment to underrepresented students does not stop with the graduate program. The department stands out nationally as a predominantly white institution in which a large number of African-Americans earn bachelor's

degrees in mathematics. Alongside its Research Experiences for Undergraduates program, the department has started REU+, which is geared toward students from historically black colleges and universities. At the postdoctoral level, the department has spearheaded a new national program called the Alliance for Building Faculty Diversity in the Mathematical Sciences, which offers postdoctoral fellowships to new Ph.D.s from traditionally underrepresented groups. Fellows will typically spend two years in one of the alliance institutions and one year in an NSF-funded mathematics institute.

After NC State was chosen for the AMS Exemplary Program Award, department head Loek

Helminck was interviewed for an article in the *Notices*. Asked how the department managed to achieve so much, he replied: "You have to create a culture in which people believe this is the right direction for the department so that there is broad faculty participation. You start with a few people and you show that a program is successful, then one by one you have faculty start to participate...They can totally change their minds."

Department head: Loek Helminck
Website: <http://www.math.ncsu.edu>

2011 Award for an Exemplary Program or Achievement in a Mathematics Department

The Award for an Exemplary Program or Achievement in a Mathematics Department was established by the AMS Council in 2004 and was given for the first time in 2006. The purpose is to recognize a department that has distinguished itself by undertaking an unusual or particularly effective program of value to the mathematics community, internally or in relation to the rest of society. Departments of mathematical sciences in North America that offer at least a bachelor's degree in mathematical sciences are eligible. Through the generous support of an anonymous donor, the award carries a cash prize of US\$5,000.

The award is presented by the AMS Council acting on the recommendation of a selection committee. For the 2011 award, the members of the selection committee were: Carlos Castillo-Chavez, Amy Cohen (chair), William Jacob, and Philip Kutzko.

The previous recipients of the award are Harvey Mudd College (2006), the University of California, Los Angeles (2007), the University of Iowa (2008), the University of Nebraska, Lincoln (2009), and North Carolina State University (2010).

The recipient of the 2011 Award for an Exemplary Program or Achievement in a Mathematics Department is the MATH CENTER AT THE UNIVERSITY OF ARIZONA. What follows is the selection committee's citation.

Citation

The American Mathematical Society is pleased to recognize the undergraduate Math Center at the University of Arizona with the 2011 Award for an Exemplary Program or Achievement by a Mathematics Department. The Math Center is a national leader in the effort to recruit, mentor, and graduate undergraduate math majors, especially those students from backgrounds traditionally underrepresented in mathematics. Since 2004 the Math Center has

- increased the total number of majors by 69 percent, from 281 to 474,
- increased the total number of female majors by 72 percent, from 102 to 175,
- increased the total number of majors from underrepresented minority groups by 125 percent, from 48 to 108, with the result that about 25 percent of math majors at the University of Arizona come from these groups.

This impressive achievement comes about not as a result of any substantial change in the structure of the math major but rather by the tireless recruitment activities of the Center, the range of activities and opportunities provided to UA math majors, and the collegial and welcoming environment created by the Center. Recruiting is done on a personal basis. There is a yearly high school calculus class visitation project in which a team consisting

of a faculty member, a graduate student, and an undergraduate student visits AP calculus classes at local high schools. There is an MAA-[Mathematical Association of America] funded five-day calculus workshop for incoming students enrolled in calculus. And, perhaps most remarkably, there is the personal effort of Professor William Vélez, Associate Head for Undergraduate Affairs for the UA Math Department, who has, for the last fifteen years, conducted a program of making twenty-minute individual appointments with every minority student enrolled in calculus. Once a student becomes a math major, the Center offers a variety of programs, ranging from a substantial undergraduate research program to a highly popular math club to encourage and support the student's progress toward success. Finally, a concerted effort is made to ensure that the student is informed of the full range of opportunities available in academe, government, and industry to someone with computational skills. Indeed, since 2007 the program has broadened its scope to target students in other fields who might be interested in a double major, thus increasing the fraction of double majors from 30 percent to 40 percent over the last three years. The numbers show that this program is succeeding: over the last two years, about a quarter of UA math majors have gone on to graduate programs, and almost 20 percent have gone into middle and high school teaching. As further evidence of this success, the May 2010 outstanding undergraduate researcher and the December 2010 outstanding graduating senior in the College of Science were both math majors.

The small numbers of women and minorities at all levels in our profession, together with an increasing alienation of all U.S. students from the mathematical sciences, is well documented and is cause for concern both on moral and on practical grounds. In that context, the Math Center at the University of Arizona stands out both as an example of what can be done and as a model of what must be done, the very definition of an exemplary program.

About the Cover

Wavelets in image compression

This month's cover was inspired by the article "Discrete wavelet transformations and undergraduate education", by Catherine Bénéteau and Patrick Van Fleet. The February 2008 issue of the *Notices* contained an article by David Austin on the JPEG format, including at the end a few remarks about the newer JPEG2000 specification, which is based on wavelets. This month's cover illustrates what the first step in a simple wavelet compression would be like, when applied to Austin's cover for the 2008 issue. The effect is much like one of the figures in the article by Bénéteau and Van Fleet.

In making the cover, we considered several sophisticated options, but in the end chose to apply Haar wavelets for a simple visual effect. Wavelets are complicated, and it would have been almost impossible to make a single cover image that showed clearly something more subtle. There is no natural way to interpret differences of colors graphically. Magnitudes in the difference images have been shifted and magnified in order to make the process more visible, and this has introduced some apparently random noise.

Although in the end we didn't use anything fancy, we found the book *Ripples in Mathematics*, listed in the Bénéteau and Van Fleet article, as well as the article "Factoring wavelet transforms into lifting steps" by Ingrid Daubechies and Wim Sweldens (*Journal of Fourier Analysis and Applications*, 1998), to be valuable guides to the lifting algorithm.

—Bill Casselman
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