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Teaching Statement

As a faculty member at California State University, Northridge (CSUN) I enjoy the challenges of teaching mathematics to students of different majors, cultures, ethnicities and levels of preparation. My goal in the classroom is to provide knowledge and to help in accessing knowledge. I do research and often get an opportunity to put knowledge in context. Pedagogically I enjoy highlighting connections between the subject and students' career objectives by combining delivery methods with demonstrations, practical application and broader discussions. I participated in many educational and curriculum enrichment activities including teaching summer and winter research institutes for undergraduate students, directing undergraduate and graduate student research, speaking at student seminars and judging student research competitions. I was the PI on a grant to develop learning resources for deaf students. I served as a co-PI on a grant to develop a multi-sectioned hybrid course which combines on-line and in-class instructions. This course is currently offered at CSUN every semester. I was a co-PI on a project to develop on-line tutoring for CSUN calculus classes. My immediate objectives are the design of upper division undergraduate and graduate courses in applied and computational mathematics, the development of an interdisciplinary student research group working on projects in computational mathematics, and the development of new infrastructures for student research on both graduate and undergraduate level. This statement summarizes my teaching activities at CSUN are and describes future plans. Also, included is a quick summary of courses taught and the student evaluations of my teaching.

1. Involvement in educational and enrichment activities at CSUN

California State University, Northridge (CSUN) is a vibrant, diverse university community of nearly 27,000 undergraduate and 6,400 graduate students and more than 4,000 faculty and staff. The campus is located in Los Angeles' San Fernando Valley in close proximity to leading research institutions. Organized into 9 colleges and 58 departments, CSUN is proud to be one of the most modern university campuses in the country. Because of the large and growing numbers of undergraduate students, the campus envisions broadening the spectrum of programs it offers to meet the demands of society. It is a major challenge to the University to serve the diverse student population. Our students come from different cultural and economic backgrounds. Many lack essential skills in mathematics and writing. Many are the first generation college students in their families. However, CSUN is especially proud of its accomplishments in preparing students for careers in Science, Mathematics, and Engineering. According to a 1996 NSF study of 529 institutions that grant a Master's degree but not the Ph.D., CSUN ranked first in the number of students who went on to receive Ph.D. degrees in science and engineering. (National Science Foundation, document NSF 96-334).

I am extremely lucky to be a faculty member at CSUN. I enjoy teaching, advising students, designing new programs for our students and participating in extra curricular activities. A summary of a few of my projects is given below.

1.1. **Development of Online Tutoring for Calculus.** In Fall 2010 and Spring 2011 I was co-developing an Accessible Online Tutoring Center for Calculus with Professors Carol Shubin and Jacek Polewczak. This project had several objectives. The first one was to develop a tutoring service that will accommodate different types of learners. To accomplish this goal we have selected resources for Calculus that suite different learning styles. For traditional learners, there were lecture notes, video-recorded lectures, tutorials and workbooks in traditional format. For visual learners, animated and graphical demonstrations have been selected. Some of the materials can be found at `http://www.carolshubin.com/moodle/course/view.php?id=18` (login: guest; password: guest). A particular emphasis in our work was to make resources accessible for learners with special needs. This is why our work was coordinated by the CSUN Accessible Technology Initiative and Universal Design group `http://www.csun.edu/accessibility/`.

There were many unique things that we, the PIs, learned from this project. However, it was our students who were the greatest beneficiaries. The general structure of the online tutoring was the following: a few undergraduate student tutors were hired to provide online consultation during some set hours. Three full-time faculty members were supervising tutor communications and occasionally answered students posts. The delivery platform for tutoring services was the Moodle system. There main two modes of communication were posts and chat rooms, with individuals quickly becoming preferential of one mode or another. Analysis of site visitors data showed that from about two hundreds people enrolled in class only about twenty would actively post questions and respond to questions. About forty students would never use the site. The rest of the students were visiting the site to view other students' posts and recordings of chats. There were spikes of attendance when hard homework topics were assigned. In particular weeks when related rates were discussed turned out to be the busiest. The analysis of the student final grades and scores on calculus placement tests showed that final grades of students with comparable placement scores were about half-grade higher if the student read several hundreds posts during the semester.

The online tutoring turned out to be a very good new service to our student. Because students had to communicate their mathematical questions in writing, we have seen a lot of improvement in their reasoning and logical skills. We have seen a lot of improvement in pedagogical skills of our tutors as well. We attribute it to being able to analyse the recorded communications and being able to give the tutors our feedback. Also, training sessions on subject matter were organized for tutors. Between the training and supervision we greatly increased the uniformity in the tutors preparation. In the future we want to increase the tutors ability to address different learning styles. We are now looking for ways to foster the development of student on-line communities and increase collaboration on the website. We are also looking for ways to engage faculty members in the process. The project is now in its second year and is currently funded by

the CSU Chancellor's Office. The student questions and tutors' replies can be viewed at `http://moodle.csun.edu/course/view.php?id=10643` (use "login as guest" option).

1.2. **The Development of a Hybrid Course.** Recently CSUN initiated the transition of some of its regularly offered lower division courses to on-line instruction. This motion is in response to the pressure of growing enrolment and the commitment of the University to meet the diverse educational needs of its students. In 2007 and 2008, Professors Elena Marchisotto, Mark Schilling and myself were awarded a grant to develop a hybrid class in MATH 131, Mathematics Explorations. The hybrid course combines on-line and in-class instructions. The course continues to be offered. This was the first time such a course was offered in the Mathematics Department. The successful implementation of the MATH 131 hybrid was followed by another hybrid course, MATH 140, Introductory Statistics.

1.3. **Participation in Infrastructure Grants.** In 2005-06, I participated in the CSUN NASA PAIR program directed by a Professor Carol Shubin (professor, Mathematics) by supervising the research of three NASA PAIR undergraduate research assistants on their projects in diffusion-weighted Magnetic Resonance Imaging. Students were developing numerical algorithms for fiber path reconstruction in tissues based on the preferred direction of diffusion at each point. As part of their projects, students proposed algorithms, developed a code in two and three dimensions using Matlab, and experimented with both synthetic and real scan data. One student, Sarah Neyer, won the second prize in the Sigma Xi Student Research Symposium for her work in "Analysis of the Discrete Anisotropic Diffusion Equation in Application to Neural Fiber Tracking". In Summer 2005, Sarah transferred to Carnegie Mellon University. Another student, John Sikora, won second place at the Annual CSUN Student Research Symposium for his work in "Fiber Reconstruction Techniques in Diffusion-Weighted Magnetic Resonance Imaging (MRI)". Later John continued his work and wrote a Master's thesis on fiber reconstruction in diffusion-weighted MRI. John graduated CSUN in the Summer of 2008.

The computer code that John and Sarah developed was used in the NASA PAIR 2005 summer class in "Fiber Tracking in Diffusion-Weighted MRI" taught to senior level math majors. All students came to the lab to participate in the data acquisition. Later students experimented with the code trying to reconstruct the fiber structure of a cabbage. The CSUN NASA PAIR program website can be found at `http://www.csun.edu/nasacsun/`.

The Mathematics Department at CSUN have currently completed the NSF Preparing Undergraduates through Mentoring toward Ph.Ds. (PUMP) program. PUMP, funded by the Division of Mathematical Sciences under the program Mentoring through Critical Transition Points, had the goal of increasing participation of highly qualified students in Mathematical Sciences Ph.D. programs. I advised several PUMP undergraduate research assistants on projects in numerical analysis and computational mathematics. I also taught the PUMP 2007 Winter Institute in Geometry.

1.4. **Development of Calculus Resources for Students with Hearing Impairments.** In Fall 2004 and Spring 2005 I co-directed a project sponsored by the Grace Petri foundation on the development of an Accessibility media library for the Calculus

class. As a part of this project I recorded a series of short videos on topics in Calculus. The videos were captioned and formatted for web-streaming to provide deaf students with an accessible and convenient resource for their Calculus classes. These videos provided an alternative instruction to the CSUN population of deaf and hard of hearing students and helped them in remediation in Calculus. Additionally, students with other learning disabilities are using these videos to learn difficult topics in Calculus within their own learning timeframes. Student comments about using the videos and their overall helpfulness were consistently positive. The topics covered in the videos include $\varepsilon - \delta$ proofs of limits, limit theorems, special trigonometric limits, limits at infinity and infinite limits, derivatives, sophisticated graphing and the Fundamental Theorem of Calculus. The videos are available at `http://www.csun.edu/~ama5348/`.

2. Plans for the new curriculum development and student research

In recent years, we have seen a large increase in the demand for individuals with solid mathematical and data processing skills. Graduates that received training in mathematics and an another discipline often find that they have an advantage in today's job market. This provides an opportunity to Mathematics Departments to increase the number of students in their applied programs and to create new programs. I am looking forward to being fully engaged in such a project. I am interested in devising new curricula and developing new research opportunities for students.

2.1. **New courses in Numerical Partial Differential Equations.** I plan to develop both undergraduate and graduate courses in applications of numerical analysis to the solution of partial differential equations. I am interested in designing courses in the dynamics of transitional gas flows. These courses will focus on computational challenges of simulating gas flows in transitional flow regimes and will highlight different approaches to such simulations. Computer simulations and practical group assignments will be included in these courses. Also, the courses will employ the software developed as a part of my research in simulation of model kinetic equations. Other source codes will be used as well. In particular, software packages CLAWPACK, Deal II and Math Python are very interesting to include in addition to Matlab/Octave and Maple. I am very interested in adopting a course developed by Professor Randy LeVeque at the University of Washington in simulations of tsunami. In this course students use real ocean and land topography data to simulate the propagation of a tsunami wave. I plan to develop a course in the numerical analysis of equations of general relativity. The course will encompass problems and analysis tools that were pivotal in numerical relativity. In addition, I am interested in developing of a topical online course on independent student research experience. The course will be dedicated to the study of a particular problem. For example, it could be fiber tracking in diffusion-weighted MRI, simulation of heat transfer in rarefied gas or simulation of electromagnetic wave propagation. The online class will provide students with research assignments, reading lists, computer codes and a step by step guide for achieving results. Students will be encouraged to work in small groups.

2.2. **Development of new infrastructure for student research.** Early involvement in research by Master's students and undergraduate students strongly enhances their chances for successful careers in academia and industry. It is therefore the responsibility of faculty members to provide topics for student research and build the infrastructure for student research. I will continue to support student research, first of all, through the grants that support my research. In Summer of 2010, Mr. Patrick Medina was supported by the AFOSR Summer Faculty Fellowship grant. I am currently visiting Air Force Research Lab at the Wright-Patterson AFB and looking for opportunities to link Mr. Medina to the research here. Student support will be sought through research grants at government agencies such as the NSF, DOE, NASA, JPL, ONR, etc. Many of these agencies have programs for graduate students to apply for scholarships. Students will be encouraged to apply for such scholarships. I plan to develop a research program in biomedical applications of kinetic equations and also seek support at the NIH. Sometimes more directed ways of funding are easier to obtain. I will look for opportunities to reach out to corporations such as Medtronic, Boeing and Lockheed Martin. Local startup companies sometimes provide a good source of internships. For example, Arette Associates, `http://www.arete.com/`, which is local to Northridge, provides summer internships to CSUN. Finally, I am interested in participating in proposals for large research infrastructure projects funded trough the NSF Workforce in the Mathematical Sciences program, the Research Training Groups program and the Mentoring through Critical Transition Points program. There are also funding opportunities at the DOE Workforce Development for Teachers and Scientists program and NASA Supplemental Education Awards for ROSES Investigators program.

3. Summary of student evaluations of teaching

I have taught courses in Precalculus, Calculus, Mathematical Analysis Ordinary Differential Equations, Real Analysis, Partial Differential Equations, Numerical Methods and Numerical Analysis. In backward chronological order I taught at Purdue University, CSUN, the University of Minnesota, Penn State and the Novosibirsk State University. The overall students evaluations out of a maximum of 5 for Spring 2010 were on the average 3.7 (MA442, Multivariable Analysis I Honors) and an average of 3.6 (MA341, Foundation of Analysis) (Purdue University). At CSUN for Fall 2008 my averages were 3.8 (Math 250, Calculus III) and 4.44 (Math 150a, Calculus I); for Spring 2008: 4.38 (Math 481a, Numerical Analysis I), 4.52 (Math 150a); for Fall 07: 2.57 (Math 320, Foundations of Mathematics); for Fall 06: 3.87 (Math 581, Numerical Analysis for Linear Systems) and 4.36 (Math 150a); for Spring 2006: 4.76 (Math150a); for Fall 05: 4.46 (Math481a), 4.5 (Math250), 4.71 (Math150a); for Spring 05: 4.12 (Math481a), 4.74 (Math150a); Fall 04: 4.6 (Math150a), 4.4 (Math250); Spring 04: 4.6 (Math150a), 4.6 (Math250); Fall 03: 4.1 (Math150a), 4.3 (Math250).