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# Self-Study and Preliminary Development Plan

Mathematics Department, University of San Francisco

April 7, 2004

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# 1 Introduction: Program Review 1993

Our department's last program review was ten years ago (Summer–Fall 1993). The self-study and preliminary development plan that we wrote (henceforth denoted by SS93) focused on our chief "asset" (a very friendly and dynamic faculty) and most pressing "problem" (a very low number of majors). Most of our suggestions and the outside reviewers' recommendations explored ways we could build on our strengths to develop a more attractive and flexible program.

We would like to structure our current Self-Study and Preliminary Development Plan on the unfinished business from 1993, since most of the issues that are important to us today were important ten years ago. The present document examines how the department and the administration responded to the 1993 recommendations, what was achieved, and what remains to be done. It also includes some new areas of concern that have surfaced since 1993.

## 1.1 The "Asset" and the "Problem"

Our previous document, SS93, and the outsider reviewers' report (henceforth called OR93) painted a picture of a very friendly and dynamic department working hard to innovate, especially with regard to technology in the classroom. But both SS93 and OR93 lamented the small number of majors. OR93 also criticized the relative inflexibility and unattractiveness of our program, and urged extensive innovation to make the major more attractive.

Today, these issues are still of paramount importance: our main asset, as always, remains our faculty with its intellectual and interpersonal strengths, and while we have made significant progress, we still struggle to raise the numbers of majors. We made many changes to the curriculum, some ongoing, in an attempt to improve our program, and also in response to college- and university-wide policy changes. In the next pages, we will study the evolution of our department, by looking at the SS93 and OR93 suggestions, and documenting what actually happened.

## 1.2 Summary of SS93/OR93

Our preliminary development plan contained the following items.

1. Improve the number of majors and minors, with a goal of tripling the number of majors.

2. Improve computing facilities and classroom environment.
3. Improve departmental space.
4. Study and improve the major program.
5. Explore creating a masters program.
6. Improve communcation with majors.
7. Clarify some tenure and promotion policies.

The outsider's report responded by focusing on four areas: Faculty, Curriculum, Attracting Majors, and Other Issues. In more detail:

**Faculty** The reviewers made several suggestions about tenure and promotion. While interesting, these were not really issues that can be addressed without radically revamping the Collective Bargaining Agreement. (Example: "The Department [should] speak with a collective voice on promotion.") Three suggestions, however were relevant: earlier sabbatical support for probationary faculty, an appropriate reward system for all faculty, and a continuation of the trend of replacing part-time faculty with full-timers.

**Curriculum** The reviewers strongly suggested that the curriculum be made more flexible and attractive, by reducing and eliminating certain requirements, and that all required courses be offered at least once a year.

**Attracting Majors** The plan outlined in SS93 should be carried out, with administration support. In addition, the proposed curriculum changes will help. Also, efforts should be made to develop a more diverse student body.

**Other Issues** A number of issues were raised: improve departmental space; continue investing in educational technology, including developing a professional computing staff; keep separate from Computer Science; improve community outreach; keep vigilant with regards to educational ideas; defer planning a graduate program.

In the next section, we will examine how the department evolved over the past ten years, partially in response to the 1993 recommendations. Our exploration will repeatedly ask, "What was done?," "How well did it work?," and "What remains to be done?"

Two faculty served in the capacity of Editor for a professional journal. Three faculty served in an administrative capacity for a professional organization (for example, member of a review committee or an advisory council)—six instances between them. Five faculty collectively published twelve books (seven original works and five edited collections). Twenty-nine articles were published in professional journals or scholarly monographs. Two faculty had nine grant proposals awarded between them. Thirty invited lectures were delivered at professional meetings. Two faculty received awards from the University of San Francisco in recognition of their contribution to our institution (Distinguished Research and Distinguished Service).

### 2.2.2 Biographical Sketches of Faculty

**Renée Brunelle** Renée Brunelle received a BS in mathematics from the University of San Francisco in 1994 and an MA in pure mathematics with emphases in modern algebra and complex analysis from the University of California, San Diego in 1997. At USF she was instrumental in establishing the use of the Calculus Readiness Test for placing incoming students into the proper entry-level mathematics course, assists with the orientation of new part-time instructors in the Mathematics Department, and is a regular volunteer at both the annual Bay Area Math Meet and the College's Major/Minor Fair. She is also involved with St. Ignatius Church as a lector, Eucharistic minister, and occasional choir member. When not trying to rid the world of math phobia one student at a time, Renée enjoys traveling, hiking, and reading.

**Allan Cruse** Allan Cruse attended college at Emory University where he majored in mathematics. He was awarded a fellowship for graduate study at UC-Berkeley by the Woodrow Wilson Foundation on condition that he agree to give "serious consideration" to pursuing a career in college teaching, and after finishing his Master's Degree at Berkeley, he accepted USF's offer in 1966 of a "temporary" position teaching classes in mathematics: that position morphed into a permanent one after he completed his mathematics doctorate, awarded by Emory University in 1974.

Professor Cruse began teaching computer science courses over two decades ago, soon after USF acquired its first UNIVAC 90/60 mainframe. His current research interests are in the areas of systems programming for microcomputers and combinatorial optimization.

**Stephen M. Devlin** Stephen Devlin grew up in New York and attended Manhattan College where he majored in Mathematics and minored in Religious Studies. He went on to study representation theory at the University of Maryland, earning his Ph.D. in 2001. He is currently finishing his third and final year as a C.L.E. Moore Instructor of Mathematics at M.I.T. before joining the faculty at USF in August 2004. Outside of mathematics his interests include writing screenplays, which he does for fun, and running, which he does to keep up with his wife Holly.

**James K. Finch** James K. Finch received his Ph.D. from the University of Illinois. His areas of interest include computational statistics and scientific visualization.

**John Sterling Kao** A native of Salt Lake City, John Kao attended the University of Utah graduating magna cum laude at the age of 17. Admitted to the Department of Mathematics at Princeton University, he earned his Ph.D. in 1991. He has taught at the USF since September of that year.

Dr. Kao's research follows two lines of investigation: birth and death processes on stochastic flows (BDFPs) and stochastic vibrational control. These are described below—references in square brackets may be found in the Curriculum Vitae section of this Program Review.

Since they were first identified in Dr. Kao's Ph.D. dissertation, BDFPs have proven fertile ground for scientific inquiry (see for example, M. Phelan, "Asymptotic Likelihood Estimation from Birth and Death on a Flow," *The Annals of Statistics* (1996); also, Kao and Cinlar [1998]). Their study represents a first step in the application of modern results from the theory of stochastic flows of homeomorphisms to the classical problem of turbulent transport by fluids.

Vibrational control refers to the stabilization of unstable mechanical (physically realizable) systems by introduction of vibrations. This technique has been used, for instance, to stabilize beam trajectories in particle accelerators (alternating-gradient focusing). In "Principle of Vibrational Control: Theory and Applications," *IEEE Transactions on Automatic Control* (1980), S.M. Meerkov wrote, "Is it possible to stabilize the system using not regular but random 'vibrations'?. . . The answer to this question is not found, although it was discussed in many publications . . . " Kao and Wihstutz [1994]

were the first to answer this question in the affirmative. Their subsequent paper [2000] provided necessary and sufficient conditions for a broad class of stochastic processes (diffusion noise) to stabilize linear companion form systems (the simplest example being the inverted pendulum). Since, scientists at Universität Hannover, Germany, have experimentally verified the characterization derived by Kao and Wihstutz—stabilizing an inverted pendulum with random, vertical line, vibration of its base.

Pursuant to these endeavors, Dr. Kao served as Visiting Associate Professor, School of Engineering, Princeton University. He is an Associate Editor for the journal, *Advances and Applications in Statistics*. With respect to his other commissions on behalf of USF (service and teaching), Stanley Nel, Dean, College of Arts and Science, wrote on Dr. Kao's Academic Career Prospectus (dated 5/8/03), "For the next 2–3 years, focus on completion of monograph. Maintain current level of service. I judge your teaching to be truly outstanding."

**Millianne Lehmann** Millianne Lehmann received her M.A. in Mathematics from San Francisco State University in 1963 and joined the USF faculty 1965. Her areas of interest include mathematics education and technology-assisted instruction in mathematics. She was project director for the USF Middle School Math Institute (an NSF-funded program from 1984–1986. She has co-authored four books, the latest of which, *Quantitative Methods for Business, a Conceptual, Excel-Based Approach* (co-authored with Paul Zeitz) will be published by Wiley in 2004.

Professor Lehmann was Mathematics Department Chair for 14 years, most recently from 1991 to 1996. She was a founder of the USF Faculty Association (AFT Local 4269), and served it as an executive officer for 13 years.

She is currently on the Editorial Board of the Mathematical Association of America's Classroom Resources Materials Series and serves as a referee for the publications of the National Council of Teachers of Mathematics.

Professor Lehmann is married and has 6 adult children.

**Tristan Needham** Tristan Needham (son of the distinguished anthropologist Rodney Needham) grew up in Oxford, England, where he studied physics as an

undergraduate at Merton College before moving to the Mathematical Institute to study black holes under the supervision of Sir Roger Penrose. Tristan received his D.Phil. in 1987 and joined the USF mathematics faculty in 1989. The specific fields in which he is most interested are geometry, complex analysis, general relativity, and the history of science, but his overarching concern is with finding intuitive visual ways of understanding mathematics and physics. His book *Visual Complex Analysis* won first prize in the 1997 National Jesuit Book Award contest. An earlier paper arising from the book received the Mathematical Association of America's Carl B. Allendoerfer Award.

**Stanley D. Nel** Stanley Nel grew up in South Africa, and studied Cosmology under George Ellis at the University of Cape Town, where he earned a Ph.D. in Applied Mathematics. As a Rhodes Scholar at Balliol College, Oxford, he did research as a member of Roger Penrose's Relativity Group at the Mathematical Institute. His papers have focused on the observational foundations of cosmology, and on techniques for obtaining solutions of Einstein's field equations in General Relativity. He joined the Mathematics Department at USF in 1983, and served as Dean of the College of Arts and Sciences from 1990–2003. He is currently the Vice President for International Relations at the University of San Francisco.

**Peter S. Pacheco** Prof. Pacheco's research interest is in parallel scientific computing. He has been involved in the development of the MPI Standard for message-passing, and has written a short User's Guide to MPI. His book *Parallel Programming with MPI* is an elementary introduction to programming parallel systems that use the MPI 1 library of extensions to C and Fortran. It is intended for use by students and professionals with some knowledge of programming conventional, single-processor systems, but who have little or no experience programming multiprocessor systems.

His current research is in developing software for computational neuroscience and optimizing parallel I/O systems. With his students and Patrick Miller of LLNL, he has been developing a collection of programs, *Object-oriented Neurosys*, for the simulation of large networks of biologically accurate neurons on parallel computers. With his student and Prof. Gregory Benson (USF Computer Science Department), he has been working on benchmarking the performance of various I/O schemes on multiprocessor nodes

of Linux Clusters.

In January 2001, with Prof. Benson, he received a grant to build a cluster from the W.M. Keck Foundation. The Keck Cluster currently consists of 64 dual-processor Pentium III nodes interconnected by Myrinet.

**John C. Stillwell** John C. Stillwell was born in 1942 in Melbourne, Australia and educated at Melbourne High School and the University of Melbourne. He received an M. Sc. from the University of Melbourne in 1965 and a Ph.D. from the Massachusetts Institute of Technology in 1970. After working for 31 years at Monash University in Melbourne, John joined the Mathematics Department at USF in 2002. He is interested in many aspects of mathematics, but particularly its history in the 19th and 20th centuries. These interests are reflected in the books he has written, on topics from number theory to geometry, and his translations of classic works by Dirichlet, Dedekind, Poincare and Dehn. His best known work to date is *Mathematics and Its History* (Springer-Verlag 1989 and 2nd edition 2002). He has been an invited speaker at several international conferences, including the International Congress of Mathematicians in Zurich in 1994, and meetings of the American Mathematical Society in Baltimore in 1998 and Melbourne in 1999.

**Benjamin Wells** Benjamin Wells teaches both mathematics and computer science courses as a member of both departments. He regularly teaches freshman seminars that combine science and art. He holds degrees from MIT and UC Berkeley and has studied in four countries. He won a John Templeton Foundation science and religion course prize in 1998 and held the USF Davies Professorship in 1989. The last student of noted logician Alfred Tarski, Wells works on the boundary of logic, algebra, and computing; he also contributes to computer graphics, visual communication, and classic computers. He is Graduate Program Director for Computer Science. He enjoys mysticism, cooking, computer-supported art, hiking, languages, dancing, tales, and married life with two children.

**Robert Wolf** Robert Wolf graduated from the Massachusetts Institute of Technology in 1962 with a bachelor's degree in mathematics. From the University of California at Berkeley, he received a master's degree in 1964 and a doctorate in 1968, both in mathematics. He received a master's degree in physics in

1990 from San Francisco State University in 1990. He is interested in the mathematical and physical sciences.

**Paul Zeitz** Paul Zeitz majored in History at Harvard and received a Ph.D. in Mathematics from the University of California, Berkeley, in 1992, specializing in Ergodic Theory. Between college and graduate school, he taught high school mathematics in San Francisco and Colorado Springs.

One of his greatest interests is mathematical problem solving. He won the USA Mathematical Olympiad (USAMO) and was a member of the first American team to participate in the International Mathematical Olympiad (IMO) in 1974. Since 1985, he has composed and edited problems for several national math contests, including the USAMO. He has helped train several American IMO teams, most notably the 1994 "Dream Team" which, for the first—and only—time in in history, achieved a perfect score. This work, and his experiences teaching at USF led him to write *The Art and Craft of Problem Solving* (Wiley, 1999). He has also been very active in local events for high school students. He founded the Bay Area Math Meet in 1994 and co-founded the Bay Area Mathematical Olympiad in 1999.

He was recently honored, in March 2002, with the Award for Distinguished College or University Teaching of Mathematics, by the Northern California Section of the Mathematical Association of America (MAA), and in January 2003, he received the MAA's national teaching award, the Deborah and Franklin Tepper Haimo Award.

When not doing mathematics, he enjoys outdoor adventures with his wife (a former park ranger) and his two small children.

### 2.2.3 Problems Faced by Faculty

Our department has been blessed with a friendly and talented faculty. As mentioned earlier, a healthy faculty culture is crucial. However, its health is rather delicate, and it has seen some erosion during the past ten years. Our two biggest problems have been a gradual "aging" of the faculty, along with a loss of tenure-track staffing.

Since Fall 1992, when Zeitz was hired, until Spring 2002, when Stillwell was hired, we had no new tenured or tenure-track appointments. And while Stillwell is a superb addition to the faculty, he will work only half-time (on campus every other semester). Since 1998, all permanent members of the department had tenure.