Request to Establish a Doctoral Program at the University of North Carolina at Greensboro in Computational Mathematics

Introduction

Following a recommendation from the Graduate Council and from the Senior Vice President for Academic Affairs, the Committee on Educational Planning, Policies, and Programs approved on May 11, 2006 the request from the University of North Carolina at Greensboro to plan a doctoral program in Computational Mathematics. The University of North Carolina at Greensboro now seeks approval to establish a doctoral program in Computational Mathematics (CIP: 27.0303) effective August 2008.

Program Description

The goal of the proposed Ph.D. program in Computational Mathematics at the University of North Carolina at Greensboro is to prepare competent scholars capable of conducting high quality fundamental and applied research as well as teaching. Graduates will be prepared for teaching and research careers in higher education institutions and research centers, and for high-level research or staff positions in industry, government and other organizations. We propose a Ph.D. program that will emphasize discrete/symbolic computational mathematics and computational aspects of pure mathematics. The program will develop scientists with sufficient professional experience and versatility to meet the research, teaching, and industrial needs of our technology-based society. This is the right program at the right time in the right department - with the evolution of computer hardware and software, computational mathematics has emerged as a vibrant and growing area of mathematics, and the Department of Mathematics and Statistics at UNCG has the faculty expertise to offer an excellent focused program within computational mathematics which perfectly complements the existing offerings in the state.

Objectives of the program.

- The program will provide students with an understanding of computational methods/techniques at the graduate level, so that these methodologies/techniques can be applied to solving fundamental as well as real world problems.
- The program will prepare students to function as leaders in mathematical research in educational, academic, industrial and government organizations.
- The program will provide research experiences designed to develop the technical and conceptual skills required for independent research.

The program focuses on discrete computational mathematics and computational aspects of pure mathematics. As such it makes use of and extends existing course offerings in pure and discrete mathematics. Some students may choose to include existing graduate

courses in the Computer Science Department, such as CSC 653 (Advanced Theory of Computation) or CSC 655 (Advanced Topics in Algorithms). The establishment of a new Ph.D. program in Computational Mathematics at UNCG will build on the existing MA degree in Mathematics as well as on the existing BA and BS programs in Mathematics. The Proposed Ph.D. program in Computational Mathematics will continue the Department's long involvement in efforts of "linking the Triad and North Carolina to the world through learning, discovery, and service" which is the focus of the UNCG Mission Statement. Establishment of the proposed program is also consistent with the UNCG Vision, Core Values, and the UNCG Plan 2003-2008 (approved by the Chancellor on August 4, 2003, and endorsed by the Board of Trustees on August 28, 2003).

The proposed program enhances our existing strength in traditional mathematics, and with its focus on the discrete part of Computational Mathematics, allows us to envision a strong, small but growing program with the potential for international distinction. The department has developed a close partnership with the Science Advisory Board and through this body is building connections with area businesses and industry. We have received extremely supportive responses from several industry leaders who are overwhelmingly in favor of establishing the proposed Ph.D. program in Computational Mathematics. Industry leaders, the department and the UNCG administration all recognize the importance of pursuing research that directly contributes to enhancing the quality of life for the citizens of the Piedmont Triad region and the entire State of North Carolina.

It is anticipated that student demand for the proposed Ph.D. program will be high. Each year the Ph.D. programs in mathematics at UNC Chapel Hill and NCSU can accept only a small percentage of strong, clearly qualified applicants (for example, last year UNC Chapel Hill accepted only 16 students – of which only 5-6 are in applied/computational mathematics – out of 140 very good applications; NCSU accepts less than 50% of first rate applicants). This indicates a sustained demand for mathematics Ph.D. programs in general in North Carolina. Since computational mathematics is a growing area within the discipline, popular with students and a fertile source of research activity, we can expect strong, sustained demand for our proposed program in computational mathematics.

The national, as well as international, demand for individuals with Ph.D. in Computational Mathematics is high compared to the supply and is expected to remain high for a number of years. Several factors, such as steadily increasing university enrollments, a growing number of faculty retirements, and extremely favorable career opportunities for the graduates of similar programs in industry have contributed to the rising demand. A recent article (August 2003) by Kirkman, Maxwell, and Rose found that applied mathematicians form one of the most "employable" groups within Mathematical Sciences in general and consequently the numbers indicate that demand for Computational Mathematicians is more promising. The same study also shows that the percentage of employed new doctoral recipients in 2002-03 holding non-academic positions was highest for those with a specialization in applied mathematics (30%), indicating the wider range of employment opportunities for graduates of such programs.

Overall, there is clear and overwhelming evidence for the strong demand for the graduates of Ph.D. programs in Computational Mathematics. It is important to emphasize

that the demand is not confined to the U.S., but is growing internationally. We expect to place many of our graduates not only in U.S. universities, colleges and companies, but also in international institutions and companies, complementing the global mission of UNCG. Graduate courses in place in the Department of Mathematics and Statistics are being used increasingly by students majoring in several fields such as biology, computer science, curriculum and instruction, communication sciences and disorders, economics, education research methodology, and information systems and operations management. Courses offered within the proposed Ph.D. program in Computational Mathematics will have a very positive impact on several of these academic programs, particularly computer science. The proposed Ph.D. program can be handled within the resources on hand at UNCG, including the allocation of sufficient number of graduate assistantships. We believe that the Computational Mathematics Ph.D. program would attract sufficient enrollment. In the past several years, UNCG has proposed new Ph.D. programs carefully tailored to meet anticipated demand and all these programs are doing very well. There is no danger of proliferation of low-productivity Ph.D. programs at this institution.

Program Review

The review process is designed to surface strengths and weaknesses in proposed new degree programs. Proposals to establish new doctoral programs are reviewed internally and externally. The concerns from the two review processes were summarized in a letter to the Chancellor prior to the presentation to the Graduate Council. That summary follows:

This reviewer has many very positive things to say about the proposed program particular regarding the proposal itself and the faculty. There should be an adequate source of students for the program and employment opportunities in both the academy and in industry.

The major concern is the strength and type of resources available from the computing area for support for the program. That would appear to need addressing. Some specific additions to the curriculum are recommended, and more strength in the faculty with the computing expertise that Dr. Pauli has is recommended.

It [the second review] shares some of the positive assessments of the first reviewer. The issues that the second reviewer brings to the fore for further consideration are the need to address student recruitment, expand the research depth so cores areas have more than one researcher, and think ahead and prioritize other sub fields that may be developed over time.

Graduate Council

The Graduate Council had, as a basis for its consideration, the proposal to plan the program, copies of the outside reviews of the program, the summary letter to the Chancellor, and a presentation to the Council by representatives of the program. In addition to the issues raised previously, the following concerns were expressed by Council members: there was a question about possible overlap with other programs, and that the research groups should focus on increasing depth.

Response
The program representative described the need for mathematicians trained in computational skills generally and applied skills particularly. Employment opportunities are growing in the area of applied and computational mathematics. The representative described the computing recourses available to the program and the acquisition plans for the future. Machinery adequate to the computational tasks for instruction and research and training are available to the program.

Need for the Program
The program will prepare graduates who are prepared to work in a variety of areas ranging from the academy to high level research in business, industry, and government. Other programs in NC turn away a significant number of well qualified applicants who may find this a suitable option for graduate training in North Carolina. The issue of more depth in research groups will be address through new hiring.

Resources
Due to the productivity of the Mathematics program it has received two new faculty positions and the chair reports that with these two additions the program has the resources to establish the degree program.

Recommendation by the Graduate Council
After consideration of the issues raised by reviewers and Council members, the Graduate Council voted, without dissent, to recommend approval for the University of North Carolina at Greensboro to establish a doctoral program in Computational Mathematics.

Recommendation
The outside reviews were very positive about the proposed program. One said, "This is a well conceived proposal. The program should be an attractive option for contemporary graduate students. Its graduates should have multiple career opportunities." The second review said, "I believe that the Ph.D. program is viable. The students trained by it would be well served. The State of North Carolina and the rest of the country would benefit from their training. There are other established programs in the proposed field, the most notable being at Princeton. The proposed program has its distinctive features that sets it apart even at this early stage of planning. I recommend approval of the program." In addition UNC Chapel Hill and UNC Charlotte provided letters of support for the program.
The staff of the General Administration recommends that the Board of Governors approve the request from the University of North Carolina at Greensboro to establish a doctoral program in Computational Mathematics.

Approved to be Recommended for Establishment to the Committee on Educational Planning, Policies, and Programs

Harold L. Martin

Senior Vice President for Academic Affairs **January 3, 2008**