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

Introduction

The University of North Carolina at Greensboro requests approval to plan a doctoral program in Computational Mathematics (CIP: 27.0303).

Program Description

The goal of the proposed Ph.D. program in Computational Mathematics 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. UNCG proposes a broad-based Ph.D. program that will emphasize the application of computational mathematics to other disciplines. Every student will be required to work in a cognate area so that students can both study fundamental mathematics and develop sufficient competence in the cognate area to be able to apply their mathematical skills to significant scientific problems. The cognate area will depend on the student's interest, but will typically be chosen from the physical, computing, biological, behavioral, or social sciences, business, education, or public health. The program will develop scientists with sufficient professional experience and versatility to meet the research, teaching, and industrial needs of our technology-based society.

Computational Mathematics arose initially as a part of Applied Mathematics and is now rapidly emerging as an independent field. Currently, most of the traditional Ph.D. programs in Applied Mathematics concentrate on areas such as differential equations, numerical analysis, or optimization. However, there are many applications of other types of mathematics to other disciplines: e.g. knot theory from topology is finding applications in biology, physics and chemistry; some very complex ideas in abstract algebra, number theory and algebraic geometry are becoming important in cryptography and communications theory; and sophisticated concepts from mathematical analysis are being applied to the study of financial instruments. Subjects like mathematical biology and bioinformatics cannot progress without a strong mathematical foundation. Data analysis tools from mathematical statistics are now used in almost all disciplines and students from many doctoral programs at UNCG benefit from the existing doctoral minor in statistics. The increasing significance of computational mathematics is shown by the fact that NSF has established a new program in Computational Mathematics within the Division of Mathematical and Physical Sciences. Unlike other doctoral programs in Applied Mathematics, this program will emphasize deep connections with other sciences and hence will produce graduates much better equipped and positioned to meet the technological demands of the 21st century. Details of the curriculum will be worked out if permission to plan is granted, but it is anticipated that students will be required to take several core courses in Applied Mathematics (such as Numerical Methods in Scientific Computing, Iterative Methods for Linear and Nonlinear Systems, Numerical Solution of

Ordinary Differential Equations, and Computational Approximation Theory), courses in high-performance computing and statistics, and additional courses in their cognate area as recommended by their advisory committee.

Program Review
The review process for requests to plan is designed to determine if the proposal is developed to the stage appropriate for taking to the Graduate Council and if so what are the issues that may need further attention. Proposals to plan doctoral programs are reviewed internally. The concerns from the reviewers were summarized in a letter to the Chancellor prior to the presentation to the Graduate Council. That summary follows:

The reviewers recognize that with computer science, pure and applied mathematics, and statistics in the same department, a computational mathematics program would have a strong basis on which to build. While there is evidence of a strong faculty to mount this program, the details of the direction of the proposed program and the match with faculty expertise is not developed in sufficient detail. The impression is that the program will work closely with other departments/disciplines to show the importance of computational mathematics for a host of problems in scientific disciplines, yet the proposal says the cognate area will depend on the student's interest. It would seem the proposed program would identify some major areas in which it will offer doctoral work in order to attract students who want to work in those areas. While there is much evidence and testimony supporting the growing importance of the field of computational mathematics, the readers do not get a good sense of exactly what the focus and the precise disciplines involved will be. Just how organized will the connection between computational mathematics and the disciplines to which it is applied be? And how committed are those departments and what resources will they devote to the program? One of the letters included raises these points about the role of other departments and faculty in this proposed program. The reviewers did raise a concern that more attention could be given to showing that there is unmet need for the kind of education proposed here.

Graduate Council
The Graduate Council had, as a basis for its consideration, the proposal to plan the program, the summary letter to the Chancellor, and a presentation to the Council by representatives of the program.

Response
Representatives of the proposed program reviewed the strengths UNCG has in its mathematics department and particularly in its applied area. Their focus will be primarily in biology and chemistry with several faculty who have strengths in computational mathematics.

Need for the Program
The representatives of the program pointed out that the demand for mathematicians is growing and especially for applied and computational mathematics. They make the case that North Carolina needs a computational mathematics program. The National Science

Foundation has established a new program in Computational Mathematics within the division of Mathematical and Physical Sciences.

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

Budgetary Issues
When at full capacity the total enrollment funding requirement for the program is estimated to be $394,834. If the program is composed of 70% in-state students and 30% out-of-state students, the State funding required (after tuition is charged) is estimated to be $298,204 at 2006-07 tuition rates.

Issues to Address in Planning
Primary attention should be given to establishing need and opportunity for graduates.

Recommendation
The General Administration recommends that the Board of Governors approve the request from the University of North Carolina at Greensboro to plan a doctoral program in Computational Mathematics.

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

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Interim Senior Vice President for Academic Affairs Alan R. Mabe   May 2, 2006