



The University of North Carolina

GENERAL ADMINISTRATION

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MEMORANDUM

TO: Members, Committee on Educational Planning, Policies, and Programs

FROM: Alan Mabe

DATE: December 15, 2010

SUBJECT: UNC Degree Program Proposal

Background:

There is one new degree program proposed for this meeting, a doctorate in Bioinformatics and Computational Biology from the University of North Carolina at Charlotte. This program has been through the full academic review and evaluation process. It was the subject of a disciplinary panel, was approved for planning by this Committee, has been reviewed by outside reviewers, and has been reviewed and recommended by the University Graduate Council.

Jurisdictional Authority:

The Code 100.1, 301 C: It [Committee on Educational Planning, Policies, and Programs] shall receive the advice and recommendations of the president and make recommendations to the board in all areas pertaining to the development of a coordinated system of higher education in North Carolina, including...the review of requests for the initiation of new degree programs and recommendations for the termination of existing programs....

Issues Involved:

The State funded a building for Bioinformatics and Computational Biology at UNCC and the building has been completed and occupied. The doctoral program, along with the already approved master's program, would provide the focus for the education and research needed to fulfill UNCC mission to impact economic development in the region and the state in this important and developing field.

Recommended Action:

The recommendation is provided at the end of the narrative.

Request by the University of North Carolina at Charlotte to Establish a Doctoral Program in Bioinformatics and Computational Biology

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 in January 2010 the request from the University of North Carolina at Charlotte to plan a doctoral program in Bioinformatics and Computational Biology. The University of North Carolina at Charlotte now seeks approval to establish a doctoral program in Bioinformatics and Computational Biology (CIP: 26.1103) effective January 2011.

Program Description

The program in Bioinformatics and Computational Biology (BCS) will be administered by the Department of Bioinformatics and Genomics within the College of Computing and Informatics and will involve participating faculty from several other departments as well.

The life sciences have changed dramatically in the last two decades. Initially, the widespread use of high-throughput technologies to generate massive databases has caused biology to become, to a great extent, an information-driven science. Now, more generally, computation is at the heart of many areas of biological science. *Bioinformatics* and *Computational Biology* are disciplines that have emerged in response to the need to utilize these new complex data sets to help solve difficult, important biological problems.

In 2000, the National Institutes of Health formed a committee to develop working definitions of these terms² (<http://www.bisti.nih.gov/CompuBioDef.pdf>). The committee offered the following definitions, recognizing that no definition could completely eliminate overlap with other activities:

Bioinformatics: Research, development, or application of computational tools and approaches for expanding the use of biological, medical, behavioral, or health data, including those to acquire, store, organize, archive, analyze, or visualize such data.

Computational Biology: The development and application of data-analytical and theoretical methods, mathematical modeling, and computational simulation techniques to the study of biological, behavioral, and social systems.

It is important to note that both Bioinformatics and Computational Biology are grounded in the life sciences, as well as in the physical, computational, and information sciences. Bioinformatics is directed toward the development and use of computational strategies to extract meaning from data, especially large, complex data sets. Current examples include the assembly and annotation of novel genomes and the analysis and interpretation of gene expression microarray data. Computational biology focuses more on modeling and simulation. Common examples include structural and physical modeling of proteins to elucidate functional and regulatory mechanisms. There is often considerable synergy between Bioinformatics and Computational Biology, since it is common for modeling and simulation studies to depend on analysis of massive data sets, and for data analysis algorithms to rely on complex theoretical models.

The initial call for bioinformatics training programs came about with the widespread use of high-throughput sequencing associated with the Human Genome Project. Since that time, the size and complexity of data analysis problems have grown enormously, especially with the widespread use of Next-Gen sequencing systems and the expansion of microarray platforms. Increasingly, the data sets are becoming far too large and complex to be analyzed with ordinary desktop computers, a situation made worse by the current 3 GHz speed limit reached by most processors. Moreover, modeling and simulation studies have come to rely heavily on high performance computing systems. Many organizations, including UNCC's program, now use large high performance computing clusters, multi-core large memory machines, graphic processing units, and hybrid (field programmable gate array) computers to keep up with the demands of growing data sets. Programming and using these computational platforms requires highly specialized training. Moreover, the introduction of single molecule sequencing systems in the next year or so will trigger another data explosion. It is likely that the data production will vastly exceed current analysis capability.

From the National Academy's Bio2010 report, the NIH Roadmaps, and the recent report from the National Academy ("A New Biology for the 21st Century: Ensuring the United States Leads the Coming Biology Revolution"), the critical need to integrate biology with computation is widely recognized. However, the problem has been that, from undergraduate through graduate to post-graduate education, biologists and computer scientists have constituted two largely non-overlapping populations. This begins at the undergraduate level, where there is little encouragement for biology students to take computer courses and biology departments rarely allow computer courses to count toward the major. This is equally true for computer science. Moreover, by the time students are in graduate school, the prerequisites are so extensive it is essentially impossible for a biology graduate student to take a graduate computer course, or for a computer science student to take a graduate biology course.

The proposed program provides a mechanism to break this pattern. Because the UNC Charlotte program is centered in a Bioinformatics and Genomics Department, it can design and deliver accelerated courses which allow a student with an undergraduate biology degree to quickly get up to speed in modern computational procedures, while providing other courses that provide the computer science, physics, or mathematics student with the background in molecular biology, genetics, and biochemistry needed to take our core courses. The UNCC program has refined this approach over the last three years with both the Professional Science Master's courses in Bioinformatics as well as in the Bioinformatics track of the Information Technology Ph.D. program. The result is that students with a variety of different undergraduate backgrounds have been able to successfully complete our core courses as well as the advanced and elective courses in these programs. Far from being a detriment, the interaction of students with different undergraduate majors has clearly enhanced the educational experience.

While the Bioinformatics track in the Information Technology Ph.D. program has been successful, it is difficult to attract applicants who are specifically interested in bioinformatics and computational biology, since they are more likely to go to universities that offer a degree in this field. More specifically, the "Information Technology" designation clearly discourages students with biology backgrounds from applying. Furthermore, because the Bioinformatics track is tied to the admissions, curriculum, and graduation criteria for the Computer Science

track, both programs are limited in their ability to tailor their programs to the needs of the students. While our program-wide track approach has been very valuable in the development and refinement of new courses, in the organization of admissions and evaluation criteria, and in the development of a rigorous research culture for our students, further advancements depend on the establishment of an independent BCB Ph.D. Program.

Educational Objectives. The development and use of new computational methods in biology generally stem from the interaction between biologists and computer or quantitative scientists with a substantial knowledge of biology. Computational scientists with little knowledge of biology are unlikely to be able to make much of a contribution. The proposed Ph.D. Program in Bioinformatics and Computational Biology seeks to avoid this pitfall. The educational objectives of this program are as follows:

- to provide students with a rigorous foundation in scientific computation;
- to provide an understanding of the biological context for development and application of bioinformatics and computational biology methods;
- to train students to develop and apply the appropriate methods to solve important problems in the biological sciences; and
- to instill research, writing, and critical thinking skills by teaching rigorous scholarly inquiry and research methods at a high level.

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:

Reviewer #1 identified several areas for further elaboration. One was about the role of statistical training in the curriculum, and a second was the extent to which there would be components on responsible conduct of research. This reviewer, while complimentary about the single department arrangement, wondered about the interdisciplinary component involving other departments. A question was raised about how doctoral students would be supported in the program and where they are likely to be found. Overall, this reviewer concluded that there were no major issues in this proposal and was supportive of its being established.

Reviewer #2, while raising a few issues and making some suggestions, judged this overall to be an excellent proposal that would draw good students and whose graduates would find good employment opportunities even in this economic environment. There was a comment that there was a good balance between classroom experience and hands-on research training. While the core faculty was judged to be of a caliber to adequately support the BCB doctoral program, there was concern that the program could profit from more senior faculty leadership in the program.

Among the suggestions was to have some courses of ½ to 1 credit to be able to cover more topics in the curriculum that might be of interest to some students and to establish internships in local industry for graduate students. Another suggestion was to encourage and incentivize faculty taking leadership roles, and promote collaborative research among the faculty to build the basis for traineeship grant support. This reviewer also thought the tracking of student will be important for future grant support.

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: the course work in research ethics and who would be teaching it, the need for senior faculty, the best way to promote a more diverse student population, and the conditions for successfully getting training grants.

Response

Representatives of the program reviewed the development of the Bioinformatics program at UNCC and responded to the reviewers and the issues raised by members of the Graduate Council. Bioinformatics was identified in 2000 as an area of interest by then Chancellor Woodward. A master's degree in Bioinformatics was established. The Board of Governors recommended and the General Assembly approved \$35 million for a new bioinformatics building on the Charlotte campus. A track in Bioinformatics was developed in 2006 within the doctoral program in Information Technology. Currently there are 21 students in that track and 19 of them have a support package. The program has received \$2.6 million in extramural research grants in the current year. UNCC has participated in the development of the North Carolina Research Campus at Kannapolis and established a bioinformatics office there with four doctoral level and two staff employees.

The representatives assured the Council that statistical instruction would permeate all the course work and that even though this doctoral program is in a single department it will involve faculty from three colleges and eight departments. They plan to recruit at the junior level for a faculty member in Statistical Bioinformatics.

To address the need for more senior faculty, the program is currently recruiting for an endowed Belk Professorship in Bioinformatics at the senior level.

The program has taken advantage of UNCC's Center for Professional and Applied Ethics for course work in the research ethics area and has offered modules and coursework in this area. Representatives of UNCC indicated they would pursue suggestions by the Graduate Council members of ways to strengthen their approach. This instruction will be linked to the basis for applying for training grants.

The current program's student population is currently 43% female. Representatives of the program have been visiting campuses with high populations of underrepresented minorities and they indicated they will follow up with suggestions from the Graduate Council.

Need for the Program

Given the revolution in the life sciences, it is essential to have people prepared to address the mass of data that is generated in order to make advances in the biological sciences. Reviewers confirmed that there are good pools of graduate students for programs in Bioinformatics and good job opportunities even in a depressed economy. This proposed doctoral program is also the culmination of previous State investments in Bioinformatics and Computational Biology at UNCC. It offers the prospect of impact on economic development and the development of human capital for the biotechnology industry in North Carolina and other parts of the country.

Resources

Facilities, equipment, and faculty are the primary resources needed for this program and UNCC has these in place. The building is complete and equipped. The students will be substantially equal in number to those in the doctoral track at start-up (21), but will grow to an expected 28 students, which will generate an enrollment change request for 7 students by 2013-14. At the point when the program is fully ramped up it would require additional state funding of approximately \$170,000. The Chancellor has indicated that if approved they will start the program up at the current level and not seek additional funding for additional students until better budgetary conditions return.

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 Charlotte to establish a doctoral program in Bioinformatics and Computational Biology.

Recommendation

The staff of the General Administration recommends that the Board of Governors approve the request from the University of North Carolina at Charlotte to establish a doctoral program in Bioinformatics and Computational Biology effective January 2011 subject to the availability of funding.

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

Senior Vice President for Academic Affairs

December 14, 2010

General Information Template for Academic Program Review

Degree Area and Level:

Ph.D in Bioinformatics & Computational Biology (CIP 26.1103)

Addressing UNC Tomorrow:

The Ph.D in Bioinformatics & Computational Biology degree program directly applies to UNC Tomorrow Recommendation 4.1.2 that states, “UNC programs, especially research programs, should be globally competitive to ensure that they are globally relevant and significant.”

Role of Program in Relation to State and Regional Needs:

According to the proposal, the Charlotte region “is well on its way to becoming a major biotechnology center in the state with the development of the North Carolina Research Campus (NCRC) at Kannapolis. The expertise provided by this program is critical in a wide range of biotechnology research problems and applications, from genomics to health care and beyond.” In 2005, the North Carolina General Assembly granted the request from UNC Charlotte for \$35 million to build a Bioinformatics building on their campus.

US Labor Department Analysis:

- Summary – N/A

Availability of Program Statewide (Enrollment and Degrees Awarded in Last 3 Years):

- Public universities – The program at UNC-CH was approved by the BOG on 11/09/07.

Enrollment			Academic Year						
			Fall 06	Spr 07	Fall 07	Spr 08	Fall 08	Spr 09	Fall 09
NCSU	Bioinformatics	PhD	40	36	39	35	34	31	24
UNC-CH	Bioinformatics and Computational Biology	PhD	N/A	N/A	N/A	N/A	1	1	9

Number of Degrees Awarded			Academic Year		
			2006-2007	2007-2008	2008-2009
NCSU	Bioinformatics	PhD	7	9	6

- Private universities – The data below was found on the Duke University Graduate School website: <http://gradschool.duke.edu/about/statistics/admitbgt.htm>

Duke University		Academic Year				
		2006-2007	2007-2008	2008-2009	2009-2010	2010-2011
Ph.D Computational Biology & Bioinformatics	Enrollment	26	28	18	39	34
	Number of Degrees Awarded	1	2	4	4	N/A

Available in Online or Distance Format from UNC institutions: Not available.

Available or not from Academic Common Market: Not available.

UNC Charlotte Campus enrollment and degrees awarded by similar programs at the Doctoral level:
 (Based on two CIP digits – 26 CIP is the summary group for Biological and Biomedical Sciences under which Bioinformatics is listed as a program.)

Enrollment			Academic Year					
			Fall 06	Spr 07	Fall 07	Spr 08	Fall 08	Spr 09
UNCC	Biology/Biological Sciences, General	PhD	23	22	24	26	29	32
								30

Number of Degrees Awarded			Academic Year		
			2006-2007	2007-2008	2008-2009
UNCC	Biology/Biological Sciences, General	PhD	3	2	8

Campus Average of enrollment and degrees awarded in this degree area at the Doctoral level:
 (Based on two CIP digits – 26 CIP is the summary group for Biological and Biomedical Sciences under which Bioinformatics is listed as a program - over the last 3 Academic Years, Fall 2006-Fall 2009)

Campus Average			
	Number of Active Programs	Enrollment per Semester	Degrees Awarded per Year
ECU	8	12	2
NCSU	13	22	4
UNCC	1	27	4
UNC-CH	14	57	9
UNCG	1	10	N/A *Program initiated Fall 2008
UNCW	1	12	2
Campus Average:		23	4

UNC Charlotte Degree Programs added in the past three years:

- Bachelor
 - BA Japanese Studies (04/09/2010)
 - BA Special Education, General Curriculum (03/20/2009)
 - BS Systems Engineering (09/07/2007)
 - BS Respiratory Therapy (05/11/2007)
 - BS Public Health (03/16/2007)
- Master
 - MA Anthropology (08/13/2010)
 - MS Fire Protection and Administration (06/11/2010)
 - MS Construction and Facilities Management (06/11/2010)
 - MUD Urban Design (06/13/2008)
 - MA Latin American Studies (02/09/2007)
 - MS Bioinformatics (05/11/2007)
- Doctoral
 - PhD Nanoscale Science (01/12/2007)

UNC Charlotte Degree Programs discontinued in past three years:

- *Bachelor*
 - BA Special Education, Mental Handicaps (03/20/2009)
- *Master*
 - MEd Special Education, Cross-Categorical Disabilities (03/20/2009)
 - MEd Special Education, Behavioral-Emotional Handicaps (03/20/2009)
 - MEd Special Education, Mental Handicaps (03/20/2009)
 - MEd Special Education, Learning Disabilities (03/20/2009)
 - MEd Special Education, Severe and Profound Handicaps (03/20/2009)
 - MA Art Administration (03/20/2009)
- *Doctoral*
 - N/A