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

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 10, 2007 the request from the University of North Carolina at Chapel Hill to plan a doctoral program in Bioinformatics and Computational Biology. The University of North Carolina at Chapel Hill now seeks approval to establish a doctoral program in Bioinformatics and Computational Biology (CIP: 26.1103) effective November 2007.

Program Description

The Carolina Center for Genome Sciences proposes to transform the current certificate program in Bioinformatics and Computational Biology (BCB) to a PhD-granting curriculum. This proposal has unanimous support from all relevant departments in the Schools of Medicine, Public Health, Dentistry, Pharmacy, Information and Library Sciences, and the College of Arts and Sciences. The BCB certificate program was established in 2002, but has since grown and matured to a point where it is now ready to transition into an independent, degree-granting program. The program currently has 26 students and 37 affiliated faculty from 18 different departments across campus. The program is housed in and receives administrative support from the Carolina Center for Genome Sciences. The program is currently funded by grants from the UNC General Administration and the National Institutes of Health, and receives additional support from institutional and industrial sources. Because of the inherently interdisciplinary nature of the program, students are currently drawn from an exceptionally large number of departments with widely varying curricular requirements. In order to train students more effectively and continue to attract the best students in this rapidly evolving field, it will be critical to have a unified, comprehensive curriculum as well as direct oversight of their research and professional development. The best mechanism for addressing this need is to create a PhD-granting program in bioinformatics and computational biology.

Bioinformatics and computational biology are two related disciplines that have developed from the need to analyze and interpret large, complex datasets which have emerged in the last decade as genomics, proteomics, systems biology, and other high-throughput approaches have become more feasible. Bioinformatics and computational biology utilize techniques from applied mathematics, informatics, statistics, and computer science to solve biological problems. Major research efforts in the field include sequence alignment, gene finding, genome assembly, protein structure alignment, protein structure prediction, prediction of gene expression and protein-protein interactions, and mathematical modeling of intracellular processes. The terms "bioinformatics" and "computational biology" are often used interchangeably, although the former typically focuses on algorithm development and computational/statistical methods for data analysis, while the latter focuses more on hypothesis testing and discovery in the biological domain. Although this distinction is used by the National Institutes of Health in their working definitions of these

fields (http://www.bisti.nih.gov/CompuBioDef.pdf), it is clear that there is a tight coupling and mutual synergy between the more hypothesis-driven research in computational biology and the technique-driven research in bioinformatics. The University of North Carolina at Chapel Hill (UNC-CH) has a long history of excellence in biological, computational, mathematical, and information sciences. In the past six years, this institution has made a concerted effort to capitalize on these assets by building a strong research and training portfolio in bioinformatics and computational biology. These comparatively new fields are undeniably a major driving force in modern biology, which UNC-CH must continue to develop in order to remain competitive on a national level. The proposed PhD Program in Bioinformatics and Computational Biology (BCB) will contribute substantially toward this overall effort.

The Carolina Center for Genome Sciences (CCGS) was established at UNC-CH in 2001 as a campus-wide umbrella organization to coordinate and stimulate growth in basic and applied genomics research, education, and training. Unlike traditional academic departments, the Center brings together faculty from a wide variety of disciplines such as biology, computer science, chemistry, statistics, public health, and medicine.

This significant faculty investment in bioinformatics and computational biology has created a pressing need for graduate training in this highly interdisciplinary area of research. As the fields of bioinformatics and computational biology continue to expand into all aspects of modern biological research, the need for graduate training programs that bridge biological, quantitative, and computational sciences will also increase. To fill this gap at UNC-CH, the CCGS created the BCB certificate program in 2002 to offer new training opportunities to graduate students in relevant departments. BCB is unique in its breadth and diversity compared to other graduate programs at UNC-CH. Unlike most training programs that primarily serve the needs of the departments in which they are housed, BCB faculty come from 18 different departments across 6 different academic units.

Since the BCB program does not currently grant degrees, interested students must first apply to an affiliated department or curriculum. Thus, BCB faculty have had to work with numerous departments to identify potential applicants interested in bioinformatics and computational biology. Although this has been an effective mechanism for initiating the program, BCB has now grown and matured to a point where it is ready to recruit its own students into an independent degree-granting program. Moreover, it has been difficult to attract applicants who are interested specifically in bioinformatics and computational biology since they are more likely to apply to other universities that offer degrees, rather than certificates, in these fields. Another advantage to having a standalone, degree-granting program is the ability to tailor students' curricular requirements as well as their intellectual and professional development. The current certificate program requires students to fulfill substantial course requirements, lab rotations, and colloquia during their first two years. These expectations, in addition to the heavy course load required in departments such as Mathematics, Statistics & Operations Research, and Computer Science, place an undue burden on students that not only discourage them from applying, but also prevent them from focusing on their research training. By contrast, BCB students based in biomedical

departments such as Biology, Microbiology & Immunology, and Biochemistry & Biophysics, have fewer course requirements but higher research expectations early in their graduate careers. Additional disparities are also evident later in their graduate careers, as expectations for the PhD vary widely across departments depending on the discipline or academic "culture" from which they are derived. For example, BCB students in experimentally based departments who are primarily developing algorithms may have difficulty convincing their thesis committees of the value of such work, particularly when compared to their peers with more traditional projects. Likewise, BCB students with experiment-based projects may experience corresponding biases from mathematical or computational departments. Although these are generalizations, such issues have already arisen for current students in the certificate program. Departmental standards for qualifying exams, publications, theses, and other PhD requirements also vary substantially. As a result, there is very little consistency in the training experience among BCB students. Moreover, students are discouraged from pursuing truly interdisciplinary projects that do not fit neatly within the conventions of their respective home departments.

In the last four years, the BCB program has been successful in attracting highly qualified, motivated students with the help and support of affiliated departments. This certificate program will continue to be offered since it is well-suited for students in other degree programs who have a more limited interest in bioinformatics and computational biology. However, for the many reasons described above, it will be difficult to create a truly innovative, nationally competitive program without an independent PhD curriculum. The goal of BCB is to train the next generation of scientists who can develop and apply quantitative/analytical tools to driving biological problems, particularly those that are well-suited for computational approaches. A PhD curriculum would provide the necessary latitude to prepare students with the right balance of quantitative skills (e.g., mathematics, statistics, computer science) and experimental approaches (e.g., genetics, cell biology, molecular biology) for making important contributions to modern biological research.

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 letters to the Chancellor prior to the presentation to the Graduate Council. Those summaries follow:

Letter 1

This reviewer provides a very favorably view of the program. The reviewer comments that the faculty is uniformly strong, that there is a large pool of students seeking doctorates in this area, and that the market for PhDs remains good. The reviewer does raise concerns about the adequacy of financial support that will be provided by the University. While the reviewer recognizes the competitiveness of the faculty for grant support, the concern seems to be focused on the needed administrative support for the program and the support of graduate students that will be required.

The reviewer also suggests that the program might consider building an international component into the program.

Letter 2
In the context of recommending approval of the program, this reviewer identified three concerns: the role of the student's home department, the role of the Graduate School in its traditional oversight function, and resources to support all the graduate students.

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 letters 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: that the advisory committee for the program be expanded or adjusted to include some member from outside the University perhaps from programs at other universities and industry.

Response
A representative of the program presented an overview of the academic program and responses to the issues raised by the reviewers. While an interdisciplinary program can be complex to administer, the representative point out that there would be, in addition to the director, two administrators to support this and another doctoral program and there will be an associate director of research. As for graduate student financial support, the first year students will all be supported, and there will be seven slots for BCB students in the second year. The expectation is that by the third year the graduate students will be participating in funded research and will be supported through program grants. It was made clear that each student will have a home department and consistent guidance once the students has selected his or her program of study. The program will fall under the oversight of the Graduate School and will undergo the eight-year review the same as other graduate programs at UNC CH. The representative indicated that they would expand the advisory board and review all the recommendations of the reviewers for inclusion in the program.

Need for the Program
The program currently exist as a certificate program in association with several other doctoral programs on the UNC Chapel Hill campus, so this is a proposal to move from a certificate combined with other doctoral programs, to a unified, though interdisciplinary, doctoral program that will focus on the core fields of the program. Reviews confirm that there is a good source of very good students for this program and that job opportunities are available for graduates of the program. UNC Chapel Hill has more than thirty students enrolled in the certificate program, so there is ample evidence that the doctoral program will draw both from those who sought a certificate in the past and from students who prefer a degree program in this field over a certificate program. This program area is at the core of developments in the biological sciences and represents the need for UNC CH to have such a program to compete at the highest leadership levels of the field.

Resources
Most of the resources for this program have already been committed since students have been participating in the program through a certificate process, so the additional resources

will be for expanding the program beyond the number served now. The facilities, faculty, and infrastructure are already in place and the additional resources will be to support the 10 to 15 students expected to enroll overall in the doctoral over those in the current certificate program. Enrollment growth funding would bring resources to the campus, and well as the likelihood of additional grants based on the higher level of visibility the doctoral program will have.

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 Chapel Hill 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 Chapel Hill to establish a doctoral program in Bioinformatics and Computational Biology.

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

Harold L. Martin

Senior Vice President for Academic Affairs Harold Martin October 29, 2007