APPENDIX N

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

Introduction

The University of North Carolina at Chapel Hill requests approval to plan a doctoral program in Bioinformatics and Computational Biology (CIP: 26.1103).

Program Description

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 the modeling of evolution. The terms "bioinformatics" and "computational biology" are often used interchangeably, although the former typically focuses on algorithm development and computational and 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 five 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 landscape of biomedical research at UNC-CH has adapted in response to the growing need for research and training in bioinformatics and computational biology. 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. To accommodate this diversity, a unique administrative structure was established to promote multi-investigator, interdisciplinary collaboration. Eighteen new faculty positions were created for the Center, each of which is appointed jointly with existing departments across campus. All these positions have since been filled, and many of the faculty have research interests in bioinformatics and computational biology. The University has also recruited seven additional faculty in a parallel effort to enhance bioinformatics expertise specifically. Although these seven faculty positions are housed exclusively in their home departments (not shared with the Center), all of them participate as members of the Center as well. In addition, there are about 20 pre-existing UNC faculty who have been asked to join the

CCGS over the past five years. BCB faculty are drawn from all these sources, in addition to others across campus, by virtue of their relevant research interests.

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 niche 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. Both the intellectual and organizational diversity of BCB faculty justify the need for an independent training program. The CCGS is a natural administrative home for the program since it has been the nexus for faculty recruitment and consequently, research/training needs in bioinformatics and computational biology. Since its inception in 2002, the BCB certificate program has been administered by CCGS. The Center also administers three other biomedical training programs so it has the appropriate experience and staff in place.

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 individually 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 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:

Both internal reviewers expressed praise and strong support for the proposal. One concluded, "This is a strong program with strong faculty and the possibility of strong Ph.D. level research." The themes that emerged that may require some additional attention are the long-range funding for the program and the relation to other programs in the state both in term of possible cooperation and the impact of those programs on the job prospects of graduates.

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. In addition to the issues raised previously, the following concerns were expressed by Council members:

Council members raised questions about the demand for graduates, the relation of the program to a similar program at Duke, and whether they had buy in for team teaching and involvement by the range of relevant departments. Clarification was also sought about the present certificate program and how it will fare if a doctoral program is established.

Response

The representatives of the program described how important the field of bioinformatics is becoming in biology and the need for people trained in this field. While the certificate program proved very valuable to provide a bioinformatics dimension to people basically taking doctorates in other fields it is not an adequate vehicle for attracting graduate students into the field of bioinformatics. The certificate program will continue to exist and will provide support for those

seeking strength in bioinformatics but want a degree in a related field. The Center has a history of departmental cooperation and with team teaching which should continue with this new degree program. The growth of the field should be strong enough to absorb graduates of the program.

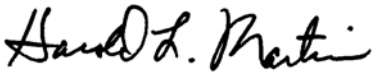
Need for the Program
The investment of General Administration of funds awarded competitively in this field has helped leverage a development process that has strengthen the emphasis on bioinformatics and computational biology to the point that a new degree program is appropriate. To be competitive with the best biological science programs in the country there needs to be strength in this area and a doctoral program will assure that strength and continuing development.

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

Issues to Address in Planning
Issues of long-range financial support of the program, support of graduate students, and assessment of the number of students that would be optimal based on the market for graduates are all items that could be development further in the planning process.

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 plan a doctoral program in Bioinformatics and Computational Biology.

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



Senior Vice President for Academic Affairs **May 1, 2007**