

To: McNichols Faculty Assembly
From: McNichols Faculty Assembly Undergraduate Standards Committee
Date: February 1, 2009
Re: College of Engineering and Science, Department of Mathematics and Computer Science Minor in Bioinformatics

The Undergraduate Standards Committee has carefully reviewed the proposal for a Minor in Bioinformatics from the College of Engineering and Science: Department of Mathematics and Computer Science submitted by Dr. Kevin Daimi and Dr. Greg Grabowski. The Undergraduate Standards Committee have discussed this minor and voted to submit the proposal for the academic minor in Bioinformatics to the McNichols Faculty Assembly.

This proposal meets all of the requirements for academic minors. The proposal demonstrates academic integrity and intellectual merit by clearly elucidate a set of objectives and outcomes and a thorough plan of assessment. The College of Engineering and Science and the Department of Mathematics and Computer Science is committed to use the results of assessment to modify the curriculum as needed and continuously improve instructional practices.

It is recommended that the current College of Engineering and Science website and all related informational materials be updated to describe the Bioinformatics Minor. The updated website and all promotional materials should clearly indicate the academic standards required of all minors as well as the requirements specific to the Bioinformatics Minor.

We conclude that the College of Engineering and Science, Department of Mathematics and Computer Science is well positioned to immediately implement the Bioinformatics Minor

Respectfully submitted by, Shirley Sherrick-Escamilla, Ph.D. for Dr. Robert Ross.



**University of Detroit Mercy
College of Engineering and Science
Department of Mathematics and Computer Science**

**Minor
In
Bioinformatics**

Prepared by

Kevin Daimi and Greg Grabowski

January 2009

INTRODUCTION

Bioinformatics is a new and rapidly evolving discipline that has emerged from the fields of Molecular Biology and Computer Science. It refers to the use computers to store, compare, retrieve, analyze or predict the composition or the structure of molecules. In 1981, the Smith-Waterman algorithm for sequence alignment was published. Following that, many Bioinformatics algorithms were designed and a number of Bioinformatics databases were created.

Bioinformatics is being used in many fields such as molecular medicine, preventative medicine, gene therapy, drug development, waste cleanup, climate change, alternative energy sources, biotechnology, antibiotic resistance, forensic analysis of microbes, bio-weapon creation, evolutionary studies, crop improvement, insect resistance, improve nutritional quality, and development of drought resistance varieties.

A number of universities started offering various levels of degrees in Bioinformatics in the late 80's. In 2000, the department of Mathematics and Computer Science suggested a joint Master degree in Bioinformatics with the Department of Biology. However, both departments agreed they were not ready for it. In 2004, the Dean of the E&S stressed the need for a Bioinformatics course for Computer Science/Biology based on his study on E&S Education in the 21st Century under the Computationally Intensive Science and Engineering theme. As a result of that theme, the Department of Mathematics and Computer Science started offering a course in Bioinformatics Algorithms at the beginning of this year. Currently, there are many universities offering degrees ranging from Bachelor to Ph.D. in Bioinformatics in addition to minors and certificates.

In April of 2007, the departments of Math and Computer Science requested a meeting with the Biology department to investigate the possibility of offering a Minor in Bioinformatics. In this meeting, it was agreed to draft a proposal for offering the minor, and an initial list of courses was created. Collaboration between Greg Grabowski in Biology, and Kevin Daimi in Computer Science, lead to this final draft, which was approved by faculty of both departments, and the Leadership Team of the College of Engineering and Science.

MISSION

Both science departments share a reputation of academic excellence that is expressed in the professional and personal success of their graduates. Alumni surveys and feedback provide testimony of a level of preparedness that goes beyond academics, to include social responsibility, community service, and spiritual and ethical commitment. Development of the Bioinformatics minor provides an integrated extension of mission fulfillment attained by both departments.

The marriage of both science disciplines in bioinformatics contributes to the expansion of fields dependent on information technology (medicine, genomics, pharmacology...). The University Mission, with an emphasis on ethics and the

responsibilities of professionals in these fields will be imprinted on Bioinformatics minors and contribute quality and uniqueness to the professional fields they enter, as it has with those entering IT, medicine, dentistry, and other science-related fields,

MINOR OBJECTIVES

- Introduce Bioinformatics algorithms, methods, and techniques for Mapping DNA, Sequencing DNA, Comparing sequences, Predicting Genes, Finding Signals, Identifying Proteins, Repeat Analysis, Genome Rearrangements, and Molecular Evolution.
- Provide the knowledge and skills necessary for understanding and implementing Bioinformatics applications
- Prepare students to benefit from the interdisciplinary nature of Bioinformatics through coursework and projects
- Prepare students for further studies or employment in the Bioinformatics field

MINOR REQUIREMENTS

The Minor in Bioinformatics consists of 6 courses equally balanced between Computer Science and Biology. All the courses are taken from the current offering of Computer Science, and Biology. The required courses are given below.

#	Prefix	Num	Title	Credits	Prerequisites
1	CSC	3540	Database Systems and Programming	3	CSC-1710
2	CSC	4610	Introduction to Data Mining	3	CSC-3540
3	CSC	4620	Introduction to Bioinformatics	3	
4	BIO	1200	General Biology I	3	
5	BIO	2700	Genetics	3	BIO-1200
6	BIO	4740	Cell and Molecular Biology	3	BIO 2700

COURSE DESCRIPTIONS

CSC 3540 Database Systems and Programming (3 credit hrs.)

Prerequisites: CSC 1710

Database management, database system architecture, relational databases, SQL, domains, relations, relational algebra, relational calculus, integrity, views, normalization, database security, database connectivity, database programming, projects.

CSC 4610 Introduction to Data Mining (3 credit hrs.)

Prerequisites: CSC 3540

Introduction to data warehousing, data preparation for data mining, classification, association, clustering, prediction, data mining applications, data mining projects.

CSC 4620 Introduction to Bioinformatics (3 credit hrs.)

This course will introduce Molecular Biology, Data Searches and Pairwise Alignments, Substitution Patterns, Distance-Based Methods of Phylogenetics, Character-Based Methods of Phylogenetics, Genomics and Gene Recognition, Protein and RNA Structure Prediction, and Proteomics. Bioinformatics techniques and algorithms will be used.

BIO 1200 General Biology I (3 credit hrs.)

Introduction to biological phenomena designed to acquaint the student with biological principles and their applications to living systems. Emphasis is on structure and function at the molecular-cellular level of organization in plants and animals. Also includes an analysis of the basic principles of inheritance as seen in various living forms.

BIO 2700 Genetics (3 credit hrs.)

Prerequisites: BIO 1200

The study of heredity. The course covers Mendelian genetics, molecular and biochemical genetics, quantitative inheritance and population genetics.

BIO 4740 Cell and Molecular Biology (3 credit hrs.)

Prerequisites: BIO 2700

An examination of basic concepts and experimental methodologies of cellular and molecular biology. Lecture presentations examine how genes work, ways in which proteins work together, and membrane structure and function. The course emphasizes cell interactions.

MINOR OUTCOMES

Upon completion of the Bioinformatics Minor, students will be able to:

1. Apply various techniques, and algorithms to Bioinformatics problems.
2. Carryout DNA, RNA, and Protein Sequencing and Analysis.
3. Perform protein and gene expression analysis.
4. Accomplish pairwise and multiple sequence alignment.
5. Accomplish gene and protein structure and function prediction.
6. Perform Phylogenetic Analysis.
7. Utilize Bioinformatics databases and software tools

MINOR ASSESSMENT

Assessment of the bioinformatics minor employs a combination of assessment procedures used by both departments, and mirrors what is being done in the majors:

- In the Bioinformatics course, students will complete a comprehensive project demonstrating the skills developed throughout the minor
- A comprehensive exam that covers all the topics of the Bioinformatics Minor will be given to students during week 13 of their last semester
- A senior survey is required of all graduating biology and computer science majors enrolled for this minor, which will include bioinformatics minor specific inquiries
- In the Bioinformatics course, students will complete a research paper on an application field of Bioinformatics
- Samples of exams, projects, and other assignments will be collected over a range of quality for evaluation of outcomes and syllabi content.
- Assessment information will be processed by respective department assessment coordinators, and the chairs of the respective departments will call a joint meeting of all participating faculty to facilitate modification of the minor.

RESTRICTIONS

1. Students must have at completion a cumulative 2.0 grade point average in all minor courses in order for the minor to be posted on the official transcript at the time of graduation.
2. At least 12 credits (or 4 courses) of the courses required for the minor must be taken at UDM unless the courses are taken as part of a consortium agreement
3. The minor is intended for students from Biology, Biochemistry, and Computer Science. However, any student fulfilling the prerequisites of the Minor's courses may enroll in the Minor in Bioinformatics with the approval of the advisors.

REQUIRED RESOURCES

As all the courses needed for the minor are currently included in the course offering of the participating departments, no course needs to be developed. In addition no faculty is needed to be hired exclusively for this minor. Both departments are currently involved in faculty searches. Hence, the addition of a minor will not strain either department.

Additional facilities and equipment are not required beyond the needs of both departments to accommodate enrollment and maintenance of contemporary technology. The websites of research institutions and government organizations in USA, Europe and Japan contain all the tools and databases needed for running the minor and even degrees in the field. Based on the outcomes of the minor, Computer Science faculty will collaborate with Biology and possibly Biochemistry faculty to submit a proposal to seek funds to establish a bioinformatics laboratory and procure collaborative technologies and equipment.

FACULTY ADVISOR

The faculty advisors for this minor will be faculty from Computer Science and Biology. They will:

- Inform and advise student about the minor
- Monitor the implementation of the minor and recommend future improvements
- Create the Minor Advising Worksheet and ensure its presence in students' files
- Confirm the completion of the minor
- Participate in promoting the minor inside and outside the University

CHANGES TO THE MINOR

Any future modifications to the minor are subject to the same review procedure as the major, which is overseen by the Computer Science Curriculum Committee. Based on the progress with offering this minor, the two departments will look into adding course(s) from Biochemistry after consulting the Biochemistry faculty. In addition, we will look into adding another Bioinformatics class.

Minor Advising Worksheet

The Advising sheet below will be used by both the Department of Mathematics and Computer Science, and the Department of Biology.

**University of Detroit Mercy
College of Engineering and Science
Department of Mathematics and Computer Science
ADVISING WORKSHEET
Minor in Bioinformatics**

Name of Student _____

Student ID _____ Major _____

Telephone _____ E-Mail _____

Courses Completed for the minor:

#	Prefix	Number	Title	Credits	Grade
1	CSC	3540	Database Design	3	
2	CSC	4610	Data Mining	3	
3	CSC	4620	Bioinformatics	3	
4	BIO	1200	General Biology I	3	
5	BIO	2700	Genetics	3	
6	BIO	4740	Cell and Molecular Biology	3	
	Comprehensive exam				

GPA for the Minor _____

Total Credits for Major _____

Total Credits _____

(Signature of Minor Advisor)

(Date)