MARQUETTE
UNIVERSITY

HELEN WAY KLINGLER
COLLEGE OF ARTS AND SCIENCES

Handbook

for

Bioinformatics
Majors

2017-2018

Department of Mathematics, Statistics and Computer Science

College of Arts and Sciences

INTRODUCTION

The bioinformatics major (INBI) is an interdisciplinary program between the Department of Mathematics, Statistics and Computer Science, and the Department of Biological Sciences. Bioinformatics is a field that lies at the intersection of biology, statistics, and computer science and is focused on the generation and analysis of large biological datasets. With the advent of high throughput technologies to generate vast amount of biological data, bioinformatics has become a vital area in the life sciences. Over the past two decades, such "big data" has become increasingly central to scientists' efforts to understand such topics as the organization and evolution of genomes, the large-scale regulation of gene expression, and the interactions among all of the proteins present in a particular cell. Such questions have become central to fields as diverse as healthcare, conservation ecology, and civil engineering, all of which rely on individuals with training and expertise in bioinformatics.

In order to gain insights from these high throughput datasets to answer complex questions in biology, skills in computer science, statistics and biology are needed. The goal of the bioinformatics major is to give students comprehensive training in biology, computer science, and statistics, enabling them to be pioneers of future developments in the field.

STUDENT LEARNING OUTCOMES

Upon completion of all required coursework, the interdisciplinary bioinformatics major will be able to:

1. Collect and prepare biological data for computational analysis,
2. Examine biological data via various computational models by creating appropriate software tools, and
3. Use the results of computational analysis to generate and test hypotheses regarding the underlying biological system.

ADVISING and PRE-REGISTRATION

A student planning to complete a major in bioinformatics should enroll in BIOL 1001, COSC 1010[1], and MATH 1450[2] in the first semester of their freshman year and in BIOL 1002 and COSC 1020 in the second semester of their freshman year. As soon as they have decided to declare their major in bioinformatics, the student should download the Major Declaration form from the Academic Forms page of the College website, fill the form out online, and then submit the printed form to the department office of either Biological Sciences (WLS 109) or MSCS (Cudahy 340). Majors will be assigned two faculty advisors, one from each department. From this time on, the student meets with the advisors to discuss course selections for the following semesters and general academic progress.

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[1]   Upon request, 4 credits for COSC 1010 will be awarded to those students who scored a 4 or 5 on their Advanced Placement (AP) Computer Science A test.

[2]   Upon request, 4 credits for MATH 1450 will be awarded to those students who scored a 4 or 5 on their Advanced Placement (AP) Calculus AB test or who scored a 3, 4, or 5 on their AP Calculus BC test.

REQUIREMENTS FOR THE BIOINFORMATICS MAJOR (INBI)

REQUIRED   COURSES

All students must take the following thirteen courses:

BIOL 1001	General Biology 1	3 sem. hrs.
BIOL 1002	General Biology 2	3 sem. hrs.
BIOL 2201	Genetics	3 sem. hrs.
BIOL 2301	Cell Biology	3 sem. hrs.
BIOL 4101	Biochemistry and the Molecular Basis of Biology	3 sem. hrs.
BIOL 4201	Genomics and Bioinformatics	3 sem. hrs.
COSC 1010	Introduction to Computer Programming	4 sem. hrs.
COSC 1020	Object-Oriented Software Design	4 sem. hrs.
COSC 2100	Data Structures & Algorithms 1	3 sem. hrs.
COSC 3090	Bioinformatics Algorithms	3 sem. hrs.
COSC 4610	Data Mining	3 sem. hrs.
COSC 4800	Principles of Database Systems	3 sem. hrs.
COSC xxxx	Bioinformatics Capstone	3 sem. hrs.

In addition, students must take the following three mathematics courses:

MATH 1450	Calculus 1	4 sem. hrs.
MATH 2100/2350	Discrete Mathematics or Foundations of Mathematics	3 sem. hrs.
MATH 4740/4720	Biostatistical Methods and Models, or Statistical Methods	3 sem. hrs

In addition, students must take two of the following laboratory courses:

BIOL 1101	Laboratory	3 sem. hrs.
BIOL 3202	Laboratory	3 sem. hrs.
BIOL 3302	Experimental Cell Biology	3 sem. hrs.
BIOL 4102	Experimental Molecular Biology	3 sem. hrs.

In addition, students must take one upper level (3000-4000) biology elective. A partial list of options is below:

BIOL 3404	Evolutionary Biology	3 sem. hrs.
BIOL 3405	Plant Biology	3 sem. hrs.
BIOL 3501	Neurobiology	3 sem. hrs.
BIOL 3601	Animal Development	3 sem. hrs.
BIOL 3701	Human Physiology	3 sem. hrs.
BIOL 3801	Microbiology	3 sem. hrs.

COGNATE REQUIREMENTS

CHEM 1001/1013	General Chemistry 1	4 sem. hrs.
CHEM 1002/1014	General Chemistry 2	4 sem. hrs.
CHEM 2111/2113	Organic Chemistry 1	4 sem. hrs.

Bioinformatics Major
SAMPLE CURRICULUM

Freshman

Fall Term	Sem. Hrs.	Spring Term	Sem. Hrs.
BIOL 1001	3	BIOL 1002	3
COSC 1010	4	COSC 1020	4
ENGL 1001	3	ENGL 1002	3
MATH 1450	4	MATH 2100	3
		UCCS – Histories of Cult./Soc.[3]	3
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	14		16

Sophomore

Fall Term	Sem. Hrs.	Spring Term	Sem. Hrs.
BIOL 2301	3	BIOL 2201	3
CHEM 1001 or CHEM 1013	4	CHEM 1002 or CHEM 1014	4
MATH 4720	3	COSC 2100	3
THEO 1001	3	PHIL 1001	3
UCCS-Ind. & Social Behavior	3	Elective	3
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	16		16

Junior

Fall Term	Sem. Hrs.	Spring Term	Sem. Hrs.
COSC 3090	3	COSC 4610	3
COSC 4800	3	BIOL upper division elective	3
BIOL 4101	3	BIOL lab course	3
CHEM 2111 or CHEM 2113	4	PHIL 2310	3
UCCS-Literature/Performing Arts	3	Elective	3
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	16		15

Senior

Fall Term	Sem. Hrs.	Spring Term	Sem. Hrs.
BIOL 4201	3	Bioinformatics Capstone	3
BIOL lab course	3	UCCS-Diverse Cultures	3
UCCS – Theology	3	Electives	6
Electives	6		
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	15		12

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[3]   BIOL 1101, 2 credit lab, should be considered for spring term of freshman year. If taken, the UCCS-History of Cultures and Society course would be moved to a later semester, and an additional 1 credit of elective would be required for graduation.

STUDENT COMPUTING FACILITIES

Katherine Reed Cudahy Hall houses the University's Information Technology Service (ITS) central computing facilities on the second floor, and MSCS department computing facilities on the first, third and fourth floors.

Marquette students, faculty and staff are granted accounts on the Emarq and CheckMarq systems maintained by ITS. Authentication credentials can be obtained from the ITS Help Desk (room CU 293) and are maintained throughout a student's enrollment at Marquette. Additional information regarding University computing facilities can be obtained by calling the ITS Help Desk at 288-7799.

The MSCS Department maintains its own independent computing facilities for both teaching and research purposes. Students enrolled in MSCS courses or as department majors are granted access to general purpose laboratories in CU 101, CU 310, and CU 412. In addition, students enrolled in particular courses or involved in research projects may be granted access to special-purpose laboratories in CU 145, CU 301, CU 310, CU 368, CU 392, or CU 410.

The MSCS network features Gigabit internal connectivity between seven subnets with a wide variety of computing hardware and operating systems. Solaris and Linux servers provide centralized file, mail, web and print services to Windows, Linux, Solaris and Mac clients. Computer configurations range from an in-desk PC classroom to laboratories of dual-head workstations for collaborative project work.

Although students may have their own computer equipment, the MSCS department provides sufficient facilities for all MSCS coursework. Students are encouraged to make use of department facilities; experience with heterogeneous computing environments provides a rich educational opportunity, and MSCS maintains a large body of software tailored to the needs and interests of department majors.

Additional information about MSCS department computing facilities can be obtained from the MSCS system administrator at 288-1580, or online at http://www.mscs.mu.edu/.