BIOINFORMATICS, BACHELOR OF SCIENCE

Bioinformatics is an exciting and rapidly-growing field that uses techniques from the computer and information sciences to study biological information and structure. Specifically, it is the science of developing computer databases and algorithms to facilitate and expedite biological research, particularly in the area of genomics. Bioinformatics is an interdisciplinary science, bringing together aspects of computer science, molecular biology, chemistry and mathematics. In order to capitalize on the growing body of genetic information, there is an immense and growing need for experts in this field. A graduate of the College of IS&T Bioinformatics program will have the background to pursue a wide variety of positions in the biomedical and biotechnology industries, graduate studies in bioinformatics or related areas, or medical school (with the addition of only a few courses).

Student Group
UNO’s Bioinformatics students, or those interested in bioinformatics, can join the Maverick Club for Bioinformatics (MCBI).

Writing in the Discipline
All UNO students are required to take a writing-in-the-discipline course within their major. Bioinformatics degree students must take CIST 3000.

Degree Requirements
A minimum of 120 credit hours is required for a Bachelor of Science degree in Bioinformatics (BSBI). Thirty of the last 36 hours must be University of Nebraska at Omaha courses. Registering for courses without having taken the stated prerequisites could result in administrative withdrawal.

To obtain a BSBI, a student must fulfill the University, College and Departmental requirements. Some courses may satisfy requirements in more than one area, but credit is awarded only once, thereby reducing the total number of credit hours for the degree to 120. (This total does not include prerequisites.)

Code   Title                                      Credits
46 hours of University General Education courses (19 hours of which can be satisfied by courses also required by the degree in the areas below) 27
24 hours of College of IS&T Core courses 24
24 hours of Bioinformatics courses 24
11 hours of Mathematics courses 11
16 hours of Biology courses 16
14 hours of Chemistry courses 14
4 hours of an elective/prerequisite course 4
Total Credits 120

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46 hours of University General Education courses (19 hours of which can be satisfied by courses also required by the degree in the areas below) 27
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24 hours of Bioinformatics courses 24
11 hours of Mathematics courses 11
16 hours of Biology courses 16
14 hours of Chemistry courses 14
4 hours of an elective/prerequisite course 4
Total Credits 120

Elective/Prerequisite
Select one of the following: 3-4
CSCI 1200 & CSCI 1204 COMPUTER SCIENCE PRINCIPLES and COMPUTER SCIENCE PRINCIPLES LABORATORY
CIST 1300 INTRODUCTION TO WEB DEVELOPMENT

College of IS&T Core Courses for Bioinformatics Majors
CIST 1400 INTRODUCTION TO COMPUTER SCIENCE I 3
CSCI 1620 INTRODUCTION TO COMPUTER SCIENCE II 3

Bioinformatics Courses
BIOI 1000 INTRODUCTION TO BIOINFORMATICS 3
BIOI 2000 FOUNDATIONS OF BIOINFORMATICS 3
BIOI 3000 APPLIED BIOINFORMATICS 3
BIOI 3500 ADVANCED BIOINFORMATICS PROGRAMMING 3
BIOI 4860 BIOINFORMATICS ALGORITHMS 3
BIOI 4870 DATABASE SEARCH AND PATTERN DISCOVERY IN BIOINFORMATICS 3
BIOI 4890 COMPUTERIZED GENETIC SEQUENCE ANALYSIS 3
BIOI 4970 SENIOR PROJECT IN BIOINFORMATICS I 1
BIOI 4980 SENIOR PROJECT IN BIOINFORMATICS II 2

Chemistry Courses
CHEM 1140 & CHEM 1144 FUNDAMENTALS OF COLLEGE CHEMISTRY and FUNDAMENTALS OF COLLEGE CHEMISTRY LABORATORY 5
CHEM 2210 & CHEM 2214 FUNDAMENTALS OF ORGANIC CHEMISTRY and FUNDAMENTALS OF ORGANIC CHEMISTRY LABORATORY 5
CHEM 3650 & CHEM 3654 FUNDAMENTALS OF BIOCHEMISTRY and FUNDAMENTALS OF BIOCHEMISTRY LABORATORY 4

Total Credits 92-93

1  NOTE: CIST 3110 counts toward the Humanities requirement.
2  NOTE: BIOI 1000 counts toward the Natural and Physical Sciences requirement.
3 NOTE: Students pursuing the pre-med requirements for the Bioinformatics degree take CHEM 2250, CHEM 2260 and CHEM 2274 in place of CHEM 2210 and CHEM 2214. Pre-Med majors also take either CHEM 4610 Biochemistry of Metabolism or two semesters of Biochemistry and the accompanying labs (CHEM 4650, CHEM 4654, CHEM 4660, and CHEM 4664) in place of CHEM 3650 and CHEM 3654 to satisfy the chemistry requirements for the BIOI major.

4 NOTE: CHEM 1140 and CHEM 1144 count toward the Natural and Physical Sciences lecture and lab requirement.

Minor Offered:
• Bioinformatics Minor (http://catalog.unomaha.edu/undergraduate/college-information-science-technology/school-interdisciplinary-informatics-si2/bioinformatic-minor)

BIOI 1000 INTRODUCTION TO BIOINFORMATICS (3 credits)
Bioinformatics is a scientific discipline that integrates mathematical and computational techniques with biological knowledge to develop and use computational tools to extract, organize and interpret information from genetic sequence data. The field is growing rapidly with the advancement in molecular technology to sequence the genomes of many different organisms. This course will provide an introduction to the field and will examine some of the problems of interest to bioinformaticians and how these relate to biology, computer science, mathematics and engineering. Topics will include an overview of the biology, mathematics and computer science needed to understand these and tools. Distribution: Natural/Physical Science General Education course

BIOI 2000 FOUNDATIONS OF BIOINFORMATICS (3 credits)
Bioinformatics is a new scientific discipline that integrates mathematical and computational techniques with biological knowledge to develop and use computational tools to extract, organize and interpret information from genetic sequence data. The field is growing quickly due to rapid advances in sequencing and other biological techniques that allow the genomes of different organisms to be easily sequenced. This course provides an overview of the field and covers the chemical, biological, mathematical and computational foundations of bioinformatics upon which later courses will depend. In addition, it introduces problems of interest to bioinformaticians and the methods and tools used to address them. Prerequisite(s)/Corequisite(s): BIOI 1000 or BIOL 1450

BIOI 3000 APPLIED BIOINFORMATICS (3 credits)
This course will provide students with the practical skills needed for the analysis of -omics data. Topics covered will include biological databases, molecular biology tools (e.g., primer design, contig assembly), gene prediction and mining, database searches, genome comparison, sequence alignments, phylogenetic inference, gene expression data analyses, functional annotation of protein sequences, protein structure and modeling. Specialized software (e.g., Vector NTI) and widely used web-based computation tools (e.g., Entrez, BLAST, ClustalX, Phylip, PyMOL, and SwissPDBviewer) will be illustrated. Multiple approaches for solving particular problems will be presented. Prerequisite(s)/Corequisite(s): BIOI 1000, BIOL 1450, and CIST 1400; or permission.

BIOI 3500 ADVANCED BIOINFORMATICS PROGRAMMING (3 credits)
Because of the volume and complexity of biological data, advanced programming skills are required for researchers in order to get the most out of their data analyses. This course will provide the expanded programming skills necessary to develop software that can exploit the complex information landscape of bioinformatics. Specific topics covered will include molecular biology basics, Unix/Linux shell programming, Perl and BioPerl, databases and using the Perl DBI, and data visualization. Prerequisite(s)/Corequisite(s): BIOI 1000 and CSCI 1620. CSCI 3320 and an introductory course in biology (e.g., Biology 1450) are strongly recommended but not required.

BIOI 4500 INDEPENDENT STUDY (1-3 credits)
This course allows students to research a topic of their interest that is not available in a formal course. The topic to be studied must be agreed upon by the student and the instructor. Prerequisite(s)/Corequisite(s): Junior or Senior within the Bioinformatics undergraduate program. Not open to non-degree graduate students.

BIOI 4510 BIOINFORMATICS INTERNSHIP (1-3 credits)
The purpose of this course is to provide the students with an opportunity for practical application and further development of knowledge and skills acquired in the Bioinformatics undergraduate program. The internship gives students professional work experience and exposure to the challenges and opportunities faced by IT professionals in the workplace. Prerequisite(s)/Corequisite(s): Junior/Senior standing and permission of Director of the School of Interdisciplinary Informatics. Not open to non-degree graduate students.

BIOI 4860 BIOINFORMATICS ALGORITHMS (3 credits)
The main objective of this course is to provide an organized forum for students to learn recent developments in Bioinformatics, particularly, from the algorithmic standpoint. The course will present basic algorithmic concepts in Bioinformatics and show how they are connected to molecular biology and biotechnology. Standard topics in the field such as restriction mapping, motif finding, sequence comparison, and database search will be covered. The course will also address problems related to Bioinformatics like next generation sequencing, DNA arrays, genome rearrangements and biological networks. (Cross-listed with BMI 8866).
Prerequisite(s)/Corequisite(s): CSCI 3320 and BIOI 1450; or permission of instructor.

BIOI 4870 DATABASE SEARCH AND PATTERN DISCOVERY IN BIOINFORMATICS (3 credits)
The course provides students basic knowledge on database aspects related to bioinformatics. The course presents fundamental materials on database management systems, including data modeling, relational database design and queries, XML, as well as basics of information retrieval. Various approaches related to biodatabase search, machine learning and pattern discovery will be covered. Prerequisite(s)/Corequisite(s): CSCI 3320

BIOI 4890 COMPUTERIZED GENETIC SEQUENCE ANALYSIS (3 credits)
The goal of this course is to introduce students to major topics in computerized analysis of genetic sequences. In particular the class will allow students to become familiar with the computational tools and software that aid in the modern molecular biology experiments and analysis of experimental results. Following the completion of this course, it is expected that the students will have a basic understanding of the theoretical foundations of the sequence analysis tools and develop competence in evaluating the output from these tools in a biological context. This course will emphasize hands-on experience with the programs for nucleotide and amino acid sequence analysis and molecular phylogeny. Prerequisite(s)/Corequisite(s): Junior or senior-level standing in the Bioinformatics program or permission from the instructor. Not open to nondegree students.

BIOI 4950 SPECIAL TOPICS IN BIOINFORMATICS (3 credits)
This course is intended to provide a mechanism for offering instruction in subject areas that are not covered in other regularly scheduled courses. In general, courses offered under the BIOI 4950 designation will focus on evolving subject areas in bioinformatics. Prerequisite(s)/Corequisite(s): Prerequisites of a specific offering of BIOI 4950 will be determined by the supervising faculty member and identified in the course proposal. It is anticipated that permission of the faculty member teaching the course will be required for registration.
BIOI 4960 SEMINAR IN BIOINFORMATICS (1 credit)
This is a variable-content course that engages students in current research
in bioinformatics and develops skills in the oral and written presentation of
scientific research.
Prerequisite(s)/Corequisite(s): Senior level status in the Bioinformatics
program.

BIOI 4970 SENIOR PROJECT IN BIOINFORMATICS I (1 credit)
This course is the first part of a two-part series that allows students to work
on a guided research project on a specific topic in bioinformatics. The goal
of this course is for the student to decide on a research topic and to write a
detailed proposal based on this topic that outlines the goals and objectives
of the proposed research. The topic and proposal will be approved by the
supervising faculty member.
Prerequisite(s)/Corequisite(s): Senior level status in the Bioinformatics
program. Not open to nondegree students.

BIOI 4980 SENIOR PROJECT IN BIOINFORMATICS II (2 credits)
This course is the second part of a two-part series that allows the student
to work on a guided research project on a specific topic in bioinformatics.
The goal of this course is for the student to perform the research proposed
in Part I of the course and to present the results of his or her work.
Presentations will be made in the form of a report, written as a scientific
research paper, and an oral defense.
Prerequisite(s)/Corequisite(s): Senior-level standing in the
Bioinformatics program and successful completion of BIOI 4970. Not open
to nondegree students.

BIOI 4990 INDEPENDENT STUDY IN BIOINFORMATICS (1-3 credits)
This is a variable-credit course designed for the junior or senior
bioinformatics major who would benefit from independent reading
assignments and research-type problems. Independent study enables
coverage of topics not taught in scheduled course offerings.
Prerequisite(s)/Corequisite(s): Junior/senior standing, permission of
supervising faculty member & approval of Bioinformatics UG Prog Comm
Chair. A formal description of the problem area to be investigated, the
resources to be used, & the results to be produced must be prepared.