BIOINFORMATICS

Bioinformatics is an interdisciplinary scientific field that addresses problems related to the collection, processing, and analysis of the vast amounts of data describing the structure and function of biological systems, combining aspects of computer science, molecular biology, chemistry and mathematics.

Bioinformatics merges computer and information science with the study of genetic information and biological structures. Bioinformatics allows researchers to open new windows of insight into our genetic makeup, providing pathways to understanding disease processes, and creating novel diagnostic and treatment strategies. To capitalize on the growing body of knowledge regarding the genome, there is an immense and growing need for experts in this field.

A graduate of the UNO bioinformatics program will possess a solid background in a wide variety of positions throughout the biomedical and biotechnology industries, providing a solid foundation for graduate studies in bioinformatics or related areas and, with the addition of a few courses, medical school. One of the benefits of completing the Arts and Sciences major in bioinformatics will be the opportunity to conduct a research project with a faculty member in Arts and Sciences, applying bioinformatics skills to address a central question in the life sciences.

Other Information

All coursework taken for the Bioinformatics major must be completed with a grade of C- or better.

Contact Information

114 Allwine Hall
402.554.2641

Website **(**http://www.unomaha.edu/college-of-arts-and-sciences/biology/academics/bioinformatics.php**)**

Degrees Offered

- Bioinformatics, Bachelor of Science (http://catalog.unomaha.edu/undergraduate/college-arts-sciences/bioinformatics/bioinformatics-bs/)

Writing in the Discipline

All students are required to take a writing in the discipline course within their major. For the bioinformatics major, the writing in the discipline requirement can be fulfilled by completing a sequence of approved biology courses at UNO that incorporate discipline-specific writing as part of their requirements. To satisfy the requirement for writing in the discipline, students must complete BIOL 1450 and BIOL 1750, both BIOL 2140 and BIOL 3020 and two additional 3000/4000 level courses that are approved as meeting the writing requirement by the Department of Biology. For the bioinformatics major, the two additional approved 3000/4000 level courses will be BIOL 4130/BIOL 4140 and BIOL 4560. Only courses taken at UNO and after January 1, 2010 can be applied to this requirement. Students not meeting the writing requirement through this sequence of courses will fulfill the writing requirement by completing ENGL 2400 or ENGL 3980.

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- Bioinformatics Analyst
- Bioinformatics Developer
- Bioinformatics Scientist
- Bioinformatics Consultant
- Genomics Data Analyst
- Biostatistician

*Other possible job titles:

- Cheminformatician
- Neuroinformatician
- Medical Informatics Analyst
- EMR Information Systems Analyst
- Nursing Informatics Specialist
- Chief Medical Information Officer
- Scientific Data Curator
- Research Assistant or Scientist
- Molecular Structural Analyst
- Bio-Statistician

*Some positions may require graduate study

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): 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): BIOI 2000 and CIST 1400; or permission of instructor.

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): BIOI 3000 and CSCI 1620; or permission of instructor. CSCI 3320 is 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): 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): 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 understand the foundations of algorithmic design and analysis in the context of health and biological data. The course will present fundamental concepts in algorithms (exhaustive, greedy, graph, heuristic, and more) and explore how those concepts extend to bioinformatics and related fields, such as biomedical informatics, and health informatics. Students will learn about historical context of these algorithms and how they were pivotal in forming more complex modern approaches, and will explore advanced algorithms in their area of interest. Students will also exercise their programming skills with the opportunity to implement and apply bioinformatics algorithms to real data, so to better grasp the technical components of algorithmic design and analysis. (Cross-listed with BMI 8866).
Prerequisite(s): CSCI 3320 or permission of instructor. Prior completion of CSCI 4850 is strongly recommended but not required.

BIOI 4870 DATABASE SEARCH AND PATTERN DISCOVERY IN BIOINFORMATICS (3 credits)
This required course for undergraduate bioinformatics majors provides foundational knowledge on database aspects used in the field and an overview of their applications in bioinformatics, biomedical informatics, and health/clinical informatics. The course begins with a brief review of key concepts in computational molecular biology related to database search/development, database management systems, the difference between primary and secondary databases, and bioinformatics-related aspects of modeling and theory in computer science. The major focus is on the multiple challenges and aspects of bio-database development, search, and pattern discovery. The course uses problem-based learning to help students develop database management skills as they apply to high throughput "-omics." data, the basics of data management, data provenance and governance, standards, and analysis through KDD-based workflows. This course will also consider the fundamentals of artificial intelligence and machine learning as they pertain to bioinformatics, from the perspective of database storage, I/O, and analysis. (Cross-listed with CSCI 8876).
Prerequisite(s): CSCI 4850 or permission of instructor. Not open to non-degree graduate students.

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 course 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. (Cross-listed with BMI 8896).
Prerequisite(s): Junior or senior-level standing in the Bioinformatics program or permission from the instructor.

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): 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 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): BIOI 4860 and BIOI 4870; BIOI 4870 can be taken concurrently. 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): Junior or senior-level standing in the Bioinformatics program or permission from the instructor.