Bioinformatics

The UAB Undergraduate Program in Bioinformatics (BIOI) is an interdisciplinary major between the Department of Biomedical Informatics and Data Science and Department of Genetics in the Heersink School of Medicine and the Department of Computer Science in the College of Arts and Sciences. Our society's accelerated scientific growth is generating an unprecedented quantity of information while computer science is learning how to handle this information through developments in data science. In particular, data from the sequencing of the human genome is helping us better understand living systems and is guiding treatment of human disease through precision medicine. That information must be stored, managed, and analyzed to reveal its biological meaning to help shape the future of research and healthcare.

Bioinformatics is the discipline that connects the biological sciences, genetics, chemistry, computer science, data science, IT, engineering, applied mathematics, biostatistics, computing, and biomedical engineering. This major is designed to build on these disciplines and provide students with a marketable degree — with an extensive background in an array of subjects — that will provide cutting-edge employment opportunities, as well as a platform for success in graduate school, medical school, and other clinical-professional schools.

As the first B.S. in Bioinformatics in the state of Alabama, this program will train students in basic concepts and skills to perform computational analysis of biological data — including the human genome. This will also create a well-trained workforce who can take on future healthcare challenges in the state of Alabama.

As members of an interdisciplinary program at UAB, Bioinformatics students will be able to participate in research with faculty from departments across the university, including:

- Heersink School of Medicine Basic Science Departments
- Heersink School of Medicine Clinical Science Departments
- Computer Science
- Biology
- Biostatistics

Admissions

High school students with an ACT score of 28 or higher and a GPA of 3.5 or higher (the UAB Honors College admissions criteria) are eligible for immediate acceptance into the Bioinformatics major. Current UAB students, or transfer students, with a 3.0 GPA are eligible for Bioinformatics. Incoming freshman or transfer students and current UAB students may be admitted into Pre-Bioinformatics with a 2.8 GPA. Remaining in Pre-Bioinformatics requires the maintenance of a 2.8 overall UAB GPA.

Advising and Information

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Major in Bioinformatics

Requirements		Hours
Core Curriculum Requirements [1]		**41**
CAS 112	Success in College	3
PSDO 200	Introduction to Research	1
Mathematics Courses [2,4]		
MA 125	Calculus I	4
or MA 225	Calculus I - Honors	
MA 126	Calculus II	4
or MA 226	Calculus II - Honors	
Biology Courses [2,4]		
BY 123	Introductory Biology I	4
BY 124	Introductory Biology II	4
BY 210	Genetics	4
Chemistry Courses [2,4]		
CH 115 & CH 116	General Chemistry I and General Chemistry I Laboratory	4
CH 117 & CH 118	General Chemistry II and General Chemistry II Laboratory	4
CH 235 & CH 236	Organic Chemistry I and Organic Chemistry I Laboratory	4
Computer Science Courses [4]		
CS 103	Introduction to Computer Science in Python	4
CS 203	Object-Oriented Programming in Java	4
CS 250	Discrete Structures	3
CS 303	Algorithms and Data Structures	3
Informatics Courses [4]		
INFO 101	Introductory Bioinformatics Seminar [3]	1
PUH 250	Biostatistics	3
GGSC 310	Genome Structure and Organization	3
INFO 302	Bioinformatics-I	3
INFO 403	Bioinformatics-II	3
INFO 404	Biological Data Management	3
INFO 499	Bioinformatics Capstone	3
Major Electives [4]		**15**
CH 237	Organic Chemistry II	
CH 460	Fundamentals of Biochemistry	
BY 245	Biological Data Interpretation and Analysis	
BY 311	Molecular Genetics	
BY 330	Cell Biology	
BY 433	Advanced Molecular Genetics and Medicine	
BY 434	Functional Genomics and Systems Biology	
GGSC 410	Genetic Basis of Human Disease	
INFO 497	Research in Bioinformatics	
or INFO 498	Honors Bioinformatics Research	
CS 332	Systems Programming	
CS 350	Automata and Formal Languages	

CS 355	Probability and Statistics in Computer Science
CS 416	Big Data Programming
CS 436	Fundamentals of Computer Security
CS 473	Fundamentals of Computer Vision
CS 475	Fundamentals of Data Visualization
CS 467	Fundamentals of Machine Learning
MA 260	Introduction to Linear Algebra
MA 434	Algebra I: Linear
PH 201	College Physics I
PH 221	General Physics I
PH 222	General Physics II
PH 475	Introduction to Biophysics I
BME 210	Engineering in Biology
BME 313	Bioinstrumentation
BME 443	Medical Image Processing
INFO 412	Visual Analytics for Bioinformatics
Total Hours	**125**

Please note the hours to degree may vary due to prerequisite requirements. For undergraduate programs, at minimum of 120 hours of undergraduate credit is required for degree. General electives may be taken to meet the hour requirement if necessary.

[1] Core Curriculum requirements
[2] Courses listed may also fulfill Core Curriculum requirements.
[3] INFO 101 should be taken twice.
[4] A grade of "C" or better must be earned in each course.

Honors in Bioinformatics

Purpose

The Bioinformatics Honors Program offers outstanding, highly motivated students the opportunity to develop research skills in preparation for graduate work or a professional career.

Eligiblity

In order to be accepted into the Bioinformatics Honors program, you must:

- Have completed at least 45 credit hours.
- Have a 3.5 GPA in Bioinformatics (INFO) and Biology courses.
- Have a 3.2 GPA overall.
- Have already completed CS 203 Object-Oriented Programming in Java and GGSC 310 Genome Structure and Organization.
- Have arranged with a faculty sponsor to do a research project, approved by a Bioinformatics program director.
- Honors Research in Bioinformatics may also be taken as part of the University Honors Programs. BIOI majors generally enter their research labs in the fall semester of their junior year; however, they may begin research in the spring semester of their sophomore year, or earlier, with permission of the Program Directors.

Requirements

To successfully complete the Bioninformatics Honors Program you will need to:

- Complete 6 semester hours of INFO 498 Honors Bioinformatics Research. Students may substitute 3 of the 6 required INFO 498 credit hours with an equivalent research course (with prior approval of a program director).
- Submit a formal research report by the end of each semester of Honors Research. The proposal should include a summary of the student's research findings incorporating an introduction, methods, and relevant literature review.
- Complete a formal written report in the form of a scientific paper.
- Submit an oral or poster presentation at UAB Expo during their junior or senior year. Under special circumstances, the poster may be presented at other times of the year pending approval of the Program Directors.

First Year

First Term	Hours	Second Term	Hours
BY 123 & 123L	4	BY 124 & 124L	4
CAS 112	3	CH 115 & CH 116	4
CS 103	4	INFO 101	1
EH 101	3	MA 125 or 225	4
PHL 116	3	EH 102	3
	17		**16**

Second Year

First Term	Hours	Second Term	Hours
BY 210	4	CS 250	3
CH 117 & CH 118	4	GGSC 310	3
CS 203	4	INFO 101	1
MA 126 or 226	4	PUH 250	3
		Blazer Core course	3
		PSDO 200	1
	16		**14**

Third Year

First Term	Hours	Second Term	Hours
CH 235 & CH 236	4	INFO 403	3
CS 303	3	Major Elective Course	3
INFO 302	3	Major Elective Course	3
Blazer Core course	3	Major Elective Course	3
Blazer Core course	3	Blazer Core course	3
	16		**15**

Fourth Year

First Term	Hours	Second Term	Hours
Major Elective Course	3	INFO 499	3
Major Elective Course	3	Major Elective Course	3
Blazer Core course	3	Major Elective Course	3
Blazer Core course	3	Major Elective Course	3
		Blazer Core course	3
		INFO 404	3
	12		**18**

Total credit hours: 124

Courses

INFO 101. Introductory Bioinformatics Seminar. 1 Hour.
Faculty-led seminar course that exposes students to cutting edge research topics and career opportunities in the field of bioinformatics. Students will read assigned articles and be prepared for discussion. Subject matter varies by term and students will take this course during multiple semesters for a maximum of two credits.

INFO 302. Bioinformatics-I. 3 Hours.
Introduction to bioinformatics and methodologies, with emphasis on concepts and application of informatics tools to molecular biology. Focus on experimental models to collect data from genomics, transcriptomics and proteomics, applied statistics when it relates to experimental design, construction of bioinformatics tools into pipelines, representing biological data, biological sequence analysis, gene annotation, basic programming, basic web/data analysis programming, sharing of biological information, social/legal aspects of open science.
Prerequisites: BY 210 [Min Grade: C] and CS 103 [Min Grade: C] and PUH 250 [Min Grade: C] and INFO 101 [Min Grade: C]

INFO 403. Bioinformatics-II. 3 Hours.
Development of computational algorithms to solve biological questions with a significant problem-solving component. This includes computational techniques such as dynamic programming, optimization, hidden Markov models, graph algorithms, and other mathematical and statistical approaches. In addition, data mining and machine learning methods in computational biology will be covered.
Prerequisites: INFO 302 [Min Grade: C] and CS 303 [Min Grade: C]

INFO 404. Biological Data Management. 3 Hours.
Introduction of biological data management concepts, theories, and applications. Basic concepts such as data representation, database modeling, ontology representation, and relational database queries will be introduced. Various database systems, particularly relational databases and emerging big data techniques, will be introduced. Application of biological data management in biology will be covered using case studies of high-impact widely used biological databases.
Prerequisites: INFO 302 [Min Grade: C]

INFO 412. Visual Analytics for Bioinformatics. 3 Hours.
In this course, we will explore the use of visualization techniques as a concise and effective way to help analyze, understand, interpret and communicate complex biological data. Principles of design, visual rhetoric/communication, and appropriate usage will be introduced. We will cover representation of different data types, concentrating on those generated by data-rich platforms such as next-generation sequencing applications, flow/mass cytometry, and proteomics, and will discuss the use of visualization techniques applied to assessing data quality and troubleshooting. Various topics including dimension reduction, hierarchical visualizations, unsupervised learning, graph theory, networks/layouts and interactivity will be discussed. We will review the algorithmic underpinnings of various methods that lead to their appropriate and effective use. Finally, we will review a variety of genomics/bioinformatics-related visualization tools that are available. We will use Matlab throughout the course to create beautiful and effective visualizations.

INFO 497. Research in Bioinformatics. 0-4 Hours.
Research in Bioinformatics for non-honors students under the supervision of a faculty sponsor.
Prerequisites: PSDO 200 [Min Grade: C] and CS 103 [Min Grade: C]

INFO 498. Honors Bioinformatics Research. 0-4 Hours.
Honors Research is an innovative course that will provide undergraduate students with an opportunity to engage in rigorous scholarly practice of the core bioinformatics skills necessary for performing independent research. Program faculty will closely work with students to identify a project that explores an area of interest for the student based on the integration of prior learning. Students will be performing bioinformatics analyses on laboratory data or publicly available large-scale data, incorporate quality control and develop software pipelines.
Prerequisites: PSDO 200 [Min Grade: C] and CS 103 [Min Grade: C]

INFO 499. Bioinformatics Capstone. 3 Hours.
With mentoring and guidance from program faculty, the student will identify a bioinformatics-oriented research project that will form the basis of their capstone project. This research project may be a continuation of an existing research project or represent an entirely new project. The capstone project is expected to culminate in a public presentation of the project as well as a formal scholarly work reflecting integration of the scientific knowledge gained through the project. The scholarly work may take the form or a written manuscript or semester report.
Prerequisites: INFO 403 [Min Grade: C] and INFO 404 [Min Grade: C] and PSDO 200 [Min Grade: C]