

Bioinformatics And Computational Biology

Department of Biological Sciences

Bioinformatics and Computational Biology
College of Arts and Sciences
109 Cooke Hall
North Campus
Buffalo, NY 14260-1300

PH: 716.645.4905
Fax: 716.645.2975
Web: www.biology.buffalo.edu

Department of Computer Science and Engineering

Bioinformatics and Computational Biology
School of Engineering and Applied Sciences
338 Davis Hall
North Campus
Buffalo, NY 14260-2000

PH: 716.645.3180
Fax: 716.645.3464
Web: www.cse.buffalo.edu

Department of Mathematics

Bioinformatics and Computational Biology
College of Arts and Sciences
244 Mathematics Building
North Campus
Buffalo, NY 14260

PH: 716.645.8785
Fax: 716.645.5039
Web: www.math.buffalo.edu

Overview

The Bioinformatics and Computational Biology (BCB) program is an interdisciplinary program that involves the application of mathematics and computing to the study of genes and proteins; computational biology addresses more general questions involving computing applied to cellular and sub-cellular structures. As such, students in bioinformatics and computational biology integrate topics of applied mathematics, computer science, and biology into specialties as diverse as genetics, computational science, and microbiology. The program prepares students for graduate studies either in a bioinformatics-related field or in a traditional discipline, as well as for immediate entry into the job market.

The BCB is a single degree program. Students in the BCB program have the option to select a major from among three concentrations, offered in the Departments of Biological Sciences, Computer Science and Engineering, and Mathematics. Students complete a full major in their area of concentration and also take additional courses important to bioinformatics in disciplines that complement their concentration. All students take courses in calculus, statistics, molecular biology, organic chemistry, and databases, as well as a core course in bioinformatics. In addition, students complete a senior project during their senior year.

About our Degrees

Students in the program complete a full major in their area of concentration and also take additional courses important to bioinformatics in disciplines that complement their concentration. All students take courses in calculus, statistics, molecular biology, organic chemistry, and databases, as well as a core course in bioinformatics.

Acceptance Criteria

Minimum GPA of 2.5 overall.
Minimum GPA of 3.0 in prerequisite courses.

Bioinformatics And Computational Biology

Acceptance Information

Students may indicate a preference to major in bioinformatics at any time, although acceptance into the major occurs only after a review of a student's progress at the end of four semesters of coursework. In exceptional circumstances, a student who wishes to major in bioinformatics may request a waiver or modification of the acceptance requirements. It is recommended that the prerequisite courses be completed by the end of the fourth semester; students with advanced placement credit may complete these courses earlier, and may then request acceptance into the program. Students are expected to maintain a minimum GPA of 3.0 in all major courses (a student may request a waiver or modification of this GPA requirement in exceptional cases). Students who follow the BCB program of study for several semesters but, for whatever reason, decide not to complete those requirements, can complete a traditional major in their area of concentration.

Degree Requirements

Please see [Degrees and Policies](#).

About our Courses

The program combines courses in biological sciences, computer science and engineering, and mathematics, among other fields.

About our Faculty

See the sections on faculty within the following Web sites:

[Department of Biological Sciences](#)

[Department of Computer Science and Engineering](#)

[Department of Mathematics](#)

Acceptance Information

Students may indicate a preference to major in bioinformatics at any time, although acceptance into the major occurs only after a review of a student's progress at the end of four semesters of coursework. Because of the significant academic demands of this program, acceptance into the bioinformatics program requires an overall minimum GPA of 2.5, and a minimum GPA of 3.0 in the prerequisite courses: [BIO 205](#), [CHE 101](#), [CHE 102](#), [CSE 115](#), [CSE 116](#), [MTH 141](#), and [MTH 142](#). (Note: [CHE 201](#) is a prerequisite to [BIO 205](#). Students should complete [CHE 201](#) or seek permission from the instructor of [BIO 205](#) to waive this prerequisite). In exceptional circumstances, a student who wishes to major in bioinformatics may request a waiver or modification of the acceptance requirements. It is recommended that the prerequisite courses be completed by the end of the fourth semester; students with advanced placement credit may complete these courses earlier and then request acceptance into the program. Students are expected to maintain a minimum GPA of 3.0 in all major courses (a student may request a waiver or modification of this GPA requirement in exceptional cases). Students who follow the BCB program of study for several semesters but, for whatever reason, decide not to complete those requirements can complete a traditional major in their area of concentration.

Academic Requirements

The core course requirements shared by all concentrations are:

[BIO 205](#), [BIO 302](#) or [BIO 319](#), [BIO 400](#) ([BIO 205](#) will serve as prerequisite for [BIO 302](#)).

[CHE 101](#), [CHE 102](#), [CHE 201](#) (or [CHE 203](#) for non-BIO students). (Note: [CHE 201](#) is a prerequisite to [BIO 205](#); students should complete [CHE 201](#) or seek permission from the instructor of [BIO 205](#) to waive this prerequisite).

[CSE 115](#), [CSE 116](#), [CSE 250](#), [CSE 462](#) (BIO students have the option to take [BIO 519](#) or [BIO 608](#) or [MCH 501](#) instead of [CSE 462](#)).

[MTH 141](#), [MTH 142](#), [MTH 241](#), [MTH 306](#), [MTH 309](#), [MTH 411](#) (BIO students are exempt from [MTH 241](#) and [MTH 306](#)) or [STA 301](#).

[MTH 191/CSE 191](#), [MTH 337/CSE 337](#) or [MTH 437/CSE 437-MTH 438/CSE 438](#) (BIO students have the option to take [BIO 519](#) or [BIO 608](#) or [MCH 501](#) instead of [MTH 337/CSE 337](#)).

Bioinformatics And Computational Biology

Senior Project

For the senior project, students work with faculty from the department of their concentration. Personnel associated with the Center of Excellence in Bioinformatics may offer additional assistance and guidance to the students.

Extracurricular Activities

In the Department of Biological Sciences:

[Undergraduate Biology Association](#)

This organization is an active group open to all students. It sponsors special speakers on research, graduate school, and other selected topics. It also sponsors social activities.

In the Department of Computer Science and Engineering:

- [Association for Computing Machines \(ACM\) Student Chapter](#)
- [Computer Science and Engineering Undergraduate Student Association](#)
- [Institute of Electronic and Electrical Engineers \(IEEE\)](#)

See the [UB Student Association](#).

Practical Experience and Special Academic Opportunities

Students should contact their departmental advisor for inquiries regarding internships, independent study, and undergraduate research opportunities.

Honors, Awards, and Scholarships

There are no specific scholarships set aside for this program. Interested students should contact the program advisor of their matriculated department for availability of scholarships and awards as well as the university's Honors College.

Career Information and Further Study

Companies need a cross-functional workforce skilled in information technology and with knowledge of the fields of molecular biology, biochemistry, and genetics. Bioinformatics is a fast-paced, growth-oriented, multi-billion dollar industry with applications that affect virtually every aspect of daily life. Bioinformaticians should be prepared to offer complete cost-effective database solutions to genome-based biotech companies all over the world.

According to a study conducted by RIT, biotechnology companies located in Western New York seek individuals highly skilled in the disciplines of microbiology, biochemistry and molecular biology, and information management. In addition, companies reported a need for graduates who have a better knowledge and understanding of topics not typically found in college curricula, such as: good laboratory practices, good manufacturing practices, regulatory issues, instrument validation, and laboratory notebook and record keeping skills that conform to industry and government standards. Practical experience, such as participation in co-op or internship positions in this industry, is also key to finding employment in this area.

Careers That Graduates Pursue

Bioinformatics prepare students for graduate studies in either a bioinformatics-related field or in a traditional discipline, as well as for immediate entry into the job market. Some career opportunities in related areas are:

- **Life Sciences:** Scientific curator, gene analyst, protein analyst, phylogenitist, research scientist/associate.
- **Computer Science/Engineering:** Database programmer, bioinformatics software developer, computational biologist, network administrator/analyst.
- **Applied Science:** Structural analyst, molecular modeler, biostatistician, biomechanics, database programmer.
- **Pharmaceutical Science:** Cheminformatician, pharmacogenetician, research scientist/associate.

Percent of Graduates Who Find Related Employment

This degree is too new to report such data for UB. Literature tells us, however, that there is a growing need nationally and internationally for

Bioinformatics And Computational Biology

bioinformaticians, especially graduates with a good grounding in computer science and software engineering, and an appreciation of the biological aspects of the problems to be solved.

According to the RIT survey, most biotechnology companies in Western New York indicated that the majority of new employees will be hired at the bachelor's degree level or above and that most companies prefer hiring employees with either a bachelors degree (84.2%) or a doctoral degree (76.3%), and they predict that this hiring trend will continue. The study also indicated that graduates from schools lacking a biotechnology program show a low success rate in finding employment in the biotechnology sector. On the other hand, more than half of the respondents from schools with a biotechnology program reported that more than three-quarters of their students were successful in finding employment in the biotechnology field. Success in obtaining employment, particularly in high-tech fields, also depends on experience. Employers seem to favor those candidates who have both the academic credentials and some level of experience, particularly if that experience is in an industrial setting.

Graduate Opportunities at UB

- Biomaterials
- Biophysics
- Biophysics (Interdisciplinary)
- Biophysics (Molecular and Cellular, Roswell)
- Biostatistics
- Biotechnology
- Computer Science and Engineering
- Roswell Park Interdisciplinary Graduate Program in Biomedical Science
- School of Medicine and Biomedical Sciences
- Structural Biology

Additional Resources

[Career Resources Center](#)

Degrees Offered

Undergraduate: BS

Concentrations: Biological Sciences, Computer Science and Engineering, and Mathematics

Links to Further Information About this Program

- [Undergraduate Catalog](#)
- [Undergraduate Admissions](#)
- [Graduate Admissions](#)
- [Department of Biological Sciences](#)
- [College of Arts and Sciences](#)

Bioinformatics And Computational Biology - B.S.

Acceptance Criteria

Minimum GPA of 2.5 overall.

Minimum GPA of 3.0 in the prerequisite courses.

Advising Note

Students must maintain a minimum GPA of 3.0 in all major courses to graduate.

Prerequisite Courses

[BIO 205](#) Fundamentals of Biological Chemistry

[CHE 101](#) General Chemistry I

[CHE 102](#) General Chemistry II

[CSE 115](#) Introduction to Computer Science for Majors I

[CSE 116](#) Introduction to Computer Science for Majors II

[MTH 141](#) College Calculus I

[MTH 142](#) College Calculus II

Bioinformatics And Computational Biology

Required Courses

[BIO 200](#) Evolutionary Biology
[BIO 201](#) Cell Biology
[BIO 203](#) General Physiology
[BIO 213](#) General Physiology Lab
[BIO 215](#) Fundamentals of Biological Chemistry Lab
[BIO 319](#) Genetics
[BIO 329](#) Genetics Lab
[BIO 400](#) Bioinformatics
[CHE 201](#) Organic Chemistry I
[CHE 202](#) Organic Chemistry II
[CSE 250](#) Data Structures
[CSE 191](#) Discrete Structures/[MTH 191](#) Introduction to Discrete Mathematics I
[MTH 337/CSE 337](#) Introduction to Scientific Computing or [CSE 462](#) Database Concepts ([CSE 305](#) prerequisite waived) or [MTH 437/CSE 437](#) Introduction to Numerical Analysis
[MTH 309](#) Introduction to Linear Algebra
[MTH 411](#) Probability or [STA 301](#) Intro to Probability
[PHY 107](#) General Physics I
[PHY 108](#) General Physics II
[PHY 158](#) General Physics Lab
Senior Project ([BIO 498](#) Undergraduate Research)

Summary

Total required credit hours for the major (concentration in bioinformatics-biology)...95

See [Baccalaureate Degree Requirements](#) for general education and remaining university requirements.

Recommended Sequence of Program Requirements

FIRST YEAR

Fall [BIO 200](#), [CHE 101](#), [MTH 141](#)

Spring [BIO 201](#), [CHE 102](#), [MTH 142](#)

SECOND YEAR

Fall [BIO 203](#), [CHE 201](#), [CSE 115](#), [CSE 191/MTH 191](#)

Spring [BIO 205](#), [BIO 215](#), [CHE 202](#), [CSE 116](#)

THIRD YEAR

Fall [BIO 313](#), [319](#), [BIO 329](#), [MTH 309](#)

Spring [BIO 400](#), [CSE 250](#)

FOURTH YEAR

Fall [MTH 411](#) or [STA 301](#), [PHY 107](#)

[MTH 337/CSE 337](#) or [CSE 462](#) or [MTH 437/CSE 437](#); [PHY 108](#), [PHY 158](#), Senior Project ([BIO 498](#))

Bioinformatics And Computational Biology - B.S.

Acceptance Criteria

Minimum GPA of 2.5 overall.

Minimum GPA of 3.0 in the prerequisite courses.

Advising Note

Students must maintain a minimum GPA of 3.0 in all major courses to graduate.

Prerequisite Courses

[BIO 205](#) Fundamentals of Biological Chemistry

[CHE 101](#) General Chemistry I

[CHE 102](#) General Chemistry II

[CSE 115](#) Introduction to Computer Science

[CSE 116](#) Introduction to Computer Science

Bioinformatics And Computational Biology

[MTH 141](#) College Calculus I
[MTH 142](#) College Calculus II

Required Courses

[BIO 302](#) Introduction to Molecular Biology or [BIO 319](#) Genetics
[BIO 400](#) Bioinformatics
[CHE 201](#) Organic Chemistry (LEC only) or [CHE 203](#) Organic Chemistry
[CSE 241](#) Digital Systems
[CSE 250](#) Data Structures
[CSE 305](#) Introduction to Programming Languages
[CSE 341](#) Computer Organization
[CSE 396](#) Introduction to the Theory of Computation
[CSE 421](#) Introduction to Operating Systems
[CSE 442](#) Software Engineering
[CSE 462](#) Database Concepts
[CSE 191](#) Discrete Structures/[MTH 191](#) Introduction to Discrete Mathematics I
[CSE 337/MTH 337](#) Introduction to Scientific Computing or [CSE 437/MTH 437](#) Introduction to Numerical Analysis I *
[MTH 241](#) College Calculus III
[MTH 306](#) Introduction to Differential Equations
[MTH 309](#) Introduction to Linear Algebra
[MTH 411](#) Probability or [STA 301](#) Intro To Probability
Senior Project

*[CSE 438/MTH 438](#) Introduction to Numerical Analysis II is an optional additional course

Summary

Total required credit hours for the major (concentration in bioinformatics-computer science and engineering)...100

See [Baccalaureate Degree Requirements](#) for general education and remaining university requirements.

Recommended Sequence of Program Requirements

FIRST YEAR

Fall [CHE 101](#), [CSE 115](#), [MTH 141](#)
Spring [CHE 102](#), [CSE 116](#), [MTH 142](#)

SECOND YEAR

Fall [CHE 201](#) or [CHE 203](#); [CSE 191/MTH 191](#), [CSE 241](#), [MTH 241](#)
Spring [BIO 205](#), [CSE 250](#), [CSE 341](#)

THIRD YEAR

Fall [CSE 305](#), [CSE 462](#), [MTH 309](#)
Spring [CSE 421](#), [CSE 442](#), [MTH 306](#)

FOURTH YEAR

Fall [BIO 302](#) or [BIO 319](#); [MTH 411/STA 301](#)
Spring [BIO 400](#), [CSE 396](#); [CSE 337/MTH 337](#) or [CSE 437/MTH 437](#); Senior Project

Bioinformatics And Computational Biology - B.S.

Acceptance Criteria

Minimum GPA of 2.5 overall.
Minimum GPA of 3.0 in the prerequisite courses.

Advising Note

Students must maintain a minimum GPA of 3.0 in all major courses to graduate.

Prerequisite Courses

[BIO 205](#) Fundamentals of Biological Chemistry
[CHE 101](#) General Chemistry I
[CHE 102](#) General Chemistry II

Bioinformatics And Computational Biology

[CSE 115](#) Introduction to Computer Science
[CSE 116](#) Introduction to Computer Science
[MTH 141](#) College Calculus I
[MTH 142](#) College Calculus II

Required Courses

[BIO 302](#) Introduction to Molecular Biology or [BIO 319](#) Genetics
[BIO 400](#) Bioinformatics
[CHE 201](#) Organic Chemistry or [CHE 203](#) Organic Chemistry (LEC only)
[CSE 250](#) Data Structures
[CSE 462](#) Database Concepts ([CSE 305](#) prerequisite waived)
[CSE 191](#) Discrete Structures/[MTH 191](#) Introduction to Discrete Mathematics I
[MTH 241](#) College Calculus III
[MTH 306](#) Introduction to Differential Equations
[MTH 309](#) Introduction to Linear Algebra
[MTH 311](#) Introduction to Higher Mathematics
[MTH 411](#) Probability or [STA 301](#) Intro To Probability
[MTH 412/STA 302](#) Introduction to Statistical Inference
[MTH 418](#) Survey of Partial Differential Equations
[MTH 419](#) Introduction to Algebra I
[MTH 431](#) Introduction to Real Variables I
[MTH 437/CSE 437](#) Introduction to Numerical Analysis I
[MTH 438/CSE 438](#) Introduction to Numerical Analysis II
Senior Project

Summary

Total required credit hours for the major (concentration in bioinformatics-mathematics)...100

See [Baccalaureate Degree Requirements](#) for general education and remaining university requirements.

Recommended Sequence of Program Requirements

FIRST YEAR

Fall [CHE 101](#), [CSE 115](#), [MTH 141](#)
Spring [CHE 102](#), [CSE 116](#), [MTH 142](#)

SECOND YEAR

Fall [CHE 203](#), [CSE 191/MTH 191](#), [MTH 241](#), [MTH 306](#)
Spring [BIO 205](#), [CSE 250](#), [MTH 309](#), [MTH 311](#)

THIRD YEAR

Fall [BIO 302](#), [MTH 411](#) or [STA 301](#), [MTH 419](#)
Spring [MTH 412/STA 302](#), [MTH 418](#)

FOURTH YEAR

Fall [MTH 437/CSE 437](#), [MTH 431](#)
Spring [BIO 400](#), [MTH 438/CSE 438](#), [CSE 462](#), Senior Project