BIOINFORMATICS

Bioinformatics is the development and application of computational and statistical techniques for solving problems involving complex biological data. This emerging discipline is growing rapidly alongside technological developments for large-scale data generation in the life sciences, such as in genomics, proteomics, functional pathway analysis, health sciences, and biodiversity. Demand is accelerating for new approaches for data storage, retrieval, analysis, and applications. A new generation of professionals is required to meet this demand, having bioinformatics skills and the capacity to create new approaches.

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This list may include Regular Graduate Faculty, Associated Graduate Faculty and/or Graduate Faculty from other universities.

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BS Waterloo, M.Sc., PhD Toronto - Associate Professor
Graduate Faculty

MBINF Program

Admission Requirements

Students will be admitted to the Master of Bioinformatics program from a range of undergraduate programs in the life sciences. Students from undergraduate programs in the physical or computational sciences will be considered for admission if they are considered to have sufficient biological background. Students must begin the Master of Bioinformatics program in a fall semester. To be considered for admission, applicants should meet the minimum requirements of a four-year degree from a recognized post-secondary institution with a minimum 75% average over the last two years of full-time equivalent study. Additionally, all applicants must have taken at least one prior university course in genetics or molecular biology and at least one university course in statistics or biostatistics. Students whose first language is not English require a minimum TOEFL score of 93 with a minimum score of 22 in each of the four categories, or a minimum IELTS score of 7.0, with a minimum of at least 6.5 in each component.

Space in the program is limited and prospective students are encouraged to apply by the application deadline to be considered for admission. Application details are posted on the program website (http://www.bioinf.uoguelph.ca/).

Program Requirements

A total of 4.0 credits are required, which must include:

Code	Title	Credits
BINF*6110	Genomic Methods for Bioinformatics	0.50
BINF*6210	Software Tools for Biological Data Analysis and Organization	0.50
BINF*6890	Topics in Bioinformatics	0.50
BINF*6970	Statistical Bioinformatics	0.50
BINF*6999	Bioinformatics Masters Project	1.00

The advisory committee and/or the Graduate Program Committee may require additional courses.

Advisory Committee

Students taking the Master of Bioinformatics will have an advisor and a co-advisor. Both the advisor and the co-advisor must be members of the Bioinformatics Graduate Faculty such that one has expertise in the life sciences and the other has expertise in statistics, mathematics or computing.

Duration of the Program

Students normally take 3 courses per semester for two semesters (3.0 credits) and complete the Bioinformatics Master's Project (1.0 credit) in a third semester. Therefore, the program typically takes 12 months of full-time study. There is, however, the option to continue the Bioinformatics Master's Project into a second fall semester, in which case the program will take 16 months of full-time study.

MSc Program

Admission Requirements

Students may be admitted to the MSc in Bioinformatics program from a range of undergraduate programs in the life, physical, statistical, mathematical, and computational sciences. To be considered for admission, applicants should meet the minimum requirements of a four-year degree from a recognized post-secondary institution with a minimum 75% average over the last two years of full-time equivalent study.

Applicants must indicate their research interests and their agreed advisors. Prospective students should commence discussions with faculty well in advance of applying. Offers of admission will only be issued in cases where a member of Bioinformatics Graduate Faculty has agreed to be the advisor. Applicants can view the Bioinformatics Faculty Page (https://www.uoguelph.ca/bioinformatics/people/?field_profile_role_tid=15&field_profile_role_tid=15) for a listing of the faculty members and links to their department homepages which include their research interests and contact information. Applicants should only begin their application once one such faculty member has agreed to be the advisor.

Program Requirements

A total of 2.0 credits are required, which must include:

Code	Title	Credits
BINF*6110	Genomic Methods for Bioinformatics	0.50
BINF*6210	Software Tools for Biological Data Analysis and Organization	0.50

The advisory committee and/or the Graduate Program Committee may require additional courses. When the course work is satisfactorily completed, the submission and successful defence of an appropriate thesis on an approved topic completes the requirements for the MSc in Bioinformatics.

Advisory Committee

Students taking the MSc in Bioinformatics will have an advisory committee comprising at least two members of the Bioinformatics Graduate Faculty. The advisor must be a member of the Bioinformatics Graduate Faculty. Usually, if there is a co-advisor, they will also be a member of the Bioinformatics Graduate Faculty; under special circumstances, the Director, after consultation with the Bioinformatics Program Committee, may approve a co-advisor who is not a member of the Bioinformatics Graduate Faculty.

Duration of the Program

The program typically takes 16-24 months of full-time study.

PhD Program

Admission Requirements

1. Applicants with a master's degree
   Applicants holding either a Master of Bioinformatics, an MSc in Bioinformatics, or a masters in a related discipline with a GPA above 80 over the last two years equivalent of full time study will be considered for admission.
2. Applicants without a master's degree (i.e., direct entry)
   Strong applicants (GPA>80) may be admitted without holding a master's degree provided that their undergraduate major is appropriate. In these cases, the program committee will assign necessary courses to ensure sufficient preparedness for research.
3. General Requirements
   Applicants must indicate an agreed advisor at the time of application. Prospective students should commence discussions with faculty well in advance of applying. Offers of admission will only be issued in cases where a member of Bioinformatics Graduate Faculty has agreed to be the advisor. Applicants can view the Bioinformatics Faculty Page (https://www.uoguelph.ca/bioinformatics/people/?field_profile_role_tid=15&field_profile_role_tid=15) for a listing of the faculty members and links to their department homepages, which include their research interests and contact information. Applicants should only begin their application once one such faculty member has agreed to be the advisor.

Program Requirements

A minimum of 1.0 credit is required, which must include:

Code	Title	Credits
BINF*6500	PhD Research Writing in Bioinformatics	1.00

The program committee and the advisory committee may, and usually will, require additional courses. After the prescribed course work is satisfactorily completed, a qualifying examination is taken. Finally, the submission and successful defence of an appropriate thesis on an approved topic completes the requirements for the PhD in Bioinformatics.

Advisory Committee

Students taking the PhD in Bioinformatics will have an advisory committee comprising at least three members of the Graduate Faculty, at least two of whom should be Bioinformatics Graduate Faculty. The advisor must be a member of the Bioinformatics Graduate Faculty. Usually, if there is a co-advisor, they will also be a member of the

Bioinformatics Graduate Faculty; under special circumstances, the Director, after consultation with the Bioinformatics Program Committee, may approve a co-advisor who is not a member of the Bioinformatics Graduate Faculty.

Duration of the Program

The completion period of the program is 12 semesters of full-time study.

Collaborative Specializations

Artificial Intelligence

The MSc in Bioinformatics program participates in the collaborative specialization in Artificial Intelligence. MSc students wishing to undertake thesis research with an emphasis on artificial intelligence are eligible to apply to register concurrently in Bioinformatics and the collaborative specialization. Students should consult the Artificial Intelligence (https://calendar.uoguelph.ca/graduate-calendar/collaborative-specializations/artificial-intelligence/) listing for more information.

Courses

BINF*6110 Genomic Methods for Bioinformatics Winter Only [0.50]
This course provides an introduction to current and emerging methods used to generate genomic data analyzed in bioinformatics. This may include techniques for DNA sequencing as well as transcriptome, proteome and metabolome analysis. The objective is to develop an appreciation for the challenges of producing data.
Offering(s): Annually
Restriction(s): Restricted to Bioinformatics students.
Department(s): Dean's Office, College of Biological Science
Location(s): Guelph

BINF*6210 Software Tools for Biological Data Analysis and Organization Fall Only [0.50]
This course familiarizes students with tools for the computational acquisition and analysis of molecular biological data. Key software for biological data acquisition, management, analysis, and visualization are presented. Laboratory exercises guide students through application of relevant tools.
Offering(s): Annually
Department(s): Dean's Office, College of Biological Science
Location(s): Guelph

BINF*6410 Bioinformatics Programming Fall Only [0.50]
This course introduces students to computer programming in languages relevant for contemporary bioinformatics. Students apply these programming skills to perform bioinformatics data analyses.
Offering(s): Annually
Department(s): Dean's Office, College of Biological Science
Location(s): Guelph

BINF*6420 Biosequence Pattern Analysis Winter Only [0.50]
This course is an overview course on different approaches to analyze biological sequences. Basic concepts are introduced, as well as related algorithms.
Offering(s): Annually
Restriction(s): Restricted to Bioinformatics students.
Department(s): Dean's Office, College of Biological Science
Location(s): Guelph

BINF*6500 PhD Research Writing in Bioinformatics Summer, Fall, and Winter [1.00]
Background literature pertinent to the student's initial research direction is studied. Starting with a reading list provided by the advisor and the instructor, the student builds on this list and constructs a major literature review over two semesters. As the student begins to generate initial ideas for their own research direction, their ideas for their doctoral research are written and explained. The emphasis is on a sub-field or sub-fields of bioinformatics.
Offering(s): Annually
Restriction(s): Restricted to PhD Bioinformatics students.
Department(s): Dean's Office, College of Biological Science
Location(s): Guelph

BINF*6890 Topics in Bioinformatics Fall Only [0.50]
The course covers a breadth of knowledge of topics in bioinformatics, which may include, but are not limited to, programming languages and development, computing skills applicable to artificial intelligence and machine learning strategies, and multi-OMICs software packages and their applications in diverse biological fields. Additionally, critical thinking, communication, presentation, and collaboration skills are developed and fostered.
Offering(s): Annually
Department(s): Dean's Office, College of Biological Science
Location(s): Guelph

BINF*6970 Statistical Bioinformatics Winter Only [0.50]
This course presents a selection of advanced approaches for the statistical analysis of data that arise in bioinformatics, especially genomic data. A central theme to this course is the modelling of complex, often high-dimensional, data structures.
Offering(s): Annually
Restriction(s): Restricted to Bioinformatics students.
Department(s): Dean's Office, College of Biological Science
Location(s): Guelph

BINF*6999 Bioinformatics Masters Project Summer and Fall Reg Required [1.00]
A major research project and paper is completed and presented by students in the Master of Bioinformatics program. Projects may involve either the development or application of bioinformatics methods. Professionalism and communication skills in written, oral, visual, and computational formats are also emphasized.
Offering(s): Annually
Prerequisite(s): BINF*6110, BINF*6210
Restriction(s): Restricted to Master of Bioinformatics students.
Department(s): Dean's Office, College of Biological Science
Location(s): Guelph

Note

Some courses may not be offered every year. Students planning to take a courses from the above list should consult with the Graduate Program Assistant for availability and scheduling.

Electives

Biological Sciences

Code	Title	Credits
ANSC*6100	Special Project	0.50
ANSC*6240	Topics in Animal Genetics and Genomics	0.50
ANSC*6330	Topics in Computational Biology and Bioinformatics	0.50

ANSC*6370	Quantitative Genetics and Animal Models	0.50
ENVS*6450	Multivariate Environmental Data Analysis	0.50
HHNS*6440	Nutrition, Gene Expression and Cell Signalling	0.50
MCB*6370	Protein Structural Biology and Bioinformatics	0.50
PLNT*6160	Advanced Plant Breeding II	0.50
PLNT*6500	Applied Bioinformatics	0.50

Note

Students may take the Machine Learning Modelling section of ANSC*6100 Special Project which is offered in Winter only.

Computer Science

Code	Title	Credits
CIS*6020	Artificial Intelligence	0.50
CIS*6060	Bioinformatics	0.50
CIS*6080	Genetic Algorithms	0.50
CIS*6120	Uncertainty Reasoning in Knowledge Representation	0.50

Mathematics and Statistics

Code	Title	Credits
STAT*4340	Statistical Inference	0.50
STAT*6801	Statistical Learning	0.50
STAT*6802	Generalized Linear Models and Extensions	0.50
STAT*6950	Statistical Methods for the Life Sciences	0.50

Note

Some courses may not be offered in every semester. Students planning to take a course from the above list should consult with the department offering the course to check for availability and scheduling.