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.

Administrative Staff

Director and Graduate Coordinator
Sarah Adamowicz (2447 Science Complex, Ext. 53055)
sadamowi@uoguelph.ca

Bioinformatics Program Manager
Monica Wong (4451 Science Complex, Ext. 56474)
moniwong@uoguelph.ca

Admissions Secretary
Karen White (3479 Science Complex, Ext. 52730)
cbssgrad@uoguelph.ca

Graduate Program Assistant
Sarah Lakhan (2483 Science Complex, Ext. 56097)
cbsibgrad@uoguelph.ca

Graduate Faculty

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

Sarah J. Adamowicz
B.Sc. Dalhousie, M.Sc. Guelph, PhD Imperial College - Associate Professor
Graduate Faculty

R. Ayesha Ali
B.Sc. Western Ontario, M.Sc. Toronto, PhD Washington - Associate Professor
Graduate Faculty

Emma Allen-Vercoe
B.Sc. London (UK), PhD Open (UK) - Professor
Graduate Faculty

Daniel A. Ashlock
B.Sc. Kansas, PhD CalTech - Professor and Chair
Graduate Faculty

Christine Baes
B.Sc. Guelph, M.Sc. Hohenheim, PhD Christian-Albrechts - Associate Professor
Graduate Faculty

Elizabeth G. Boulding
B.Sc. British Columbia, M.Sc. Alberta, PhD Washington - Professor
Graduate Faculty

Joseph L. Colasanti
B.Sc., PhD Western Ontario - Associate Professor
Graduate Faculty

Karl A. Cottenie
M.Sc., MS, PhD K.U. Leuven - Associate Professor and Associate Dean,
Graduate Studies
Graduate Faculty

Angela Cánovas
B.Sc. Lledia, M.Sc. Valencia, PhD Lledia - Associate Professor
Graduate Faculty

Lorna Deeth
B.Sc., M.Sc., PhD Guelph - Assistant Professor
Graduate Faculty

Giannina Descalzi
BA Guelph, M.Sc., PhD Toronto - Assistant Professor
Graduate Faculty

Jeremy Dettman
B.Sc., M.Sc. British Columbia, PhD California-Berkeley - Research Scientist, Agriculture and Agri-Food Canada
Associated Graduate Faculty

Hermann J. Eberl
Dipl. Math (M.Sc.), PhD Munich Univ. of Tech. - Professor
Graduate Faculty

Michael J. Emes
B.Sc., PhD Sheffield - Professor
Graduate Faculty

Mazyar Fallah
BA Johns Hopkins, MA, PhD Princeton - Professor and Dean, College of Biological Sciences

Vahab Farzan
DVM Tehran, M.Sc., PhD Guelph - Research Associate, Population Medicine, University of Guelph
Associated Graduate Faculty

Zeny Feng
B.Sc. York, MMath., PhD Waterloo - Professor
Graduate Faculty

Jinzhong Fu
B.Sc. Nankai, M.Sc. Chinese Academy of Sciences, PhD Toronto - Associate Professor
Graduate Faculty

Jennifer Geddes-McAlister
B.Sc., M.Sc. Lethbridge, PhD British Columbia - Assistant Professor
Graduate Faculty

Steffen P. Graether
B.Sc., M.Sc., PhD Queen's - Professor
Graduate Faculty

Thomas Graham
B.Sc., M.Sc., PhD Wageningen - Assistant Professor, Environmental Sciences, University of Guelph
Graduate Faculty

T. Ryan Gregory
B.Sc. McMaster, PhD Guelph - Professor and Chair
Graduate Faculty

Cortland K. Griswold
B.Sc. Wisconsin, M.Sc. Toronto, PhD British Columbia - Associate Professor
Graduate Faculty

Mehrdad Hajibabaei
B.Sc. Tehran Azad, PhD Ottawa - Associate Professor
Graduate Faculty

Andrew Hamilton-Wright
B.Sc., M.Sc. Guelph, PhD Waterloo - Associate Professor
Graduate Faculty

Robert Hanner
B.Sc. Eastern Michigan, PhD Oregon - Associate Professor
Graduate Faculty

George Harauz
BASc, M.Sc., PhD Toronto - Professor Emeritus
Associated Graduate Faculty

Andreas Heyland
B.Sc., M.Sc. Zurich, PhD Florida - Professor
Graduate Faculty

Sheridan Houghten
B.Sc., M.Sc., PhD Concordia - Professor, Brock University
Associated Graduate Faculty

Rui Huang
B.Sc. Peking, PhD Michigan - Assistant Professor
Graduate Faculty

Niel A. Karrow
B.Sc. Guelph, M.Sc., PhD Waterloo - Professor
Graduate Faculty

Stefan M. Keller
DVM Berlin, Dr. Med Vet, Diplomate ECVP Zurich, PhD UC Davis - Assistant Professor
Associated Graduate Faculty

Jibran Khokhar
B.Sc. Queen's, PhD Toronto - Assistant Professor
Graduate Faculty

Peter T. Kim
BA Toronto, MA Southern California, PhD UC San Diego - Professor
Graduate Faculty

Stefan C. Kremer
B.Sc. Guelph, PhD Alberta - Professor
Graduate Faculty

Jasmin Lalonde
BA Ottawa, MA, PhD McGill - Assistant Professor
Graduate Faculty

Jonathan LaMarre
DVM, PhD Guelph - Professor
Graduate Faculty

Brandon N. Lillie
DMV, PhD Guelph, DIP. A.C.V.P. - Associate Professor and Chair
Graduate Faculty

Lewis N. Lukens
B.Sc. Carleton College, PhD Minnesota - Associate Professor
Graduate Faculty

John S. Lumsden
B.Sc., DVM, M.Sc., PhD Guelph, Diplomate ACVP - Professor
Graduate Faculty

David W. L. Ma
B.Sc., PhD Alberta - Professor
Graduate Faculty

Elizabeth Mandeville
B.Sc. Yale, PhD Wyoming - Assistant Professor, Integrative Biology
Graduate Faculty

Baozhong Meng
B.Sc., M.Sc. Hebei Agricultural (China) - Associate Professor
Graduate Faculty

A. Rodney Merill
B.Sc. Lethbridge, PhD Ottawa - Professor
Graduate Faculty

David M. Mutch
B.Sc. Queen's, PhD Lausanne - Associate Professor
Graduate Faculty

Khurram Nadeem
B.Sc., M.Sc. Karachi, PhD Alberta - Assistant Professor
Graduate Faculty

Annette Nassuth
B.Sc., M.Sc. Free (Amsterdam), PhD Leiden - Retired Faculty, Molecular and Cellular Biology, University of Guelph
Associated Graduate Faculty

K. Peter Pauls
B.Sc., M.Sc., PhD Waterloo - Professor
Graduate Faculty

Zvonimir Poljak
DVM Croatia, M.Sc., PhD Guelph - Associate Professor
Graduate Faculty

Ryan Prosser
BEd Wollongong, B.Sc., PhD Guelph - Associate Professor
Graduate Faculty

Nicole Ricker
BSc Guelph, M.Sc., PhD Toronto - Assistant Professor
Graduate Faculty

J. Andrew B. Robinson
B.Sc., M.Sc. Guelph, PhD Cornell - Associate Professor
Graduate Faculty

Scott Ryan
B.Sc. Memorial, PhD Ottawa - Associate Professor
Graduate Faculty

Flavio S. Schenkel
BBA, B.Sc., M.Sc. Brazil, PhD Guelph - Professor
Graduate Faculty

M. Alexander Smith
B.Sc., M.Sc. Trent, PhD McGill - Associate Professor
Graduate Faculty

Dirk Steinke  
B.Sc., M.Sc. Konstanz, PhD Goethe - Associate Director, Centre for Biodiversity, University of Guelph  
Associated Graduate Faculty

Leonardo Susta  
DVM Perugia, PhD Georgia, Diplomate ACVP - Assistant Professor  
Graduate Faculty

Graham Taylor  
B.A.Sc., M.A.Sc. Waterloo, PhD Toronto, P.Eng - Professor  
Graduate Faculty

Dan Tulpan  
B.Sc. Burcharest, PhD British Columbia - Assistant Professor  
Graduate Faculty

Siavash Vahidi  
PhD Western Ontario - Assistant Professor  
Graduate Faculty

George van der Merwe  
B.Sc., M.Sc., PhD Stellenbosch (South Africa) - Associate Professor  
Graduate Faculty

Terry Van Raay Van Raay  
B.Sc. Windsor, M.Sc. Guelph, PhD Utah - Associate Professor  
Graduate Faculty

Geoffrey A. Wood  
DVM Guelph, PhD Toronto, D.V.Sc. Guelph - Associate Professor  
Graduate Faculty

Krassimir (Joseph) Yankulov  
B.Sc. Sophia, PhD ICRF London - Professor  
Graduate Faculty

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

Wei Zhang  
B.Sc. Beijing, MA York, PhD Toronto - Assistant Professor  
Graduate Faculty

MBINF Program

Admission Requirements

Program 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.

Space in the program is limited and prospective students are encouraged to apply as early as possible. 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:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BINF*6110</td>
<td>Genomic Methods for Bioinformatics</td>
<td>0.50</td>
</tr>
<tr>
<td>BINF*6210</td>
<td>Software Tools for Biological Data Analysis and Organization</td>
<td>0.50</td>
</tr>
<tr>
<td>BINF*6890</td>
<td>Topics in Bioinformatics</td>
<td>0.50</td>
</tr>
<tr>
<td>BINF*6970</td>
<td>Statistical Bioinformatics</td>
<td>0.50</td>
</tr>
<tr>
<td>BINF*6999</td>
<td>Bioinformatics Masters Project</td>
<td>1.00</td>
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</table>

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 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.

Program Requirements

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

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<tbody>
<tr>
<td>BINF*6110</td>
<td>Genomic Methods for Bioinformatics</td>
<td>0.50</td>
</tr>
<tr>
<td>BINF*6210</td>
<td>Software Tools for Biological Data Analysis and Organization</td>
<td>0.50</td>
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</tbody>
</table>

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.

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.

Program Requirements

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

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<tr>
<th>Code</th>
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<th>Credits</th>
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<tbody>
<tr>
<td>BINF*6500</td>
<td>PhD Research Writing in Bioinformatics</td>
<td>1.00</td>
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</table>

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, 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, (s)he 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 (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.

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.

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.

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.

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.

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.

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.
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.
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 course from the above list should consult with the Graduate Program Assistant for availability and scheduling.

Electives

Biological Sciences

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ANSC*6240</td>
<td>Topics in Animal Genetics and Genomics</td>
<td>0.50</td>
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<tr>
<td>ANSC*6330</td>
<td>Topics in Computational Biology and Bioinformatics</td>
<td>0.50</td>
</tr>
<tr>
<td>ANSC*6370</td>
<td>Quantitative Genetics and Animal Models</td>
<td>0.50</td>
</tr>
<tr>
<td>ENVS*6450</td>
<td>Multivariate Environmental Data Analysis</td>
<td>0.50</td>
</tr>
<tr>
<td>HHNS*6440</td>
<td>Nutrition, Gene Expression and Cell Signalling</td>
<td>0.50</td>
</tr>
<tr>
<td>MCB*6370</td>
<td>Protein Structural Biology and Bioinformatics</td>
<td>0.50</td>
</tr>
<tr>
<td>PLNT*6160</td>
<td>Advanced Plant Breeding II</td>
<td>0.50</td>
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<tr>
<td>PLNT*6500</td>
<td>Applied Bioinformatics</td>
<td>0.50</td>
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</table>

Computer Science

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<thead>
<tr>
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<th>Title</th>
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<tbody>
<tr>
<td>CIS*6020</td>
<td>Artificial Intelligence</td>
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<tr>
<td>CIS*6080</td>
<td>Genetic Algorithms</td>
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<tr>
<td>CIS*6120</td>
<td>Uncertainty Reasoning in Knowledge Representation</td>
<td>0.50</td>
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Mathematics and Statistics

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<tbody>
<tr>
<td>STAT*4340</td>
<td>Statistical Inference</td>
<td>0.50</td>
</tr>
<tr>
<td>STAT*6801</td>
<td>Statistical Learning</td>
<td>0.50</td>
</tr>
<tr>
<td>STAT*6802</td>
<td>Generalized Linear Models and Extensions</td>
<td>0.50</td>
</tr>
<tr>
<td>STAT*6950</td>
<td>Statistical Methods for the Life Sciences</td>
<td>0.50</td>
</tr>
</tbody>
</table>

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.