Bioinformatics and Computational Biology

An interdepartmental, undergraduate Specialist Program at the [University of Toronto](), jointly sponsored by the Departments of [Biochemistry](), [Cell & Systems Biology](), [Computer Science](), [Ecology & Evolutionary Biology](), and [Molecular Genetics]()

Can you pick the single most important scientific advance of the last century? It could be the invention of the computer, the success story of information science. Alternatively, it could be decoding the molecular basis of life. However, do you realize these two are intimately related? In principle, life is an expression of pure information, encoded in physical molecules. The more we discover about the details, the more we find that molecular biology is an information science as much as it is a physical science.

Genome sequencing, proteome analysis and the study of cellular "systems" have given us breathtaking insights into the inner workings of biological function at the molecular level. However, a deep understanding of the complex organization of the cell and the interaction of its components has yet to be achieved. Substantial further progress is needed to make our science predictive, to fulfill the promises of "post-genomic" biology.

Bioinformatics builds the toolbox of this science. We design methods that make biological information computable - we *abstract* properties of molecules, cellular systems and biological organisms, we build large computer systems to efficiently *store and manage* the very large volumes of data that are accumulating in our laboratories, we support sensitive *analyses and discover* significant associations with sophisticated tools.

Computational biology is bioinformatics' goal: we hope to advance our understanding of life through computational *analysis, modelling, and prediction*. The modelling of relationships, the analysis of theoretical abstractions, such as graphs, networks and systems, and their integration into computational models will lead us to a true *understanding* of life in its molecular detail. The dream we pursue is to explain life, and to provide the insights we need for biotechnology and molecular medicine.

Biological Data Analysis in Your Career

Biotechnology industry professionals see three major needs: *biological analysts* who are involved in experimental work and trained in bioinformatics applications, *software engineers* with enough domain knowledge to be able to support method and database integration, and the true *generalist* with enough skills in both areas to develop new methods and original, innovative research strategies. Generalists are rare and the most highly sought in the academic sector. It is the Program's goal to provide in-depth training for such generalists. Graduates of the program would typically pursue graduate studies in any of the participating departments: Computer Science, Biochemistry, Cell & Systems Biology, Ecology & Evolutionary Biology or Molecular Genetics. Their professional careers may span a wide range of opportunities, including academic research, clinical medicine, drug development, agrotechnology or even patent law.

What the Program Offers

The Bioinformatics and Computational Biology Specialist Program provides a balance between computer science, mathematics and statistics, and biochemistry, molecular and cellular biology and genetics. Even so, the Program leaves ample space to add advanced courses in Computer Science or Life Science specializations, to prepare for graduate studies, and perhaps fulfill the requirements for a Major in parallel with their Specialist. The Program emphasizes research experience: in fact, almost a sixth of the required course credits are hands-on project courses in one of the University's laboratories. The unique concentration of scientists in the field, a thriving landscape of graduate and postgraduate research, the Collaborative Graduate Program in Bioinformatics and Genome Biology, and numerous advanced research opportunities all come together to make a real difference for your own academic career.

Who We Are Looking For

If you would like to become part of one of science's greatest adventures, if you are looking for a challenging program in an outstanding academic environment, if you are exceptionally motivated and committed to excellence, we would like to hear from you. Students are advised that the very rigorous courses that are part of the Program, the very limited overlap in course material between the theory-centric and the biology-centric courses, and the different academic cultures in the life and computer sciences, make this Program suitable only for the academically strongest and most highly motivated students on campus. As a rule of thumb, students who expect to do well should be able to perform regularly at the top 20% level in their classes.

More information:

Please visit https://csb.utoronto.ca/undergraduate-studies/undergraduate-programs/bioinformatics-and-computational-biology/ or contact undergrad.csb@utoronto.ca.