

# BIOL 432

## Introduction to Computation and Big Data in Biology

**Instructor:** Dr. Robert Colautti, 4325 BioSciences, [robert.colautti@queensu.ca](mailto:robert.colautti@queensu.ca)

**Format:** 3hr Lectures + 1hr Tutorial/Help Sessions per week

**Prerequisites:** **NONE**

**Co-requisite:** **NONE**

*recommended:* BIOL 243, BIOL 343, CISC 151, CISC 251, BIOL 331

**Textbook:** **None Required**

*Useful reference books:*

Practical Computing for Biologists by Haddock & Dunn (Oxford University Press)

Bioinformatics Data Skills by Buffalo (O'Reilly)

**Assessments:** 40% Weekly Assignments & Pop Quizzes  
10% Final Project – Proposal (group)  
20% Final Project – Report (group)  
10% Final Project – Code (group)  
20% Participation and peer evaluation

### Course Learning Outcomes:

Students completing this course shall be able to:

1. Design and implement a strategy for project management in biological research, based on the philosophy that scientific research should be **OPEN** and **REPRODUCIBLE**
2. Use regular expressions to modify biological data files (e.g. automated error correction, file conversion, and data extraction)
3. Create publication-ready visualizations of biological data
4. Write custom scripts to curate, merge, subset, reformat, and parse large biological datasets
5. Write original scripts for data analysis pipelines using high-performance computers, particularly those maintained by Queen's **Centre for Advanced Computing**
6. Analyze and interpret 'big data' formats in biology (e.g. CSV, FASTA, FASTQ, SAM, BED, BAM, KML, XML, BMP, PNG, SVG, SHP) to address biological hypotheses.

### Philosophy

This course applies computational skills to a range of research topics in the biological sciences. The best way to learn coding is with extensive practice, trial and failure, using real-world examples. The philosophy of this course is that you won't learn to code by reading and memorization – only through extensive application and practice. For this reason, there are no major exams; instead, you are assessed through regular assignments and quizzes designed to encourage skill development and problem-solving. In addition, you are **STRONGLY ENCOURAGED** to find opportunities to practice coding wherever possible. For example, write code instead of messing around with spreadsheet program like Excel, use Markdown or LaTeX instead of a word processor to render final reports for your other classes. It will take longer at first, but it will save a lot of time in the long run. Finally, be prepared to get frustrated – you will make many errors and most of your coding time will be debugging and searching for answers on the internet. It is important to know that **this is COMPLETELY NORMAL** and self-directed research to solve coding problems is perhaps the most crucial skill you will learn in this course.

## Assistance

This course has no lectures in the traditional sense. Weekly 3-hr 'lectures' are more like hands-on tutorial sessions where you are expected to participate and to ask questions. There is also a scheduled 1-hr weekly (optional) drop-in help session to assist with assignments and quizzes. It's also a good place to challenge your coding skills by helping other students with the guidance of a TA. Outside of tutorials, a very common and useful approach to solving errors or other problems is to search Google or Stack Overflow. Often, simply copying and pasting an error into an online search will produce a helpful link.

## Grade Assessment

### Weekly Assignments:

Each assignment accounts for a relatively small portion of your final mark, so don't worry if you don't do well on a few of them. They are designed to motivate you to practice coding and to help you memorize and understand key concepts that will be tested through in-class pop quizzes. For this reason, it is important that you begin the assignment as soon as possible and complete it on your own. Assignments will typically be posted by the end of lecture and are due within 48 hrs of posting. **A late assignment receives 0%.** Students who require accommodation for any reason will receive a 5-day grace period without penalty (see "Accommodations" and "Extenuating Circumstances", below).

### Tests:

There are no exams in this course. Instead, you will be tested on your understanding of the course content periodically through unannounced pop quizzes. The purpose of the quizzes is to reinforce learning concepts from tutorials and assignments. Quizzes are not announced ahead of time and occur at the beginning of lecture. **There are no make-up quizzes**, however students requiring accommodation for any reason may miss up to two quizzes, or drop their two lowest quiz marks without penalty (see "Accommodations" and "Extenuating Circumstances", below).

### Final Project:

A large part of your final grade depends on a group project in which you work collaboratively and apply methods learned in this course to write original code for managing and interpreting a large dataset. The project is due 1 week after the last tutorial. **A late project receives 0%.** However, groups with students requiring accommodation for any reason receive a 2-week grace period without penalty.

### Participation:

Part of your final grade will be based on participation marks provided to students who contribute to discussion in class in a collegial and respectful manner. Each member of your group will also provide a peer assessment grade based on their opinion of your contributions to the group according to the following statement: "This group member was respectful, helpful, and made important contributions to the group assignments without dominating the discussion."

## Other Considerations

### Grievances:

It is the student's responsibility to raise any concerns about grading errors within 5 business days of receiving a grade on any quiz or assignment. Requests must be made in writing (e.g. email) and must include a very clear explanation of the reason for concern. Any identified grading errors will be corrected, which may result in a lower or higher grade. Other grade adjustments not will NOT BE CONSIDERED without prior approval of accommodations or extenuating circumstances, as follows:

### Accommodations:

Queen's University is committed to achieving full accessibility for people with disabilities. Part of this commitment includes arranging academic accommodations for students with disabilities to ensure they have an equitable opportunity to participate in all of their academic activities. If you are a student with a disability and think you may need accommodations, you are strongly encouraged to contact the Queen's Student Accessibility Services (QSAS) and register as early as possible. For more information, including

deadlines and application forms, please visit the QSAS website:  
<http://www.queensu.ca/studentwellness/accessibilityservices/>

**Extenuating circumstances:**

For excused absences due to short-term extenuating circumstances (e.g. flu, injury, short personal leave), please submit a formal Academic Consideration Request Portal (ACRP) on the Arts & Sciences accommodations website: <https://www.queensu.ca/artsci/accommodations>.

**Academic Integrity** (<http://www.academicintegrity.org>):

Queen's students, faculty, administrators and staff all have responsibilities for supporting and upholding the fundamental values of academic integrity. Academic integrity is constituted by the five core fundamental values of honesty, trust, fairness, respect and responsibility and by the quality of courage. These values and qualities are central to the building, nurturing and sustaining of an academic community in which all members of the community will thrive. Adherence to the values expressed through academic integrity forms a foundation for the "freedom of inquiry and exchange of ideas" essential to the intellectual life of the University. Students are responsible for familiarizing themselves with and adhering to the regulations concerning academic integrity. General information on academic integrity is available at **Academic Integrity @ Queen's University**, along with Faculty or School specific information. Departures from academic integrity include, but are not limited to, plagiarism, use of unauthorized materials, facilitation, forgery and falsification. Actions which contravene the regulation on academic integrity carry sanctions that can range from a warning, to loss of grades on an assignment, to failure of a course, to requirement to withdraw from the university

**Turnitin:**

Queen's University has partnered with the third-party application Turnitin to help maintain our standards of excellence in academic integrity. Turnitin is a suite of tools that provide instructors with information about the authenticity of submitted work and facilitates the process of grading. Submitted files are compared against an extensive database of content, and Turnitin produces a similarity report and a similarity score for each assignment. A similarity score is the percentage of a document that is similar to content held within the database. Turnitin does not determine if an instance of plagiarism has occurred. Instead, it gives instructors the information they need to determine the authenticity of work as a part of a larger process.

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