



Syllabus
EN.601.452 / AS.020.415
Computational Biomedical Research & Advanced Biomedical Research
Fall, 2021 (3 credits, EQ)

Instructors

- **Section 01:**
Professor Michael C. Schatz, mschatz@cs.jhu.edu, <http://schatz-lab.org>
Office: Malone 323
Office hours: TBD; and by appointment
TA: Samantha Zarate, slzarate@jhu.edu
TA Office Hours: TBD; and by appointment

Meetings

- **Section 01:** Monday and Wednesday, 3:00pm to 3:50pm in Hodson 211.

Textbook

No textbooks are required, but a few are suggested

Online Resources

The following online resources are essential:

- The course web site location at <https://github.com/schatzlab/biomedicalresearch2021>. You will find a schedule of topics, class notes, and assignment details there.
- The course Piazza site at <http://piazza.com/jhu/fall2021/en601452>. This site will serve as our discussion site for the course. Please use Piazza to ask questions of the instructor, TA and fellow students.

Course Information

- The goal of this course is to prepare undergraduates to understand and perform state-of-the-art biomedical research. This will be accomplished through three main components: (1) classroom-style lectures on cross cutting techniques for biomedical research focusing on data visualization, statistical inference, and scientific computing; (2) research presentations from distinguished faculty on their active research projects; and (3) a major research project to be performed under the mentorship of a JHU professor. Students will present their research during an in-class symposium at the end of the semester.

- Throughout the course, we will study the leading computational and quantitative approaches for comparing and analyzing genomes starting from raw sequencing data. The course will focus on human genomics and human medical applications, but the techniques will be broadly applicable across the tree of life. The topics will include genome assembly & comparative genomics, variant identification & analysis, gene expression & regulation, personal genome analysis, and cancer genomics.
- Grading will be based on (1) homework exercises, (2) a midterm exam, (3) a written and oral research proposal, (4) an interim research report, (5) an oral research presentation, and (6) a final research report.
- There are no formal course prerequisites, although the course will require familiarity with UNIX scripting and/or programming to complete the assignments and course project.

Course Goals

Upon successful completion of this course, you should be able to:

1. Understand the theoretical foundations for several of the most important genomic analysis tools
2. Have hands-on experience running several of the most important genomic tools
3. Perform novel research and analysis in computational biology

The course will address the following student outcomes:

- (SO1) Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.
- (SO3) Communicate effectively in a variety of professional contexts.
- (SO5) Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
- (SO6.) Apply computer science theory and software development fundamentals to produce computing-based solutions.

Course Topics

We will study the leading computational and quantitative approaches for comparing and analyzing genomes starting from raw sequencing data. The course will focus on human genomics and human medical applications, but the techniques will be broadly applicable across the tree of life. The topics will include genome assembly & comparative genomics, variant identification & analysis, gene expression & regulation, personal genome analysis, and cancer genomics. Please see the main course website for a more detailed schedule, which will be updated as the semester progresses

Course Expectations & Grading

Course grades will be based on assignments (typically running and analyzing existing tools and/or analyzing a dataset), an examination, and a class project, according to the proportions below. Each homework assignment will be assigned a point value; the overall homework assignment grade will be computed as your total points earned divided by the total achieved in the class.

- 25% - Assignments
- 30% - Midterm (Nov 11 take home)
- 45% - Class Project (Final report along with an in-class presentation and preliminary report)

All grades will be distributed via email. Please keep your own record of your grades so that you will know your standing in the course. Letter grades for the course will be assigned on a standard scale, subject to the instructor's evaluation of your overall class performance. Students are allowed a total of 96 hours to extend the deadline for assignments, but not the class project, without any penalty. No further extensions will be allowed without a doctor's note or a note from the university.

Assignment Logistics. The assignments and projects in this course will require you to execute command line programs, write code in the language of your choice, or carry out a calculation. You must write all code independently unless the assignment specifically states that you can work in groups.

Attendance. All students are generally expected to attend all meetings of this course, and actively participate in all course meetings. If you miss a class meeting for any reason, you are responsible for material presented, and it is your responsibility to obtain any missed handouts or other materials. If you will be missing more than 1 class, please contact the instructor to discuss how to best review the missed materials.

Key Dates

Assignment and exam schedule will be distributed on the course webpage.

Assignments & Readings

Assignment and exam schedule will be distributed on the course webpage.

Ethics

The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful, abiding by the *Computer Science Academic Integrity Policy*:

Cheating is wrong. Cheating hurts our community by undermining academic integrity, creating mistrust, and fostering unfair competition. The university will punish cheaters with failure on an assignment, failure in a course, permanent transcript notation, suspension, and/or expulsion. Offenses may be reported to medical, law or other professional or graduate schools when a cheater applies.

Violations can include cheating on exams, plagiarism, reuse of assignments without permission, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. Ignorance of these rules is not an excuse.

Academic honesty is required in all work you submit to be graded. Except where the instructor specifies group work, you must solve all homework and

programming assignments without the help of others. For example, you must not look at anyone else's solutions (including program code) to your homework problems. However, you may discuss assignment specifications (not solutions) with others to be sure you understand what is required by the assignment.

If your instructor permits using fragments of source code from outside sources, such as your textbook or on-line resources, you must properly cite the source. Not citing it constitutes plagiarism. Similarly, your group projects must list everyone who participated.

Falsifying program output or results is prohibited.

Your instructor is free to override parts of this policy for particular assignments. To protect yourself: (1) Ask the instructor if you are not sure what is permissible. (2) Seek help from the instructor, TA or CAs, as you are always encouraged to do, rather than from other students. (3) Cite any questionable sources of help you may have received.

On every exam, you will sign the following pledge: "I agree to complete this exam without unauthorized assistance from any person, materials or device. [Signed and dated]". Your course instructors will let you know where to find copies of old exams, if they are available.

In addition, the specific ethics guidelines for this course are:

1. In the completion of individual homework assignments, you may not discuss your approach with or show specifics of your code to others. This includes fellow students, former students, friends, etc. You are permitted to request assistance from course staff (instructors, TAs and CAs) only.
2. You are permitted and expected to reuse and adapt code from lectures and the assigned texts in completing your projects. However, all original sources must be cited in comments within your code.
3. In using Piazza to ask questions about homework assignments, you should post privately to Instructors any questions that involve code or that would give away your approach to solving the assignment. Otherwise, you are encouraged to ask general, abstract questions, and post them publicly, so other students may benefit from the discussion.

Report any violations you witness to the instructor.

You can find more information about university misconduct policies on the web at these sites:

- For undergraduates: <http://e-catalog.jhu.edu/undergrad-students/student-life-policies/>
- For graduate students: <http://e-catalog.jhu.edu/grad-students/graduate-specific-policies/>

Students with Disabilities

Any student with a disability who may need accommodations in this class must obtain an accommodation letter from Student Disability Services, 385 Garland, (410) 516-4720, studentdisabilityservices@jhu.edu .