



Course Format Information

Course: BIOL 522: Bioinformatics for NGS data analysis. Spring 2026

Credit Hours: 3

Professor: Feseha Abebe-Akele

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Office Hours:

- **In-Person:**

MTWR	11:00AM-12:00 PM
TR	12:00PM-01:00 PM
MTWR	11:00AM-12:00 PM

- **Virtual:** • [Request zoom session by e-mail.]

Course Format / Location

Face to Face in Person: Course meets face to face. When necessary, we will meet Online (synchronously or asynchronously). This is a combined Lecture/hands-on Lab class and attendance to ALL classes is mandatory.

LOCATION: JSC 102

Time: TR 6:00 – 8:50 PM

Course Description

BIOL 522: Bioinformatics for NGS Data Analysis

Next-generation sequencing (NGS) has transformed life sciences by producing vast amounts of genomic, transcriptomic, and metagenomic data whose analysis requires bioinformatics computational skills. BIOL 522 is designed to provide a hands-on introduction to the computational skills required for NGS data analysis. Students begin by developing Linux command navigation skills and are then introduced to Python scripting to apply these tools to real sequencing datasets. Through structured modules, students explore essential workflows for quality assessment, genome alignment, variant detection, and data visualization, using standard tools such as FastQC, BWA, SAMtools, and the UCSC Genome Browser. The course prepares students to independently navigate computational environments and apply bioinformatics workflows in their research.

Learning Outcomes:

By the end of the course, students will be able to:

1. Navigate Unix/Linux command-line interfaces (CLI) for data management and bioinformatics workflows.
2. Write and execute basic Bash and Python scripts for data parsing, automation, and analysis.
3. Use key NGS tools and pipelines for alignment, variant calling, and data visualization.
4. Apply CLI navigation to use HPC resources for NGS data analysis.
5. Use GitHub repository to enhance their learning in analyzing NGS data and interpreting results in the context of biological questions.

Course Requirements

Required Text(s) and Materials: (NO required text)

Online resources: Articles, book excerpts, YouTube videos will be provided.

- **Access:** Student will need their own computer and access to an internet connection to participate in the online part of the course.
- **Access to HPC cluster through NAIRR ACCESS-CI allocations.**
- **Students are required to Clone the GitHub repository for the course.**
- **Software:** Opensource Bioinformatics software and Libraries, data sets will be provided.

Course Grading Components

G	Assignment	Due Date	Number of Points for Assignment	% of Final Grade
r	1. Research Paper		100	5
a	2. Homework Assignments		45	10
d	3. Discussion Board		100	10
i	4. Portfolio		100	10
n	5. Attendance and Participation		5	5
g	6. Examinations		350	60

e [Insert detailed listing of grading scale]: The Grading Scale is consistent with University policy and is as follows:

- 90-100 = A
- 80-89 = B
- 70-79 = C
- 60-69 = D
- below 60 = F

Course Outline

Course Matrix

Dates	Topic to be Covered, Comments. Abd Submissions due.
Week-1	Course overview, diagnostic test. NGS intro, FASTA/FASTQ. ACCESS allocations, ssh, scp, SRA toolkit basics. GitHub intro: cloning course repo, making first commit (students fork a class repo for assignments).
Week-2	Linux/CLI basics, navigation, permissions. External module: molecular biology refresher. Git/GitHub continued: branches, pull requests (students submit homework via GitHub)
Week-3	File manipulation (cat, grep, wc, gzip, tar). FASTA/FASTQ formats revisited. SGX3 practical: transferring and unpacking large datasets on HPC
Week-4	Permissions, and Bioinformatics modules. chmod, #!/usr/bin/sh. Environment Variables, \$PATH, ~/.bashrc Conda and module systems on HPC: managing software reproducibly.
Week-5-6	Shell scripting (variables, loops, conditionals). Automating data parsing. SLURM job submission: sbatch, job arrays, resource requests. Checkpoint: project proposal due on GitHub.
Week-7-9	Python basics: variables, conditionals, functions. File I/O, parsing FASTA/FASTQ. Python with bioinformatics tools (SeqTk, Biopython). Integrate HPC Python workflows (batch Python scripts via SLURM). GitHub workflow: submit Python assignments via repo.
Week-10-11	NGS data analysis on HPC: Quality Control with FastQC, MultiQC. Read trimming: Cutadapt/Trimmomatic. Project checkpoint: intermediate results pushed to GitHub.
Week-12 -13	Read alignment: BWA, Bowtie2 on HPC. Intro to workflow managers (Snakemake or Nextflow) to chain QC → trimming → alignment. Students containerize one step (Singularity/Apptainer demo).
Week-14 Wrap-up	Best practices in reproducibility, FAIR data Principles, GitHub portfolio building. Final project presentations + repo submission.

Note Carefully:

- Actual dates and holiday calendar will be updated each academic year.
- Assignment due dates and Project Submission dates will be adjusted to the academic calendar.
- Students are responsible to consult the syllabus and submit work on the due dates (Failure to do has penalties).

Expectations for Students

Course Expectations

- Attendance Policy [Attend **ALL** classes: This is a hands-on class and **daily assessment quizzes** will be administered that will greatly affect your grades]
- Class Discussion Policies: Discussion and participation will be monitored and graded.
- **NO Cell phone use in class** – Except for course related activities requested by instructor.
- **Absolutely NO HEADPHONES in class** – I will ask you to leave the class

Student Expectations

You will need to use CANVAS shell to post discussions and GitHub Repository for assignments.

- Participation/attendance policy: It is not ONLY whether you come to class or not that matters. What counts is whether you come to learn or to goof around – I do not tolerate the use of cellphones and headphones in class.
- Homework/assignment policy: If you skip your homework or assignments, you are likely to earn a D or an F as your grade.
- Online components (discussions, team/group work, etc.): everything counts. The more you do, participate meaningfully, the better you learn and the higher your grades will be.
- Exams/quizzes (especially if proctored!)
- Late assignment policy: Late assignment means lower grades ... assignments and lab reports that are late incur **10% for each week for up to 50%** of assigned grade.
- Time commitment: You need to commit 3-5 hours of reading to be able to participate in class discussion.
- Writing standards: write concisely and submit in time.

Special Course Policies

1. Students who are unable to attend class for a valid reason can expect the professor to examine their case and accept or reject their claim. In order to receive a reasonable accommodation, the students should communicate with the faculty member within 48 hours of the absence (longer with a doctor's note).
2. For long-term absences from a class, the student needs to address the concerns regarding attending class with Office of Students with Disabilities.
3. Absent exigent circumstances, faculty members will respond to emails, within 24 – 48 hours.

Course Policies

Netiquette Guidelines

- **Write in digestible chunks.** Lengthy paragraphs are difficult for readers to digest. Keep your paragraphs short and your writing concise.
- **NO YELLING.** When you write in uppercase letters in online communication, it is usually

- interpreted as yelling.
- **Add some emotion :-).** Sometimes it helps communicate the tone of your message when you add an emoticon or emoji. However, only do so as necessary, for it can end up being annoying to readers if you have too many, which is probably the opposite of your intention.
- **Use humor carefully.** Sarcasm, in particular, does not translate well in an online environment. It's best to avoid the potential pitfalls of misunderstood messages.
- **Assume the best intentions.** In an online environment, it is easy to misread someone's tone or intended message. Give your peers and instructor the benefit of the doubt, and ask them to clarify their meaning.
- **We are not the same.** Respect differences, and don't make assumptions.
- **Language matters.** Choose your words carefully; avoid using slang, and be kind.

University Policies

Policy on Academic Honesty:

As members of the academic community, students are expected to recognize and uphold standards of intellectual and academic integrity. The examples and definitions given below are intended to clarify the standards by which academic honesty and academically honorable conduct are to be judged. The following list is merely illustrative and is not intended to be exhaustive.

- **PLAGIARISM.** Plagiarism is presenting another person's work as one's own. It includes paraphrasing or summarizing the works of another person without acknowledgement, including submitting another student's work as one's own.
- **CHEATING.** This involves giving or receiving unauthorized assistance before, during or after an examination.
- **UNAUTHORIZED COLLABORATION.** Submission for academic credit for a work, product or a part thereof, represented as being one's own effort that has been developed in substantial collaboration with or without assistance from another person or source is a violation.
- **FALSIFICATION.** It is a violation to misrepresent material or fabricate information in an academic exercise or assignment.
- **MULTIPLE SUBMISSIONS.** It is a violation of academic honesty to submit substantial portions of the same work for credit more than once without the explicit consent of the instructor(s) to whom the material is submitted for additional credit. In cases where there is a natural development of research or knowledge in a sequence of courses, use of prior work may be desirable or even required.

Policy on Limitations of Course Withdrawals (300.1.26)

- 1. Maximum Course Withdrawal (Semester Hours):** Students can drop classes without penalty during the schedule change (drop/add) period at the start of the semester. Schedule change deadlines are published in the academic calendar. After the drop/add deadline, students can withdraw from no more than 15 semester hours during their undergraduate career. After a student has exceeded this limit, the student must receive a final grade of A, B, C, D, or F. Incompletes "I" will not be allowed as a substitute for a course withdrawal beyond the course withdrawal limit. The course withdrawal limit applies to first-time college students and follows them until they graduate. Current and returning students are not affected. Any course that a student drops is counted toward the 15 semester hour limit.
- 2. Transfer Students:** Regardless of the number of colleges a student may have attended, the number of classes they may have taken, or the number of years they enroll as undergraduates, the policy limits

them to 15 semester hours of course withdrawals. This includes any course a transfer student has dropped at another institution of higher education.

Accommodation Statement:

ECSU is on record as being committed to both the spirit and letter of federal equal opportunity legislation; reference Public Law 92-112 - The Rehabilitation Act of 1973 as amended. With the passage of federal legislation entitled *Americans with Disabilities Act (ADA)*, pursuant to section 504 of the Rehabilitation Act, there is renewed focus on providing this population with the same opportunities enjoyed by all citizens.

The university is required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of that disability. Student responsibility primarily rests with informing faculty of their need for accommodation and in providing authorized documentation through designated administrative channels.

Any student in the class who has a disability that may prevent full demonstration of ability should contact the instructor personally before the end of the first week of classes so that a discussion can be held regarding accommodations necessary to ensure full participation and facilitate individual educational opportunities.

COVID-19 Policies and Update

- Please see the ECSU Viking Compass Website for the most updated information (<https://www.ecsu.edu/vikingcompass/>)