

**ALBANY STATE UNIVERSITY
COLLEGE OF ARTS AND SCIENCES
DEPARTMENT OF NATURAL SCIENCES**

BIOL3506- Bioinformatics Syllabus

Course: BIOL3506 Bioinformatics
Semester: Spring 2025
Time: Tue/Thurs 2:00 – 3:10 pm
Lecture location: XXXXX
Credit Hours: 3

Instructor: Dr. Olabisi Ojo, PhD
Email: olabisi.ojo@asurams.edu
Office Room: XXXXX

Office Hours: Tue: XXXXX Wed:
XXXXX

COURSE DESCRIPTION:

In this course, students explore the principles underlying the analyses of sequences and biological databases using computational and statistical tools. The course provides students with an understanding of, and practical experience with, the application of these tools in biotechnology and biomedical sciences. *This course also integrates fundamental concepts with hands-on High-Performance Computing (HPC) applications. Students will learn programming basics, advanced genomic analysis, structural bioinformatics, and HPC-based visualization. The curriculum includes project-based modules using a local supercomputer, culminating in an HPC-based final project. This course equips students with essential skills for tackling computational challenges in modern biological research and data-intensive scientific discovery.*

COURSE OBJECTIVES:

- Examine and describe the fundamentals of Bioinformatics;
- Compare and contrast the basic methodologies employed in analysis of biological information using information technologies;
- Identify the available databases and web based tools currently used in Bioinformatics;
- Discuss bioinformatics use in biomedical settings; and
- Develop critical thinking and analytical skills

STUDENT OUTCOMES:

At the completion of the course, students will be able to:

- Define Bioinformatics and explain its applications to biological and biomedical data analysis;
- Integrate and interpret results obtained using bioinformatics approaches, albeit in class or published;
- Assess and critique the ethical and social implications of Bioinformatics; and
- Produce scientific writing, critical topical reports, and effective oral presentations.

INSTRUCTIONAL MODES:

The main instructional mode will be lectures using active learning pedagogic approaches. The lectures will be supported by

- ASU Online/Blackboard Learning Management System
- Interactive Laboratory Sessions
- Small Group Discussions
- PowerPoint Presentations

COURSE PRE-REQUISITES:

BIOL 3501K (Principles of Genetics)

REQUIRED MATERIALS:

Bioinformatics and Functional Genomics, 3rd Edition, Jonathan Pevsner, Wiley-Blackwell. ISBN

978-1-118-58178-0

Other materials such as articles to be discussed, lecture slides etc. will be distributed through Blackboard in advance of the specific class.

Required Technological Materials

Access to a laptop or desktop computer with internet access (also available on campus in the Computational Biology (Natural Sciences) Computer lab in BCB 332), and a dedicated flash drive.

STUDENT REQUIREMENTS AND GUIDELINES

1. **Course Accommodations:** This course complies with Albany State University policies for students with disabilities. Students with disabilities are encouraged to register with Disability Support Services (DSS). Students who suspect that they have a disability but do not have documentation are encouraged to contact DSS for advice on how to obtain appropriate evaluation. A memo from DSS authorizing your accommodation is needed before any accommodation can be made and should be presented to your instructor during the first week of class. Should a student not identify a problem until late in the semester, the instructor is not required to retroactively change grades for tests or assignments already completed.
2. Keep up with studying/reading and assignments from day to day. Trying to "cram" for the exam and/or presentations just before the deadline will not work. It will be most beneficial to you to do all required reading before coming to class. As you read, note areas where you have questions, write them down, and discuss them during class.
3. Focus your study. It is important to focus on the key concepts and skills. The amount of information you will receive in this seminar class will sometimes seem overwhelming. Listen intently for what is emphasized in lecture.
4. **ASK QUESTIONS!!! DON'T WAIT UNTIL YOU ARE TOTALLY LOST!!!!** *No matter what, do not feel intimidated or embarrassed to ask questions! Other students probably have the same questions...*
5. You are expected to follow Albany State University attendance guidelines as outlined in the student handbook (https://www.asurams.edu/student-affairs/student_affairs_handbookpg_/index.php). **Attendance will be taken every class. Excessive unexcused absences will result in an automatic F grade in the course.** In order to be successful in this course, you should attend and actively participate in every session of the class.
6. **ELECTRONIC DEVICE POLICY: Course related laptop, tablet or smartphone use during class is allowed. However, use for other purposes (texting/music even with headphones, etc.) is NOT allowed.** It is disruptive to your peers and professors. If you choose not to abide by this policy your class participation grade will be adversely affected.
7. You are expected to follow the Albany State University Code of Conduct as outlined in the Student Code of Conduct. Specifically, behavior that is disruptive to the normal conduct of class, and that undermines the learning of fellow students, is not acceptable, and consequences, and corrective measures as outlined in the Student Code of Conduct will be applied.

Exams:

- a. **Conduct during exams:** All exams are individual, and no support materials either written or electronic are allowed. If the exam is "on-line", please be aware that fraud

/monitoring detection systems will be in place. **If fraud of any kind is detected the exam will automatically receive a zero.** If the exam is “in person”, all book bags, purses, backpacks etc, need to be placed at the front of the classroom, before the exam begins, and are to remain there until the student turns in the exam and leaves the classroom. Additionally, no drinking or eating is allowed during exams. Lastly, if you leave the classroom, you must turn in your exam. You will not be allowed to come back to the classroom and continue to work. No exceptions!

- b. **Make-up exams:** Make-up exams will be offered **up to one week** after the missed exam date. Make up exams will be offered **only** in cases of illness or unavoidable absence (court appearances, verifiable family emergency). A written health care provider note or other official documentation (court summons, etc) **MUST** be presented as soon as possible (no later than one week after the date of the missed exam) in order to be eligible to take the make-up exam. If you know that you will not be present for an exam, it is your responsibility to make arrangements **ahead of time** to take the exam at an alternative time.
- c. **Grading disputes:** If your exam points were added incorrectly, please see me after class or during office hours, and I will be happy to make a correction. All other requests for exam re-grading must be in written form, justifying why your answer should be accepted, and if accepted, the entire exam may be re-graded. **No exam taken in pencil will be re-graded.** All appeals for changes must be made within 5 days after the exam is returned to the students.

8. **ACADEMIC INTEGRITY: Plagiarism or any form of cheating or document fabrication/falsification is unacceptable under any circumstances. Students found cheating will receive a grade of zero for that particular assignment, and may be the subject to further institutional disciplinary actions as outlined in the Albany State University Code of Conduct.**

GRADING/EVALUATION PROCEDURES:

The Final Grade will be determined as follows:

Exams I - III	30%
Project	20%
Homework	15%
Quizzes	10%
Class Participation	10%
Final Exam	15%

GRADING:

The standard Albany State University grading system will be utilized. Your grade will be calculated using the weighted system outlined below. All of your grades will be recorded in Blackboard and your current course grade will be updated accordingly and timely

A	B	C	D	F
90-100%	80-89%	70-79%	60-69%	<60%

Keep up with your grades, NO EXTRA credit activities will be offered! The grade you earn is the grade you get!!!

BIBLIOGRAPHY:

Lesk, Artur M. (2019) “*Introduction to Bioinformatics*” Fifth edition. Oxford, England. Oxford University Press.

Bioinformatics and Functional Genomics, 3rd Edition, Jonathan Pevsner, Wiley-Blackwell. Helms, Volkhard (2019) “*Principles of Computational Cell Biology*” Second Edition, Weinheim, Germany, Wiley-VCH

Important Dates:

Dates	Description
1/13	First Day of Classes
1/13 - 1/16	Schedule Adjustments (Add/Drop)
1/20	MLK Holiday – Campus Closed
3/5 - 3/7	Midterm Exams Week
3/10 - 3/14	Spring Break (No Classes)
3/19	Midterm Grades Available to Students
4/4	Last Day to Withdraw without Academic Penalty
4/4	Founder's Day Observance
5/1	Last Day of Classes
5/2	Student Study Day (no classes scheduled)
5/5 - 5/8	Final Exams Week

A full Albany State University Academic Calendar can be found on the website and by following the link below: https://www.asurams.edu/enrollment-management/office_of_the_registrar/academic-calendar/index.php

The Class Project will be evaluated using the following rubric:

Assessment Areas	5 Rating (A)	4 Rating (B)	3 Rating (C)	2 Rating (D)	1 Rating (F)

Introduction	Background information is complete and correct	Background information mostly complete and correct	Background information is partially complete and correct	Background information is mostly incomplete and incorrect	Background information is incomplete and incorrect
Objective	Subject to be analyzed is stated succinctly and correctly	Subject to be analyzed is mostly stated clearly	Subject to be analyzed is partially stated clearly	Subject to be analyzed is stated unclearly	Subject to be analyzed is not stated
Analytical Approach	Describes all of tools and methodologie s used clearly and with precision.	Describes most of tools and methodologie s used. Mostly accurate and precise.	Describes some of tools and methodologies used; somewhat accurate	Describes few tools and methodologi es used	Analytical approach description missing
Results	Presents results in a accurate and appropriate format	Presents most results in a accurate and appropriate format	Presents some results in a accurate and appropriate format	Few results presented a accurately or in appropriate format	No results presented
Discussion	Carefully and fully analyses and interprets the results	Result analysis is mostly complete	Result analysis is somewhat complete	Result analysis is incomplete or flawed	No result analysis
Conclusion	Conclusion is based on available knowledge and results	Conclusion is based mostly available knowledge and results	Conclusion is based on some available knowledge and experimental results	Conclusion is not based on the available knowledge and results.	No or flawed conclusion.

COURSE OUTLINE

Please note: This outline is intended to provide guidance and will be followed as close as possible. However, the professor reserves the right to modify, supplement and make changes, based on class progress and needs. Chapter numbers are based on “Bioinformatics and Functional Genomics” by Jonathan Pevsner, 3rd edition.

Week No.	Week of	Class Topic	Assignments
1	1/13/2025	Course overview and expectations, Introduction to Bioinformatics and HPC	- Read Chapter 1
			- Set up Python environment
			- Complete HPC access tutorial
2	1/20/2025	Introduction to Biological Databases and Scientific Gateway Access	- Read Chapter 2
			- Complete database access exercises
			- Bash scripting basics
3	1/27/2025	Programming Fundamentals for Bioinformatics	- Read Chapter 2
			- Python programming exercises
			- Introduction to parallel programming concepts
4	2/3/2025	HPC Fundamentals and Introduction to Bioinformatics	- Read Chapter 3
			- HPC job submission tutorial
			- Basic parallel algorithm implementation
5	2/10/2025	Pairwise Sequence Alignment and HPC-enabled BLAST	- Read Chapter 4
			- Implement parallel BLAST search
			- Exam 1 (Chapters 1-3)
6	2/17/2025	Advanced Database Searching with HPC	- Read Chapter 5
			- Large-scale database search using HPC
			- Optimize search algorithms for parallel execution
7	2/24/2025	Multiple Sequence Alignment on HPC	- Read Chapter 6
			- Implement MSA using parallel algorithms
			- Analyze performance gains with HPC
8	3/3/2025		- Read Chapter 7

		Phylogenetic Analysis and HPC Project Overview	- Design HPC-based phylogenetic analysis - Exam 2 (Chapters 4-7)
9	3/10/2025	Large-scale Genomic Data Analysis with HPC	- Implement genomic data processing pipeline on HPC - Analyze big genomic datasets
10	3/17/2025	Machine Learning/AI in Bioinformatics with HPC	- Implement ML algorithms for bioinformatics on HPC - Analyze performance of distributed ML models
11	3/24/2025	Deep Learning in Bioinformatics using GPUs	- Set up deep learning environment on HPC - Train neural networks for protein structure prediction
12	3/31/2025	HPC for Structural Bioinformatics and Data Visualization	- Use HPC for molecular dynamics simulations - Visualize large-scale biological data
13	4/7/2025	HPC-enabled Comparative Genomics	- Implement comparative genomics workflows on HPC - Analyze multi-genome datasets
14	4/14/2025	HPC Project Review and Ethics in Bioinformatics	- Present HPC-based bioinformatics projects - Discuss ethical considerations in large-scale data analysis
15	4/21/2025	Advanced Topics in HPC Bioinformatics	- Exam 3 (HPC applications in bioinformatics) - Review cutting-edge HPC applications in the field
16	4/28/2025	Final Exam (HPC-based project)	Submit and Present final HPC-based bioinformatics project