RUTGERS–NEW BRUNSWICK
School of Environmental and Biological Sciences

Course Syllabus

Course Name; Number; Semester; Meeting Days, Times, and Place

Bioinformatics
Course Number: 11:126:485/16:765:585 (undergraduate/graduate)
Fall 2026
3 Credits
Prerequisites: Introduction to Computer Science (01:198:111) and Genetics (01:447:380)

Meeting Times/Locations
Lecture: Mondays, 5:40-7:00 PM, Foran Hall 124 (computer lab)
Lab: Thursdays, 5:40- 8:40 PM, Foran Hall 124 (computer lab)

Contact Information
Instructor(s): Dr. Alanna Cohen
Office Location: Foran Hall 280
Phone: (848) 932-6369
Email: alanna.b.cohen@rutgers.edu
Office Hours: Mondays 12:00-1:00 PM or by appointment

Dr. Anat Kreimer (graduate section)
Office Location: Center for Advanced Biotechnology and Medicine 239
Email: kreimer@cabm.rutgers.edu

Course, Website Resources and Materials

- Canvas course site
- Suggested text: Bioinformatics (4th edition) by Andreas D. Baxevanis, Gary D. Bader, and David S. Wishart (Wiley). ISBN 9781119335580

COURSE DESCRIPTION
Bioinformatics aims to build computational models of biological systems. This is accomplished primarily by the creating of algorithms, databases, and web applications to solve questions in biology. Bioinformatics implements computational advances such as dynamic computing, artificial intelligence, and cloud computing. These methods are required to deal with the huge amounts of data being produced by high-throughput sequencing in order to identify patterns, address biological questions, and provide statistical significance.

This course is primarily for biologists, to introduce them to bioinformatics concepts and techniques. We will expand on previous courses that utilized web-based databases and tools and introduce command-line programming. This will allow you to perform more complex and computationally expensive analyses with larger datasets. We will also explore how to write our own code to extract specific information or results. I strongly believe that there are good programs available, it is not usually necessary to write your own code from scratch. However, you must understand when and how to use certain tools and how to optimize parameters to best fit the needs of your project or biological question.

All the work will be done in a live development environment, using Amarel, the high-performance computing cluster used by many labs at Rutgers. Working in this environment requires a basic knowledge of how to navigate a command-line environment and some basic programming/scripting. These concepts should have

been covered in prerequisite courses but will be reviewed here as well. By the end of the course, students will be comfortable working with UNIX/LINUX systems, Python script development, and automating existing applications for large datasets.

Please sign up for an Amarel account prior to our first lab meeting. You may request access to the cluster at https://oarc.rutgers.edu/amarel-cluster-access-request/

COURSE OBJECTIVES

1. Introduce bioinformatic algorithms/concepts and their implementations
2. Introduce the basics of working in a Linux environment, SLURM environment job submissions for parallel computing, and python scripting
3. Teach how to approach a biological problem as one that can be answered/addressed with bioinformatics. Students will learn the skills necessary to select appropriate tools, install/use them, optimize them based on their particular data, and build pipelines from a combination of existing tools and *de novo* code
4. Prepare students for more advanced bioinformatic courses
5. Provide students with a bioinformatic skill set that includes knowledge of basic script development and the vocabulary to collaborate within a multi-disciplined research team

TENTATIVE COURSE SCHEDULE (subject to change)

Monday	Lecture	Thursday	Lab
		3-Sep	Introduction to Bioinformatics (Lecture)
8-Sep (Tuesday)	Online Tools and Databases	10-Sep	Intro to Linux/command line programming
14-Sep	Gene Finding	17-Sep	Python I: data structures
21-Sep	Pairwise Alignments	24-Sep	Python II: conditional statements and loops
28-Sep	BLOSUM and BLAST	1-Oct	BLAST/command line programs
5-Oct	Multiple Sequence Alignments	8-Oct	Python III: functions and scripts
12-Oct	Sequence Signatures and Motifs	15-Oct	Structural Bioinformatics (Lecture) and Review
19-Oct	Midterm	22-Oct	Office hours
26-Oct	Phylogenetics I: parsimony and UPGMA	29-Oct	Pfam, HMMER, and MUSCLE
1-Nov	Phylogenetics II: NJ, ML, and Bayes	5-Nov	IQ-Tree and Mr. Bayes
09-Nov	Metagenomics	12-Nov	USEARCH
16-Nov	Differential Expression	19-Nov	Tophat and Cufflinks
23-Nov	Single Cell RNA-seq (Dr. Igor Shmarakov)	26-Nov	No class (Thanksgiving)
30-Nov	Variation and Molecular Level Selection	3-Dec	Ka/Ks
7-Dec	Disease Gene Prioritization	10-Dec	Office hours/Final Review

Final Exam/Paper Date and Time

Online Final exam Schedule: http://finalexams.rutgers.edu/

ASSIGNMENTS/RESPONSIBILITIES, GRADING AND ASSESSMENT

Homework/Quizzes

Homework assignments will be assigned during your lab period and due the following week, at the start of the next laboratory period, unless otherwise specified. Late submissions will not be accepted.

Assignments with coding components must run properly in a standard development environment. I will not debug your code, but partial credit will be given where appropriate. Lack of submission, empty submissions, or "fake" submissions will receive a score of 0%. Your code must be yours and properly commented.

Any quizzes will be given during the laboratory session, and may be written questions, coding assignments, or both. Quizzes are up to my discretion and may be announced, but do not have to be. The material may come from either lecture or lab but will be appropriate to the current topic covered. There are no make-up quizzes or extra time given for late starts.

Midterm/Final

The midterm exam will consist of 1) a written portion taken during lecture time and 2) a take-home programming assignment. The midterm will be based on material covered in lecture AND lab. The take-home component will be assigned during lab and be due the following week.

The final exam will consist of 1) a question-based portion taken during our assigned exam time during finals week that will include some combination of different tools and techniques learned throughout the semester and 2) a writing component that will include designing, running, and writing up a computational analysis of some biological data. Your final writing project should be modeled after primary literature articles including an introduction/background, results, materials and methods, and discussion. You will have at least three weeks to complete the take-home portion. Full guidelines will be posted to Canvas.

Critical Assessment of Bioinformatic Paper (Graduate Component Only)

As part of the graduate component of this course, each student will critically evaluate a recently published bioinformatics research paper selected by the instructor. Students will be asked to identify strengths/weaknesses of the work, assess the computational methodology, and propose a realistic strategy for improving the study through additional analyses, datasets, computational approaches, and experimental validation.

Full guidelines for this assignment will be posted to Canvas. Any specific questions can be directed to Dr. Kreimer at kreimer@cabm.rutgers.edu.

GRADING POLICY

Each category of coursework will be weighted as follows:

11:126:485 (Undergraduate)		**16:765:585 (Graduate)**	
Lab Homework/Quizzes	30%	Lab Homework/Quizzes	25%
Midterm *Split evenly between in-class written exam and take-home coding project*	30%	Midterm *Split evenly between in-class written exam and take-home coding project*	25%

Final *Split evenly between in-class written exam and take-home final project*	40%	Final *Split evenly between in-class written exam and take-home final project*	35%
N/A		Critical Assessment of Bioinformatic Paper	15%

Grading Scale

Letter Grade	Range
A	100-90%
B+	<90 to 86%
B	<86 to 80%
C+	<80 to 76%
C	<76 to 70%
D	<70 to 60%
F	<60%

Final course grades will not be rounded.

ACCOMODATIONS FOR STUDENTS WITH DISABILITIES

Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: https://ods.rutgers.edu/students/documentation-guidelines. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodation. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible.

To begin this process, please complete the Registration form on the ODS web site at: https://webapps.rutgers.edu/student-ods/forms/registration. Full policies and procedures can be found at https://ods.rutgers.edu.

AVAILABILITY OF TEACHING MATERIALS

You are responsible for any information presented or discussed during lecture (regardless of if it is the slides). Slide presentations will be posted to course Canvas site prior to each lecture. Lectures will not be recorded. Student recording of lecture is prohibited and must be discussed with the instructor in advance. Please remember that all lecture materials are protected intellectual property and cannot be shared or posted without permission of the instructor.

Rutgers is committed to maintaining minimum digital accessibility standards. Compliance with these standards is part of the Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act. If there is an issue with the accessibility of any digital information, please bring it to the attention of your instructor, who will work to rectify the situation.

ABSENCE POLICY

Each week will consist of a lecture (Mondays) and a laboratory (Thursdays) session. Lecture attendance is not required, and class participation is not included in your grade. But attendance is strongly encouraged as all test material will be taken directly from our lectures.

Lab attendance **IS** required. Missing a lab without a valid excuse will result in a zero grade for any quizzes or homework assignments associated with that laboratory session. Missing three or more labs without a valid excuse with proper documentation will result in an automatic failing grade for the course. Important lab information and coding quizzes will typically be given at the beginning of the lab session. Please be on time as lateness will not guarantee make-up or extra time given.

In the event of illness or emergency, I will arrange to make up missed work. If you expect to miss a lecture or lab, please let me know as soon as possible through the self-reporting absence form at https://sims.rutgers.edu/ssra/. For periods of absence longer than two days due to serious illness, confidential, or sensitive personal reasons, you must contact the office of the Dean of Students (https://deanofstudents.rutgers.edu/) to verify your extended absence from class.

ACADEMIC INTEGRITY

Academic Dishonesty, in any form will not be tolerated. This includes copying from another student or online resources. Students are allowed and encouraged to discuss homework problems, but should not copy any code directly. Use the “coffee break” rule. If you have a discussion about a problem, you should be able to walk away, have a cup of coffee, and then return and be able to come up with a solution from memory. The same applies to searching the web for solutions to problems. You may use online resources to learn from, but you must be able to write your own code from what you learn. This includes the use of generative AI, such as ChatGPT. Copying ANYTHING directly is strictly prohibited and is considered a violation of academic integrity and will reported to the Rutgers University office of student conduct.

The university's policy on Academic Integrity is available at https://academicintegrity.rutgers.edu/sites/default/files/pdfs/current.pdf. The principles of academic integrity require that a student:

- properly acknowledge and cite all use of the ideas, results, or words of others.
- properly acknowledge all contributors to a given piece of work.
- make sure that all work submitted as his or her own in a course or other academic activity is produced without the aid of impermissible materials or impermissible collaboration.
- obtain all data or results by ethical means and report them accurately without suppressing any results inconsistent with his or her interpretation or conclusions.
- treat all other students in an ethical manner, respecting their integrity and right to pursue their educational goals without interference. This requires that a student neither facilitate academic dishonesty by others nor obstruct their academic progress.
- uphold the canons of the ethical or professional code of the profession for which he or she is preparing.

Adherence to these principles is necessary in order to ensure that

- everyone is given proper credit for his or her ideas, words, results, and other scholarly accomplishments.
- all student work is fairly evaluated, and no student has an inappropriate advantage over others.
- the academic and ethical development of all students is fostered.

- the reputation of the University for integrity in its teaching, research, and scholarship is maintained and enhanced.

Failure to uphold these principles of academic integrity threatens both the reputation of the University and the value of the degrees awarded to its students. Every member of the University community therefore bears a responsibility for ensuring that the highest standards of academic integrity are upheld.

Fair Use of AI

Generative AI and AI tools (e.g., ChatGPT, Copilot) may be used SOLELY to support learning (such as clarifying concepts) or for limited editing (grammar and vocabulary check). Any use of AI must be explicitly acknowledged and cited appropriately. Remember that genAI is a tool, but you are responsible for checking the accuracy and appropriateness of any output.

All submitted work must reflect your own understanding and critical thinking. Therefore, the use of AI to fabricate or generate data/figures or submitting AI responses as your own work is strictly prohibited and constitutes a violation of academic and scientific integrity. Online submissions will be checked for AI generated text. Violation of this policy will result in penalties ranging from failing the assignment/course to further disciplinary action (e.g. suspension or expulsion) in accordance with university policy. If you are in doubt whether a certain use of AI is acceptable, please contact your instructor to discuss appropriate use of AI.

STATEMENT OF DIVERSITY, EQUITY, AND INCLUSION

It is our intention that students of all backgrounds will be well served by this course. We will work to create an environment of inclusion which respects and affirms the inherent dignity, value, and uniqueness of all individuals, communities and perspectives. We are lucky to have a diverse university. Diverse voices and life experiences enhance the learning process, and we welcome students to share their personal experiences. DEI in our classroom includes the following:

- Respect for classmates and their identities
- Diversity of students' experiences and ideas
- The historical context and possible biases of the subject area

We will not tolerate disrespectful language or behavior against any individual or group. If you feel as though you have been disrespected or treated unfairly by the instructors or any other individual, please let us know. You may speak with the instructors in person, over email or report anonymously via the Office of Academic Programs. In addition, you may also report bias to the Rutgers Diversity and Inclusion initiative using this link: http://inclusion.rutgers.edu/report-bias-incident/.

RELIGIOUS OBSERVANCES

It is university policy (University Regulation on Attendance, Book 2, 2,47B, formerly 60.1 4f) to excuse, without penalty, students who are absent from class because of religious observance and to allow the makeup of work missed because of such absence. Examinations and special required out-of-class activities shall ordinarily not be scheduled on those days when religiously observant students refrain from participating in secular activities. Absences for reasons of religious obligation shall not be counted for purposes of reporting. Students are advised to provide timely notification to instructors about necessary absences for religious observances and are responsible for making up the work or exams according to an agreed-upon schedule.

STUDENT WELLNESS SERVICES

Counseling, ADAP & Psychiatric Services (CAPS)
(848) 932-7884 / 17 Senior Street, New Brunswick, NJ 08901/ www.rhscaps.rutgers.edu/
CAPS is a University mental health support service that includes counseling, alcohol and other drug assistance, and psychiatric services staffed by a team of professionals within Rutgers Health services to support students' efforts to succeed at Rutgers University. CAPS offers a variety of services that include individual therapy, group therapy and workshops, crisis intervention, referral to specialists in the community and consultation and collaboration with campus partners.

Violence Prevention & Victim Assistance (VPVA)
(848) 932-1181 / 3 Bartlett Street, New Brunswick, NJ 08901 / https://vpva.rutgers.edu/
The Office for Violence Prevention and Victim Assistance provides confidential crisis intervention, counseling, and advocacy for victims of sexual and relationship violence and stalking to students, staff, and faculty. To reach staff during office hours when the university is open or to reach an advocate after hours, call 848-932-1181.

Compliance and Title IX
Rutgers faculty are committed to helping create a safe learning environment for all students and for the university as a whole. If you have experienced any form of gender or sex-based discrimination or harassment, including sexual assault, sexual harassment, relationship violence, or stalking, know that help and support are available. Rutgers has staff members trained to support survivors in navigating campus life, accessing health and counseling services, providing academic and housing accommodations, and more. The University strongly encourages all students to report any such incidents to the University. Please be aware that all Rutgers employees (other than those designated as confidential resources such as advocates, counselors, clergy and healthcare providers as listed in Appendix A to Policy 60.1.33) are required to report information about such discrimination and harassment to the University. This means that if you tell a faculty member about a situation of sexual harassment or sexual violence, relationship violence, stalking or other related misconduct, the faculty member must share that information with the University's Title IX Coordinator. If you wish to speak to a confidential employee who does not have this reporting responsibility, you can find a list of resources in Appendix A to University Policy 60.1.33. For more information about your options at Rutgers, please visit https://endsexualviolence.rutgers.edu/.

Disability Services
(848) 445-6800 / Lucy Stone Hall, Suite A145, Livingston Campus, 54 Joyce Kilmer Avenue, Piscataway, NJ 08854 / https://ods.rutgers.edu/
Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: https://ods.rutgers.edu/students/documentation-guidelines. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodation. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the Registration form on the ODS web site at: https://webapps.rutgers.edu/student-ods/forms/registration.

DoSomething button through Rutgers Dean of Students office:
http://health.rutgers.edu/do-something-to-help/

Wellness Coaching through Rutgers HOPE:
https://health.rutgers.edu/health-education-and-promotion/health-promotion-peer-education/wellness-coaching

Self-Help Apps found on the Rutgers Student Health website:
https://health.rutgers.edu/health-education-and-promotion/self-help/self-help-apps

NJ Hopeline - (1-855-654-6735) | **National Suicide Hotline** - (1-800-273-8255)

Basic Needs Resources

Any student who has difficulty affording groceries or accessing sufficient food, or who lacks a safe and stable place to live, is urged to contact the Rutgers Student Food Pantry and/or the Dean of Students (details below). Furthermore, please notify the professor if you are comfortable doing so, as they may be able to provide additional support.

Rutgers Student Food Pantry
848-932-5500 / College Ave Student Center, Room 115 (126 College Ave) /
http://ruoffcampus.rutgers.edu/food/
Check their website for hours and additional locations. The Rutgers Student Food Pantry is dedicated to helping all Rutgers students in need of food, no questions asked. Students will be provided with groceries that typically last about one week.

Dean of Students Office
848-932-2300 / 88 College Avenue, New Brunswick, NJ 08901 / https://deanofstudents.rutgers.edu/
Mon-Fri, 8:30am-5:00pm
The Dean of Students Office at Rutgers University-New Brunswick provides solutions, services, and support to help students navigate Rutgers University. The Office serves as a student support network by providing advocacy, problem resolution, and critical incident intervention for those times when additional assistance is needed. Please call to schedule an appointment to meet with a representative from the Dean's office.