Syllabus Spring 2026

MMG3320, Advanced Bioinformatics, 3 Credit Hours

Meeting Time, Meeting Pattern, Location

MMG 3320 is offered in person. Lectures meet on Mondays and Wednesdays (2-3:15) in Stafford Hall Room 410.

Instructor Name, Contact Information, Office Hours

Princess Rodriguez, princess.rodriguez@uvm.edu

Office Hours: Given Courtyard S453, by appointment only

Technical support for students

Students, please read this technology checklist to make sure you are ready for classes.
https://www.uvm.edu/it/kb/student-technology-resources/

Students should contact the Helpline (802-656-2604) for support with technical issues.

Pre-requisites or co-requisites

MMG3310 is a prerequisite.

Catamount Core/General Education (e.g., AH1; D1) or other requirements satisfied **(if applicable). Please include corresponding outcomes information.**

Quantitative Reasoning (QR)

Course Description

This course is intended for students in the biological sciences who have already completed the introductory course, Survey to Bioinformatic Databases. The advent of next-generation sequencing (NGS) platforms has made sequencing more accessible, faster, and less expensive, resulting in over 150,000 publicly available datasets that can be utilized to support research findings or testing hypotheses. In this course, students will learn and execute key steps in the

bioinformatic workflow by processing a publicly available genomics dataset. By the end of the course, students will have accessed, processed, analyzed, visualized, and interpreted an NGS dataset of their choosing. The course covers several topics, including an introduction to UNIX, data processing, R programming basics (including data frames, cleaning, and fundamentals with ggplot2), as well as an in-depth overview of selected genomics analysis. Throughout the course, best practices for reproducible data and data management will be emphasized. The course uses a direct, hands-on approach, as such most classes are interactive and require student participation.

Course Learning Objectives/Outcomes

By the end of the course, students will:

1. Develop an understanding of advanced genomics-based bioinformatic techniques and their applications in biological research,
2. Independently access and download publicly available genomic data from NCBI databases,
3. Gain proficiency in programming languages such as UNIX and R to automate bioinformatic workflows and manipulate data,
4. Explore the principals and techniques of data visualization and analysis,
5. Utilize new features and versions of computational programs to analyze genomics datasets as they become available,
6. Use online bioinformatics resources and programs to solve technical errors and determine data quality,
7. Interpret bioinformatic data generated and communicate results effectively to draw sound biological conclusions.

Modality description/Outline (for Hybrid or Online courses)

MMG3320 lecture will be delivered in person.

Required Course Materials:

There is no textbook required for this course. A laptop computer will be required to participate in this course.

Required platforms and software:

Each student will be provided with an account on the Vermont Advanced Computing Cluster (VACC). Students will use VACC - Open OnDemand (OOD) https://vacc-ondemand.uvm.edu/pun/sys/dashboard to access their VACC account, command line, and R/RStudio.

Brightspace, MS Teams, or other course sites:

This course will be coordinated through Brightspace https://brightspace.uvm.edu/d2l/login. Brightspace will provide students with the course syllabus, assignments, grades, and links to supplemental web sites required for the course.

For Brightspace information, students can access the following UVM Knowledge Base article:

https://www.uvm.edu/it/kb/article/brightspace-for-students/

The course website(s) contain scripts, homework prompts, and lectures. Please note that materials will become available week-by-week.

https://prodriguez19.github.io/MMG3320-5320/

Attendance Policy and Classroom Environment Expectations:

In this class, we will work together to develop a learning community that is inclusive and respectful. As a learning community we will seek to encourage and appreciate expressions of different ideas, opinions, and beliefs in the spirit of Our Common Ground. Meaningful and constructive dialogue is encouraged in this class. This requires mutual respect, willingness to listen, and open-mindedness to opposing points of view. Respect for individual differences and alternative viewpoints will be maintained at all times in this class. Conduct that substantially or repeatedly disrupts the ability of faculty and instructors to teach and the ability of students to engage may result in my asking a student to temporarily leave the classroom. See Undergraduate Catalogue - Classroom Code of Conduct (p. 443-444).

Lecture Attendance Policy

Attendance in lecture is expected. Class participation using your laptop with internet-connection will be a component of the course grade and used in most lectures to encourage participation and interaction.

Grading Criteria/Policies

The grade will be determined as follows:

Homework assignments	50%
Final Project	25%
Primary Literature Summaries	20%
Participation	5%
TOTAL	100%

A+ | 97 - 100	A | 94 - 96	A- | 90 - 93	
B+ | 87 - 89	B | 84 - 86	B- | 80 - 83	
C+ | 77 - 79	C | 74 - 76	C- | 70 - 73	
D+ | 67 - 69	D | 64 - 66	D- | 60 - 63	F | 59 or below

Academic Integrity and AI:

This course assumes that all work submitted by students will be generated by the students themselves, working individually or in groups. Students should not have another person/entity do the writing of any substantive portion of an assignment for them, which includes hiring a person or a company to write assignments and using artificial intelligence tools like ChatGPT.

Assessments (Graded Work):

Below are descriptions of the assessments that will be used to measure the students understanding of course concepts.

Homework assignments (50% of grade):

There will be at least 10 homework assignments assigned. These homework assignments can be categorized as *mini* or *take-home based* assignments.

- The *mini* homework assignments are developed to take students anywhere from 10 - 45

minutes to complete. Students will be granted time during class to start the homework but are still given an additional students 48 hours after assigned to complete and submit the homework. No late work will be accepted when it comes to mini-homework assignments. Specific guidelines in the form of a 20 to 50-point grade sheet will be provided to students.

- The *take-home based* homework assignments are developed to take students anywhere from 1 - 4 hours to complete. As a result, students are granted one week to complete and turn in the assignment. Each homework is designed to aid students prepare for the final project. Late homework be accepted but will be docked 10% of the overall grade for every day that the assignment is late. An assignment is considered late if it is not submitted by the time and due date specified. Three days past the due date (weekend included), the assignment will no longer be accepted, and the student will receive a ZERO. Specific guidelines in the form of a 100 to 150-point grade sheet will be provided to students one week before the assignment is due.

Primary Literature Summaries (20%):

Students will be asked to summarize and evaluate up to four primary research articles. In the prerequisite course MMG3310, students were provided a comprehensive overview on how to perform a search on NCBI PUBMED, as well as strategies on how to summarize peer-reviewed literature. Building on these skills, students will select and comprehensively summarize an article that features an NGS dataset for their final project for one primary literature assignment. For the other paper summaries, students will only summarize select portions of the article selected by the instructor. Grading rubric in the form of a 50 to 100-point grade sheet will be provided to students.

Participation (5%):

A skill that requires training is scientific communication and evaluation of oral presentations to express knowledge and understanding of a given topic. To ensure students are practicing these skills, students will be required to provide constructive feedback to their peers anonymously. These feedback forms will be available online for each student presenter. Students will also be asked to actively participate during all *paper discussion* sessions.

Final Project (25%):

One final project will be used to demonstrate an understanding of bioinformatics approaches acquired throughout the semester. The final project is an opportunity to apply tools using a real-world dataset and then practice presenting this information to professors and peers in a formal scientific way. The self-selected trail will guide the downstream analysis performed by the student on their reanalysis of the publicly dataset selected.

Ski Trails: Ski trails are categorized by their level of difficulty, which are indicated by a color code system. This is used to signify to the skier the level of difficulty associated with the trail selected. Green trails are designed for beginners while blue trails are made for intermediate skiers with more technical skills, and finally **black trails** are designed for advanced skiers who are comfortable skiing at high speeds on challenging terrain. They often have the most obstacles and require a high level of technical skill to navigate.

Similarly, the final project for this course will mirror these ratings with the understanding that within this class there are varying levels of bioinformatic competency. Students will self-select the trail they would like to undertake during the first few weeks of the course. Detailed rubrics for each trail will be provided in the form of 100-point grade sheet. Below are the overall objectives for each trail.

- Green Trail: Replicating figures from a primary research article is a common exercise used to practice data generation. Here, the student will identify and replicate one figure from the primary research article. Overall, the student will gain a better understanding of the data, identify potential errors or inconsistencies of the original analysis using software used by the authors to process and visualize the data, compare their results to the original figures, and draw biological conclusions.
- Blue Trail: A barrier to processing bioinformatic data is that there are many programs that can be used for a similar outcome in the pipeline. There are important considerations when selecting a short-read aligner, a program for read counting, or peak caller. Students who select the blue trail will be asked to modify select parameters within the bioinformatic pipeline and then compare how this impacts their overall results. Students who select this trail will be asked to comment on the overall usability, accuracy, speed, and complexity when testing these bioinformatic programs to understand which are best suited for the task at hand.
- Black Trail: When working with an NGS dataset, one common goal is to test an original hypothesis by analyzing the data and generating new insights. Students who select this trail will process and download an NGS dataset with this overall aim in mind. As such, the student will be asked to generate new and original insights that were not previously reported in the published body of work. The figures generated during the final presentation should present new information that advances the understanding of the research question, rather than simply replicating existing figures.

Note: Regardless of the trail selected all students will download and process an NGS dataset, perform quality control, downstream analysis, and create outputs that will be presented to the class in the form of an oral presentation format using Microsoft PowerPoint. Each student will be evaluated on the overview of the topic given, experimental design and quality control performed, major findings and interpretation of plots generated with R/RStudio, grammar, format, overall delivery of topic.

Additional Policies

Lived Name and Pronoun Information

The UVM Directory includes fields for indicating your lived name and your pronouns. Lived names (preferred names, names in use) are names that an individual wants to be known by in the University community. Entering your pronouns is strongly encouraged to help create a more inclusive and respectful campus community. To update your information, login to the UVM Directory. A preview box will allow you to see how this information will appear in other systems used on campus such as Microsoft Teams and Blackboard.

More information about how to make changes to your lived name and pronouns is available in the Knowledge Base.

Research and Citation Help

For help selecting research topics, finding information, citing sources, and more, ask a librarian. The UVM Libraries are eager to help. You may ask questions by phone, e-mail, chat, or text, or make an appointment for an individual consultation with a librarian.

Howe Library: https://library.uvm.edu/askhowe
Dana Medical Library: https://dana.uvm.edu/help/ask
Silver Special Collections Library: https://specialcollections.uvm.edu/help/ask

Course Evaluation:

UVM, MMG, and your course instructors would appreciate feedback in the organization and presentation of this course. You will have the opportunity to provide your formal feedback in an anonymous and confidential course evaluation at the end of the semester to improve the course. We will be soliciting your feedback throughout the course.

For more information on the use of Blue for course evaluation: student instructions on how to access Blue course evaluations.

General statement regarding potential changes during the semester:

http://catalogue.uvm.edu/
The University of Vermont reserves the right to make changes in the course offerings, mode of delivery, degree requirements, charges, regulations, and procedures contained herein as

educational, financial, and health, safety, and welfare considerations require, or as necessary to be compliant with governmental, accreditation, or public health directives.

Intellectual Property Statement/Prohibition on Sharing Academic Materials:

Students are prohibited from publicly sharing or selling academic materials that they did not author (for example: class syllabus, outlines or class presentations authored by the professor, practice questions, text from the textbook or other copyrighted class materials, etc.); and students are prohibited from sharing assessments (for example homework or a take-home examination). Violations will be handled under UVM's Intellectual Property policy and Code of Academic Integrity.

Tips for Success (optional):

Course-specific study/preparation tips
Here are a few resources for students on remote/online learning:

- Checklist for success in https://learn.uvm.edu/about/support-for-students/checklist-online-credit-courses/
- Academic support for online courses: https://www.uvm.edu/academicsuccess/online-learning-student-resources-remote-instruction

Helpful resources other than the professor (e.g., Undergraduate/Graduate Writing Center, Supplemental Instruction, Learning Co-op tutors, supplemental course materials)

Student Learning Accommodations:

In keeping with University policy, any student with a documented disability interested in utilizing ADA accommodations should contact Student Accessibility Services (SAS), the office of Disability Services on campus for students. SAS works with students and faculty in an interactive process to explore reasonable and appropriate accommodations, which are communicated to faculty in an accommodation letter. All students are strongly recommended to discuss with their faculty the accommodations they plan to use in each course. Faculty who receive Letters of Accommodation with Disability Related Flexible accommodations that go beyond the default accommodations will need to fill out the Disability Related Flexibility Agreement. Any questions from faculty or students on the agreement should be directed to the SAS specialist who is indicated on the letter.

Contact SAS:
A170 Living/Learning Center;
802-656-7753
access@uvm.edu
www.uvm.edu/access

Important UVM Policies

Academic Integrity:

The Academic Integrity policy addresses plagiarism, fabrication, collusion, and cheating.

Code of Student Conduct:

UVM's Code of Student Conduct outlines conduct expectations as well as students' rights and responsibilities.

FERPA Rights Disclosure:

The purpose of UVM's FERPA Rights Disclosure is to communicate the rights of students regarding access to, and privacy of their student educational records as provided for in the Family Educational Rights and Privacy Act (FERPA) of 1974.

Final Exam Policy:

The University final exam policy outlines expectations during final exams and explains timing and process of examination period.

Grade Appeals:

If you would like to contest a grade, please follow the procedures outlined in this policy.

Grading:

This link offers information on grading and GPA calculation.

Religious Holidays:

Religions may be practiced in many different ways, and can impact participation in classes variably. Students have the right to practice the religion of their choice. Each semester students should submit in writing to their instructors as early as possible and at least one week prior to their documented religious holiday the date(s) of the conflict or absence. Faculty must permit students who miss work or exams for the purpose of religious observance to make up this work. The complete policy is here.

Promoting Health & Safety:

The University of Vermont's number one priority is to support a healthy and safe community:

Center for Health and Wellbeing

Counseling & Psychiatry Services (CAPS) Direct Phone Line: (802) 656-3340

C.A.R.E. If you are concerned about a UVM community member or are concerned about a specific event, we encourage you to contact the Dean of Students Office (802-656-3380). If you would like to remain anonymous, you can report your concerns online by visiting the C.A.R.E. Team website.