Course Change Request

New Course Proposal

Date Submitted: 04/05/23 12:04 pm

Viewing: BINF 735 : Next Generation Sequencing Data Analysis

Last edit: 04/05/23 12:04 pm

Changes proposed by: clockha2

Are you completing this form on someone else's behalf?

No

In Workflow

1. **BINF Graduate Representative**
2. **SC Curriculum Committee**
3. SC Associate Dean
4. Assoc Provost-Graduate
5. Registrar-Courses
6. Banner

Approval Path

1. 04/07/23 1:07 pm Iosif Vaisman (ivaisman): Approved for BINF Graduate Representative

Effective Term: Fall 2023

Subject Code: BINF - Bioinformatics

Course Number: 735

Bundled Courses:

Is this course replacing another course? No

Equivalent Courses:

Catalog Title: Next Generation Sequencing Data Analysis

Banner Title: NGS Data Analysis

Will section titles vary by semester? No

Credits: 3

Schedule Type: Lecture

Hours of Lecture or Seminar per week: 3

Repeatable: May be only taken once for credit, limited to 3 attempts (N3)

Max Allowable Credits: 9

Default Grade Mode: Graduate Regular

Recommended Prerequisite(s):

Equivalent of BINF 531/631 (molecular biology) and BINF 634 (bioinformatics programming) or with permission of the instructor.

Recommended Corequisite(s):

Required Prerequisite(s) / Corequisite(s) (Updates only):

Registrar's Office Use Only - Required Prerequisite(s)/Corequisite(s):

And/Or	(	Course/Test Code	Min Grade/Score	Academic Level	)	Concurrency?

Registration Restrictions (Updates only):

Registrar's Office Use Only - Registration Restrictions:

Field(s) of Study:

Class(es):

Level(s):

Degree(s):

School(s):

Catalog Description:

This course introduces students to next generation sequencing (NGS) technologies and computational pipelines to store, validate, quantify, and visualize NGS data. Students will be exposed to the concepts and software driving NGS analysis and will acquire hands-on experience utilizing these tools both through the

command-line and through integrated platforms. Students will demonstrate practical knowledge of NGS data analysis through the course's final project, which will require students to produce an analytical pipeline and present their findings in written form.

Justification:

What: Offering a new course in Next Generation Sequencing (NGS) data analysis.

Why: In recent years, the staggering amount of data produced by next generation sequencing technologies has led to specific challenges in the storage, analysis, and visualization of that data. Additionally, there are many NGS analysis tools in existence, and finding the appropriate book or tutorial to use as a reference can be exceedingly difficult. This course will provide students in the School of Systems Biology with explicit experience accessing, analyzing, and manipulating NGS data, through command-line tools and through integrated platforms like Galaxy. Therefore, this course is an important learning resource for any students interested in bioinformatics analysis of NGS data. NGS data analysis has previously been taught at GMU as a special topic (BINF 739), but a permanent course that focuses on NGS data analysis does not exist.

Does this course cover material which crosses into another department? No

Learning Outcomes:

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

1. Discuss NGS technologies and their advantages and pitfalls.
2. Understand NGS data formats, how to manipulate these formats, and convert between them.
3. Utilize modern NGS software via command-line and integrated platforms to process NGS data, performing steps such as pre-processing of raw reads, quality control, and read mapping.
4. Develop a computational pipeline for the analysis of NGS data, which will be assessed through the course's final project.

Attach Syllabus

BINF 735 - NGS Data Analysis - Syllabus.pdf

Additional Attachments

Staffing:

Possible instructor: Amy K. Smith, PhD or Christopher Lockhart, PhD

Relationship to Existing Programs:

The proposed BINF 735 course will be included as an elective in the PhD and MS Bioinformatics and Computational Biology programs. It may also be taken as elective by the students from Biology MS and Biosciences PhD programs.

Relationship to Existing Courses:

The School of Systems Biology (SSB) has offered Next Generation Sequencing for the past three years (Fall 2020, Fall 2021, and Fall 2022) as a special topic (BINF 739) taught by Dr. Amy K. Smith. BIOS 715

(Introduction to Molecular Ecology) also covers Next Generation Sequencing technology; however, the focus of the course is on ecology and does not specifically or exhaustively cover NGS data analysis. Additionally, in Fall 2019 the Biology department offered a special topic course (BIOL 575) on Next Generation Sequencing Techniques.

Additional Comments:

Reviewer Comments

Key: 18151

BINF 735 Next Generation Sequencing Data Analysis

School of Systems Biology
George Mason University
Manassas, VA

Instructor: Chris Lockhart (he/him)
Email: clockha2@gmu.edu
Phone: Microsoft Teams
Office Hours: Zoom, by appointment (schedule with Microsoft Bookings)

Course Modality: In person or remote
Course Website: Blackboard

Credits: 3

Course Description

This course introduces students to next generation sequencing (NGS) technologies and computational pipelines to store, validate, quantify, and visualize NGS data. Students will be exposed to the concepts and software driving NGS analysis and will acquire hands-on experience utilizing these tools both through the command-line and through integrated platforms. Students will demonstrate practical knowledge of NGS data analysis through the course's final project, which will require students to produce an analytical pipeline and present their findings in written form.

Prerequisites: Equivalent of BINF 531/631 (molecular biology) and BINF 634 (bioinformatics programming) or with permission of the instructor.

Learning Outcomes

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

1. Discuss NGS technologies and their advantages and pitfalls.
2. Understand NGS data formats, how to manipulate these formats, and convert between them.
3. Utilize modern NGS software via command-line and integrated platforms to process NGS data, performing steps such as pre-processing of raw reads, quality control, and read mapping.
4. Develop a computational pipeline for the analysis of NGS data, which will be assessed through the course's final project.

Course Material

Textbook: Next Generation Sequencing and Data Analysis. (2021) Springer. Editor: Melanie Kappelmann-Fenzl. ISBN: 978-3-030-62490-3

Tentative Course Topics

Lecture	Topic
1	Review of molecular biology and genetics
2	Introduction to next generation sequencing (NGS) technologies Experimental design
3	NGS databases NGS data formats Introduction to Linux terminal and R/Bioconductor
4	NGS data quality control (working with raw NGS data, visualizing the quality, and pre-processing) Introduction to Galaxy (usegalaxy.org)
5	*De novo* sequence assembly Mapping to reference sequences
6	Working with SAM files Integrated Genomics Viewer (IGV)
7	Midterm exam
8	Variant calling, filtering, and annotation
9	RNA-seq Differential expression
10	ChIP-seq
11	Metagenomic analysis
12	Pathway analysis Clustering Gene ontology
13	Survey of advanced analyses, including machine learning
14	Applications Case study Outlook

Each lecture is a 2 ½ hour presentation with a 10-minute break.

Course Policies

Grading scale (points): A+ (>100), A (90-100), B (80-89), C (≤79).

Grading policy: Students will be graded on homework (30%), a midterm exam (25%), a final project (25%), and class participation (20%).

- Homework assignments will be equally weighted and will involve several theoretical and/or practical problems related to the weekly lecture.
- The midterm exam will be administered half-way through the semester and will be a practical evaluation of material learned to date in the course.
- The final project will require students to analyze one of several example problems prepared by the instructor and present the results in written form.
- Class participation will be met by asking questions during lecture or presenting results during class working sessions. Students are expected to contribute to discussion at least once per class.

Campus closure: If the campus closes or class is canceled due to weather or other concern, students should check Blackboard and/or contact the instructor for updates on how to continue learning and information about any changes to events or assignments.

Late assignments and make-up work: In case of illness or quarantine, please contact the instructor to set up a plan for make-up work. Late assignments will not be accepted unless due to emergency, illness, quarantine, work-related, or other documented reasons.

Course recordings: All meetings in this class will be recorded to provide necessary information for students in this class. Recordings will be stored on Zoom and will only be accessible to students taking this course during this semester.

Other considerations: If there are any schedule issues related to religious holidays, please inform the instructor the first week of class.

Course Logistics

Content distribution: The course uses Blackboard for distributing lecture materials, submission of problem sets, and grading. Blackboard can be accessed by visiting https://mymason.gmu.edu and logging in with your MasonID and password.

Communication: Mason email will be used to distribute class updates and communicate with students (see Email section in Student Responsibilities). If you wish, please share your name and gender pronouns with the instructor and how best to address you in class and via email.

Course Technology Requirements

Software and hardware: This course uses Blackboard as a learning management system available at https://mymason.gmu.edu. Students are required to have regular, reliable access to a computer with an updated operating system (recommended: Windows 10 or Mac OS X 10.15 or higher) and a stable broadband Internet connection (cable modem, DSL, satellite broadband, etc., with a consistent 1.5 Mbps download

speed or higher). Activities and assignments in this course will use web-conferencing software (Blackboard Collaborate and/or Zoom). In addition to the requirements above, students are required to have a device with a functional camera and microphone.

Technical help: If you have difficulty with accessing Blackboard, please contact the ITS Support Center at (703) 993-8870 or support@gmu.edu. If you have trouble with using the features in Blackboard, email courses@gmu.edu.

Student Responsibilities

Email: Students must use their Mason email account to receive important University information, including communications related to this class. Per University policy, I will not respond to messages sent from or send messages to a non-Mason email address.

Academic integrity: The integrity of the University community is affected by the individual choices made by each of us. Mason has an Honor Code with clear guidelines regarding academic integrity. Three fundamental and rather simple principles to follow always are that: (1) all work submitted be your own; (2) when using the work or ideas of others, including fellow students, give full credit through accurate citations; and (3) if you are uncertain about the ground rules on a particular assignment, ask for clarification. No grade is important enough to justify academic misconduct. Plagiarism means using the exact words, opinions, or information from another person without giving the person credit. Writers give credit through accepted documentation styles, such as parenthetical citation, footnotes, or endnotes. Paraphrased material must also be cited, using the appropriate format for this class. A simple listing of books or articles is not sufficient. Plagiarism is the equivalent of intellectual robbery and cannot be tolerated in the academic setting. If you have any doubts about what constitutes plagiarism, please see me, or consult the Academic Integrity website at https://oai.gmu.edu/.

Disability accommodations: Disability Services at George Mason University is committed to providing equitable access to learning opportunities for all students by upholding the laws that ensure equal treatment of people with disabilities. If you are seeking accommodations for this class, please first visit http://ds.gmu.edu/ for detailed information about the Disability Services registration process. Then please discuss your approved accommodations with me. Disability Services is in Student Union Building I (SUB I), Suite 2500. Email: ods@gmu.edu | Phone: (703) 993-2474.

Student Services

University writing center: Take advantage of the Writing Center as you work on written assignments in this course. You can book a free 45-minute appointment to meet with a tutor on Zoom or to submit a draft for written feedback. Tutors will work with you on any phase of a writing project. They can help you develop your ideas, provide feedback on a draft, answer your questions, and show you strategies for brainstorming, organizing,

drafting, revising, and editing. To schedule an appointment, go to writingcenter.gmu.edu, register with the center, and make an appointment using the online scheduler. Watch this short video (https://youtu.be/LA-B0Szoe28) for more detailed guidance on making an appointment and send any questions to wcenter@gmu.edu.

University Libraries: University Libraries provides resources for distance learning students (See the Library website: https://library.gmu.edu/for/online).

Counseling and psychological services: The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance (See the Counseling and Psychological Services website: https://caps.gmu.edu).

Family Educational Rights and Privacy Act (FERPA): The Family Educational Rights and Privacy Act of 1974 (FERPA), also known as the "Buckley Amendment," is a federal law that gives protection to student educational records and provides students with certain rights (See the Registrar's Office website: registrar.gmu.edu/ferpa/).

Course Materials and Student Privacy

Video recordings of class meetings that are shared only with the instructors and students officially enrolled in a class do not violate FERPA or any other privacy expectation. Video recordings that only include the instructor (no student names, images, voices, or identifiable texts) may be shared without violating FERPA (but see University Policies: Privacy, for some qualifications and recommendations). All course materials posted to Blackboard or other course site are private to this class; by federal law, any materials that identify specific students (via their name, voice, or image) must not be shared with anyone not enrolled in this class.

Video conferencing or recordings: Video recordings - whether made by instructors or students — of class meetings that include audio, visual, or textual information from other students are private and must not be shared outside the class. Live video conference meetings (e.g. Collaborate) that include audio, textual, or visual information from other students must be viewed privately and not shared with others in your household or recorded and shared outside the class.