Master Course Syllabus

For additional course information, including prerequisites, corequisites, and course fees, please refer to the Catalog: https://catalog.uvu.edu/

Semester: Spring
Year: 2025
Course Prefix: BIOL
Course and Section #: 1011-002
Course Title: Introduction to Bioinformatics
Credits: 3

Course Description

With the development and influx of new technologies, such as next-generation and third generation sequencing, biological data is generated faster and faster at less and less cost. It has become increasingly unwieldy to both manage and analyze these data in a robust and efficient manner. Bioinformatics is a rapidly evolving interdisciplinary field in which computational resources are necessary to investigate and interpret complex biological data. This course covers a broad range of fundamental topics within bioinformatics, including genome sequencing and assembly, bioinformatics databases, sequence alignment, protein structure prediction. This course uses current examples to introduce an overview of methodologies and applications sufficient to introduce students to the field of bioinformatics as a whole. Designed as a General Education and Core course for Bioinformatics majors to introduce students to this growing field.

Course Attributes

This course has the following attributes:
☐ General Education Requirements
☐ Global/Intercultural Graduation Requirements
☐ Writing Enriched Graduation Requirements
☒ Discipline Core Requirements in Program
☐ Elective Core Requirements in Program
☒ Open Elective
Other: *Click here to enter text.*

Instructor Information

Instructor Name: Dr. Carl E Hjelmen

Student Learning Outcomes

1. Understand and explain science as an iterative process driven by empirical observation and experimentation, and appreciate the limits imposed on our comprehension and knowledge by sensory, physical, or technical constraints.
2. Apply scientific methods by quantitatively investigating and assessing situations extracted from ordinary experience or from societal or environmental problems related to modern science.
3. Demonstrate understanding of some of the fundamental unifying principles of the life sciences, which include evolution, heredity and reproduction, essential chemical and physical components

required for life, and the human role in, and impact on, the biosphere, including the importance of biodiversity and sustainability of ecosystems.
4. Distinguish the process of science from other ways of understanding the world.
5. Evaluate evidence to solve problems using scientific thinking.
6. Describe the basic terminology and principles of the bioinformatic "omics" - such as genomics, transcriptomics, proteomics, etc.
7. Contrast the different methodologies of DNA sequencing.
8. Effectively use databases, websites, and computational methods for studying biological data in relation to the evolution of genes, proteins, and whole genomes.
9. Interact with the practical applications of bioinformatics, including some basic coding

Course Materials and Texts

No required text

Course Requirements

Course Assignments, Assessments, and Grading Policy

Assignments:

Unless otherwise stated, there will be weekly assignments. These will be made available on Canvas and should be turned in electronically by the date on the assignment. As these are submitted electronically, they should be typed and in correct file format (doc, docx, pdf. **NOT PAGES**)

Project:

Your "final" will be a "cumulative" project. You will be given a scenario and a few pieces of data. You are required to use your newly learned bioinformatics and scientific skills to analyze and interpret the data you are given and provide a short write-up and submit an R-script. More details will be provided later in the course.

Exams:

Exams will be open-book take home exams. While I encourage students to work together in most aspects of the course, exams are to be completed individually. Exam questions will be posted on Canvas after class the Thursday before they are due, and must be submitted online by class time the following Tuesday. These exams will be subject to plagiarism checks using Unicheck. Exams 1 and 2 are worth 11% of your final grade, whereas Exam 3 is worth 13% of your final grade

Grade calculation:

Your final grade will be determined by the following formula. Keep in mind that these scores are weighted to percentage. For example, if assignments are removed for any reason, the assignments will still be worth 30% of your grade.

Late work:

I will keep the window for submitting assignments open, but they will accrue a 10% grade per day deduction if submitted after their respective exam. (ex: week 2 homework submitted after Exam 1, week 8 homework after exam 2, etc.)

I understand that life can be chaotic and there are many things outside of your control. **If you are unable to complete an assignment for any reason by the due date, please let me know and we can work something out**! Remember to always let Dr. Hjelmen know if you're going to be late!

Required or Recommended Reading Assignments

Lesk: Preface, pp.34-47 Gauthier et al. 2019 Markowetz 2017
Lesk: pp. 1-7
Lesk: pp. 9-17, 49-58 Crick 1970
Lesk: pp. 88-122
Lesk: pp. 57-67
Shendure et al. 2017 Sims et al. 2014 Logsdon et al. 2020 Heather and Chain 2015 Goodwin et al. 2016
Lesk: pp. 68-73 Rice and Green 2017
Lesk: pp. 123-143 Langmead and Nellore 2018 Erlich and Narayanan 2014
Lesk: pp. 154-171 Kapli et al. 2020
Lesk: pp. 356-372 Lesk: pp. 378-393 Stark et al. 2019

General Description of the Subject Matter of Each Lecture or Discussion

Week	Day	Material	Assignments/ Activities
1	01/07 T	Introduction to Bioinformatics	Syllabus quiz

	01/09 R	Scientific Process	
2	01/14 T 01/16 R	Evolution Evolution pt. 2	Sci. Process Case Study
3	01/21 T 01/23 R	**NO CLASS** Inheritance	Evolution Worksheet
4	01/28 T 01/30 R	Inheritance and Variation Central Dogma-DNA structure	Inheritance Assignment
5	02/04 T 02/06 R	DNA Replication RNA Transcription	DNA Structure
6	02/11 T 02/13 R	Protein Translation Central Dogma—Omics	***TAKE HOME EXAM 1 DUE: Feb 11***
7	02/18 T 02/20 R	Genome Sequencing Intro Next and 3rd Generation Sequencing	Sequencing intro Assignment
8	02/25 T 02/27 R	Steps of Sequencing Processing Genome Assembly	Sequencing Assignment
9	03/04 T 03/06 R	Genome Assembly pt. 2 BLAST	BLAST Assignment (In Class)
-	**03/10-03/15**	**Spring Break**	
10	03/18 T 03/20 R	Other uses of NCBI Phylogenetics	NCBI Activity
11	03/25 T 03/27 R	Phylogenetic Hands on Biology and Computers	Building your own Phylogeny (in Class) ***TAKE HOME EXAM 2 DUE: Mar 25***
12	04/01 T 04/03 R	DNA Kits/Genetic Privacy Introduction to R	
13	04/08 T 04/10 R	Using R	R Assignment
14	04/15 T 04/17 R	Subsetting Data Writing a function	
15	04/22 T	Identifying Types of Chromosomes	***TAKE HOME EXAM 3 DUE: Apr 22***

Required Course Syllabus Statements

Generative AI

Artificial intelligence (AI) is becoming an ever-prevalent tool in society and it is important to understand how this tool works. It is important to recognize this as a "tool" and not a "crutch". AI is prone to "hallucinating" and giving incorrect or false results; it also does not allow me to gauge **your understanding** of material. I encourage use of all resources for your work but ask that you make it your own and that you do not ask AI to complete your assignments for you. If you utilize AI, be sure to indicate it in your response that you used AI and indicate how you corrected the response and made it your own. If I feel you are not adequately responding or that you are relying on AI too much, I reserve the right to remove points on responses, up to zero credit.

Using Remote Testing Software

☒ This course does not use remote testing software.

☐ This course uses remote testing software. Remote test-takers may choose their remote testing locations. Please note, however, that the testing software used for this may conduct a brief scan of remote test-takers' immediate surroundings, may require use of a webcam while taking an exam, may require the microphone be on while taking an exam, or may require other practices to confirm academic honesty. Test-takers therefore shall have no expectation of privacy in their test-taking location during, or immediately preceding, remote testing. If a student strongly objects to using test-taking software, the student should contact the instructor at the beginning of the semester to determine whether alternative testing arrangements are feasible. Alternatives are not guaranteed.

Required University Syllabus Statements

Accommodations/Students with Disabilities

Students needing accommodations due to a permanent or temporary disability, pregnancy or pregnancy-related conditions may contact UVU Accessibility Services at accessibilityservices@uvu.edu or 801-863-8747.

Accessibility Services is located on the Orem Campus in BA 110.

Deaf/Hard of Hearing students requesting ASL interpreters or transcribers can contact Accessibility Services to set up accommodations. Deaf/Hard of Hearing services can be contacted at DHHservices@uvu.edu

DHH is located on the Orem Campus in BA 112.

Academic Integrity

At Utah Valley University, faculty and students operate in an atmosphere of mutual trust. Maintaining an atmosphere of academic integrity allows for free exchange of ideas and enables all members of the community to achieve their highest potential. Our goal is to foster an intellectual atmosphere that produces scholars of integrity and imaginative thought. In all academic work, the ideas and contributions of others must be appropriately acknowledged and UVU students are expected to produce their own original academic work.

Faculty and students share the responsibility of ensuring the honesty and fairness of the intellectual environment at UVU. Students have a responsibility to promote academic integrity at the university by not participating in or facilitating others' participation in any act of academic dishonesty. As members of the academic community, students must become familiar with their rights and responsibilities. In each course, they are responsible for knowing the requirements and restrictions regarding research and writing, assessments, collaborative work, the use of study aids, the appropriateness of assistance, and other issues. Likewise, instructors are responsible to clearly state expectations and model best practices.

Further information on what constitutes academic dishonesty is detailed in UVU Policy 541: *Student Code of Conduct*.

Equity and Title IX

Utah Valley University does not discriminate on the basis of race, color, religion, national origin, sex, sexual orientation, gender identity, gender expression, age (40 and over), disability, veteran status, pregnancy, childbirth, or pregnancy-related conditions, citizenship, genetic information, or other basis protected by applicable law, including Title IX and 34 C.F.R. Part 106, in employment, treatment, admission, access to educational programs and activities, or other University benefits or services. Inquiries about nondiscrimination at UVU may be directed to the U.S. Department of Education's Office for Civil Rights or UVU's Title IX Coordinator at 801-863-7999 – TitleIX@uvu.edu – 800 W University Pkwy, Orem, 84058, Suite BA 203.

Religious Accommodation

UVU values and acknowledges the array of worldviews, faiths, and religions represented in our student body, and as such provides supportive accommodations for students. Religious belief or conscience broadly includes religious, non-religious, theistic, or non-theistic moral or ethical beliefs as well as participation in religious holidays, observances, or activities. Accommodations may include scheduling or due-date modifications or make-up assignments for missed class work.

To seek a religious accommodation, a student must provide written notice to the instructor and the Director of Accessibility Services at accessibilityservices@uvu.edu. If the accommodation relates to a scheduling conflict, the notice should include the date, time, and brief description of the difficulty posed by the conflict. Such requests should be made as soon as the student is aware of the prospective scheduling conflict.

While religious expression is welcome throughout campus, UVU also has a specially dedicated space for meditation, prayer, reflection, or other forms of religious expression.