Introduction to Bioinformatics – F 2023
BIOL 1011 Section 001/002 – 3 Credits
Utah Valley University

Instructor Information
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Office hours:
Monday 1-2pm and Thursday 4-5pm or by Appointment

Resources:

Text:
No required text. Supp. Text (up to you): Introduction to Bioinformatics 5th Ed., AM Lesk

If you are interested in the topic we are discussing, additional readings on the topic will be available on Canvas. These are not required readings but may increase your understanding of the topic.

Course website:
Canvas. Additional helpful resources are also available on **https://cehjelmen.github.io**
You can access these sites from any computer linked to the internet.

Access to Canvas will be critical as assignments, grades, updates, and other announcements will be posted there.

Computation:
While much of this class will rely on paying attention to lecture and participation in discussion and activities, some work requires use of a computer with internet access. I highly suggest that you bring your own laptop to class. **Please let me know if this is not possible.**

Course Information:

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.

Life Sciences GE Course Learning Objectives:
Upon completion of this course, students will be able to:
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.

Course Learning Outcomes
Upon completion of this course, students will be able to:
1. Distinguish the process of science from other ways of understanding the world.
2. Evaluate evidence to solve problems using scientific thinking.
3. Describe the basic terminology and principles of the bioinformatic "omics" - such as genomics, transcriptomics, proteomics, etc.
4. Contrast the different methodologies of DNA sequencing.
5. Effectively use databases, websites, and computational methods for studying biological data in relation to the evolution of genes, proteins, and whole genomes.
6. Interact with the practical applications of bioinformatics, including some basic coding

Course Expectations:
Student Responsibilities

Everyone (students and instructor) should treat others with mutual respect and patience. I encourage students to work together to solve problems, unless otherwise explicitly stated. I recognize students come from their own unique background and have had their own unique experiences. If you need any special accommodations or assistance, please do not hesitate to contact me with questions.

How to do well in this course:

How well you do will be directly related to the effort you put into it. Below are suggestions:
1. <u>Regular attendance</u> - You will benefit from class discussion and activities. Furthermore, the class needs your participation to establish a group dynamic that provides encouragement and support.
2. <u>Be prepared</u> - Please do assigned readings and assignments on time. If you are interested, I can always provide additional reading materials.
3. <u>Listening and Speaking</u> - We will practice being generous and respectful listeners. Know that the class will benefit from what you have to contribute. Please, no side conversations.
4. <u>Additional Information</u> - Keep up with the work--it's not intended to be difficult, but you can't stir up your thinking without a commitment to taking the class seriously. You will be required to do additional informal assessments and exercises. Many of these exercises will be in-class work; if you have sustained absences, you will have difficulty passing the course.
5. <u>Making your needs known</u> - Please let me know what your needs are throughout the term. I am happy to work with you to improve your experience in this course when possible.
6. <u>Writing</u> – Assignments must be typed unless otherwise specified. Well-written English and good spelling are expected; I will deduct points for excessive spelling and/or grammar errors on any assignment.
7. <u>Distractions</u> – Unless told otherwise, put away all electronic devices during class.
8. <u>Success may take time outside of class</u> - Mastery isn't immediate. Part of success is spending as much time studying that is necessary for you. This amount will vary from student to student. If you need tips or help, please contact me.

Professor Responsibilities

It will be my goal in this course to be prepared, organized, and provide a safe, productive environment to learn. Students can be expected to be treated fairly, and with respect. Additionally, all assignments will be graded and returned in a timely manner.

I will be available outside of class time to help any students who ask for it during student hours. If for any reason you cannot meet with me during the pre-determined times, you are welcome to contact me to discuss arranging an additional meeting time. You are always welcome to come by my office, but unless it is arranged in advance, I cannot guarantee I will be available.

The best method to reach me is through e-mail, however please be patient and recognize that you may not always receive an immediate response. I will do my best to respond in a timely manner within reasonable hours, but e-mails sent late at night will not be responded to until the next day.

Disclaimer - Communication and Syllabus Changes

All items in this syllabus are subject to change or modification to correct errors or accommodate extenuating circumstances. You are responsible for messages sent by me and other UVU officials to your UVU email address. If you do not regularly use this address, please forward your UVU email to the address you regularly use. Please check the email for important class announcements and updates.

Assessment:

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.

Assignment	% of grade
Exams	35
Quizzes and assignments	35
Project	30
Total	100

Grading scale:
We will follow the following standard as a grading scale:

		A	94 - 100%	A-	90 - 93%
B+	87 - 89%	B	83 - 86%	B-	80 - 82%
C+	77 - 79%	C	73 - 76%	C-	70 - 72%
D+	67 - 69%	D	63 - 66%	D-	60 - 62%
E	<60				

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!

Cheating and plagiarism:
I encourage students to work together to solve problems, unless otherwise explicitly stated. This does not mean copying answers. I do not tolerate cheating of any kind, including copying from another student on exams or assignments. I will impose one of several penalties for cheating that range from a warning up to assigning a failing grade for the course. Please ask me if you are not sure about what constitutes plagiarism.

UVU Policies and Resources
Policies and Success Strategies (Links to an external site.)

Accessibility Services (Links to an external site.)
- Students who need accommodations because of a disability may contact the UVU Office of Accessibility Services (OAS), located on the Orem Campus in LC 312. To schedule an appointment or to speak with a counselor, call the OAS office at 801-863-8747. Deaf/Hard of Hearing individuals, email nicole.hemmingsen@uvu.edu or text 385-208-2677.

Campus Resources (Links to an external site.)

Technology Support Services
 For 24/7 technical support contact Instructure's Canvas Support Live Chat (Links to an external site.)
(385) 204-4930 (Available 24/7)

Student Care Statement

Any student who has difficulty affording groceries or accessing sufficient food to eat every day, or who lacks a safe and stable place to live, and believes this may affect their performance in the course, is urged to visit https://www.uvu.edu/studentcare/ for access to a variety of resources. You may also email care@uvu.edu for assistance.

 All of us have a need to maintain mental health and benefit from the assistance of professionals to do so. UVU offers mental health services at very low cost (some are free). While there may be a wait list for individual counseling, group counseling may be available in some circumstances. Student Health Services is

located in SC 221, telephone 801-863-8876 https://www.uvu.edu/studenthealth/psych/ . The following community resources are available 24/7- the National Suicide Prevention Lifeline 1-800-273-8255 and the Safe UT Crisis Chat & Tip Line https://safeut.med.utah.edu/. You may also access the Crisis Text Line 741-741 or call 9-1-1. If an emergency is happening on campus, call campus police 801-863-5555.

Tentative Course Schedule

Here is a (tentative) schedule for topics. It is your responsibility to make up any work that you might miss if absent. Assignments are listed the week they are due. Recommended readings are not required but may improve your understanding of the material. Lesk is the book listed at the top of the syllabus; any other readings can be found on Canvas.

Week	Day	Material	Assignments/ Activities	Recommended Readings:
1	08/24 R	Introduction to Bioinformatics	Syllabus quiz	Lesk: Preface, pp.34-47 Gauthier et al. 2019 Markowetz 2017
2	08/29 T	Scientific Process	Sci. Process Case Study	Lesk: pp. 1-7
	08/31 R	Evolution		
3	09/05 T	Evolution	Evolution Worksheet	
	09/07 R	Inheritance		
4	09/12 T	Variation and Selection	Inheritance Assignment	Lesk: pp. 9-17, 49-58 Crick 1970
	09/14 R	Central Dogma-DNA structure		
5	09/19 T	DNA Replication	DNA Structure	Lesk: pp. 88-122
	09/21 R	RNA Transcription		
6	09/26 T	Protein Translation	*TAKE HOME EXAM 1 DUE: SEP 26*	Lesk: pp. 57-67
	09/28 R	Central Dogma—Omics		
7	10/03 T	Genome Sequencing Intro	Sequencing intro Assignment	Shendure et al. 2017 Sims et al. 2014 Logsdon et al. 2020 Heather and Chain 2015 Goodwin et al. 2016
	10/05 R	Next and 3rd Generation Sequencing		
8	10/10 T	Steps of Sequencing Processing	Sequencing Assignment	Lesk: pp. 68-73 Rice and Green 2017
	10/12 R	Genome Assembly		
9	10/17 T	Genome Assembly pt. 2		
	10/19 R	*NO CLASS—FALL BREAK*		
10	10/24 T	BLAST	BLAST/NCBI Assignment (In Class)	Lesk: pp. 123-143 Langmead and Nellore 2018
	10/26 R	Other uses of NCBI		

				Erlich and Narayanan 2014
11	10/31 T	Phylogenetics	***TAKE HOME EXAM 2 DUE: OCT 31***	Lesk: pp. 154-171
	11/02 R	Phylogenetics Hands on	Building your own Phylogeny (in Class)	Kapli et al. 2020
12	11/07 T	DNA Kits/Genetic Privacy		Lesk: pp. 356-372 Lesk: pp. 378-393
	11/09 R	Biology and Computers		Stark et al. 2019
13	11/14 T	Introduction to R		
	11/16 R	Using R		
-	**11/20-11/24**	**Thanksgiving Break**		
14	11/28 T	Using R	R Assignment	
	11/30 R	Subsetting Data		
15	12/05 T	Writing a Function	***TAKE HOME EXAM 3 DUE: DEC 05***	
	12/07 R	Identifying Types of Chromosomes		

Final Exam: Submit Final "project" DUE DEC 12