

BIOL 2300
Fundamentals of Bioinformatics
(2 credits)
Syllabus—Spring 2024

Course Instructor

Name: Dr. Randy Klabacka
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Office hours: Tue 3:00-4:30
Wed 12:30-1:20* ; 3:00-4:30
Fri 1:00-2:00

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Course Teaching Assistant

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Course Details

Credits:	2
When:	Mondays and Wednesdays 1:30–2:20 pm
Where:	SET 216
Prerequisites:	BIOL 1610 and BIOL 1615 (or other intro bio)
Course materials:	You will need a laptop for this course (If you don't have one, there is a laptop loaning program in the biology department—reach out to your instructor for more info) Additional materials will be provided by the instructor during the course of the semester

Student Success Statement

Per Utah Tech University Policy, “students should plan to spend two hours on coursework outside of class for each hour they spend in class for each college credit. For example, a 2 credit course meets for two hours per week and requires an average of four additional hours of work outside of class per week.” (<https://catalog.utahtech.edu/academicpoliciesandprocedures/>). Students who are struggling to study effectively should reach out to their instructor who will help them develop a study plan.

Course description

This course provides students with exposure to broad themes in bioinformatics. Specifically, it is focused on: the objectives of bioinformatics, the overarching techniques of bioinformatics, and bioinformatics-related career opportunities. No coding experience is required for this course.

Course Objectives

This course has two primary objectives: (1) Provide students with exposure to broad themes in bioinformatics, and (2) Introduce students to common bioinformatics tools and basic principles of computational biology. For the first objective, students will learn (i) the aims and purposes of bioinformatics, (ii) the overarching techniques of bioinformatics, and (iii) bioinformatics-related career opportunities. For the second objective, students will learn (i) basics of computer programming in Python and BASH, (ii) how to analyze DNA/RNA/proteins using common graphical user interfaces, and (iii) how to analyze biological data using computer science.

Course Learning Outcomes

The BIOL 2300 course at Utah Tech University has developed a set of program learning outcomes (PLOs). At the successful conclusion of this course, students will be able to:

1. Explain how bioinformatics is used in diverse research fields
2. Describe bioinformatics-related career opportunities
3. Evaluate the scientific literature in bioinformatics and applications in society
4. Perform basic bioinformatic analyses of biological data

Program Learning Outcomes

The Biological Sciences Department at Utah Tech University has developed a set of program learning outcomes (PLOs). The key DBS student learning outcomes that we will address in BIOL 2300 are:

- PLO 1: Outline the foundational concepts of biology including cellular, organismic, ecological, and evolutionary biology.
- PLO 2: Evaluate hypotheses, design research, test hypotheses, conduct data analysis, and draw conclusions on biology related problems.
- PLO 3: Integrate knowledge of scientific literacy in oral and written assignments when communicating biological topics.
- PLO 4: Evaluate information to discriminate between science and non-science.

Course website

The syllabus, grades, announcements, and some class materials will be posted on the Canvas website for this course. Search around and familiarize yourself with this site.

Some class materials will be available elsewhere on the web (e.g., <http://klab-ut.github.io/coursemat/0B>).

Course Assignments and Grading

Course points

Item	Points
Participation	20 (6.7%)
Guest Bioinformatician Questions	20 (6.7%)
Activities	180 (60%)
Interview Project	40 (13.3%)
Final Exam	40 (13.3%)
Total:	300

Letter grade distribution

Percentage	Grade
≥ 90.0	A
80.0 – 90.0	B
70.0 – 80.0	C
60.0 – 70.0	D
<60.0	F

Participation

You will earn two points for showing up to each class and participating in class discussions (e.g., asking questions, interacting with guests, helping other students). Just showing up will get you 1 point; the second point will be earned based on the instructor’s perception of your class engagement.

Guest Bioinformatician Questions

Several guest bioinformaticians will be attending the class for Q&A sessions. It is your responsibility to prepare three questions based on the guest’s background. While designing questions, you should research (1) who the guest is (name, institution, institution history), (2) their research history (look at some of their papers and projects they have been involved in). Your questions should reflect your preparation. Question such as “What do you do for work?”, “Where did you go to school?”, and “What kind of research have you done?” will earn 0 points. Here is an example of a well-prepared question: “I read your research paper on _____ and thought it was interesting that you used _____ to test the hypothesis _____. I saw that you used _____ in your methodology, what was it like learning how to use that methodology?”.

You will complete this assignment for each guest, and each assignment will be worth 10 pts (2 guests = 20 pts total). Each assignment should be submitted on Canvas before the assigned due date. For each guest, here is a template that you should use for the completion of this assignment:

Guest Bioinformatician Question Template

Guest name:

Guest institution:

Guest academic background (Where attended? BS? MS? PhD? MBA?):

Research focus:

Journals where research has been published:

Question 1:

Question 2:

Question 3:

Lab activities

Bioinformatics lab activities will be introduced in each class and students will have time to orient themselves. Each lab activity will be worth 15 pts. Lab activities allow students to actively engage in bioinformatics at an introductory level; students will use tools regularly used by bioinformaticians including language learning models (LLM), NCBI, BLAST, Aliview, Unipro, and the coding languages BASH and Python. The description and requirements for each lab activity will be located on Canvas, where the activity will be submitted before the assigned due date. Activities will be graded primarily for completion, with the requirement that the task has been completed successfully. Partial credit may be awarded based on the instructor's judgement. Late submissions will receive a one percent reduction for each day the assignment is late.

Lab Activity Number	Lab Activity Title	Due Date
Lab Activity 1	Using AI LLM to learn about bioinformatics	Jan 17
Lab Activity 2	Looking at DNA <i>in silico</i>	Jan 31
Lab Activity 3	Transcribe a DNA sequence	Feb 7
Lab Activity 4	Replicate a DNA sequence	Feb 14
Lab Activity 5	Translate a DNA sequence	Feb 14
Lab Activity 6	Using NCBI and GenBank	Feb 21
Lab Activity 7	Creating a multiple sequence alignment	Feb 28
Lab Activity 8	Estimating a phylogeny	Mar 6
Lab Activity 9	Reading a bioinformatics publication	Mar 20
Lab Activity 10	Bioinformatics pipelines	Mar 27
Lab Activity 11	Using IGV with human genome data	Apr 3
Lab Activity 12	Using PyMol	Mar 19
Total Points (each worth 15):		180

Code Review

You will research an individual that uses bioinformatics in their research / career and prepare a 12-minute presentation about who they are and what kind of research / work do they do. You will also examine some of their code (e.g., on their github page) and provide an explanation about how it works.

At week 8 each student is required to submit a name for the person they plan to research and a publication of theirs that they plan to review. This checkpoint will be worth 2 points of the Code Review grade. No late items will be accepted for the Code Review Project- everything must be turned in before the due-date.

Students will be randomly assigned a presentation date (see schedule). Each presentation should consist of a one-to-two-minute introduction of the scientist (name, institution, academic background, their career path, any other relevant information), a five-minute description of their research / work (including a thorough example of a published research paper), a five-minute dissection of some of their published code, and a one-to-two-minute reflection on what you learned during this project. A minute or two will also be used after the presentation for questions.

Here is the rubric for this assignment:

Code Review Project Rubric

Item	Points
Introduction	10
Name	2
Institution	2
Academic background	2
Career path	2
Research / Work	10
Summary of research focus (question[s] they address)	2
Introduction of research publication (hypothesis and predictions)	2
Description of how bioinformatics was used in publication	3
Description of an important figure/table from the publication	3
Summary of the findings from the publication	2
Code dissection	8
Location of code (how to find it)	2
Visual overview of code (show us the script)	2
Description of the overall purpose of the code	3
Reference of principles learned in class seen within the code	3
Conclusion	4
What you learned during this assignment	2
Delivery	8
Interviewee was approved by the instructor at week 6	2
Overall aesthetic and flow of presentation	2
Ability to answer questions	2
Timing (not too long, not too short)	2
Total Points:	40

Final Exam

The final exam will consist of a coding portion and a non-coding portion. The coding portion will consist of coding questions related to the activities. The non-coding portion will consist of questions focused on bioinformatics concepts. The exam will be administered on Wednesday May 1 from 1:30-2:50 pm in SET 216.

Schedule

Week 1 (Jan 8 – 14): Introduction			
	Monday	In-class Topic: Intro to Lab Activity 1 :	Syllabus and introduction to bioinformatics
	Wednesday	In-class Topic:	Using AI to learn about bioinformatics Overview of opportunities in bioinformatics
Week 2 (Jan 15 – 21): Installation week			
	Monday	NO CLASS	Martin Luther King, Jr. Day
	Wednesday	Due before class: In-class Topic:	Lab Activity 1 Installing a UNIX system
Week 3 (Jan 22 – 28): Python bootcamp cont.			
	Monday	In-class Topic: Intro to Lab Activity 2:	Navigating the command line DNA in-silico
	Wednesday	In-class Topic:	Variables
Week 4 (Jan 29 – Feb 4): Python bootcamp cont.			
	Monday	In-class Topic: Intro to Lab Activity 3:	Python collections Transcribe a DNA sequence
	Wednesday	Due before class: In-class Topic:	Lab Activity 2 Loops and Flow Control
Week 5 (Feb 5 – 11): Python bootcamp cont.			
	Monday	Due before class: In-class Topic: Intro to Lab Activity 4:	Guest bioinformatician questions (guest TBA) Functions Replicate a DNA sequence
	Wednesday	Due before class: In-class Topic: Intro to Lab Activity 5:	Lab Activity 3 Python libraries and modules Translate a DNA sequence
Week 6 (Feb 12 – 18): Public bioinformatics resources			
	Monday	Due before class: In-class Topic: Intro to Lab Activity 6:	Guest bioinformatician questions (guest TBA) Public genetic databases Using NCBI and GenBank
	Wednesday	Due before class: In-class Topic:	Lab Activity 4 and Lab Activity 5 Bioinformatics literature and finding published code
Week 7 (Feb 19 – 25): Sequence alignments			
	Monday	Due before class: In-class Topic: Intro to Lab Activity 7:	Guest bioinformatician questions (guest TBA) Aligning and Visualizing Sequence Data Creating a Multiple Sequence Alignment
	Wednesday	Due before class: In-class Topic:	Lab Activity 6
Week 8 (Feb 26 – Mar 3): Using variation to make biological inference			
	Monday	Due before class: In-class Topic: Intro to Lab Activity 8:	Guest bioinformatician questions (guest TBA) Utility of Sequence Alignments Estimating a Phylogeny
	Wednesday	Due before class: In-class Topic:	Lab Activity 7
Week 9 (Mar 4 – 10): Bioinformatics literature			
	Monday	Due before class: In-class Topic: Intro to Lab Activity 9:	Author name and publication for code review How to read bioinformatics literature Reading a bioinformatics article
	Wednesday	Due before class: In-class Topic:	Lab Activity 8
Week 10 (Mar 11 – 17): Spring Break			
	Mar 11 – 15	NO CLASS	Spring Break
Week 11 (Mar 18 – 24): Bioinformatic processing of genomic data			
	Monday	Due before class: In-class Topic: Intro to Lab Activity 10:	Author name and publication for code review How bioinformatics pipelines are used for genomic data Bioinformatics Pipelines
	Wednesday	Due before class: In-class Topic:	Lab Activity 9
Week 12 (Mar 25 – 31): GUIs in bioinformatics			
	Monday	In-class Topic: Intro to Lab Activity 11:	Variant Visualization Using IGV with human genome data
	Wednesday	Due before class: In-class Topic:	Lab Activity 10
Week 13 (Apr 1 – 7): GUIs in bioinformatics cont.			
	Monday	In-class Topic: Intro to Lab Activity 12:	Translating sequence variation to structure Using PyMol
	Wednesday	Due before class: In-class Topic:	Lab Activity 11
Week 14 (Apr 8 – 14): Careers for people who know bioinformatics			
	Monday	In-class Topic:	Bioinformatics and Machine Learning
	Wednesday	Due before class: In-class Topic:	Lab Activity 12 Course summary and exam prep
Week 15 (Apr 15 – 21): Student Presentations			
	Monday	In-class Topic:	Students present projects
	Wednesday	In-class Topic:	Students present projects
Week 16 (Apr 22 – 28): Student presentations			
	Monday	In-class Topic:	Students present projects
	Wednesday	In-class Topic:	Students present projects
Finals Week (Apr 29 – May 5)			
	May 1	Final Exam:	1:30-2:50pm

Course Policies

Class Inclusiveness

It is our intent that students from all backgrounds and perspectives be well-served by this course. We are committed to creating an inclusive space that fosters diversity along its many axes: ethnicity, race, sex, gender, disability, age, socioeconomic status, nationality, and culture. As your instructor and as a student in this class, it is our shared responsibility to develop and maintain a positive learning environment for everyone. Any type of discrimination or aggression toward your peers or instructor will not be tolerated. If you experience any form of discrimination in this course, please report your concern at <https://utahtech.edu/report-a-concern/>.

Disruptive Behavior Policy

Disruptive behavior includes, but is not limited to, conversations during instruction, use of electronic devices for purposes unrelated to the class, physical disruption (e.g., shouting, throwing objects, or physically intimidating others), and excessive lateness or early departure. Violations of this policy will result in a verbal or written warning (depending on the disruptive behavior), and further violations may result in the instructor asking a student to leave class (in which scenario they will lose their participation points for the day).

Makeup Policy

Students who miss the normal exams will need to contact the instructor and turn in the valid excuse within 48 hours from the time that the exams were given. The makeup exam schedule is determined by the instructor and will need to be done within ONE week (5 work days) from the time that the exams were given. The format, questions and difficulty-level of make-up exams are not guaranteed to be same as the normal exam, which are at the discretion of the instructors. The student and the instructor will agree upon a date and time for the makeup exam. Valid excuses include: 1). illness documented by a physician. 2) evidence of personal or family emergency. 3) official university excuses (e.g., college functions).

Instructor Communication Policy

It is your responsibility to read course announcements sent by your instructor (over Canvas). Your Utah Tech University email address is the university-approved form of communication between instructors and students. Students should give the instructor 48 hours to get back to them on any communication, and one week for grading turnaround time on major assignments.

Academic Integrity

Academic dishonesty is an offense that will be reported to the UTU Academic Integrity Committee and handled by the instructor following [University Policy 555](#). Acts of academic dishonesty include group work on quizzes/exams, sharing notes, communicating quiz/exam materials, and plagiarizing materials (including using machine learning natural language processing such as ChatGPT). Please refer to the following document for further information regarding academic honesty: [UTU Academic Integrity Committee](#)

Accessibility

Students who need accommodations are asked to electronically submit their approved accommodations to the UTU Disability Resource Center. If you need accommodations but have not established them, make an appointment with [Disability Resource Center](#), North Plaza Building (Beside the Testing Center), 435-652-7516.

Generative AI

Generative AI models, such as language learning models, are recognized as valuable tools for enhancing the learning process in this course. These models are approved for guiding your learning experience, aiding in creating practice problems, and facilitating solution exploration. However, it's important to emphasize that while generative AI can support your understanding, it must not be employed to directly answer questions or complete assignments. Use of generative AI to develop practice problems and work through their solutions is encouraged as a study method. Misuse of generative AI will be considered an act of academic dishonesty in this course. If you have any uncertainties or inquiries regarding the appropriate utilization of generative AI, please reach out to the instructor. Open discussions about responsible AI implementation are welcomed, ensuring that we collectively uphold the educational value of these technologies. (This section was written with the help of chatGPT).

Important University Dates

See the [UTU Academic Calendar](#)

- Jan 8: Date classwork begins
- Jan 8: Tuition and fees due
- Jan 12: Last day to add without instructor signature
- Jan 15: Dr. Martin Luther King, Jr. Day (no classes)
- Jan 18: Drop/Audit fee begins
- Jan 20: End of 100% Refund Period
- Jan 29: Pell Grant Census
- Jan 29: Last day to drop
- Jan 29: Last day for refund
- Feb 5: Last day to add/audit
- Feb 19: President's Day Holiday (no classes)
- Mar 1: Midterm grades posted
- Mar 5: Last day to withdraw from class
- Mar 11-15: Spring Break (no classes)
- Apr 25: Date classwork ends
- Apr 26: Reading Day
- Apr 29-30 & May 1-2: Final Exams
- May 6: Final grades posted

Useful Links

[Disability Resource Center](#)

[IT Help Desk](#)

[Library](#)

[Testing Center](#)

[Tutoring Center](#)

[Writing Center](#)

Title IX Statement

Utah Tech University affirms its commitment to the promotion of fairness and equity in all aspects of the educational institution. Harassment and discrimination – including sex/gender discrimination, gender identity, gender expression, sexual harassment, sexual misconduct, gender-based violence, dating violence, domestic violence, stalking, pregnancy or parental , family or marital status and or retaliation –not only disrupts our commitment to maintaining an environment in which every member of the University community is treated with respect and dignity, but may also

violate University policy and federal, state, and/or local law.

Should you or someone you know experience behavior that is coercive, discriminatory, harassing, and or sexually violent in nature, or if you or someone you know has questions about their rights and options regarding such behavior, you are encouraged to contact:

– Hazel Sainsbury, Dir. Of Equity Compliance, Title IX Coordinator: 435-652-7747 (ext. 7747)
hazel.sainsbury@utahtech.edu ; titleix@utahtech.edu

Incidents may also be reported directly to law enforcement, either separately or in conjunction with any report made to the University's Title IX Coordinator, and the University will aid in making contact if requested.

– Utah Tech University Police: 435-275-4300 or by calling 9-1-1.

Maintaining a safe and inclusive University community is a shared responsibility. For more information on how Title IX protections can benefit you and help us keep a productive campus environment, visit titleix.utahtech.edu to learn more.

Utah Tech Email Disclaimer

You are required to frequently check your Utah Tech email account as important class and university information will be sent to this account, including bills, financial aid/scholarship notices, notices of canceled classes, reminders of important dates and deadlines, course information, and other information critical to your success at UT. To access your Utah Tech email account, visit mail.utahtech.edu. Your email account username is Digital-ID@utahtech.edu (e.g. D12345678@utahtech.edu). If you don't know or have forgotten your Digital-ID or password, please visit changepassword.utahtech.edu.

References and Changes to Syllabus

The instructor will reference the syllabus when students have questions on course objectives, policies, and grading. The instructor can make changes to the syllabus during the course of the semester, but these changes will always be reasonable and announced to the class.