Bioinformatics Algorithms
CSCE 4810.001 / CSCE 5810.001
BIOL 4810.001 / BIOL 5810.001
MATH 4810.001

Course Information & Syllabus

Instructor: Dr. Xuan Guo
Lecture Time: Mondays & Wednesdays, 10:00 AM – 11:20 AM, Wh 221
Office Hours: Wednesdays, 2:00 – 4:00 PM, or by appointment
Office Location: NTDP F290
Phone: 940-565-2817
Email: xuan.guo@unt.edu
Class Website: Canvas

Recommended Textbooks:

- Bioinformatics Algorithms, Phillip Compeau and Pavel A. Pevzner, Active Learning Publishers; 3rd edition (2018); ISBN-10: 0990374637; ISBN-13: 978-0990374633; URL: https://www.bioinformaticsalgorithms.org/
- Exploring Bioinformatics: A Project-Based Approach, Caroline St. Clair & Jonathan E. Visick, Jones & Bartlett Learning; 2nd edition, ISBN-10: 1284034240, ISBN-13: 978-1284034240

Course Description: This course introduces computational problems inspired by the life sciences and the algorithms behind bioinformatics tools. Students will learn to formulate biological problems such as computational problems and to design and implement algorithms to solve them efficiently. Emphasis is placed on sequence data analysis in computational molecular biology

Course Prerequisites or Other Restrictions:
Required: Intermediate/advanced background in programming and data structures.
Recommended: Basic molecular biology knowledge. Supplemental resources will be provided via Canvas; students lacking this background are expected to review them.

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

- Identify popular algorithms for key biological problems.
- Define components of the central dogma of molecular biology.
- Apply graph algorithms to perform sequence assembly.
- Use randomized algorithms to find motifs in biological data.
- Apply dynamic programming to sequence alignment.

Grading:

Undergraduate version		Graduate version	
Assignments	60%	Assignments	40%
Group Presentation 1	20%	Group Presentation 1	15%
Group Presentation 2	20%	Group Presentation 2	15%
		Project	30%
Attendance & Participation	2% bonus	Attendance & Participation	2% bonus
In-class practices	10% bonus	In-class practices	10% bonus

Grading Scale: A = 90–100, B = 80–89.99, C = 70–79.99, D = 60–69.99, F < 60

Tentative Schedule

The following is a list of topics we will attempt to cover during this course:

Week #	Description	Assignments
1-2	Molecular biology – A gentle introduction	
1-2	Introduction to the world of algorithms	HW#1
3-4	A (very) quick overview of Python	HW#2
5	Sequence alignment	
6	Sequence assembly	Group Presentation 1
7	Gene predication	HW#3
8	Finding regulatory motifs	
9	Phylogenetic tree	Group Presentation 2
10	Genome variations	HW#4
11	Clustering/Gene expression	
12-13	Protein sequencing	HW#5
14	Thanksgiving Break	
15	Project presentations	
16	Project reports	

The course calendar above is subject to change. Students will be notified via Eagle Alert in the event of a campus closure that impacts a class session.

Homework: Homework assignments will include both theoretical and programming exercises. There will be approximately five assignments, each with a duration of 1–2 weeks.

Group Presentation: Students will work in assigned groups to present two bioinformatics research papers from the list provided (or others approved by the instructor). Presentations are graded as a group effort, with all members equally responsible for researching, preparing, and delivering the talk. Each presentation has two parts: a 15-minute overview (background, motivation, problem, methods, results, conclusion) and a 5-minute discussion on computational details, methods, and possible improvements. Papers and partners must be chosen by Sept. 25. Presentations are scheduled for Oct. 8 and Nov. 5.

In-class practices/assignments: There will be approximately 10 in-class practices/assignments, each lasting around 15-30 minutes. Students will work individually on a problem and submit their solutions during class. The schedule for these activities will be communicated via Canvas. The format of these questions will be similar to the homework assignments.

Submission: All assignments and projects must be submitted electronically via Canvas. Work submitted within 24 hours after the deadline will be eligible for 50% credit. No homework will be accepted after this extended deadline.

Attendance: Attendance will not be formally recorded but is expected. Students are responsible for all material covered in class. Active participation can earn you up to 2% bonus toward your final grade. To receive full participation credit, you are expected to attend each class and engage by asking questions, answering questions, and participating in class activities.

Graduate Term Project: The goal of the term project is to apply computational methods to contemporary problems in biology. The project topic is open-ended; you may select a topic that is of interest to you or relevance in your profession. Some project ideas will be given by the instructor, too. Term projects can be done in groups up to 3. Each member must contribute equally to the project to avoid a lower score including 0.
The specific milestones of the term project are as follows. More information for each milestone will be made available on Canvas.

Milestone	**Due by (tentative)**	**Grade Weight**
Submit background/interests and choose teams	9/12	5%
Submit Project Title and 1 Paragraph Summary	10/3	10%
Submit Specific Aims and Research Strategy	10/17	15%
Submit Preliminary Results	11/7	20%
Oral Project Presentation	12/3	25%
Final Report	12/5	30%

Academic Integrity Policy:
According to UNT Policy 06.003, Student Academic Integrity, academic dishonesty occurs when students engage in behaviors including, but not limited to cheating, fabrication, facilitating academic dishonesty, forgery, plagiarism, and sabotage. A finding of academic dishonesty may result in a range of academic penalties or sanctions ranging from admonition to expulsion from the University.

Homework exercises are intended to reflect individual effort in the course. Students may discuss assignments in a general way, i.e., discussing the nature of the assignment or providing clarifications. However, sharing code (even a few lines), pseudo-code, program outputs, analysis results are strictly prohibited. Borrowing any code from other sources (internet, book, friend, AI-assisted tools, etc.) are not allowed unless stated otherwise by the instructor. The instructor may ask you to explain your logic for any source code that you upload to Canvas.

You are encouraged to refer to outside material such as journals, web pages, and books. Do not feel guilty about using outside material; just make sure that you cite your references. Further-

more, you must write your solutions in your own words. It is not acceptable to directly copy material from another source. Failure to properly cite your references may result in a charge of plagiarism. Give proper credit where credit is due! The instructor may cross-check submitted work via computational tools such as Turnitin to find highly similar submissions.

A note on AI-assisted technologies
The recent developments of AI-based models will have a significant impact in our lives. As mentioned above, I encourage you to use external materials to enhance your learning in class. Utilizing supplementary tools like ChatGPT is recommended to facilitate a deeper grasp of the subjects introduced during the course. While utilizing such tools, be aware that these tools must be biased and might contain incorrect or irrelevant information. Thus, you should vet the information to ensure its authenticity by checking other resources. In the future these tools will improve even further, and they will be integrated into the classroom settings in creative ways.

However, about the academic integrity policy, using these tools directly to obtain solutions for assignments, to generate code for programming assignments, or write reports for the term project is strictly prohibited unless stated by the instructor explicitly. In other words, all submissions to Canvas must be the outcome of your individual writing and effort.

Academic honesty policy is strictly enforced in this class. Violators of this policy will be reported to the Office of the Provost and the Office for Student Success. There are no exceptions. Multiple violators might get a failed grade.

In this era, making sure that you follow academic integrity policy is even more crucial. Please make sure you understand this policy and make every effort to follow it. If you have any questions or doubt about this policy, please contact the instructor.

Americans with Disabilities Act: We cooperate with the Office of Disability Accommodation to make reasonable accommodations for qualified students (cf. Americans with Disabilities Act and Section 504, Rehabilitation Act) with disabilities. If you have not registered with ODA, we encourage you to do so. If you have a disability for the accommodation, please discuss your needs with the instructor or submit a written Accommodation Request on or before the fourth-class day. The Office of Disability Access (ODA) can work with you on academic accommodation if needed. The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking reasonable accommodation must first register with the Office of Disability Access (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with a reasonable accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request reasonable accommodation at any time; however, ODA notices of reasonable accommodation should be provided as early as possible in the semester to avoid any delay in implementation. You must obtain a new letter of reasonable accommodation each semester and must meet with each faculty member prior to implementation in each class. For additional information, refer to the Office of Disability Access website (https://studentaffairs.unt.edu/office-disability-access). You may also contact ODA by phone at (940) 565-4323 or visit their website to begin the registration process for additional support.

Rules of Engagement: Rules of engagement refer to the way students are expected to interact with each other and with their instructors. Here are some general guidelines:

- While the freedom to express yourself is a fundamental human right, any communication that utilizes cruel and derogatory language on the basis of race, color, national origin, religion, sex, sexual orientation, gender identity, gender expression, age, disability, genetic information, veteran status, or any other characteristic protected under applicable federal or state law will not be tolerated.
- Treat your instructor and classmates with respect in any communication online or face-to-face, even when their opinion differs from your own.
- Ask for and use the correct name and pronouns for your instructor and classmates.
- Speak from personal experiences. Use "I" statements to share thoughts and feelings. Try not to speak on behalf of groups or other individual's experiences.
- Use your critical thinking skills to challenge other people's ideas, instead of attacking individuals.
- Avoid using all caps while communicating digitally. This may be interpreted as "YELLING!"
- Be cautious when using humor or sarcasm in emails or discussion posts as tone can be difficult to interpret digitally.
- Avoid using "text-talk" unless explicitly permitted by your instructor.
- Proofread and fact-check your sources.
- Keep in mind that online posts can be permanent, so think first before you type.

See these Engagement Guidelines (https://clear.unt.edu/online-communication-tips) for more information.

Acceptable Student Behavior: Student behavior that interferes with an instructor's ability to conduct a class or other students' opportunity to learn is unacceptable and disruptive and will not be tolerated in any instructional forum at UNT. Students engaging in unacceptable behavior will be directed to leave the classroom and the instructor may refer the student to the Dean of Students to consider whether the student's conduct violated the Code of Student Conduct. The University's expectations for student conduct apply to all instructional forums, including University and electronic classroom, labs, discussion groups, field trips, etc. Visit UNT's Code of Student Conduct (https://deanofstudents.unt.edu/conduct) to learn more.

Syllabus Change Policy: The schedule, policies, procedures, and assignments in this course are subject to change in the event of extenuating circumstances, by mutual agreement, and/or to ensure better student learning.