Algorithmic Foundations of Computational Biology

CS 4390/5390
Fall 2019

Instructor:	Dan DeBlasio	**Time:**	TR 12:00 – 13:20
Email:	dfdeblasio@utep.edu	**Place:**	CCSB 1.0702
Office:	CCSB 3.1008	**Office Hours:**	T 14:00 – 15:00, or by appointment W 14:00-15:00 (until Oct .11) W 16:00-17:00 (after Oct. 11)

Course Description: This course provides an introduction the algorithms that are used to fuel the recent advances in computational biology research. While the applications of such algorithms are in biology, we will focus on the computational foundations, thus little biological background is necessary. The topics we cover will include both foundational algorithms as well as cutting edge methods including: sequence alignment, sequence database searching, genome assembly, phylogenetic tree construction, metagenomics, biological network analysis, and protein structure prediction. During the course students will have the opportunity to interact with the data sources that are common in the field. We will use a combination of textbooks and literature, which will give students exposure to the current state of the art in computational biology.

Course Website: Course content will be on UTEP Blackboard and at cs5390f19.deblasiolab.org.

Course Texts: This course will take material from current publications that will be listed on the course blackboard in a timely manner. If the selected papers are not available though the campus website copies will be made available before the discussion.

Objective: At the end of the course, the students are expected to have an understanding of the fundamental algorithms used in computational biology. Not only will they recognize the major computational problems and their solution, they should be prepared to create new algorithms for computational biology and other data intensive sciences.

Prerequisites: This course is designed for graduate students and upper level undergraduates, but has no formal prerequisites. No background in biology is required, but familiarity with algorithmic techniques will be helpful. Interested students are encouraged to discuss questions or concerns with the instructor.

Important Dates:

First Class Meeting	August 27, 2019
▷ Homework 1 Due	~~September 11, 2019, 23:59~~
	September 18, 2019, 23:59
▷ Homework 2 Due	~~September 25, 2019, 23:59~~
	October 2, 2019, 23:59
▷ Homework 3 Due	~~October 9, 2019, 23:59~~
	October 23, 2019, 23:59
Midterm Exam	October 17, 2019
▷ Homework 4 Due	~~November 6, 2019, 23:59~~
	November 13, 2019, 23:59
▷ Homework 5 Due	November 27, 2019, 23:59
Thanksgiving Holiday (no class)	November, 28, 2019
Last Class Meeting	December 3, 2019
Final Exam	December 10, 2019, 13:00-15:45
Project Due Date (note time)	December 13, 2019, 23:59

Disclaimer: This course syllabus is subject to change at the instructors discretion. Any changes will be discussed in class and posted on the course blackboard.

Tentative Course Outline:

Week	Tuesday meeting	Thursday meeting
Aug 27–29	Course overview/Exact alignment	Exact alignment (continued)
Sept 3–5	Inexact Alignment	Inexact Alignment (continued)
Sept 10–12	*TBD*	Inverse Parametric Alignment
Sept 18–20	Multiple sequence alignment	Multiple sequence alignment (continued)
Sept 24–26	Database search	Phylogenomics
Oct 1–3	Intro to Next-generation Sequencing	Genome assembly
Oct 8–10	Genome assembly (continued)	Transcript assembly
Oct 15–17	Midterm Exam Review	**Midterm Exam**
Oct 22–24	Long-read assembly	Long-read assembly (continued)
Oct 29–31	Alignment-free genomics	Metagenomics
Nov 5–7	Network Biology	Network Biology (continued)
Nov 12–14	Genome Rearrangement	Genome Alignment
Nov 19–21	Motif finding	Protein Structure Prediction
Nov 26–28	Emerging Topics	Thanksgiving Holiday
Dec 3–5	Emerging Topics (continued)	Exam Review
Dec 10	**Final Exam**	

Class Policies: Regular attendance is essential and expected. Due to the high emphasis of group discussion and dialogue all students are discouraged from missing classes. Missed course meetings will be noted and chronic absences may impact the students grade if not discussed with the course instructor.

The course project and homeworks are meant to expose the student to the topics being discussed. While each student is responsible for their individual projects and homeworks cooperation and collaboration between students is highly encouraged but plagiarism will not be tolerated.

Grading:

Homeworks	25%
Project	20%
Midterm Exam	20%
Final Exam	25%
Course participation	10%

Those attaining at least a 90% will be awarded an A, 80% a B, 70% a C, 60% a D. These thresholds may be lowered, but will not be raised.

Grading for homework and exam questions is roughly according to the following scheme: correct solution idea and the right technical execution – >90%, correct idea but with errors in its execution – >80%. wrong idea and errors in its execution, but demonstrating comprehension of the material – >70%. wrong idea, errors in execution, and deficiencies in comprehension – ∼60%, work that shows no understanding– ∼50%. Writing an answer that relates to the question guarantees at least 50% of the points for the question, no points are awarded for writing nothing.

On homework, very-high-level ideas can be discussed with friends, but solutions must represent individual work and must be written up separately. Any material from the Internet that is used in a solution must be cited by its URL; to not cite it is plagiarism, which is considered cheating.

Late ~~projects and~~ homeworks will lose 10% of their value per day. Due to the time constraints of grading project, late projects cannot be accepted.

Exams: Both exams (midterm and final) will be comprehensive. All material presented in class (including during discussions and project presentations) and those in homework and assigned readings will be included.

Course project: Each student will complete a project related to the content of the course. The project details will be posted on the website by October 1. Students may either work individually or in pairs. The goal will be to have hands-on experience with the algorithms we discuss in class. Students with related research are encouraged to choose a project which is related to their work, but it must be separate from any research that is currently ongoing.

Extra credit: As a source of extra credit, a student may choose a wikipedia entry related to the course and improve it substantially. This can be accomplished once though the course of the semester and will be added to the students final grade, it can be worth an additional 7%. See Dr. DeBlasio either during office hours, by email, or by scheduling an appointment before any changes are made to any wikipedia page you plan to use.

Accommodations: If you have a disability and need classroom accommodations, please contact The Center for Accommodations and Support Services (CASS) at 747-5148, or by email to cass@utep.edu, or visit their office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at www.sa.utep.edu/cass

Academic Honesty: Any student who commits an act of scholastic dishonesty is subject to discipline. Scholastic dishonesty includes, but not limited to cheating, plagiarism, collusion, submission for credit of any work or materials that are attributable to another person.

Cheating is:

- Copying from the test paper of another student.
- Communicating with another student during a test to be taken individually.
- Giving or seeking aid from another student during a test to be taken individually.
- Possession and/or use of unauthorized materials during tests (i.e. crib notes, class notes, books, etc.).
- Substituting for another person to take a test.
- Falsifying research data, reports, academic work offered for credit.
- Plagiarism is using someone's work in your assignments without the proper citations.
- Submitting the same paper or assignment from a different course, without direct permission of instructors.

Collusion is unauthorized collaboration with another person in preparing academic assignments.

To avoid plagiarism see:
https://www.utep.edu/student-affairs/osccr/_Files/docs/Avoiding-Plagiarism.pdf.

NOTE: When in doubt on any of the above, please contact your instructor to check if you are following authorized procedure.