BIO310: Introduction to Bioinformatics

Syllabus, Spring 2021

This is an undergraduate-level course that aims to introduce students to the field of bioinformatics– the area concerning the development and application of computational methods to address fundamental biology problems. The course touches on algorithmic and data science related topics of this vast domain. Upon completion of the course, students are expected to acquire a perspective to design computational solutions to biological problems and hands-on skills. The lab sections and the programming assignments will complement the lectures by providing hands-on experience and introducing common tools and resources.

Prerequisite: Because the course takes a quantitative perspective and is computational in nature, programming skills are required. Python will be the programming language of choice. Basic biology, as well as probability and statistics knowledge, will be useful.

Schedule

Lectures:	Thu 10:40 – 12:30
	Fri 14:40 – 15:30
Computational Labs:	Mon 17:40 – 19:30

*No lab in the first week.

Contact Information

Instructors:	Oznur Tastan, `otastan@sabanciuniv.edu`
	Zoom, office hours by appointment via email.
Teaching Assistant:	Afshan Nabi, `afshannabi@sabanciuniv.edu`
	Aylin Bircan, `aylinbircan@sabanciuniv.edu`

FENS, office hours by appointment.

Course Webpage

SuCourse+ will be used for lecture notes, homework assignments, discussions, and announcements.

Textbook:

No required textbooks. There will be **required readings and videos** posted on SuCourse+.

Optional textbooks

- P. Compeau, P. Pevzner. Bioinformatics Algorithms: An Active Learning Approach. Active Learning Publishers, 2nd Ed. Vol. 1 and Vol.2, 2015. http://bioinformaticsalgorithms.com
- J. Pevsner, Bioinformatics and Functional Genomics, 3rd Edition, 2015.
- A. Lesk, Introduction to Bioinformatics, 4th Edition, Oxford University Press, 2014 (3rd edition also OK). ISBN - 978-0199651566.
- N. Jones and P. Pevzner. An Introduction to Bioinformatics Algorithms (Computational Molecular Biology), MIT Press, 2004.
- P. Baldi, S. Brunak. Bioinformatics: The Machine Learning Approach, Second Edition, MIT Press.

- R. Durbin, S. R. Eddy, A. Krogh, G. Mitchison, Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids, Cambridge University Press.

Tentative List of Topics

Introduction

- Introduction to molecular biology – molecules, proteins, DNA, RNA.

Biological Sequence Analysis

- Genome assembly
- Sequence alignment (local, global, pairwise and multiple, space efficient alignment algorithms, profile alignment)
- Sequence similarity search algorithms
- Patterns and profiles
- Genomic variation

Data analysis and prediction for biology and medicine

- Different data types
- Differential gene expression analysis
- Dimensionality reduction
- Classification
- Clustering
- Hidden markov models

Functional Interpretation of Gene Sets

- Gene ontologies
- Gene set enrichment analysis

Network Based Analysis of Biological Data

- Protein-protein interaction networks
- Regulatory networks
- Network-based biomarker discovery

Structural Biology

- Introduction to protein structure
- Structural motifs and domains

Some topics will be covered through readings and paper presentations.

Grading

- One midterm (30 %)
- Final exam (30 %)
- Homework assignments (20%)
- Lab assignments (15 %)
- One paper presentation (5%)

Homework assignments: There will be tentatively 4 assigments include both programming and written questions. The weight of homework assignments are equal weight and will be determined

based on the difficulty of the homework assignment.

Lab assignments: These will complement the lectures with hands on experience by solving a lab assignment. Certain tools will be introduced in the lab.

Paper presentations: The paper presentations will be conducted in groups. You will select from a list of papers that is provided or will suggest a relevant paper. These paper presentations are intended to provide you a breadth of different topics in this field and to help you improve your scientific and technical communication skills.

IMPORTANT: One of the following conditions will result in an automatic F regardless of other grades:

1. Not submitting more than one homework assignment (empty assignments do not count as a submission)
2. Not submitting more than two lab assignment (empty assignments do not count as a submission)
3. The average homework assignment grade is below 30 out of 100
4. The average lab assignment grade is less than 30 out of 100
5. Omitting the paper presentation
6. Not taking the midterm or the final exam.

*** These are to ensure your active participation in the course. Not falling in one of the conditions does not guarantee to pass the course, if your overall performance is poor, you will fail the course.

Class Rules:

- The exams will take place with certain proctoring standards that would require you to allow camera and screen recording. For proctored exams, your webcam and microphone should be on during the exam. In the case of non-compliance with this and other declared exam procedures, your exam will be void. Make sure to check that your webcam and microphone function properly before the exam.
- There will be oral exams following the written exam and the quizzes. There may also be oral exams to ensure a fair assessment in assignments. The instructor might ask questions from a broader range of topics to evaluate student's understanding of the course material in the oral exams.
- You must attend the synchronous Zoom lectures, recitations, etc. and real-time online exams with your SU email account.
- The class material, including video lectures or sound recordings, must not be shared outside of class.
- Each of us is responsible for creating a safe and inclusive classroom experience for everyone in the class.

Homework late day policy: Each student will have a total of four free late (calendar) days to use for homework assignments. Once these late days are exhausted, any assignments turned in late will be penalized and will incur a reduction of 33% in the final score, for each day (or **part thereof**) it is late. For example, if an assignment is up to < 24 hours late, it incurs a penalty of 33%. Else if it is up to more than 24 hours and less than 48 hours late, it incurs a penalty of 66%. And if it is 72 or more hours late, it will receive no credit. You do not need to tell the TA or me

that you are using a late day.

Homework regrade policy: If you feel that an error was made in grading your homework, please get in touch with your TA. Important: You may object to your homework within 14 days after the grades are announced.

Make up policy: There will be no make ups for the lab or homework assignments. One make-up examination, covering the whole course material, will be given after the final exam date for the students who missed midterm and/or final examination due to a valid excuse approved by the Health Services or University.