Course Information

Course Code	5710465
Course Section	1
Course Title	INTRODUCTION TO BIOINFORMATICS
Course Credit	3
Course ECTS	6.0
Course Catalog Description	This course covers computatioanl techniques for mining the large amount of information produced by recent advances in biology, such as genome sequencing and microarray technologies. Main topics of the course include: DNA and protein sequence alignment, phylogenetic trees, protein structure prediction, motif finding, microarray data analysis, gene/protein networks.
Prerequisites	No prerequisites
Consent of Dept./Inst.	Knowing a programming language is required for the assignments.
Schedule	Monday , 10:40 - 12:30, BMB5 Thursday , 12:40 - 13:30, BMB5
Course Website	https://user.ceng.metu.edu.tr/~tcan/ceng465_s2021/overview.shtml
Learning Management System	ODTU-Class

Instructor Information

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Course Assistants

Name/Title	Araş.Gör. HAZAL MOĞULTAY
Office Address	
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Office Hours	

Course Objectives

The main objective of the course is to provide the student with a solid foundation for conducting further research in bioinformatics. By the end of the course, the students will have learned:

- the bioinformatics terminology,
- main bioinformatics problems,
- and the key methods and tools used in bioinformatics

Course Learning Outcomes

At the end of this course, students will be able to:

- **Understand** main computational problems in life sciences.
- **Understand** the main terminology used in bioinformatics.
- **Apply** statistical analyses on results of algorithms.
- **Understand** key methods and tools used in bioinformatics.
- **Design** and **implement** a computational solution to a molecular biology problem

Program Outcomes Matrix

Undergraduate

		Contribution	
	Program Outcomes	**No**	**Yes**
1	An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics		X
2	An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	X	
3	An ability to communicate effectively with a range of audiences	X	
4	An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	X	
5	An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives		X
6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions		X
7	An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	X	

Instructional Methods

3 hours of lectures is the main instructional method for this course. Course web site includes reading materials and lecture slides. Homework assignments are given for hands-on experience on the subject matter.

Tentative Weekly Outline

Week	Topic	Relevant Reading	Assignments
1	Introduction to molecular biology and genetics, biological databases, and high-throughput data sources. Overview of bioinformatics problems.	Bioinformatics - An Introduction for Computer Scientists Introduction to Molecular Biology More reading on cells and genomes: Cells and Genomes How cells read the genome	
2	Pairwise sequence alignment algorithms: Dynamic programming	Pairwise Sequence Alignment	
3	Pairwise sequence alignment algorithms: Dynamic programming		

Week	Topic	Relevant Reading	Assignments
4	Statistical significance of alignments - Part I Statistical significance of alignments - Part II	Statistical Significance of Alignments Statistical Significance of Alignments (Reading 2)	
5	Suffix Trees, Suffix Arrays		
6	Patterns, Profiles, and Multiple Alignments Hidden Markov Models	Chapter 6 from the textbook	
7	Multiple Sequence Alignment Algorithms		
8	Phylogenetic trees		
9	Introduction to protein structures		
10	Protein Structure Prediction		
11	Structural Alignment of Proteins		
12	Microarray data analysis Clustering techniques	Microarrays Intro Paper - 1 Microarrays Intro Paper - 2 Microarrays Intro Paper - 3	
13	Introduction to Systems Biology Gene regulatory networks Analysis of biological networks		
14	Theoretical computational models for systems biology	Reading: Algorithmic Systems Biology A systems view of protein-protein interactions A systems view of metabolism A systems view of regulatory mechanisms	

Course Textbook(s)

M. Zvelebil and J. O. Baum, *Understanding Bioinformatics,* Garland Science, 2008.

Course Material(s) and Reading(s)

Material(s)

- D.E. Krane and M.L. Raymer, *Fundamental Concepts of Bioinformatics,* Pearson Education, 2003.
- N. C. Jones and P. A. Pevzner, *An Introduction to Bioinformatics Algorithms,* MIT press, 2004.
- C.A. Orengo, D.T. Jones and J.M.Thornton, *Bioinformatics: Genes, Proteins and Computers,* Roultledge, 2003.
- A. M. Lesk, *Introduction to Bioinformatics,* Oxford University Press, 2002.
- D. Mount, *Bioinformatics: Sequence and genome analysis,* Cold Spring Harbor Laboratory Press, 2001.
- P. A. Pevzner, *Computational Molecular Biology: An Algorithmic Approach,* MIT press, 2000.
- P. Baldi and S. Brunak, *Bioinformatics: the machine learning approach (2nd edition),* MIT press, 2001.
- T. Jiang, Y. Xu, and M. Zhang, eds. *Current Topics in Computational Molecular Biology,* MIT press, 2002.
- S. Karlin, *Frontiers of Bioinformatics: Unsolved Problems and Challenges,* National Academy Press, 2005

Reading(s)

Additional reading will be provided on ODTU-Class.

Supplementary Readings / Resources / E-Resources

Resources

Various databases such as NCBI GEO, PDB, Uniprot.

Assessment of Student Learning

Assessment	Dates or deadlines
4 Written and Programming Assignments	
1 Midterm Exam	
1 Final Exam	

Course Grading

Deliverable	Grade Points
Assignment #1	5
Assignment #2	5
Assignment #3	5
Assignment #4	5
Midterm Exam	40
Final Exam	40
Total	100

Course Policies

Late Submission of Assignments

Assignments can be submitted late with 20 points/day penalty.

Information for Students with Disabilities

Students who experience difficulties due to their disabilities and wish to obtain academic adjustments and/or auxiliary aids must contact ODTU Disability Support Office and/or course instructor and the advisor of students with disabilities at academic departments (for the list: http://engelsiz.metu.edu.tr/en/advisor-students-disabilities) as soon as possible. For detailed information, please visit the website of Disability Support Office: https://engelsiz.metu.edu.tr/en/

Academic Honesty

The METU Honour Code is as follows: *"Every member of METU community adopts the following honour code as one of the core principles of academic life and strives to develop an academic environment where continuous adherence to this code is promoted. The members of the METU community are reliable, responsible and honourable people who embrace only the success and recognition they deserve, and act with integrity in their use, evaluation and presentation of facts, data and documents."*