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 computational 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, 11:40 - 13:30, -
Tuesday, 10:40 - 11:30, BMB4
Course Website http://www.ceng.metu.edu.tr/~tcan/ceng465_f1718/

Instructor Information

Name/Title Prof.Dr. TOLGA CAN
Office Address Department of Computer Engineering B-109
Email tcan@metu.edu.tr
tcantr@gmail.com
Personal Website http://www.ceng.metu.edu.tr/~tcan
Office Phone 210 5537
Office Hours By appointment

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

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>Level of Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 an ability to apply knowledge of mathematics, science, and engineering</td>
<td>X</td>
</tr>
<tr>
<td>2 an ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td>X</td>
</tr>
</tbody>
</table>
Program Outcomes

<table>
<thead>
<tr>
<th>Level of Contribution</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health, and safety, manufacturability, and sustainability</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>4 an ability to function on multidisciplinary teams</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>5 an ability to identify, formulate, and solve engineering problems</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
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<tr>
<td>6 an understanding of professional and ethical responsibility</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>7 an ability to communicate effectively</td>
<td></td>
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<td>X</td>
</tr>
<tr>
<td>8 the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>9 a recognition of the need for, and an ability to engage in life-long learning</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>10 a knowledge of contemporary issues</td>
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<td></td>
<td>X</td>
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<tr>
<td>11 an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>12 an ability to apply design and development principles in the construction of software systems of varying complexity.</td>
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<td></td>
<td></td>
<td>X</td>
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</tbody>
</table>

0: No Contribution 1: Little Contribution 2: Partial Contribution 3: Full Contribution

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

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Relevant Reading</th>
<th>Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to molecular biology and genetics, biological databases, and high-throughput data sources. Overview of bioinformatics problems.</td>
<td>Bioinformatics - An Introduction for Computer Scientists, Introduction to Molecular Biology</td>
<td>More reading on cells and genomes: Cells and Genomes, How cells read the genome</td>
</tr>
<tr>
<td>2</td>
<td>Pairwise sequence alignment algorithms: Dynamic programming</td>
<td></td>
<td>Pairwise Sequence Alignment</td>
</tr>
<tr>
<td>3</td>
<td>Pairwise sequence alignment algorithms: Dynamic programming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week</td>
<td>Topic</td>
<td>Relevant Reading</td>
<td>Assignments</td>
</tr>
<tr>
<td>------</td>
<td>------------------------------------------------</td>
<td>----------------------------------------</td>
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<tr>
<td>4</td>
<td>Statistical significance of alignments - Part I</td>
<td>Statistical Significance of Alignments</td>
<td></td>
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<tr>
<td></td>
<td>Statistical significance of alignments - Part II</td>
<td>Statistical Significance of Alignments (Reading 2)</td>
<td></td>
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<tr>
<td>5</td>
<td>Suffix Trees, Suffix Arrays</td>
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<tr>
<td>6</td>
<td>Patterns, Profiles, and Multiple Alignments</td>
<td>Chapter 6 from the textbook</td>
<td></td>
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<tr>
<td>7</td>
<td>Hidden Markov Models</td>
<td></td>
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<tr>
<td>8</td>
<td>Multiple Sequence Alignment Algorithms</td>
<td></td>
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<tr>
<td>9</td>
<td>Phylogenetic trees</td>
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<tr>
<td>10</td>
<td>Introduction to protein structures</td>
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<tr>
<td>11</td>
<td>Protein Structure Prediction</td>
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<tr>
<td>12</td>
<td>Structural Alignment of Proteins</td>
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<tr>
<td></td>
<td>Microarray data analysis</td>
<td>Microarrays Intro Paper - 1</td>
<td></td>
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<tr>
<td></td>
<td>Clustering techniques</td>
<td>Microarrays Intro Paper - 2</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Microarrays Intro Paper - 3</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Introduction to Systems Biology</td>
<td></td>
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<tr>
<td></td>
<td>Gene regulatory networks</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Analysis of biological networks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Theoretical computational models for systems biology</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Course Textbook(s)

**Course Material(s) and Reading(s)**

**Material(s)**

**Reading(s)**
Reading material provided on the course web site at:

http://www.ceng.metu.edu.tr/~tcan/ceng465_f1718/Schedule/index.shtml

**Supplementary Readings / Resources / E-Resources**

**Resources**
Course web site at:

http://www.ceng.metu.edu.tr/~tcan/ceng465_f1718/Schedule/index.shtml

**Assessment of Student Learning**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Dates or deadlines</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Written and Programming Assignments</td>
<td></td>
</tr>
<tr>
<td>1 Midterm Exam</td>
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<tr>
<td>1 Final Exam</td>
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</tbody>
</table>

**Course Grading**

<table>
<thead>
<tr>
<th>Deliverable</th>
<th>Grade Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment #1</td>
<td>5</td>
</tr>
<tr>
<td>Assignment #2</td>
<td>5</td>
</tr>
<tr>
<td>Assignment #3</td>
<td>5</td>
</tr>
<tr>
<td>Assignment #4</td>
<td>5</td>
</tr>
<tr>
<td>Midterm Exam</td>
<td>40</td>
</tr>
<tr>
<td>Final Exam</td>
<td>40</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
Course Policies

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

Information for Students with Disabilities
To obtain disability related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the ODTÜ Disability Support Office as soon as possible. If you need any accommodation for this course because of your disabling condition, please contact me. For detailed information, please visit the website of Disability Support Office: http://engelsiz.metu.edu.tr/

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."