BB485/585 - Applied Bioinformatics – 3 credits

Learner Outcomes –As a result of taking this course the students will:
• Correctly utilize the specialized language of bioinformatics and computational biology.
• Analyze data using bioinformatics to understand eukaryotic gene regulation.
• Choose appropriate methods and research questions for bioinformatics investigations.
• Appropriately use command-line software in a unix environment to answer specific bioinformatics questions.
• Appropriately use modules and methods from Biopython to answer specific bioinformatics questions.
• Apply modern methods of bioinformatics to medicine and biology.

Pre-requisites and Co-requisites
BI314 or equivalent, or by instructor approval.

Professor
David Hendrix

Teaching Assistant
TBD

Text:
We will use the text "Applied Bioinformatics of Nucleic Acid Sequences" here:
http://hendrixlab.cgrb.oregonstate.edu/teaching/ab/AB.pdf
Class Lecture slides provided by Professor on canvas.

Grading:

Undergrads taking 400 level version:
Homework, 5 problem sets (50%: 5 sets 10% each for weeks 2,4,6,8,10)
Project write-ups (10%, close to weekly)
Mid Term Exam 50pts (20%)
Final Exam 100pts (20%)

Graduate Students taking 500 level version:
Graduate students will have additional, more advanced homework and/or test questions, as well as a Term Project consisting of either a **research proposal** or **Biopython implementation** in which ideas from the course are further synthesized and learned at a deeper level.

Homework, 5 problem sets (40%: 5 sets 8% each for weeks 2,4,6,8,10)
Project write-ups (10%, close to weekly)
Mid Term Exam 50pts (20%)
Final Exam 100pts (20%)
Term Project (10%)

Course Outline:

Week 1: Introduction
Reading: Chapter 1: Introduction to Biological Sequences
Objectives: In week 1 you will learn how to

- Represent biological sequences in python, biopython, and more generally
- Navigate the GNU/Linux command line environment
- Represent sequences with the Bio.Seq module
- Read and write sequence files with SeqIO module
- Retrieve and print sequences with the Entrez module.

Week 2: Sequence Motifs
Reading: Chapter 2: Sequence Motifs
Objectives: In week 2 you will learn how to:

- Represent sequence motifs as consensus sequences and weight matrices
- Search for sequences patterns
- Discover motifs with MEME
- Search for motif instances with FIMO
- Represent sequence motifs with the Bio.motifs module

Week 3: Sequence Alignment
Reading: Chapter 3: Sequence Alignment
Objectives: In week 3 you will learn how to:

- Compute sequence alignments with Smith-Waterman and Needleman-Wunsch
- Search for sequences alignments using BLAST
- Understand BLAST statistics

Week 4: Molecular Evolution and Phylogenetics
Reading: Chapter 4: Molecular Evolution and Phylogenetics
Objectives: In week 4 you will learn how to:

- Understand the concept of phylogentic trees
- Understand how to computer a multiple sequence alignment with Clustalw and Phylip
- Understand how to use the python module Phylo
- Represent multiple sequence alignments in various file formats

Week 5: Genomics
Reading: Chapter 5: Genomics
Objectives: In week 5 you will learn how to:

- Understand how to represent genomic annotations
- Interpret genome annotation files: GFF, BED, BedGraph
- Navigate with a genome browser

Week 6: Transcriptomics
Reading: Chapter 6: Transcriptomics
Objectives: In week 6 you will learn how to:

- Perform an RNA-seq analysis including alignment, transcriptome assembly, expression quantification
- Understand paired-end vs single-end sequencing
- Understand high-throughput methods for determining transcription start sites, RNA polymerase stalling, small RNA expression

Week 7: Noncoding RNAs
Reading: Chapter 7: Noncoding RNAs
Objectives: In week 7 you will learn how to:

- Understand thermodynamic parameters in RNA structure formation
- Understand thermodynamic parameters in triplex formation
- How to computer RNA structures using RNAfold

Week 8: Proteins
Reading Chapter 8: Proteins
Objectives: In week 8 you will learn how to:

- Identify protein domains with HMMer
- Predict protein secondary structure with jnet
- How to retrieve substitution matrices using Bio.SubsMat module
- Understand substitution matrices

Week 9: Gene Regulation
Reading: Chapter 9: Gene Regulation
Objectives: In week 9 you will learn how to:

- Understand how genes are regulated by transcription factors
- Perform a data-analysis workflow for ChIP-Seq with bowtie, MACS and MEME
- Understand how microRNAs regulate gene expression
- Predict microRNA targets with TargetScan

Week 10: Catch-up and Review

Final Exam

Learner Expectations

1. Attend lectures (exams will be based on subjects covered in lecture)
2. Prepare for lectures by reviewing lecture notes and readings BEFORE lecture.
3. Attend office hours if there is difficulty in understanding concepts or problems.
4. Talking, eating, chewing gum noisily, using cell phones and other distracting activities are inconsiderate to fellow students and the lecturer; be considerate.

Statement Regarding Students with Disabilities: Accommodations are collaborative efforts between students, faculty and Disability Access Services (DAS). Students with accommodations approved through DAS are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through DAS should contact DAS immediately at 737-4098 (tracy.bentley@oregonstate.edu).

Statement of Expectations for Student conduct: The Student Conduct & Community Standards office has generated a set of standards & expectations for student behavior. This information is at http://oregonstate.edu/admin/stucon/index.htm>http://oregonstate.edu/admin/stucon/index.htm.

Cheating or plagiarism by students is subject to the disciplinary process outlined in the Student Conduct Regulations. Students are expected to be honest and ethical in their academic work. Academic dishonesty is defined as an intentional act of deception in one of the following areas:

- cheating – use or attempted use of unauthorized materials, information or study aids

- fabrication – falsification or invention of any information
- assisting – helping another commit an act of academic dishonesty
- tampering – altering or interfering with evaluation instruments and documents
- plagiarism – representing the words or ideas of another person as one's own

Behaviors disruptive to the learning environment will not be tolerated and will be referred to the Office of Student Conduct for disciplinary action.

"The goal of Oregon State University is to provide students with the knowledge, skill and wisdom they need to contribute to society. Our rules are formulated to guarantee each student's freedom to learn and to protect the fundamental rights of others. People must treat each other with dignity and respect in order for scholarship to thrive. Behaviors that are disruptive to teaching and learning will not be tolerated, and will be referred to the Student Conduct Program for disciplinary action. Behaviors that create a hostile, offensive or intimidating environment based on gender, race, ethnicity, color, religion, age, disability, marital status or sexual orientation will be referred to the Affirmative Action Office."