Bioinformatics Course Syllabus

UC San Diego EXTENSION

Course Number: BIOL40236

Credit: 3 units

Instructor Information

Name: **Ryan Koehler**

Communication Policy: Discussion board / email.

I will try to answer your emails within 48 hours of receiving them. For general course-related questions, however, **posting on the discussion board is strongly preferred over email**. This way others can benefit by viewing questions and answers (and you may get a more rapid response).

Welcome

Welcome to Bioinformatics! My teaching philosophy aims to combine theory and practice, first building a framework of theoretical concepts and then exploring real-world examples, approaches and applications.

Course Purpose and Prerequisites

Bioinformatics is the glue that allows us to manipulate, utilize and learn from vast amounts of biological data. Bioinformatics tools and databases enable a range of scientific, technological, and biomedical applications that would otherwise be impossible to achieve. Familiarity with core bioinformatics concepts and widely used tools allows one to effectively leverage biological data into useful biological information.

Instruction centers on traditional and evolving technologies touching on core bioinformatics applications, such as sequence alignments, but also looking at newer aspects related to genomics. For each topic, we start with theoretical background then explore published literature applications. Students should be comfortable with college level molecular biology concepts; Familiarity with basic concepts of genetics, statistics and computer science is helpful. **The ability to initiate and actively contribute to online discussions is also expected.**

Course Goal and Objectives

The primary goal is to introduce students to bioinformatics concepts and tools. A secondary goal is to illustrate the application of bioinformatics in biotechnology and medicine. Encouragement of learning via student-posed questions and group discussion are pedagogical goals.

Learning Objectives

By the end of this course, the student will be able to:

- Describe bioinformatics in both theoretical and practical terms, including a description of the domains where bioinformatics is particularly useful and a list of some of the more widely used algorithms, tools, and databases.
- Understand what problems key algorithms are designed to solve and list several software implementations (i.e. tools) that employ these algorithms to solve these problems. For example, sequence alignment can reveal biological similarities and BLAST is one tool that facilitates this task.
- Practically appreciate the utility of resources like NCBI / Entrez, the UCSC genome browser, EBI / EMBL, Uniprot, BLAST, etc
- Be able to take one piece of biological information and expand on this to build a more complete picture of what is known about the systems where this information is relevant. For example, given a gene name, or a DNA sequence, etc, one should be able to use appropriate databases and search tools to build a coherent picture to answer such questions as: What genes are related to this and in what organisms to they occur? What variations and / or mutations are known? Are these associated with disease? Are structures of the derived protein known? Are there known chemicals / drugs that interact with this protein? Etc, etc, etc.

Course Materials

All required literature for assigned reading consists of open-access articles (free on the web). These papers (pdf files and/or links) will also be posted on Canvas. Also, we do not have a required textbook. “Bioinformatics for Dummies” used to be a reasonable option to see step-by-step use of various tools. This is still an option, though the book is a bit dated so some web interfaces will have changed.

Course Overview

This course has **9 weekly sessions**. Each week's session consist of slides, assigned reading of scientific literature, a quiz / work assignment, and participation on the discussion board. The first and last weeks have no quiz. In addition, a *summary report* illustrating the application of bioinformatics to characterize some target of interest comprises the course project.

Weekly sessions follow this outline:

1: Introduction, Background & Examples
2: Fundamentals: Molecular Biology & Computer Science
3: Information & Literature
4: Sequence searches
5: Genomes and Genomics

6: Genotype / Phenotype
7: Comparative Genomics
8: Gene products: Proteins, RNAs
9: Integration & Summary

Requirements

In order to satisfy course requirements, students must participate in discussions, complete all course assignments on time, and use graduate level writing / presentation for all written assignments. Late assignments (anything posted after the due date) will be down graded for each day late unless due to a verifiable medical or family emergency. Assignments sent with the *wrong naming convention or in the wrong format* will be considered late until they are sent correctly.

In general, the performance criteria for an A grade for assignments is listed below:

- Demonstrates a high level understanding of issues, including complexities.
- Is well focused and sequenced. Has a clear sense of purpose. Thoughts are clearly developed and easily understandable.
- Critically evaluates the topic beyond what is stated in readings, research, and discussions. Makes connections.
- Expresses views clearly. Provides specific examples, details, illustrations, anecdotes, etc. to support positions taken.
- Does more than repeat what the text says or what was said in class. Draws out additional important implications.
- Shows originality of thought.
- Uses proper citations for resources.
- Uses organizers: table of contents, topic headings, etc.
- Has no punctuation, grammar, spelling errors. Style, formatting, and appearance add to quality of final product.

Written assignments MUST be sent as a PDF attachment! No exceptions.

Assignments/Quizzes/Discussion Board Participation

Discussion Board Participation—20 points

Regular presence in blackboard discussions. Substantial contributions are expected to gain full points. This may include taking a leadership role in weekly online discussions, such as pointing out key literature findings and directing follow up questions, pointing to useful web resources, etc.

Assignment / Quiz Grades—40 points
These will be made accessible (in blackboard) on or before Sunday and must be completed by the following Wednesday. You should receive feedback within a few days, always before the next class.

Class Project—40 points
For this, you will choose some biological molecule(s) of interest and provide a comprehensive picture of what biological information is known (and unknown) about this system, along with an analysis of why this is important and relevant to some application(s) in medicine, biotechnology, etc. For this class, a good biological target would be a gene / protein system that is relevant to some application(s) you are interested in. Your chosen target (e.g. some gene) will serve as your example test-case for each week's quiz assignment. In this way you will collect relevant information for your final project as you proceed through the course.

The project should be doubly formatted as both a high-level graphic presentation (i.e. slides), and as a more comprehensive written report, including methods (i.e. where did you get the data and how did you process it?), references, etc. Ideally, the biological target you choose can be explored in light of each class topic we cover and then written up. Progress on your projects should be regularly shared on the discussion board, as this will both help to keep you on track as well as allow others to learn from the multiple different results we can expect for different target systems.

Grades

No late assignments or quizzes are accepted.

Grades are based on points and the letter grades are given as follows:

A+	97-100
A	94-96
A-	90-93
B+	87-89
B	84-86
B-	80-83
C+	77-79
C	74-76
C-	70-73
D+	67-69
D	65-66
F	0-64

You may check your grade anytime by clicking **Course Tools** and then **My Grades**. This will show you the points you have earned so far in this course.

About Discussion Board Participation

A regular presence is expected in blackboard discussions, with substantial contributions about class topics and discussion questions expected. What this means, essentially, is coming into blackboard regularly, reading what others are discussing and contributing to existing topic threads or initiating your own thread. So what is contribution/participation? Here are some ideas:

- start a discussion on blackboard (add a thread)
- respond thoughtfully to a topic
- provide links and resources related to the topic
- pose a though-provoking question related to the topic
- provide pros and cons
- thoughtfully rebut another person's comments
- make you postings in a timely manner

In grading, quality and quantity are considered. Regular contributions that add to the knowledge base of other students, links to additional resources, and providing substantive food for thought get points. If you don't know a lot (yet!) about the topics, feel free to share some questions to others and/or search the Internet and share what you find with the class. Think about the logic behind this. We can sometimes learn just as much from the person sitting next to you (even in the virtual classroom) as you can from the instructor. We are all here to learn.

About Assignments/Quizzes

The quizzes must be **submitted by Wednesday of the week assigned.** Quizzes will be made visible the proceeding Sunday (i.e. you have at least three days to view and complete each quiz). Plan ahead and give yourself plenty of time to complete it. These quizzes are based upon the lesson, the readings, and also your own independent investigation (i.e. internet searches and resources). You may only attempt the quiz once.

About the Course Evaluation

This is an anonymous course evaluation that is collected by UC San Diego Extension. I expect you to fill it out as a part of this course. I use the feedback to improve the next offering of this course.

Student Resources

On any blackboard screen, there are tabs across the top and one is called the Student Tab. There is information on how to get started as a student and who to contact if you encounter any problems. There are also videos and written instructions on how to do some of the most common things in blackboard.

Another one of these tabs is called FAQ (Frequently Asked Questions). If you click on the Students Category (on the left), you can find step-by-step directions for everything from sending email to uploading your assignments to posting a reply on the discussion board.