CISC 436/636 Computational Biology &Bioinformatics (Fall 2016)

Time and Place: Tuesdays and Thursdays, 11:00AM - 12:15PM; Alison Hall 318

Web page: http://www.cis.udel.edu/~lliao/cis636f16

Course Staff and Contact

Staff	Name	Office	Email	Phone	Office Hours
Instructor	Li Liao	Smith 424	liliao@udel.edu	831-3500	Tuesdays, Thursdays: 12:45MP-1:45PM, or by appointment
TA	Chunbo Song	Smith 201	songcb@udel.edu		Wednesdays: 3:30PM-5:30PM

Course Description

Bioinformatics, as its name suggests, is to use informatics/computing approaches to solve biological problems. This course introduces basic concepts, methodologies, and tools in bioinformatics. The goals are 1) to pick up the concepts and vocabularies; 2) to become familiar with various bioinformatics resources (tools and databases); and most importantly, 3) to master basic algorithms and models.

Because no prior knowledge of molecular biology is assumed, the course will introduce some basic concepts, including

1. Central dogma of molecular biology: DNA $\rightarrow$ RNA $\rightarrow$ Proteins
2. Cellular processes: transcription regulation, signaling transduction, metabolism, cell cycles, …
3. Genetics and Evolution
4. Structures of proteins and RNA

We will also briefly introduce some major experimental technologies, including: *Clone, PCR, DNA Sequencing, DNA chips (Microarray), Yeast 2 hybrid system, 2D gel and Mass Spec*. These high throughput technologies enable studies of biological systems at an ever large scale, and the huge amount of data from experiments utilizing these technologies however present a grand challenge for interpretation -- bioinformatics is thus emerged as a new discipline to meet the challenge. For that, not only should we know how the data are produced, but also know the characteristics of the data, including their limitations. Questions like the following will be answered.

1. How are whole genomes (such as of humans) sequenced?
2. How are the expression levels for all genes in a genome measured?
3. How do we know if a pair of proteins interacts?

Understanding the various cellular processes—how the genotypes will affect the phenotypes – is fundamental in biology, and is being attempted via computational approaches to answering questions like the following:

1. Can we predict protein functions? and how?
2. Can we predict protein structures? and how?
3. Can we use genomic sequences to make new vaccines?
4. Can we predict which drugs will be effective in different cancers?

In its short history, bioinformatics has made great progresses towards answering these important, fundamental questions in biology. From this course, you will learn some major computational methods and techniques, including:

1. Dynamic programming
2. Pairwise and multiple sequence alignment
3. Phylogenetic tree reconstruction
4. Hidden Markov models
5. K-mean clustering

Textbook

Understanding Bioinformatics by Marketa Zvelebil and Jeremy Baum, (Garland Science, 2008).

You may find several other books also useful:

1. **Fundamental Concepts of Bioinformatics** by D.E. Krane and M.L. Raymer, (Benjamin Cummings, 2003)
2. **Biological Sequence Analysis** by R. Durbin, S. Eddy, A. Krogh and G. Mitchison, (Cambridge University Press, 1998)
3. **Computational Molecular Biology: An Introduction** by Peter Clote and Rolf Backofen (Willey 2000)
4. **Introduction to Computational Molecular Biology** by Setubal and Meidanis (Brooks Cole, 1997)
5. **Bioinformatics: Sequence and Genome Analysis** by David Mount (2nd Ed. Cold Spring Harbor Press, 2004)

Assignments and Grading

1. 4 Homework assignments (40%), one mid-term (25%), and a final exam (35%).
2. For assignments involved programming, the accepted programming languages are C, C++, Java, and Perl. You are strongly encouraged to learn and use the Perl language.
3. Late assignments will be penalized 15% per class meeting, and will not be accepted more than two class meetings late.

Policy on Academic Dishonesty

The homework assignments in this class should be performed individually. You are permitted to discuss with other students on any conceptual problems, but the work handed in must be entirely your own. Any evidence of academic dishonesty will be handled as stated in the Official Student Handbook of the University of Delaware. If you are in doubt regarding the requirements, please consult with me before you complete any requirement of this course.