SYBB 311/411C: Translational Bioinformatics

Course Syllabus

Instructor:	**Gürkan Bebek, Ph.D.**	Term:	Fall 2015
Office:	BRB 921	Class Meeting Days:	*Sept. 10th - Nov 19rd (see Topic Schedule)*
Phone:	216-368-4541	Class Meeting Hours:	Thursdays 12:00-1:15 PM
E-Mail:	gurkan.bebek@case.edu	Class Location:	SOM T501 (School of Medicine Sears Tower, Circle Drive 222, Cleveland, OH 44106)
Website:	http://gurkan.case.edu/teaching.html		
Office Hours:	*by appointment only*: Thu, 2:00-3:00 PM		

Course Overview

Surveys of Bioinformatics

The SYBB Survey Series is composed of the following course sequence: (A) Technologies in Bioinformatics, (B) Data Integration in Bioinformatics, (C) Translational Bioinformatics, and (D) Programming for Bioinformatics. Each standalone section of this course series introduces students to an aspect of a bioinformatics project - from data collection (SYBB 311/411A), to data integration (SYBB 311/411B), to research applications (SYBB 311/411C), with a fourth module (SYBB 311/411D) introducing basic programming.

Course Description

SYBB 311/411C is a longitudinal course that introduces students to the latest applications of bioinformatics, with a focus on translational research. Topics include: 'omic drug discovery, pharmacogenomics, microbiome analysis, and genomic medicine. The focus of this course is on illustrating how bioinformatics technologies can be paired with data integration tools for various applications in medicine. The course is organized as weekly discussions of recent landmark advances in translational bioinformatics. Students are expected to complete assigned readings and exercises beforehand for in class discussions. Students will work in teams to investigate a topic of interest and present bioinformatics approaches they identify by reviewing recent innovations in the field.

Course Objectives

Big Idea	Enduring Understandings	Learning Outcomes
Bioinformatics in Translational Research	Understand current applications of bioinformatics in translational research projects.	• Can identify bioinformatics tools, algorithm or methods used in large-scale projects. • Can assess the tools selected for bioinformatics analysis • Can explore alternative approaches to accomplish the bioinformatics analysis.
	Demonstrate how to merge bioinformatics tools, technologies, and experiments.	• Can identify study design and goals in a translational study. • Can summarize and present datasets and integration of these data in a study. • Can outline the data requirements and results in a study.

Course Prerequisites

Undergraduate
Prerequisites: BIOL 214 AND 215; OR 250
Co-requisites: SYBB311A, SYBB311B and SYBB311D

Graduate
Prerequisites: Graduate standing OR Prerequisites not met permission
Graduate students have the option of enrolling in all four courses or choosing the individual modules most relevant to their background and goals with the exception of SYBB411D, which must be taken with SYBB411A. Based on experience in the field, instructor can waive this co-requisite.

Required Texts and Materials

Online Textbook(s)
"Translational bioinformatics." PLoS Computational Biology. www.ploscollections.org/translationalbioinformatics
This is an e-book that is free to access. Please make sure you can access to this resources.

Classroom Response Clickers:
We will be using iClicker+ in class on a regular basis. You will need to purchase an iClicker+ pad (commonly called a "clicker") from the bookstore or online and bring it with you to every class session. It would be wise to bring extra batteries as well, as we will be using the pads in activities that count for class points. The purchase of a clicker is required (NOT optional). It will be used as an integral part of this course. I will provide a short demonstration of how to use it in class. [Note: the clicker can be used in other classes]. After you purchase your clicker, you must *register your clicker* on the course Blackboard site *before the first class*. It is imperative that every student registers their unit before the first week of class. Instructions for the registration process can be found on Blackboard. Make sure you buy the clicker that looks like the image on the right.

Course Website:

The course website is available on Blackboard. The URL is: http://blackboard.case.edu Students will need their CWRU network ID and password to access the site. Important course information and announcements will be posted on Blackboard including the course syllabus, assignments, and grades. The students are responsible to refer to this site regularly. Additional information on the SYBB 311/411 Series can be found on Instructors web page http://gurkan.case.edu/teaching.html.

Course format

This is an active-learning class. The focus is on understanding and critically evaluating the current bioinformatics methods and approaches in diverse biomedical fields. Readings and in class exercises will be assigned on a weekly basis. Students are expected to complete these assignments before coming to class.

Class participation and weekly quizzes (via iClicker+) will be the primary mode of assessing students' grasp of the material. Students (in groups) will also prepare a project and give a final presentation at the end of the course.

In class exercises can be assigned before class. These will be shared on blackboard. Students should follow the directions, and provide written evidence of completion via Blackboard when asked.

Topic Schedule

Week	Instr. / Date	Topic	Readings / Resources
1	*Dr. Bebek* *Sept. 10, 2015*	Genomics	1. 1000 Genomes Project. An integrated map of genetic variation from 1,092 human genomes, Nature. (2012). 2. The ENCODE Project Consortium, An integrated encyclopedia of DNA elements in the human genome, Nature (2012). *Additional reading/resources:* 3. http://www.nature.com/encode/ 4. http://www.1000genomes.org
	Dr. Bebek *Sept. 17, 2015*	'Omic mapping	1. Nagaraj et al. Deep proteome and transcriptome mapping of a human cancer cell line. Mol Sys Bio (2011). 2. Kim et al. A draft map of the human proteome, Nature (2014). *Additional reading/resources:* 3. Titz et al. Proteomics for systems toxicology. Computational and Structural Biotechnology Journal (2014). 4. http://www.humanproteomemap.org/
3	*Dr. Bebek* *Sept. 24, 2015*	Integrative 'omics	1. Parikshak et al. Integrative Functional Genomic Analyses Implicate Specific Molecular Pathways and Circuits in Autism. Cell (2013). 2. O' Roak et al. Sporadic autism exomes reveal a highly interconnected protein network of de novo mutations. Nature (2012). 3. *PLOS Computational Biology*: Translational Bioinformatics, Chapter 4: Protein Interactions and Disease
4	*Dr. Bebek* *Oct. 8, 2015*	Cancer 'omics	1. Ellis et al. Whole-genome analysis informs breast cancer response to aromatase inhibition. Nature (2012). 2. Hoadley et al. Multiplatform Analysis of 12 Cancer Types Reveals Molecular Classification within and across Tissues of Origin, Cell (2014). *Additional reading/resources:* 3. Kristensen, Principles and methods of integrative genomic analyses in cancer. Nature Reviews Cancer (2014). 4. The Cancer Genome Atlas Pan-Cancer analysis project. Nat Genetics (2013). 5. http://www.nature.com/tcga/
5	*Dr. Bebek* *Oct. 15,*	Pharmaco-genomics	1. Thorn, Klein & Altman. Pharmacogenomics and bioinformatics: PharmGKB. Pharmacogenomics (2010).

Week	Instr. / Date	Topic	Readings / Resources
	2015		2. Cheng et al. Prediction of Drug-Target Interactions and Drug Repositioning via Network-Based Inference. PLoS Comp Bio (2012). *Additional reading:* 3. Nelson et al. An Abundance of Rare Functional Variants in 202 Drug Target Genes Sequenced in 14,002 People. Science (2012) 4. Von Eichborn et al. PROMISCUOUS: a database for network-based drug-repositioning. Nuc Acid Res (2011). 5. *PLOS Computational Biology*: Translational Bioinformatics, Chapter 7: Pharmacogenomics
6	*Dr. Bebek* *Oct. 22, 2015*	Microbiome Analysis	1. Human Microbiome Project Consortium. Structure, function and diversity of the healthy human microbiome. Nature (2012). 2. *PLOS Computational Biology*: Translational Bioinformatics, Chapter 12: Human Microbiome Analysis
7	*Dr.* Michelle Puchowicz - *Oct. 29, 2015*	Metabolomics	1. Patti et al. Metabolomics: the apogee of the omics trilogy. Nature Reviews (2012). 2. Wang et al. Metabolite profiles and the risk of developing diabetes. Nature Medicine (2011).
8	*Dr. David Lodowski* *Nov. 12, 2015*	Structural Genomics	1. Cooper S, Kazmierczyk M, Gilski M, et al. with Khatib F, DiMaio F, Foldit Contenders Group, Foldit Void Crushers Group. Crystal structure of a monomeric retroviral protease solved by protein folding game players. Nature structural & molecular biology 2011;18(10):1175-1177. doi:10.1038/nsmb.2119. *Additional reading:* 2. Mizianty MJ, Fan X, Yan J, et al. Covering complete proteomes with X-ray structures: a current snapshot. Acta Crystallographica Section D: Biological Crystallography2014;70(Pt 11):2781-2793. doi:10.1107/S1399004714019427.
9	*Nov. 19, 2015*	Final Presentations	Presentations by students.

Final Presentation and Report

Students will be broken into groups (5 groups max, depending on class size). Based on the topical areas discussed in class, each group will be expected to identify a similar journal article (Deadline for Article selection is 5th lecture). Instructor's approval of the article is needed. The selected papers should be posted on Blackboard for other classmates to share.

Each group will present their paper on the Final Presentation Day and receive feedback. The group will then summarize the article in a 2-3 page report (single spaced, Arial size 11 font). The report should be formatted according to the structure in Table 1 (below). Reports are due on the first day of Final Exams (12:00pm EST).

These papers must be submitted on Blackboard using SafeAssign. If an issue arises, email the paper to Dr. Bebek before the deadline. Late papers will be penalized a full grade or more depending upon the time until the paper is submitted.

Graduate students: In addition to helping the group write the report, graduate students will be responsible for writing specific sections (See Table 1).

Table 1. Structure of the final report.

Section	Description	Undergraduate grading	Graduate grading
Impact	**All:** This section of the report should describe the (1) problem the researchers were trying to address; (2) why this problem is important; (3) what the impact of this research is to society as a whole.	25 pts	20 pts
Technologies	**All:** Summarize (1) the types of technologies employed to generate data, (2) the modifications made to technologies necessary for the experiments in the paper.	25 pts	20 pts
	Graduate students: Describe the modifications made to technologies necessary for the experiments in the paper.	--	15 pts
Informatics methods	**All:** Describe the methods used to analyze the large-scale datasets in the paper.	25 pts	7.5 pts
	Graduate students: For each method: (1) list 2 alternative methods that could also be used to address this question; and (2) list 2 reasons why the authors chose this method for analysis over other available methods.	--	15 pts
Experimental design	**All:** Summarize how the technologies and informatics methods were arranged. Describe how this particular sequence of experiments addresses the investigators' key hypotheses.	25 pts	7.5 pts
	Graduate students: Discuss the following questions: (1) why did the authors choose this particular sequence of experiments? (2) Is there an alternative sequence of experiments that might address the same hypotheses?	--	15 pts
Final Grade		**100 pts**	**100 pts**

Grading

Grading will be based on weekly reports, in-class attendance and participation, and the final presentations. Each group's **final presentation** will be held during the last class and will consist of a 10 minute presentation of their submitted paper report. *Disclaimer: the time allotted for each presentation may change, depending on the class size.*

Graded item	Undergraduate %	Graduate %
Class participation	50	40
Final Presentation	25	25
Final Report	25	35

Final letter grades will correspond to the percentage of points you earn out of the possible 100 points. The tentative scale is ≥90%=A, 80-89.4%=B, etc. However, these ranges may be adjusted at the discretion of the instructor.

Make-up Policy:

Schedule of classes are listed on this document. Requests for make-up will only be considered in the event of an emergency that can be verified (e.g., a doctor's note must be provided & possible verification from Undergraduate Studies) or a pre-scheduled academic conflict (presenting at a seminar series, presenting at a conference (Students have to notify instructor at least 2 weeks prior to this conflict).

If a student misses final presentation due to an illness or other emergency, students are responsible to contact right away to report their emergency (48 hours). If the student fails to do this, they will not be granted a make-up and they will earn a zero for the exam.

Disabilities

If you have a disability and anticipate needing accommodations for this course, we are willing to work with you and Disability Resources (http://students.case.edu/education/disability) to help provide the accommodations you need.

Computers

Computer with Internet access is required for homework assignments. In class use of computers area allowed as long as students stay on task (no Facebook, texting, etc.). Any misuse will be penalized.

Academic Integrity

No form of academic dishonesty including cheating, plagiarism, misrepresentation, or obstruction will be tolerated in this class. Plagiarism in any form will result in a failing grade. Please see: http://studentaffairs.case.edu/office/judicial

Students are expected to abide by the academic integrity policy of the university, which can be found at: http://studentaffairs.case.edu/handbook/policy/integrity.html. It is the student's responsibility to read and familiarize him/herself with the academic integrity policy.

Evidence of academic misconduct will be reported to the Dean and could result in a judicial action. If a student is caught cheating, they may fail the assignment or the entire course depending on the severity of the offense. Examples of academic integrity violations include:

1. Possession of a cell phone, calculator or tablet during an exam.
2. Copying from a student's exam.
3. Lying about an illness or other emergency to get out of taking an exam.
4. Participating in class with another student's clicker.