Proteomics Informatics Spring 2016 (BMSC-GA 4437)

Course Directors:
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Course overview

This course will give an introduction of proteomics and mass spectrometry workflows, experimental design, and data analysis with a focus on algorithms for extracting information from experimental data. The following subjects will be covered in: (1) Protein identification (peptide mass fingerprinting, tandem mass spectrometry, database searching, spectrum library searching, de novo sequencing, significance testing); (2) Protein characterization (protein coverage, top-down proteomics, post-translational modifications, protein processing and degradation, protein complexes); (3) Protein quantitation (metabolic labeling - SILAC, chemical labeling, label-free quantitation, spectrum counting, stoichiometry, biomarker discovery and verification). Examples will be provided throughout the course on how the different approaches can be applied to investigate biological systems. The class will be structured to include hands-on practical techniques for analyzing relevant proteomics datasets.

Learning objectives

At the conclusion of the course, the student will be able to:

· Understand experimental design for mass spectrometry based proteomics;
· Demonstrate detailed understanding of the possibilities and limitations of algorithms that are applied to proteomics data; and
· Analyze a large proteomics data set using available algorithms.

Course Assessment

• Readings and participation (30%): Students are required to attend class, to complete reading assignments and to participate in discussions and engage in healthy exchange of ideas. Each student is required to lead at least one reading from the assigned weekly readings. This discussion lead will be graded.
• Assignments (30%): Programming assignment will be given at the end of each class, and the solutions to these assignments should be e-mailed to Assignments@FenyoLab.org within a week.
• Final project (40%)
Missed Exams and Grade Appeals

Make-up examinations (for final only) will be given under special circumstances. Documentation will be required to verify a student’s claim. If a make-up exam is permitted, a different exam will be written for that student and may have a different format than the regular examination.

The assignments must be turned in on time and no late assignments will be accepted.

If there is a time that you believe that there is a mistake in grading of an assignment/exam, you will have a chance to appeal your exam grade within a week after you receive your grade. If you think this is the case, you must write a note describing the error, attach it to the original exam, and give it to me within a week of the return of your exam. I will review your argument and my initial grading, and then return your exam with a decision to you in a timely manner.

General Policies

- Late/missed work: You must adhere to the due dates for all required submissions. If you miss a deadline, then you will not get credit for that assignment/post. Try to avoid last minute submissions.
- Incompletes: No “Incompletes” will be assigned for this course unless we are at the very end of the course and you have an emergency.
- Responding to Messages: I will check e-mails daily during the week, and I will respond to course related questions within 48 hours.
- Announcements: I will make announcements throughout the semester by e-mail. Make sure that your email address is updated; otherwise you may miss important emails from me.
- Safeguards: Always back up your work on a safe place (electronic file with a backup is recommended) and make a hard copy. Do not wait for the last minute to do your work. Allow time for deadlines.
- Plagiarism: Plagiarism, the presentation of someone else's words or ideas as your own, is a serious offense and will not be tolerated in this class. The first time you plagiarize someone else's work, you will receive a zero for that assignment. The second time you plagiarize, you will fail the course with a notation of academic dishonesty on your official record.

Lecture 1 Overview of proteomics (January 26, 2016 TRB 718 5pm)
Lecturer: Fenyo
Tutorial Instructor: Grover
Reading List


Lecture 2 Overview of mass spectrometry (February 2, 2016 TRB 718 5pm)
Lecturer: Fenyo
Tutorial Instructor: Fenyo

Reading List


· Chalkley, R. "Instrumentation for LC-MS/MS in proteomics" Methods Mol. Biol 658, 47-60 (2010).

Lecture 3 Signal processing I: analysis of mass spectra (February 9, 2016 TRB 718 5pm)
Lecturer: Fenyo
Tutorial Instructor: Fenyo

Reading List


Lecture 4 Protein identification I: searching protein sequence collections and significance testing (February 16, 2016 TRB 718 5pm)
Lecturer: Fenyo
Tutorial Instructor: Grover
Reading List


Lecture 5 Protein quantitation I: overview (February 23, 2016 TRB 718 5pm)
Lecturer: Fenyo
Tutorial Instructor: Grover

Reading List


Lecture 6 Databases, data repositories and standardization (March 1, 2016 TRB 718 5pm)
Lecturer: Fenyo
Tutorial Instructor: Grover & Chapman

Reading List


Lecture 7 Protein quantitation II: multiple reaction monitoring (March 8, 2016 TRB 718 5pm)
Lecturer: Ruggles
Tutorial Instructor: Grover

Reading List


Lecture 8 Proteogenomics (March 15, 2016 TRB 718 5pm)
Lecturer: Ruggles
Tutorial Instructor: Grover & Chapman

Lecture 9 Protein identification II: de novo sequencing (March 22, 2016 TRB 718 5pm)
Lecturer: Ueberheide
Tutorial Instructor: Grover

Reading List


Lecture 10 Protein characterization I: post-translational modifications (March 29, 2016 TRB 718 5pm)
Lecturer: Fenyo
Tutorial Instructor: Grover

Reading List

**Lecture 11** Signal processing II: image analysis (April 5, 2016 TRB 718 5pm)
Lecturer: Fenyo
Tutorial Instructor: Grover

*Reading List*

* Introduction to the Quantitative Analysis of Two-Dimensional Fluorescence Microscopy Images for Cell-Based Screening

**Lecture 12** Protein characterization II: protein interactions (April 12, 2016 TRB 718 5pm)
Lecturer: Fenyo
Tutorial Instructor: Grover

*Reading List*


**Lecture 13** Data analysis and visualization (April 19, 2016 TRB 718 5pm)
Lecturer: Ruggles
Tutorial Instructor: Grover

*Reading List*

* Think Stats by Allen B. Downey

* Data Analysis with Open Source Tools by Philipp K. Janert

* Data visualization: A view of every Points of View column

**Lecture 14** Molecular signatures (April 26, 2016 TRB 718 5pm)
Lecturer: Fenyo
Tutorial Instructor: Grover
Reading List


Lecture 15 Presentations of projects (May 3, 2016 TRB 718 5pm)