

October 6, 2016

CMPBIO 293 Doctoral Seminar in Computational Biology

Instructor: Lisa F. Barcellos, PhD, MPH (Fall) Nir Yosef, PhD (Spring)

Offered: FALL and SPRING SEMESTER

Units: 2.0 (Letter Grade)

Course Format: Seminar

Course Number: 34868

Course Description: This one-year interactive seminar builds skills, knowledge and community in computational biology for first year PhD and second year Designated Emphasis students. Topics covered include concepts in human genetics/genomics, laboratory methodologies and data sources for computational biology, workshops/instruction on use of various bioinformatics tools, critical review of current research studies and computational methods, preparation for success in the PhD program and career development. Faculty members of the graduate program in computational biology and scientists from other institutions will participate. Topics will vary between Fall and Spring semesters.

FALL 2016 SYLLABUS:

Week	Date	Subject	Instructor (s)
1	8/24	Introduction to Course and Scheduling Concepts in Human Genetics and Genomics Group assignment for presentation #1	L. Barcellos
2	8/31	Bioinformatics Workshop #1: UCSC Genome Browser <i>Homework #1 due 9/14</i>	B. Rhead/L. Barcellos
3	9/7	Group Presentations #1: Laboratory Methodologies in Computational Biology <i>see bCourses for Resources</i>	L. Barcellos Students
4	9/14	Bioinformatics Workshop #2: Introduction to ENCODE <i>Homework #2 due 9/28</i>	B. Rhead/L. Barcellos
5	9/21	Bioinformatics Workshop #3: Pathway Analysis Methods <i>Homework #3 due 10/5</i>	M. Laurance/UCSF
6	9/28	Journal Club #1: Computational Methods for Genomics <i>See Reading List</i>	L. Barcellos Students
7	10/5	Spotlight on Faculty Research #1: Haiyan Huang Title: Inferring gene interactions beyond standard models using expression data <i>Discussion: First Rotations/Research</i>	H. Huang Students

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8	10/12	Methods for Computational Biology: Protein Structure/Function Prediction and Phylogenomics Group assignment for presentation #2	K. Sjolander L. Barcellos
9	10/19	No Class ASHG Meeting in Vancouver, CANADA Students meet to work on Group Presentation #2	Open classroom
10	10/26	Group Presentations #2: Bioinformatics Tools in Computational Biology <i>see bCourses for Resources</i>	L. Barcellos Students
11	11/2	Journal Club #2: Computational Methods for Genomics <i>See Reading List</i>	L. Barcellos Students
12	11/9	Methods for Computational Biology: Introduction to LaTeX Workshop <i>Homework #4 due 11/30</i>	I. Holmes
13	11/16	Spotlight on Faculty Research #2: Ian Holmes Title: Is everything everywhere? Neutral models of microbial communities and their connections to bioinformatics <i>Report on First Rotations/Research</i>	I. Holmes Students
14	11/23	No Class/Thanksgiving Holiday	
15	11/30	Spotlight on Faculty Research #3: Elizabeth Purdom Title: mRNA expression analysis for single cell transcriptome sequencing <i>Reports on First Rotations/Research</i>	E. Purdom Students
16	12/7	<i>Demystifying the Qualifying Exam</i> Course Wrap-up and Evaluations	PhD Student Panel L. Barcellos

Grading:

- Attendance & participation (very important!): 20%
- Homework assignments (4): 30%
- Group Presentations (2): 30%
- Journal Clubs (2): 20%

Instructor Contact Information:

Professor: Lisa F. Barcellos
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Graduate Student Instructor: Brooke Rhead

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Attendance: Attendance (sign-in) is taken each week. If you are going to miss a class you are encouraged to contact the instructors ahead of time. Attendance each week of the semester is critical to success in the course. **If you miss more than two classes, you will be dropped from the course.**

Lecture Slides and Course Reading Assignments: Slides will be posted on bCourses *after* each class. All Reading Assignments (see **Reading List below**) will be posted on bCourses. Don't get behind on reading! Reading is required ahead of the assigned class.

Homework Assignments: These will be posted on bCourses and are due before class begins on dates listed in syllabus. Assignments should be submitted as pdf or word document through bCourses. Last name must be included in file name as shown: (LASTNAME_CMPBIO293_Homework1_2016.pdf). In addition, First and Last name should be included at the top of the document. There will be a place for you to insert this information in each homework assignment.

Location: 221 Stanley Hall, Wednesdays 12:00-2:00 p.m. Students are encouraged to bring their lunch to class!

Laptop Policy: Laptops are only allowed for designated work/workshop periods and journal club sessions; otherwise do not plan on using them. Phones are not permitted. This is a strict policy.

Mental Health:

If you are experiencing stress, anxiety, or other forms of distress during the semester, we hope to be a resource for you. Please reach out to the GSI or Professor if you need support. There are also many resources available to you. All registered Berkeley students are eligible to use Counseling Psychological Services. You do not have to purchase the Student Health Insurance Plan to use these services. The first five counseling sessions are free for registered Berkeley students. Counselors can provide support in academic success, life management, career and life planning, and personal growth and development.

UC Berkeley, Counseling Psychological Services:

- Please call (510) 642-9494 or stop by the office on the 3rd floor of the Tang Center to make an appointment with a counselor.
- Drop-in counseling for emergencies: Monday - Friday, 10:00AM - 5:00PM
- After hours counseling: In the case of emergencies at night or on weekends, call (855) 817-5667 for free assistance and referrals. Request to speak with a counselor.
- For emergency support: Call UCPD by dialing 911 from a landline anywhere on campus or call (510) 642-3333 from any phone.

24 Hour Crisis Hotlines:

- Alameda County Crisis Line: (offers confidentiality, TDD services for deaf and hearing impaired callers and translation in 140 languages) Call 1-800-309-2131
- National Crisis Help Line: Call 1-800-273-TALK

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- National HopeLine Network: Call 1-800-SUICIDE
- Crisis Text Line: Text START to 741741

We also ask that you look out for your fellow peers. If you see any of the signs below that may indicate your classmate may need assistance, please use the resources above or reach out to the GSI or Professor.

- Withdrawing from other people
- Changes in weight or eating patterns
- Changes in sleeping patterns
- Fatigue or lack of energy
- Increased anxiety or irritability
- Feeling worthless or hopeless

Academic Dishonesty:

Academic dishonesty is not acceptable at UC Berkeley. Academic dishonesty is any action that may result in creating an unfair academic advantage for oneself or unfair academic disadvantage for another member of the academic community. Therefore, any exam, quiz, paper, and/or homework assignment submitted by you for any class that bears your name should be your own original work. In all of your assignments, including your homework or drafts of papers, you may use words or ideas written by other individuals in publications, web sites, or other sources, but only with proper attribution. 'Proper attribution' means that you have fully identified the original source and extent of your use of the words or ideas of others that you reproduce in your work for this course, usually in the form of a footnote, parentheses or quotations. If you are not clear about the expectations for completing an assignment, be sure to seek clarification from the instructor or GSI beforehand. Cheating and plagiarism are forms of academic dishonesty and are NOT TOLERATED under any circumstance. Any evidence of academic dishonesty will result in a score of zero (0) on that assignment or exam, and will be reported as soon as possible to the Center for Student Conduct (<http://sa.berkeley.edu/conduct>). This will result in a permanent scar on your academic record. In 2015, UC Berkeley launched the Turnitin service (<https://www.ets.berkeley.edu/discover-services/academic-integrity/turnitin-students-getting-started>) to support academic integrity and the campus honor code. Turnitin is an opt-in tool enabled through bCourses that allows Instructors and GSIs to check student assignments for originality. We will use Turnitin in this course for all written assignments. The consequences of cheating and academic dishonesty are substantial, including a formal discipline file, possible loss of future internship, scholarship, or employment opportunities, and denial of admission to graduate or medical school.

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Assigned Reading List for Fall Semester 2016:

Week 1 Date 8/24 Concepts in Human Genetics and Genomics

Readings:

1. Green, E.D., Watson, J.D. & Collins, F.S., 2015. Twenty-five years of big biology. *Nature*, 25(9), pp.1682–1690.
2. The 1000 Genomes Project Consortium, 2015. A global reference for human genetic variation. *Nature*, 526(7571), pp.68–74. **(Also see supplementary data and image files on bCourses)**

Week 2 Date 8/31 Bioinformatics Workshop #1: UCSC Genome Browser

Readings:

1. Speir, M.L. et al., 2015. The UCSC Genome Browser database: 2016 update. *Nucleic acids research*, 44(D1), pp.D717–D725.
2. Mangan, M.E. et al., 2014. The UCSC genome browser: What every molecular biologist should know. *Current Protocols in Molecular Biology*, pp.19.9.1-19.9.36.

Week 3 Date 9/7 Laboratory Methodologies in Computational Biology

Readings: see bCourses for Group Presentation #1 Resources

Week 4 Date 9/14 Bioinformatics Workshop #2: Introduction to ENCODE

Readings:

1. Sloan, C.A. et al., 2016. ENCODE data at the ENCODE portal. *Nucleic Acids Research*, 44(D1), pp.D726–D732.
2. Ecker, J.R. et al., 2012. Genomics: ENCODE explained. *Nature*, 489(7414), pp.52–55.
3. Maher, B., 2012. ENCODE: The human encyclopaedia. *Nature*, 489(7414), pp.46–48.

Week 5 Date 9/21 Bioinformatics Workshop #3: Pathway Analysis Methods

Readings:

1. Khatri, P., Sirota, M. & Butte, A.J., 2012. Ten years of pathway analysis: current approaches and outstanding challenges. *PLoS computational biology*, 8(2), p.e1002375.
2. Subramanian, A. et al., 2005. Gene set enrichment analysis: a knowledge-based approach for interpreting genome-wide expression profiles. *Proceedings of the National Academy of Sciences of the United States of America*, 102(43), pp.15545–50.
3. Vaske, C.J. et al., 2010. Inference of patient-specific pathway activities from multi-dimensional cancer genomics data using PARADIGM. *Bioinformatics*, 26(12), pp.237–245.
4. Hofree, M. et al., 2013. Network-based stratification of tumor mutations. *Nature methods*, 10(11), pp.1108–15.

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5. Kelder, T. et al., 2010. Finding the right questions: Exploratory pathway analysis to enhance biological discovery in large datasets. *PLoS Biology*, 8(8), pp.11–12.

Week 6 Date 9/28 Journal Club #1: Computational Methods for Genomics

Readings:

1. Dozmorov, M.G. et al., 2016. GenomeRunner web server: Regulatory similarity and differences define the functional impact of SNP sets. *Bioinformatics*, 32(April), pp.2256–2263.
2. Ding, J., Li, X. & Hu, H., 2016. TarPmiR: a new approach for microRNA target site prediction. *Bioinformatics*, (May), pp.1–8.

Week 7 Date 10/5 Spotlight on Faculty Research #1: Haiyan Huang

Title: Inferring gene interactions beyond standard models using expression data

Readings:

1. Wang, Y.X.R. et al., 2015. Inferring gene–gene interactions and functional modules using sparse canonical correlation analysis. *The Annals of Applied Statistics*, 9(1), pp.300–323.
2. Wang, Y.X.R., Waterman, M.S. & Huang, H., 2014. Gene coexpression measures in large heterogeneous samples using count statistics. *Proceedings of the National Academy of Sciences*, 111(46), p.1417128111.

Week 8 Date 10/12 Methods for Computational Biology: Protein Structure/Function Prediction and Phylogenomics

Readings:

1. Sjölander, K., 2004. Phylogenomic inference of protein molecular function: Advances and challenges. *Bioinformatics*, 20(2), pp.170–179.
2. Sankararaman, S. et al., 2010. Active site prediction using evolutionary and structural information. *Bioinformatics*, 26(5), pp.617–624.

Week 9 Date 10/19

No Class: Student Meetings to work on Group Presentation #2

Week 10 Date 10/26 Bioinformatics Tools in Computational Biology

Readings: see *bCourses for Group Presentation #2 Resources*

Week 11 Date 11/2 Journal Club #2: Computational Methods for Genomics

Readings:

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1. Smith, K.S. et al., 2015. SomVarIUS: Somatic variant identification from unpaired tissue samples. *Bioinformatics*, 32(6), pp.808–813.
2. Steinhauser, S. et al., 2016. A comprehensive comparison of tools for differential ChIP-seq analysis. *Briefings in Bioinformatics*, pp.1–14.

Week 12 Date 11/9 Methods for Computational Biology: Introduction to LaTeX Workshop

Instructions: Students should install LaTeX on their laptops and run the first "hello world"-type exercise from this site before the class meeting:

1. <https://www.latex-tutorial.com/installation/>
2. <https://www.latex-tutorial.com/tutorials/beginners/how-to-use-latex/>

Week 13 Date 11/16 Spotlight on Faculty Research #2: Ian Holmes

Title: Is everything everywhere? Neutral models of microbial communities and their connections to bioinformatics

Readings:

1. Arumugam, M. et al., 2011. Enterotypes of the human gut microbiome. *Nature*, 473(7346), pp.174–180.
2. Holmes, I., Harris, K. & Quince, C., 2012. Dirichlet multinomial mixtures: Generative models for microbial metagenomics. *PLoS ONE*, 7(2).

Week 14 Date 11/23

No Class: Thanksgiving Holiday

Week 15 Date 11/30 Spotlight on Faculty Research #3: Elizabeth Purdom

Title: mRNA expression analysis for single cell transcriptome sequencing

Readings:

1. Purdom, E. & Mukherjee, S., 2011. Transcriptomic Technologies and Statistical Data Analysis. In *Handbook of Statistical Systems Biology*. Wiley Online Library, pp. 133–162.
2. Shapiro, E., Biezuner, T. & Linnarsson, S., 2013. Single-cell sequencing-based technologies will revolutionize whole-organism science. *Nature reviews. Genetics*, 14(9), pp.618–630.

Week 16 Date 12/7 Demystifying the Qualifying Exam

Student Panel and Course/Semester Wrap-up