

Instructor: [Nir Yosef](mailto:niryosef@berkeley.edu) <niryosef@berkeley.edu>

Time: W 1:00-3:00 PM

Location: Zoom

GSI: Adam Gayoso <adamgayoso@berkeley.edu>

Office Hours:

- NY: 9-10 Fri
- AG: 9:30-10:30 Mon

In the spring semester we will cover various topics in computational genomics, and provide several examples for how the respective data-driven approaches are utilized in practice. We will have special emphasis on single-cell genomics, CRISPR/Cas9, and other high throughput studies of regulatory regions in the genome. The course will consist of an overview of the respective laboratory methodologies as well as algorithms for interpreting the ensuing data. In addition to staff-led lectures, class will include student-led presentations, critical review of the relevant literature, and visits of guest speakers who will present their own perspective and work. We will also cover more general topics, pertaining to broadly useful computational tools (e.g., building classifiers, data visualization) and lab techniques (e.g., Next generation sequencing), as well as development of skills that are generally important for success in graduate school, such as delivering presentations.

Homework: There will be four assignments that involve answering questions related to the four respective journal club papers. Please upload answers to bCourses before class. There will also be three, non-mandatory programming-based homeworks.

Presentations: Each student will give two ~20 minute presentations as part of a group.

Grading: Participation (40%), Presentations and assignments (60%)

Texts: No required texts. Most reading will be journal papers.

Course schedule: Subject to changes

#	Date	Topic	Readings
1	1/20/21	Course Introduction How to make a bad presentation	Video

2	1/27/21	Guest lecture: Zoë Steier Next generation sequencing Sequencing output: format and basic QC	Video 1 [Seq tech] Video 2 [FASTQ format] Video 3 [FastQC]
3	2/3/21	Read alignment: Burrows Wheeler Transform, handling mismatches with Bowtie	1. Bowtie manuscript 2. Bowtie 2 manuscript
4	2/10/21	Read alignment: The case of mRNA sequencing Group presentations 1 <i>Programming HW1 released</i>	1. TopHat2 manuscript 2. STAR manuscript See Group presentations 1 assignment
5	2/17/21	Group presentations 1 (continued)	See Group presentations 1 assignment
6	2/24/21	Principles of classification	Suggested reading: 1. Sections 1.1-1.3 of Probabilistic Machine Learning book 2. Machine learning applications in genetics and genomics
7	3/3/21	CCB Virtual Retreat (class cancelled)	
7	3/5/21	(MAKEUP) A primer on deep learning for classification Lab: Basic CNN for TF binding <i>Programming HW2 released</i>	1. Deep learning: new computational modeling techniques for genomics 2. A primer on deep learning in genomics

8	3/10/21	Guest lecture: Anshul Kundaje <i>JC1 answers due</i>	<ol style="list-style-type: none"> 1. Base-resolution models of transcription factor binding reveal soft motif syntax 2. For journal club: The dynamic, combinatorial cis-regulatory lexicon of epidermal differentiation
9	3/17/21	Unsupervised learning and dimensionality reduction (DR) from the context of single-cell genomics Lab: DR + viz of scRNA-seq data	<ol style="list-style-type: none"> 1. tSNE paper 2. UMAP background 3. PCA blog post
	3/24/21	Spring break (no class)	
10	3/31/21	Guest lecture: Aviv Regev <i>JC2 answers due</i>	Design for inference and the power of random experiments in biology
11	4/7/21	Guest lecture: Priya Moorjani Topic: Genetics, Heredity and Ethics	<ol style="list-style-type: none"> 1. Prepare answer to questions (no submission). 2. References found here.
12	4/14/21	Bias busters	Pre-course survey
13	4/21/21	Guest lecture: Liana Lareau <i>JC3 answers due</i>	<ol style="list-style-type: none"> 1. Accurate design of translational output by a neural network model of ribosome distribution 2. For journal club: Improved Ribosome-Footprint and mRNA Measurements Provide Insights into Dynamics and Regulation of Yeast Translation

14	4/28/21	Walking through the review process	
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