BISC478: Computational Genome Analysis (Spring 2019)

Over the next decade, millions of genomes will be sequenced (likely including yours), and genetic analysis will be a cornerstone of medical care. The goals of this course are to provide students with (1) broad knowledge of computational genome analysis, (2) biological questions that motivate computational analysis, and (3) specific technical skills of immediate practical use. This course covers DNA sequencing technology, and the computational methods to: analyze sequence data, individual genomes, disease studies, inter species comparison, functional genomics, and gene expression. The data analysis techniques covered in this course are founded in computer science and statistics, and motivated by real examples from modern studies.

Text book: *"Computational Genome Analysis"* by Deonier, Tavaré and Waterman. Roughly half the course content is covered in the text. The text is supplemented by notes posted on Blackboard and selected review articles.

Evaluation: Students are evaluated based on one midterm, worth 30%, a final exam worth 40%, and 5 practical assignments, each worth 6%. The practical assignments are diverse, some requiring students to complete exercises and submit brief reports, others requiring simple programming or completing practical data analysis tasks.

Lecture schedule:

Week	Date	Topic
1	01/08/19	Course overview
	01/10/19	DNA, RNA, Protein, the central dogma of biology
2	01/15/19	Probability for genetic analysis
	01/17/19	How to sequence a million genomes
3	01/22/19	Sequencing in outer space from single molecules
	01/24/19	Building the first human genome (1)
4	01/29/19	Building the first human genome (2)
	01/31/19	Sequence mapping: Google for genomes (1)
5	02/05/19	Sequence mapping: Google for genomes (2)
	02/07/19	Storing petabytes of DNA and other databases
6	02/12/19	Genetic variation: single nucleotide variation
	02/14/19	Copy number variation: most genes come in pairs, but not all
7	02/19/19	How 23&Me works: Genome-wide association studies
	02/21/19	Interpreting variation for precision medicine
8	02/26/19	How high-throughput sequencing can fail
	02/28/19	Midterm
9	03/05/19	Spring break
	03/07/19	Spring break
10	03/12/19	Pairwise sequence alignment
	03/14/19	Inferring function across species
11	03/19/19	Multiple sequence alignment
	03/21/19	Comparative genomics and gene finding
12	03/26/19	Measuring gene expression with RNA-seq
	03/28/19	Differential gene expression (1)
13	04/02/19	Differential gene expression (2)
	04/04/19	Clustering, gene-set enrichment and functional databases
14	04/09/19	Regulatory genomics and epigenomics
	04/11/19	Measuring genome regulation with ChIP-seq
15	04/16/19	Analysis of ChIP-seq
	04/18/19	DNA methylation
16	04/23/19	Hidden codes in DNA
	04/25/19	The future of genomics and medicine