Computational Systems Biology: Biology X

Bud Mishra

Room 1002, 715 Broadway, Courant Institute, NYU, New York, USA

Human Population Genomics

Outline

"The curse of the human race is not that we are so different from one another, but that we are so alike."
–Salman Rushdie, *The Enchantress of Florence*, 2008.

Outline

Administrivia

- **Instructor:** Bud Mishra
- Room 1002, 715 Broadway
- email: mishra@nyu.edu
- phone: 212-998-3464
- Office Hours: Mondays, 1:30 pm

Administrivia

- **Course Details:** G22.3033-005
  || Computational Systems Biology
- **Time and Place:** 7:10-9:00 pm EST
  || Room 1221, 719 Broadway
- **Number of Credits:** 3 credits
- **Course Work:** Software Project, Analyzing Genetics Data
- **Languages of Choice:** Python, Matlab, Mathematica, R (No Perl please)

Text Books

- W.J. Ewens || Mathematical Population Genetics: I. Theoretical Introduction || Publisher: Springer; 2nd edition (January 9, 2004)
- J.F.C. Kingman || Mathematics of Genetic Diversity|| Publisher: Soc. for Industrial & Applied Math (December 1980)
- L.L. Cavalli-Sforza || Genes, Peoples, and Languages|| Publisher: University of California Press; 1 edition (April 3, 2001)
- S. Kim, H. Tang and E.R. Mardis || Genome Sequencing Technology and Algorithms || Publisher: Artech House Publishers; 1 edition (October 31, 2007)
- D. Gusfield || Algorithms on Strings, Trees and Sequences: Computer Science and Computational Biology|| Publisher: Cambridge University Press; 1 edition (May 28, 1997)

Outline

Genomics from a Population View-point

- **Main Thesis**
- Assume that in the not-so-distant future, we face no computational, technological or biological obstacles to gathering a large amount genomic (+epigenomic, transcriptomic, proteomic, etc.) ...
  1. *How would such data be anlayzed? Mathematical Models?*
  2. *To what use, can these data be put to?*
  3. *What is the most cost effective ways of creating such data?*

Areas we wish to touch on...

- Biotechnology
- Algorithms for Biological Data Analysis
- Association Studies
- Population Models

Let us think about these inter-connected questions from a single global perspective...

A Tentative Syllabus

I would like to focus this course on four basic questions...

1. Who are we (humans)?
2. Where did we come from? How do we differ?
3. Why do we suffer?
4. Why do we die?

Possible Sets of Lectures

- **Lecture 1:** Introduction to Biology (Genomics)
- **Lectures 2, 3 & 4:** Reading Human Genomes Haplotypically: New generation sequencing technologies. The challenges. Resequencing algorithms. Sequence assembly algorithms
- **Lecture 5:** Genome Evolution: (Point Mutations; Rearrangements; Evolution by Duplication)
- **Lecture 6 & 7:** Genome Structure: (Retro-Elements and their distributions; Physical Properties of a genome; Large Segmental Duplications; Models of Segmental Duplications); Polymorphisms: (SNPS & CNPS; Haplotyping and Haplotype phasing);

Possible Sets of Lectures (Contd.)

- **Lecture 8 & 9:** Genetics: (Linkage Analysis; Association Studies)
- **Lecture 10 & 11:** Population Genomics (Wright-Fisher Model, Moran Model, Coalescent Model, Testing the Neutral Theory, Population and Species Comparison)
- **Lecture 12 & 13:** Diseases: Cancer, Autism and CFIDS (Chronic Fatigue and Immune Dysfunction Syndrome)
- **Lecture 14:** Personalized Medicine

Questions???

Heated Discussions on the Suggested Topics...
Resulting in a New and Better Syllabus...
That EVERYONE Loves!

[End of Lecture #1]