Computational Biology Syllabus

Instructor: Satvik Dasariraju

Weekly Classes on Sundays at 6:30 PM EST from 10/25 to 12/13 (8 Classes)

Course Description

The computational biology course is intended for bright, innovative middle school and early high school students looking to learn about the cutting edge topic of computational biology that has become necessary for professionals and researchers in every field of biology/medicine. This course will expose students to the applications of computer science in solving biological and medical issues. Over 8 weeks, we'll talk about computational thinking, motifs in genetics, biomedical image segmentation and analysis, and machine learning. We'll also go into scientific research and research papers/presentations at a high school level. A highlight of the course is 4 guided projects (listed in the syllabus) that will be covered during meetings, which intend to serve as an example for students looking to pursue their own computational biology projects.

Meeting Agenda

10/25 Meeting 1: Introduction to Computational Biology

- What is computational biology?
- Introduction to course topics and projects
- Examples of applications of computer science in biology
- Significance and relevance of computational biology

11/1 Meeting 2: Overview of Computer Programming

- Explanation of computational thinking
- Syntax and features of Python
- Special packages useful for computational biology
- Other useful languages (Matlab and R) and their strengths

11/8 Meeting 3: Genes and Motifs

- Overview of genes and importance
- Biological processes of transcription and translation
- Algorithms for transcription
- Project 1: Finding and counting motifs (patterns) in genome

11/15 Meeting 4: Biomedical Image Processing and Segmentation

- Overview of purpose of biomedical image segmentation
- Processing large data sets
- Project 2: Segmenting medical images (eg. isolating lungs in a CT scan)

11/22 Meeting 5: Biomedical Image Analysis

- How to analyze and extract information from segmented images
- Image features (eg. irregularity of tumors)
- Cytomorphological features (eg. nucleus to cytoplasm ratio)
- Project 3: Feature extraction

11/29 Meeting 6: Machine Learning Part 1

- Introduction to machine learning and purpose
- Types of machine learning algorithms
- Strengths and weaknesses of each machine learning algorithm

12/6 Meeting 7: Machine Learning Part 2

- How to choose a machine learning algorithm for a specific project
- Project 4: Implementing machine learning to make predictions on biomedical data

12/13 Meeting 8: Glimpse into Science Research

- Scientific method
- Computational biology research
- How you can explore and tinker with your own computational biology projects!
- Research papers and presentations