Biocomputational Engineering

Biocomputational Engineering is an academic program that is at the nexus of the biological sciences, engineering, and computer science. The curriculum begins with classes in the mathematics and life & physical sciences, as well as computer programming and core engineering principles, which form the foundation for our biocomputations courses that cover a range of subjects, from bioinformatics and machine learning to biophysical models and biomedical signals. In our capstone courses, the students integrate and apply what they have learned in the earlier portion of the curriculum in a hands-on, collaborative setting. Our faculty are drawn from Bioengineering, Computer Science and Engineering, Biological Sciences, Physics, and Industrial and Systems Engineering, which will expose the students in this program to a rich, diverse range of expertise in this exciting discipline. Opportunities for academic research and employment in the field of Biocomputational Engineering are growing dramatically. People with experience in areas such bioinformatics and data analysis are currently in high demand at pharmaceutical, biotechnology, and software companies.

For more information about the program, please contact Professor Anand Ramamurthi (anr320@lehigh.edu) or Professor Lori Herz (loh208@lehigh.edu).

OUR MISSION

The mission of the Biocomputational Engineering Program at Lehigh University is to prepare students for the growing academic and professional opportunities at the interface of bioengineering and computational data sciences. Students will be prepared to apply concepts from these converging fields of study, enabling them to solve problems in biological systems, biotechnology, and healthcare within the framework of an engineering education.

curriculum

The degree requirements for the B.S. in Biocomputational Engineering, including the typical four-year schedule, can be found at: https://engineering.lehigh.edu/bioe/undergraduate/biocomputational/requirements/

Courses

BIOC 213 Fundamentals of Biomedical Signals 3 Credits
Fundamentals of analysis of data obtained from common quantitative techniques, including imaging, EEG, cardiograms, and bioinformatics. Introduction to sampling, Fourier transforms, filters, clustering, and classification. Common tools for data processing and application of programming.
Prerequisites: MATH 205 and PHY 021 and BIO 210
Can be taken Concurrently: BIO 210

BIOC 240 Biocomputational Engineering - Capstone 1 3 Credits
Students work in teams on design projects in which they will integrate and apply concepts from numerous courses in the Biocomputational Engineering curriculum. Projects have constraints, including technical feasibility, engineering standards, and economic analysis, as well as global and/or social impact.
Prerequisites: BIOC 214 and BIOC 236

BIOC 241 Biocomputational Engineering - Capstone 2 3 Credits
Students continue their work on Biocomputational Engineering design projects from BIOC 240. Designs from the previous semester will be further developed, such that they have more technical depth and adhere to established constraints and standards.
Prerequisites: BIOC 240

BIOC 214 Fundamentals of Biological Modeling 3 Credits
Introduction to quantitative biology approaches through modeling. Practical methods of applying basic mathematical modeling and programming. Topics include linear and non-linear models, DNA and protein structures, ligand-receptor binding, reaction kinetics, electrical and mechanical cell dynamics, gene regulatory models, and fundamentals of epidemiology.
Prerequisites: MATH 205 and CSE 017 and PHY 021

BIOC 236 Biomolecular Modeling and Simulation 3 Credits
Concepts, methods, and tools for biomolecular modeling and simulation. Topics include molecular mechanics, minimization, molecular dynamics, Monte Carlo simulation, explicit and implicit solvation, continuum electrostatics, advanced sampling techniques, and free energy calculations. Overviews provided for UNIX operating system, text editors, Python programming, and Protein Data Bank. Lectures and hands-on practice with tools in CHARMM-GUI.
Concepts, algorithms, and applications to current biological problems. Students may not earn credit for both this course and BIOS 237.
Prerequisites: CSE 017