BIOMEDICAL COMPUTATION UNDERGRADUATE MAJOR

Biomedical Computation (BMC)

Completion of the undergraduate program in Biomedical Computation leads to the conferment of the Bachelor of Science in Engineering. The subplan "Biomedical Computation" appears on the transcript and on the diploma.

Mission of the Undergraduate Program in Biomedical Computation

Quantitative and computational methods are central to the advancement of biology and medicine in the 21st century. These methods span the analysis of biomedical data, the construction of computational models for biological systems, and the design of computer systems that help biologists and physicians create and administer treatments to patients. The Biomedical Computation major prepares students to work at the cutting edge of this interface between computer science, biology, and medicine. Students begin their journey by acquiring foundational knowledge in the underlying biological and computational disciplines. They learn techniques in informatics and simulation and their numerous applications in understanding and analyzing biology at all levels, from individual molecules in cells to entire organs, organisms, and populations. Students then focus their efforts in a depth area of their choosing, and participate in a substantial research project with a Stanford faculty member. Upon graduation, students are prepared to enter a range of disciplines in either academia or industry.

Requirements

<table>
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<th>Units</th>
<th>Course</th>
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| 21 | Mathematics
| 3 | MATH 19 Calculus (or AP Calculus )
| 3 | MATH 20 Calculus (or AP Calculus )
| 4 | MATH 21 Calculus (or AP Calculus )
| 3-5 | CS 103 Mathematical Foundations of Computing
| 3-5 | CS 109 Introduction to Probability for Computer Scientists
| 17 | Science
| 4 | PHYSICS 41 Mechanics
| 4 | PHYSICS 41E Mechanics, Concepts, Calculations, and Context
| 6 | CHEM 31M Chemical Principles: From Molecules to Solids (formerly CHEM 31X)
| 5 | CHEM 31B Chemical Principles II
| 4 | CHEM 33 Structure and Reactivity of Organic Molecules
| 5 | BIO 82 Genetics (or HUMBIO 2A)
| 4 | BIO 83 Biochemistry & Molecular Biology (or BIO 84 or HUMBIO 3A)
| 4 | BIO 86 Cell Biology (or HUMBIO 4A)
| 3-5 | Engineering Fundamentals
| 4 | CS 106B Programming Abstractions
| 3-5 | CS 106X Programming Abstractions
| | Technology in Society
| 3-5 | Computer Organization and Systems
| | Science
| 1 | Calculus (or AP Calculus )
| 1 | Calculus (or AP Calculus )
| 1 | Calculus (or AP Calculus )
| 1 | Mathematical Foundations of Computing
| 1 | Introduction to Probability for Computer Scientists
| 1 | Mechanics
| 1 | Mechanics, Concepts, Calculations, and Context
| 1 | Chemical Principles: From Molecules to Solids (formerly CHEM 31X)
| 1 | Chemical Principles II
| 1 | Structure and Reactivity of Organic Molecules
| 1 | Genetics (or HUMBIO 2A)
| 1 | Biochemistry & Molecular Biology (or BIO 84 or HUMBIO 3A)
| 1 | Cell Biology (or HUMBIO 4A)
| 3-5 | Programming Abstractions
| 3-5 | Programming Abstractions
| 6-10 | Information Core (three courses)
| 3-5 | Data Management and Data Systems
| 3-5 | Introduction to Human-Computer Interaction Design
| 3-5 | Artificial Intelligence: Principles and Techniques
| 3-5 | Probabilistic Graphical Models: Principles and Techniques
| 3-5 | Machine Learning
| | Organism/Cells Concentration
| 3-5 | Vector Calculus for Engineers
| 3-5 | Biostatistics
| 3-5 | Linear Algebra, Multivariable Calculus, and Modern Applications
| 3-5 | Human Physiology
| | Design and Analysis of Algorithms
| | Modeling Biomedical Systems: Ontology, Terminology, Problem Solving
| | The Human Genome Source Code
| | Representations and Algorithms for Computational Molecular Biology
| | Translational Bioinformatics
| | Computational Biology: Structure and Organization of Biomolecules and Cells
| | Biomedical Computation research in any department
| | Concentrations:
| | Mathematics: Select one of the following:
| | Vector Calculus for Engineers
| | Biostatistics
| | Linear Algebra, Multivariable Calculus, and Modern Applications
| | Advance Molecular Biology: Epigenetics and Proteostasis
| | The Chemical Principles of Life I (or CHEM 171)
| | Cell/Molecular Electives (two courses)
| | Informatics Electives (two courses)
| | Simulation Electives (two courses)
| | Simulation, Informatics, or Cell/Mol Elective (one course)
| | Informatics Concentration
| | Mathematics: Select one of the following:
| | Data Management and Data Systems
| | Introduction to Human-Computer Interaction Design
| | Artificial Intelligence: Principles and Techniques
| | Probabilistic Graphical Models: Principles and Techniques
| | Machine Learning
| | One additional course from the previous two lines
| | Informatics Electives (three courses)
| | Cellular Electives (two courses)
| | Organs Electives (two courses)
| | Organs/Cellular Concentration
| | Mathematics: Select one of the following:
| | Vector Calculus for Engineers
| | Biostatistics
| | Linear Algebra, Multivariable Calculus, and Modern Applications
| | Human Physiology

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Honors Program

The Biomedical Computation program offers an honors option for qualified students, resulting in a B.S. with Honors degree in Engineering (ENGR-BSH, Biomedical Computation). An honors project is meant to be a substantial research project during the later part of a student's undergraduate career, culminating in a final written and oral presentation describing the student's project and its significance. There is no limit to the number of majors who can graduate with honors; any BMC major who is interested and meets the qualifications is considered.

1. Students apply by submitting a 1-2 page proposal describing the problem the student has chosen to investigate, its significance, and the student's research plan. This plan must be endorsed by the student's research and academic advisers, one of whom must be a member of the Academic Council. In making its decision, the department evaluates the overall scope and significance of the student's proposed work.

2. Students must maintain a 3.5 GPA.

3. Students must complete three quarters of research. All three quarters must be on the same project with the same adviser. A Summer Quarter counts as one quarter of research.

4. Students must complete a substantial write-up of the research in the format of a publishable research paper. This research paper is expected to be approximately 15-20 pages and must be approved by the student's research adviser and by a second reader.

5. As the culmination of the honors project, each student presents the results in a public forum. This can either be in the honors presentation venue of the home department of the student's adviser, or in a suitable alternate venue.

6. Students submit a pdf of their thesis, including the signature page signed by both readers, to the student services officer by May 15. Students are sent email instructions on how to archive a permanent electronic copy in Terman Engineering library.

For additional information and sample programs, see the Handbook for Undergraduate Engineering Programs (UGHB) (http://ughb.stanford.edu).