

APPLIED COMPUTER SCIENCE, B.S.

Concentration in Bioinformatics

2019-20

The Bachelor of Science degree in Applied Computer Science (BS ACS) has been created for those students who want and need the knowledge and expertise of computer science to work in one of the many disciplines that require advanced computing techniques. These fields do not merely "use" computing but create new and interesting problems for the computer scientist.

The objectives of the BS ACS program are to provide students with the following:

1. The fundamental knowledge regarding theory, methods and applications of Computer Science.
2. A foundation in a second chosen discipline.
3. Knowledge of concepts that integrate Computer Science with the second chosen discipline using senior level classes that focus on the emerging issues.
4. Preparation for employment as a computational expert in a non-computer science discipline.
5. Preparation for graduate studies in fields such as Computer Science, their second discipline and related computational areas.

Application Area

The study of computational issues central to biological science, (i.e. bioinformatics) requires knowledge of both biology and computer science. In bioinformatics, vast files of raw data are being analyzed to find answers to important questions in molecular biology. Computer scientists have a better understanding of the computational techniques, but do not have the background required to formulate the computational biology questions. Biologists understand the molecular issues, but lack knowledge of computational techniques. The interdisciplinary nature of bioinformatics requires a strong preparation in both computer science and biology fundamentals which the bioinformatics concentration provides.

Degree Requirements

The bioinformatics concentration of the ACS program can be successfully completed within the normal 120 semester hour degree GMU. In addition to Mason Core requirements, including humanities, and social science, the BS ACS program requires foundation, core, and

concentration courses as described in this brochure.

The foundation and core course requirements provide the student with expertise in programming, computer systems, software requirements and modeling, formal methods and analysis of algorithms. At least 45 semester hours of the degree requirements must be at the 300 level or above.

ACS Foundation Courses: CS 110, 112, 211;
MATH 113, 114, 125, 203.

ACS Core:

CS 262, 310, 321, 330, 367, 471, 483.

One CS course numbered above 400 (#498)

All BS ACS majors must complete at least 36 additional credits to meet the course requirements of the Bioinformatics concentration. These credits will include either STAT 344 (Statistics and Probability) or a course in Statistics relevant to the concentration.

Bioinformatics Concentration

Foundation:

PHYS 160/161, CHEM 201, BIOL 213, CS 306 and
STAT 344

Core:

BINF 450, BIOL 482, BIOL 580, CS 450
BINF 401 or CS 444
BINF 402 or CS 445

Two approved electives related to bioinformatics

Sample Schedule

FIRST SEMESTER (14 CREDITS)

CS 110 Essentials of Computer Science	3
CS 112 Introduction to Programming	4
MATH 113 Analytic Geometry and Calculus I	4
ENGH 101 Composition	3

SECOND SEMESTER (16 CREDITS)

CS 211 Object-Oriented Programming	3
MATH 114 Analytic Geometry and Calculus II	4
MATH 125 Discrete Mathematics I	3
Western Civilization Elective	3
COMM 100/101 Public Speaking	3

THIRD SEMESTER (16 CREDITS)

CS 262 Low-Level Programming	3
CS 310 Data Structures	3
MATH 203 Linear Algebra	3
PHYS 160/161 University Physics + Lab	4
Literature	3

FOURTH SEMESTER (15 CREDITS)

CS 330 Formal Methods and Models	3
CS 367 Computer Systems and Programming	4
CHEM 201 Introductory Chemistry I	3
Social and Behavioral Science Elective	3
Elective	2

FIFTH SEMESTER (16 CREDITS)

ENGH 302 Advanced Composition	3
CS 471 Operating Systems	3
CS 483 Analysis of Algorithms	3
BIOL 213 Cell Structure & Function	4

SIXTH SEMESTER (14 CREDITS)

BIOL 482 Introduction to Molecular Genetics	3
CS 321 Software Req's & Design Modeling	3
STAT 344 Prob/Stat for Engrs & Scientists	3
Arts Elective	3
Elective	2

SEVENTH SEMESTER (16 CREDITS)

CS 306 Synthesis of Ethics & Law	3
CS 444 Introduction to Computational Biology	3
BINF 450 Bioinformatics for Life Science	4
Bioinformatics related elective	3
Global Understanding Elective	3

EIGHTH SEMESTER (15 CREDITS)

BIOL 580 Computer Applications-Life Science	3
CS 450 Database Concepts	3
CS 445 Computational Methods for Genomics	3
Bioinformatics related elective	3
CS Senior course	3
Elective	1

A Closer Look at Bioinformatics Specific Courses

The following courses have been created specifically for this program and tailor the standard computer science degree for bioinformatics.

CS 444 Introduction to Computational Biology

Prerequisite: Grade of C or better in CS 310. This course introduces students to computational methods in molecular biology. The course will cover a broad array of topics in bioinformatics and computational biology and will be organized as three four-week modules. The modules are intended to capture the current classification of bioinformatics and computational biology methods and so to provide students with a broad view of the field. The modules will range from sequence-centric bioinformatics, to structure-centric computational biology, and system-centric algorithmic systems biology. The class will give students the ability to obtain hands-on experience and expertise through design and programming projects.

CS 445 Computational Methods for Genomics

Prerequisite: Grade of C or better in CS 310 and STAT 344. Fundamental principles and techniques for implementing computational algorithms to solve problems in biology arising from the need to process large volumes of genomic information. Topics include sequence analysis, alignment, and assembly, gene prediction, and knowledge-based protein structure prediction. Projects involve designing and programming basic alignment and prediction methods.