I. The Ohio State University

Total Credits Required: 18 credits (four core courses and at least one elective)

Required Courses

Simulation and Modeling: An introductory course on the use of models (continuous and discrete) and simulation in science and engineering.
CSE2021 - Concepts of modeling and simulation; develop MATLAB skills to explore modeling concepts; project: design, implementation, verification/validation of model; oral and written project report.

Programming and Algorithms: A course on computer programming and the use of a programming language for problem solving is the second required course.
CSE1222 - Introduction to computer programming and to problem solving techniques using computer programs with applications in engineering and the physical sciences; algorithm development; programming lab experience.

Numerical Methods: An applied introduction to use of numerical methods in solving linear and nonlinear equations, interpolation, numerical solution of differential equations.
MATH3607 – Beginning Scientific Computing: ntroduction to mathematical theory of algorithms used to solve problems that typically arise in sciences, engineering, and finance.

Capstone Research/ Internship Experience: Each student must complete a guided research project or internship on a computational topic. The mechanism used to satisfy this requirement may differ across departments – e.g. computationally oriented senior design project or honors thesis, or a computationally oriented independent research study with a faculty member at Ohio State, or internship experience with an external agency or company that meets the goals of this requirement. Credit will be given through available independent studies or research course designations.

Elective Courses

Domain-Specific Course: Any approved computationally oriented course from the student's major discipline. Currently there are related courses in biomedical informatics, chemistry, mathematics, microbiology, and physics.

CSE 3521 - Survey of Artificial Intelligence I: Basic Techniques
Survey of basic concepts and techniques in artificial intelligence, including problem solving, knowledge representation, and machine learning.

BMI 5730 - Introduction to Bioinformatics
Introduces students to basic topics of bioinformatics including sequence analyses, proteomics, microarrays, regulatory networks, sequence and protein databases. Recommended background in molecular biology and computer science.

CHEM 5440 - Introduction to Computational Chemistry

Introduction to fundamental concepts in computational chemistry, including molecular modeling, molecular dynamics, and semi-empirical and ab initio calculations.

MATH 5651 - Mathematical Modeling of Biological Processes
Enzyme dynamics, predator-prey and competition model, spread of diseases, plant growth, cell cycle and cell differentiation, reaction-diffusion with advection, cancer models and cancer therapy, wound healing.

PHYSICS 5740 - Quantitative Cell Biology for Engineers and Scientists
Introduction to the biophysical and biochemical principles underlying the behavior of cellular processes with an emphasis on surveying engineering models and quantitative measurements.

LING 5801 - Computational Linguistics I
Symbolic and probabilistic computation applied to the structure of words and sentences, models of syntax, parsing algorithms.

ECON 4050 - Experimental Economics
Introduction to economics as an experimental social science. Students participate in and study results of economic experiments dealing with markets, individual decision making, and a broad array of game theoretic economic models.

GEOG 5221 - Spatial Simulation and Modeling in GIS
Fundamental modeling and simulation techniques in GIS, including cellular automata, diffusion models, and agent-based models, and their applications in social, environmental, and natural resources research.

PSYCH 5608 - Introduction to Mathematical Psychology
Survey of mathematical and computational modeling in psychology. Topics include psychophysical scaling, information processing, probabilistic choice, signal detection theory, model comparison, and Bayesian graphical modeling.

Other Electives

MATH 2255 - Differential Equations and Their Applications
Ordinary differential equations, their series solutions, numerical methods, Laplace transforms, physical applications.

MATH 2415 - Ordinary and Partial Differential Equations
Ordinary and partial differential equations: Fourier series, boundary and initial value problems.

MATH 2568 - Linear Algebra
Matrix algebra, vector spaces and linear maps, bases and dimension, eigenvalues and eigenvectors, applications.

CSE 5441 - Introduction to Parallel Computing
Parallel programming models; sequential and parallel performance issues; high-performance computer architecture; design, analysis, implementation and performance evaluation of parallel algorithms.

CSE 5544 - Introduction to Scientific Visualization

Principles and methods for visualizing data from measurements and calculations in physical and life sciences, and transactional and social disciplines; information visualization; scientific visualization.

CIVILEN 5168 - Introduction to the Finite Element Method
Basic concepts, formulation, and application of finite element techniques for numerical solution of problems of engineering and scientific interest.

ISE 3200 - Linear and Integer Programming
Introduction to formulation, solution and analysis of continuous and discrete linear models to optimize the design of production and service systems and other engineering applications.

ISE 3230 - Systems Modeling and Optimization for Analytics
Introduction to formulation, solution and analysis of continuous and discrete linear and nonlinear models to optimize systems using data-driven techniques.

II. Capital University

Total Credits Required: 21 credits

Required

CS 160 - Introduction to Computer Science
Algorithm design, algorithm development techniques and programming with emphasis on good program style. Topics include control, functions, arrays, classes and files.

CSAC 225 - Calculus and Modeling for Biological Sciences
n introduction to mathematical modeling and calculus with applications to biology. Topics include limits, continuity, derivatives, definite and indefinite integrals. Students will employ computational software to solve problems and to analyze models of various biological processes.

Or

MATH 230 - Calculus I
Exploration of the concepts, techniques and application of calculus through a study of the properties and applications of polynomial, rational, exponential and trigonometric functions; development of concepts of limit, continuity, differentiation and integration; applications of derivatives and integrals; the Fundamental Theorem of Calculus.

CSAC 245 - Computational Science I
An introduction to the problems and solution methodologies in computational science. Computational tools such as a computer algebra system, a high performance computing engine, visualization software and Internet resources will be used to explore and solve mathematical problems drawn from various fields of science.

CSAC 335 - Differential Equations and Dynamical Systems
A modeling approach is used to cover techniques for solving a variety of Ordinary Differential Equations (ODE): linear (first and higher order), non-linear, and systems of ODEs. The course also examines methodologies for solving linear and non-linear continuous dynamic systems. (Requires Calculus II)

MATH 435 - Computational and Numerical Methods
Students explore the solution methodology of problems in computational science with an emphasis on numerical techniques. Topics include error analysis, numerical integration and differentiation, FFTs, solutions of linear systems, and numerical solutions of ODEs.

CSAC 445 - Research Experience in Computational Science
A capstone research experience usually comprising a comprehensive literature review, design, and implementation of computational science techniques to solve a problem in the behavioral, computer, financial, mathematical, natural, physical, or social sciences. This may also be an internship experience and is repeatable for additional credit.

And

Two elective courses

CSAC 394 - Comp Neuroscience and Psychology
CSAC 392 - Computational Biology
CSAC 391 - Computational Chemistry
CSAC 393 - Computational Environmental Science
CSAC 396 - Computational Physics

III. Wofford College - Emphasis in Computational Science

Calculus I
A graphical, numerical, and symbolic study of the theory and applications of the derivative of algebraic, trigonometric, exponential, and logarithmic functions, and an introduction to the theory and applications of the integral. Suitable for students of both the natural and the social sciences.

COSC 201 Modeling and Simulation for the Sciences
An introduction to modeling and simulation as part of the interdisciplinary field of computational science. Large, open-ended scientific problems often require the algorithms and techniques of discrete and continuous computational modeling and Monte Carlo simulation. Students learn fundamental concepts and implementation of algorithms in various scientific programming environments. Throughout, applications in the sciences are emphasized.

COSC235 Programming and Problem Solving
Students learn to develop programs using an object-oriented language. Students are introduced to problem solving and algorithm development with emphasis on good programming style.

COSC350 Data Structures
An introduction to the formal study of data structures, such as arrays, stacks, queues, lists, and trees, along with algorithm design and analysis of efficiency.

Summer Internship

Electives

One of the following:

COSC370 Computational Science: Data and Visualization
An introduction to data and visualization, part of the interdisciplinary field of computational science. The course contains a brief introduction to the network environment and the UNIX operating system. Because large Web-accessible databases are prevalent for storing scientific information, the course covers the concepts and development of distributed relational databases. Effective visualization of data helps scientists extract information and communicate results. Students will learn fundamental concepts, tools, and algorithms of computer graphics and scientific visualization in three dimensions. Throughout, applications in the sciences are emphasized

COSC365 High Performance Computing
An introduction to the concepts, tools, languages, and algorithms for solving problems on massively parallel and distributed computers. Advanced computer architectures; performance and optimization; and the design, analysis, and implementation of applications in parallel are studied.

Molecular Biology & Genomics
Study of the mechanisms of life on the molecular level. Topics include gene cloning, the study of the mechanisms of life on the molecular level, as well as the use of large computer databases of DNA sequence data to study those mechanisms. In the laboratory, students will use modern technologies including Western Blot, PCR, and DNA sequencing. The laboratory will also include bioinformatics tools to analyze DNA.

IV. University of Mary Washington - Data Sciences Minor

Total credits: 23

Required

MATH 200 Introduction to Statistics
First course in statistical methods. Includes descriptive and inferential techniques and probability, with examples from diverse fields. Topics vary with instructor and may also include sampling methods, regression analysis, and computer applications. (MATH 121 and 122 are Prerequisites)

MATH 300 Linear Algebra (3)

An introduction to linear algebra. Usually includes matrix algebra, systems of equations, vector spaces, inner product spaces, linear transformations, and eigenspaces.

CPSC220 Computer Science I (4)

Continued coverage of disciplined problem-solving and algorithmic development including emphasis on procedural and data abstraction. Topics include elementary data structures such as arrays, files, and classes. The notions of data modeling and the linking of data type definitions with their associated operations is introduced. Study of program design, coding, debugging, testing, and documentation in a higher level language that supports the object-oriented paradigm. Intended for students who have had previous programming experience.

CPSC419 Data Mining
Practical knowledge of data mining and information retrieval. Students will examine the theoretical foundations of a variety of techniques, gain experience with these techniques using open source software, and learn how to apply them to real-world problems. Topics include decision trees, Naïve Bayes, Probabilistic retrieval models, clustering, support vector machines and approaches to web mining.

CPSC420 Modeling and Simulation (3)
A robust introduction to techniques of mathematical modeling and computational simulation applied to practical problems. Topics include system dynamics approaches, discrete-event simulation, and agent-based models. Students complete small projects on topics as diverse as population growth, epidemic transmission, queuing theory, and forest fire outbreaks.

Electives

Four elective credits from the following:

CPSC230 Computer Science II: Data Structures
Continued study of data modeling and incorporation of abstract data types including linked lists, stacks, queues, heaps, trees, and graphs. Study of advanced sorting and searching techniques. Provides experience in the use of algorithm analysis. Continued study of program design, coding, debugging, testing, and documentation in an object-oriented higher level language.

BUAD 400 Analytics Application Development
A course in programming and data manipulation techniques for constructing analytics-based applications. Topics include SQL and no-SQL databases, using web service API's to acquire data, introduction to Hadoop and MapReduce, and use of third-party analytic component API's.

Three elective credits from the following:

BUAD 403 Foundations and Applications of Data Analytics

This course develops an overview of the challenges of developing and applying analytics for insight and decision-making. Examples and cases will come from customer relation management, price modeling, social media analytics, location analysis and other business domains.

CPSC 425 Parallel Processing
Introduces massive parallelism, shared-memory strategies, and message passing approaches. Other topics are synchronization, parallel algorithm development, performance measurements, degradation, granularity, interconnection networks, and processor communication strategies. Includes study of multi-computer topologies (e.g. rings, meshes, tori, and hypercubes) and topological embeddings. Programming tools may include Multi-Pascal, MPI, and C-Linda.