<h1 style="text-align:center">2024-2025   MCB Area of Interest Course Information</h1>

Computational Biology

Please check the University of Washington Time Schedule for the most updated course information.

FOUNDATIONAL COURSES

<u>Foundational Course One:</u>

Course Number: GENOME 541

Course Title: Introduction to Computational Molecular Biology: Molecular Evolution

Instructor (s): Bill Noble

Location: UW

Credits: 4

Quarter, Weeks, and Frequency course is offered: Spring, weeks 1-10, every year. *Will be offered in Spring 2025*

Attributes: Graded, lecture-based

Sub Area (if applicable):

Synopsis: Computational methods for studying molecular evolution. Students must be able to write computer programs in Python/R for data analysis. **Prerequisites**: Prior coursework in biology and probability.

<u>Foundational Course Two:</u>

Course Number: GENOME 559

Course Title: Introduction to Statistical and Computational Genomics

Instructor(s): Bill Noble, Brian Beliveau

Location (e.g., UW, FH, SLU): UW

Credits: 3

Quarter, Weeks, and Frequency course is offered: Winter, weeks 1-10, every year. *Will be offered in Winter 2025*

Attributes (e.g., graded, lecture-based): Graded, lecture-based, hands-on computational work

Sub Area (if applicable):

Synopsis: Emphasis on basic probability and statistics, and in introduction to computer programming. This course is intended to introduce students with non-computer science background to the major concepts of programming and statistics. After taking this course, students will be able to describe and perform basic analysis tasks relating to biological sequence analysis, phylogenetics, pedigree analysis, genetic association studies, population genetics and microarray analysis. Students will be able to demonstrate an understanding of fundamental statistical concepts, such as p-values, t-tests, chi-squared tests and multiple testing correction. Finally, students will be able to write computer programs to perform statistical and bioinformatics analysis. **Note**: For those with very little or no programming experience, contact instructor to obtain permission to enroll.

<u>Foundational Course Three:</u>

Course Number: GENOME 560

Course Title: Introduction to Statistical Genomics

Instructor (s): Devin Schweppe, Nasa Sinnott-Armstrong

Location: UW

Credits: 3

Quarter, Weeks, and Frequency course is offered: Spring, weeks 1-10, every year. *Will be offered in Spring 2025*
Attributes: Graded, lecture-based
Sub Area (if applicable):
Synopsis: An introduction to fundamental concepts necessary for the analysis of genetic and genomic data including, basic elements of probability theory, parameter estimation, and hypothesis testing. **Prerequisite:** First year Genome Sciences graduate students or by permission of instructor.

Foundational Course Four:
    Course Number: MCB 536
    Course Title: Tools for Computational Biology
    Instructor (s): Arvind Subramaniam
    Location (e.g., UW, FH, SLU): FH
    Credits: 3
    Quarter, Weeks, and Frequency course is offered: Autumn, weeks 1-10, every year. *Will be offered in Autumn 2025*
    Attributes (e.g., graded, lecture-based): Graded, lecture-based, hands-on computational work
    Sub Area (if applicable): Computational
    Synopsis: Introduction to established best practices in computational biology. Learn to organize unstructured data into standard formats, transform data for statistical analyses, and visualize the transformed data. Learn workflows for reproducible research such as version control, project organization, and code documentation. Gain basic experience with Linux command line tools and the Python and R programming languages. Classes will involve hands-on learning through coding exercises, collaborative problem solving, and extensive use of online learning resources.

ELECTIVE COURSES
Elective Course One:
    Course Number: CSE 512
    Course Title: Data Visualization
    Instructor (s): TBD
    Location: UW
    Credits: 4
    Quarter, Weeks, and Frequency course is offered: Spring, weeks 1-10. *Will be offered in Spring 2025*
    Attributes: Lecture, graded
    Sub Area (if applicable):
    Synopsis: Covers techniques and algorithms for creating effective visualizations based on principles from graphic design, visual art, perceptual psychology, and cognitive science. Topics include data and image models; visual encoding; graphical perception; color; animation; interaction techniques; graph layout; and automated design. Lectures, reading, and project.

Elective Course Two:
    Course Number: CSE 527
    Course Title: Computational Biology
    Instructor (s): TBD
    Location: UW
    Credits: 4

Quarter, Weeks, and Frequency course is offered: Autumn, weeks 1-10. *Course not currently being offered*
Attributes: Lecture, graded
Sub Area (if applicable):
Synopsis: Introduces computational methods leveraging artificial intelligence (AI) and machine learning (ML) techniques to understand biological systems and enhance healthcare. Utilizes various AI/ML techniques, including explainable AI, interpretable ML, deep learning, probabilistic graphical models, and causal inference. Explores diverse problem areas such as genetics, epigenomics, transcriptomics, proteomics, imageomics, and electronic health records.

Elective Course Three:
 Course Number: CSE 583
 Course Title: Software Development for Data Scientists
 Instructor (s): TBD
 Location: UW
 Credits: 4
 Quarter, Weeks, and Frequency course is offered: Autumn, weeks 1-10. *Course not currently being offered*
 Attributes: Lecture, graded
 Sub Area (if applicable):
 Synopsis: Provides students outside of CSE with a practical knowledge of software development that is sufficient to do graduate work in their discipline. Modules include Python basics, software version control, software design, and using Python for machine learning and visualization.

Elective Course Four:
 Couse Number: CSE 590
 Course Title: Computational Biology Seminar (Seminar C)
 Instructor(s): Su-In Lee
 Location: UW
 Credits: 1-3
 Quarter, Weeks, and Frequency course is offered: Autumn, Winter, Spring, weeks 1-10, every year. *Will be offered in Winter 2025*
 Attributes: Seminar
 Sub Area (if applicable):
 Synopsis: A taste of current research in Computational Biology (local and non-) + critical reading of literature + presentation skills. Students, with faculty advice, pick and present CompBio papers from recent journals/conferences. Students & faculty also present their own research (mostly in Spring, but may be sprinkled throughout, depending on schedules). Background knowledge of biology is not assumed; come learn! **Note**: Credit/no credit grading. Entry codes available by email at ugrad-adviser@cs.washington.edu.

Elective Course Five:
 Course Number: GENOME 540
 Course Title: Introduction to Computational Molecular Biology: Genome and Protein Sequence Analysis
 Instructor (s): Phil Green
 Location: UW
 Credits: 4

Quarter, Weeks, and Frequency course is offered: Winter, weeks 1-10, every year. *Will be offered in Winter 2025*
Attributes: Lecture, graded
Sub Area (if applicable):
Synopsis: Algorithmic and probabilistic methods for analysis of DNA and protein analysis. Students must be able to write computer programs for data analysis. Prior coursework in biology and probability is highly desirable.

Elective Course Six:

Course Number: GENOME 569
Course Title: Bioinformatics Workflows for High-Throughput Sequencing Experiments
Instructor (s): TBD
Location: UW
Credits: 1.5
Quarter, Weeks, and Frequency course is offered: Spring, weeks 1-5, every year. *Will be offered in Spring 2025*
Attributes: Lecture, graded
Sub Area (if applicable):
Synopsis: Programming skills and software tools for building automated bioinformatics pipelines and computational biology analyses. Emphasis on UNIX tools and R libraries for distilling raw sequencing data into interpretable results. For students familiar with UNIX and with some programming experience in Python, R, or C/C++.

Elective Course Seven:

Course Number: STAT 509 (offered jointly with CS&SS 509/ECON 580)
Course Title: Econometrics I: Introduction to Mathematical Statistics
Instructor (s): Thomas Richardson
Location: UW
Credits: 4
Quarter, Weeks, and Frequency course is offered: Autumn, weeks 1-10. ***Course not currently being offered***
Attributes: Graded, lecture
Sub Area (if applicable):
Synopsis: Examines methods, tools, and theory of mathematical statistics. Covers, probability densities, transformations, moment generating functions, conditional expectation. Bayesian analysis with conjugate priors, hypothesis tests, the Neyman-Pearson Lemma. Likelihood ratio tests, confidence intervals, maximum likelihood estimation, Central limit theorem, Slutsky Theorems, and the delta-method. **Prerequisites**: STAT 311; MATH 126 or MATH 136; and MATH 208 or MATH 209.