

Course Syllabus – CBB 430

Course Information

Course Number: CBB 430 WI25

Course Name: Applied Bioinformatics and Computational Biology

Term: Winter 2025

Start Date: 01/07/2025

End Date: 03/28/2025

Credits: 3.0

Meeting Days / Times

Tuesdays and Thursdays, 8:15-9:45am PT / 11:15am-12:45pm ET
(See Calendar in Canvas for the most up-to-date schedule.)

Location

CA: Graduate Office Dining Room (Hazen Theory Building)
FL: B158

Course Managers

Role	Last Name	First Name	Email Address
Course Director	Su	Andrew	asu@scripps.edu
TA	Calverley	Ben	bcalverley@scripps.edu
TA	Min	Charles	cmin@scripps.edu
TA	Turner	Natalie	naturner@scripps.edu

Course Description

This course is designed to teach the fundamentals of applied bioinformatics and computational biology. As an applied course, the primary objective is to develop hands-on skills and experience manipulating and analyzing biomedical data. Although the class will focus on using R and RStudio, the principles of programming and data science will be generalizable to other languages and technologies. In addition to hands-on programming activities, students will develop oral and written presentation skills through class presentations and reports. The class will conclude with a capstone project in which students reproduce a figure or analysis from a published paper.

Program Learning Outcomes

By the end of the program, students will have accomplished these objectives:

PLO1: Original Research – graduate students are expected to develop the skills critical for generating high-quality research output. This would include absorbing, recalling, and contextualizing scientific

knowledge, evaluating scientific information and data, creating testable hypotheses and investigating hypotheses, mastering scientific tools and techniques, displaying ethical behavior, and receiving and giving feedback.

PLO2: Communication – graduate students are expected to demonstrate the oral, written, and media skills to effectively communicate the impact of a study or a body of work to the greater scientific community and to the public at large using a number of methods.

PLO3: Critical Thinking – graduate students are expected to develop a self-directed process to analyze information, form opinions or judgments, and use this process to improve the quality of their scientific thoughts, navigate problems, and make informed decisions.

PLO4: Intellectual Curiosity – graduate students are expected to acquire the capacity to build their intellectual curiosity and demonstrate problem solving approaches that serve their professional growth and ability to impact a field.

PLO5: Career and Professional Development – graduate students are expected to develop a variety of transferable skillsets throughout their graduate experience, including management and leadership, inclusiveness, resilience, scientific rigor, collaboration, accountability, time management, teamwork, networking, and career planning.

Course Learning Outcomes

Upon completion of this course students will be able to:

CLO1: Perform end-to-end analyses in R on a select number of biomedical data types

CLO2: Adapt the general principles of data science to new and unfamiliar datasets

CLO3: Understand basic principles for finding and assessing computational tools

CLO4: Practice and present on learned R skillset via a Capstone project

Background Preparation (Prerequisites)

CBB 410 Introduction to Data Science, or permission of the Course Director.

Students will communicate with instructors, teaching assistants, and each other via Slack.

Course Materials

To be provided.

Attendance Statement

Students are expected to attend all classes in person. Attending via zoom is only available on a case-by-case basis and with prior approval of the course instructor. Students unable to attend class can seek permission for an excused absence from the course director or teaching assistant. Unapproved absences or late attendance for (3) or more classes may result in a lower grade, or an “incomplete” for the course. If a student has to miss a class, they can arrange to get notes from a fellow student as well as meet with the teaching assistant to obtain the missed material.

Scientific and Professional Ethics

The work you do in this course must be your own. Feel free to build on, react to, criticize, and analyze the ideas of others but, when you do, make it known whose ideas you are working with. You must

explicitly acknowledge when your work builds on someone else's ideas, including ideas of classmates, professors, and authors you read. If you ever have questions about drawing the line between others' work and your own, ask the course director(s) who will give you clear guidance. Exams must be completed independently. Any collaboration on answers to exams, unless expressly permitted, may result in an automatic failing grade and possible expulsion from the Graduate Program.

Technology Requirements and Support

For issues related to Canvas, please contact the Graduate Office by email at: gradprgm@scripps.edu or by phone at: 858-784-8469.

Course Grading

Grading is in accordance with the academic policies of the Skaggs Graduate School. The breakdown of grading is as follows:

- Homework: 60%
 - Module 1: 20%
 - Module 2: 20%
 - Module 3: 20%
- Bioconductor presentation: 20%
- Capstone Project: 20%

Letter Grade	Percent	GPA	Description
A	93-100	4.00	Outstanding achievement. Student performance demonstrates full command of the course subject matter and evinces a high level of originality and/or creativity that far surpasses course expectations.
A-	90-92	3.67	Excellent achievement. Student performance demonstrates thorough knowledge of the course subject matter and exceeds course expectations by completing all requirements in a superior manner.
B+	87-89	3.33	Very good work. Student performance demonstrates above-average comprehension of the course subject matter and exceeds course expectations on all tasks as defined in the course syllabus. There is notable insight and originality.
B	83-86	3.00	Satisfactory work. Student performance meets designated course expectations and demonstrates understanding of the course subject matter at an acceptable level.
B-	80-82	2.67	Marginal work. Student performance demonstrates incomplete understanding of course subject matter. There is limited perception and originality.
C+	77-79	2.33	Unsatisfactory work. Student performance demonstrates incomplete and inadequate understanding of course subject matter. There is severely limited or no perception or originality. Course will not count toward degree.
C	73-76	2.00	Unsatisfactory work. Student performance demonstrates incomplete and inadequate understanding of course subject matter. There is severely limited or no perception or originality. Course will not count toward degree.
P	73-100	0.00	Satisfactory work. Student performance demonstrated complete and adequate understanding of course subject matter. Course will count toward degree.

F	0-72	0.00	Unacceptable work/Failure. Student performance is unacceptably low level of knowledge and understanding of course subject matter. Course will not count toward degree. Student may continue in program only with permission of the Dean.
I		0.00	Incomplete is assigned when work is of passing quality but is incomplete for a pre-approved reason. Once an incomplete grade is assigned, it remains on student's permanent record until a grade is awarded.
W		0.00	Withdrew from the course with Dean's permission beyond the second week of the term.

- All courses will be recorded and maintained in the student's permanent academic record; only courses that apply towards the degree will appear on the academic transcript. Non-credit or audited courses will not appear on the transcript.
- 4 core courses taken for a letter grade (pass = B- or higher for a core course)
- 2 elective courses taken pass/fail (pass = A, B, C for an elective)

Because students are encouraged to take electives outside their area of expertise, a "C" letter grade is passing.

Course Summary

Date	Details
Tue Jan 7, 2025	Introduction to Proteomics; Importing proteomics data into R (Su)
Thu Jan 9, 2025	Data cleaning techniques: handling missing values and outliers. Data manipulation using dplyr. (Su)
Tue Jan 14, 2025	Intro to Data Visualization with mixOmics; overview of multivariate data, loading and preparing data for mixOmics (Su)
Thu Jan 16, 2025	PCA and PLS-DA (in class exercise)
Mon Jan 20, 2025	Martin Luther King, Jr. Day (No Class)
Tue Jan 21, 2025	Intro to Differential Protein Abundance and Visualization with MSstats: data preparation for dataProcess (Su)
Thu Jan 23, 2025	Differential protein abundance analysis & Volcano plots (in class exercise)
Tue Jan 28, 2025	Phenotype-genotype bioinformatics: importing and exploring data (Su)
Thu Jan 30, 2025	Different theoretical approaches to findings in patient data overview (Su)
Tue Feb 4, 2025	Finding correlations and relationships - class exercises
Thu Feb 6, 2025	Finding correlations and relationships - class exercises
Tue Feb 11, 2025	Setting hypotheses and making predictions (Su)
Thu Feb 13, 2025	Setting hypotheses and making predictions (Su)
Mon Feb 17, 2025	Presidents' Day (No Class)
Tue Feb 18, 2025	Module overview & Theory/Background of MD (Su)
Thu Feb 20, 2025	Running MD simulations (in class exercise)
Tue Feb 25, 2025	Introduction to MD analysis with Bio3D/CPPTAJ (Su)
Thu Feb 27, 2025	Analyzing MD simulations (in class exercise)
Tue Mar 4, 2025	Advanced topics in MD (Su)
Thu Mar 6, 2025	MD group exercises
Tue Mar 11, 2025	Capstone work
Thu Mar 13, 2025	Capstone work

Tue Mar 18, 2025	Capstone presentations
Thu Mar 20, 2025	Capstone presentations
Tue Mar 25, 2025	Capstone presentations
Thu Mar 27, 2025	Capstone presentations