

Computation for Biologists – BIOL-4360
Department of Life Sciences
Fall 2025

A. COURSE & INSTRUCTOR INFORMATION**Course number/section:** 5360.1**Class meeting time:** F 2-4:30**Class location:** OCNR 241**Course Website:** https://github.com/tamucc-comp-bio/classroom_repo_2025**Instructor:** Dr. Christopher E. Bird**Office location:** TH 234**Office hours:** M-W 4-5:30, F 4:30-5**Telephone:** 361-443-5676**e-mail:** cbird@tamucc.edu

Appointments: A student may make an appointment to see me at times other than the scheduled office hours. I am available for consultation and extra help, but it is the student's responsibility to request such help. [Book an appointment](#)

B. COURSE DESCRIPTION**Catalog Course Description**

This course is designed to prepare and enable students to use computational tools for bioinformatic applications in advanced courses and independent research projects. Students will be introduced to powerful open-source computing tools used in biological research for creation, organization, manipulation, processing, analysis, and archiving of big data. While not a formal requirement, it is assumed that students have a firm command of basic algebra.

Extended Course Description

This is a 3-credit course that introduces the powerful open-source computing tools that are used in biological research for the creation, organization, manipulation, processing, analysis, and archiving of “big data”. This course is designed to prepare and enable students to use computational tools for bioinformatic applications in advanced courses and independent research. The primary topics covered are: data formats, organization, and repositories; command line Linux computing and scripting with BASH; regular expressions; super-computing; data wrangling with BASH and R; data visualization with R & Python; version control and dissemination of scripts and programs with GIT and GitHub; and typesetting with Markdown. The usage of large language models (e.g. ChatGPT) will be incorporated throughout the course.

Whether you want to learn basic data handling skills for your research project or you are curious about a career in bioinformatics and “big data”, this course will provide you with the proper foundations.

C. PREREQUISITES AND COREQUISITES**Prerequisites**

“None”

Corequisites

“None”

D. REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES**Required Textbook(s)**

R for Data Science. Grolemund and Wickham. (Free), <https://r4ds.hadley.nz/>, <https://r4ds.had.co.nz/>

Associated Website, Optional Textbook(s) or Other References

[Computing skills for biologists: a toolbook. Allesina & Wilmes 2019.](#)

https://github.com/tamucc-comp-bio/classroom_repo_2025/blob/master/resources

Supplies

Windows, Mac, or Linux computer (not chrome, not iOS, not Android). Recommended at least 8gb RAM, 512 GB storage. If you don't own a computer, make arrangements with Dr. Bird – there are resources available.

E. STUDENT LEARNING OUTCOMES AND ASSESSMENT

Assessment helps improve learning by providing feedback to both students and instructors. It starts with clearly defined student learning outcomes, which outline what students should achieve to succeed in the course. Sharing assessment data helps students focus their efforts and allows instructors to adjust teaching to address learning challenges.

By the end of this course, students should be able to:

1. *Recognize, describe, and organize data into “tidy” data structures*
2. *Locate scientific data repositories and download data*
3. *Operate UNIX/LINUX (super)computers from command line*
4. *Construct and modify computer programming/scripting logic structures for processing biological data*
5. *Describe and use regular expressions to query data*
6. *Use version control software (git) in coordination with GitHub to organize and manage projects*
7. *Typeset with LaTeX or Markdown*
8. *Use the most popular open-source tools for biological data manipulation*
 - a. *Shell scripting (bash)*
 - b. *Statistical computing (R, tidyverse)*
 - c. *Scientific computing (python)*
9. *Use large language models effectively to assist in data processing.*

F. INSTRUCTIONAL METHODS AND ACTIVITIES

Classroom time involves a mix of lecture and interactive hands-on computing exercises. Weekly assignments are due at the beginning of the weekly lecture.

G. MAJOR COURSE REQUIREMENTS AND GRADING

Computation for 21st Century Biologists will convene once a week for 2.5 hours. Class periods will involve interactive lectures that require each student to have a computer designed for content creation (Linux, OSX, Windows, not chrome, not iOS, not Android). Homework exercises will embellish upon concepts addressed in lecture. Participation involves attending lectures and performance on unannounced quizzes. Weekly Assignments will be given to reinforce concepts covered in lectures and encourage students to start using computational tools. Exams will be used to evaluate comprehension of the materials covered in lectures and assignments. For undergraduates only, a comprehensive Final Exam will be used to assess the learning objectives detailed above.

Student learning outcomes will be assessed using in-class exercises, assignments, and exams. Your final grade will be based on the percentage you earn out of the total possible points, extra points may be built into exams or other assignments. It is also possible to lose points by turning in assignments late. Statistical manipulations to adjust grades, if used (at the Instructor's discretion), will be performed for each exam individually and all assignments in aggregate. A standard grading scale will be used:

A = 90	-	100 %
B = 80	-	89.9 %
C = 70	-	79.9 %
D = 60	-	69.9 %
F = 0	-	59.9 %

ACTIVITY	% of FINAL GRADE
Participation	15
Assignments	40
Exam 1	15
Exam 2	15
Final Exam	15

H. COURSE CONTENT/SCHEDULE

Date	Lecture Topic	HW Due
	Theme I: Welcome to the Matrix	
Wk 0	1. Course overview 2. Biological Data Repositories, Structures, Formats 3. Computer set up	
Wk 1	Linux Boot Camp I 1. UNIX philosophy 2. Navigating/creating/manipulating directories & files 3. How to get help: man pages 4. Basic commands: cd, ls, cp, mv, mkdir, rm, tr, cut, cat, head, tail, 5. Commands useful for manipulating data files in text streams	Assignment 0
Wk 2	Linux Boot Camp II 1. Wildcards, substituting characters, permissions, sudo 2. Pattern matching with grep & regex 3. Intro to Computer Programming: Shebang!, Scripting, For Loops	Assignment 1
Wk 3	Linux Boot Camp III 1. More Computer Programming with bash 2. Logic: if-then-else; looping with while, and GNU parallel 3. Functions: diy commands 4. Advanced text stream manipulation: sed, paste, ...	Assignment 2 SuperComputer Acct
Wk 4	Version Control & Supercomputing 1. Linux repositories and tools for biologists	Assignment 3

	2. Version control with git 3. Super computing, ssh	
	Theme II: Wrangling and Visualizing Data With R	
Wk 5	R Boot Camp I 1. R Philosophy 2. Command line R 3. R data types & structures 4. Math, equalities, logic 5. Basic statistical functions 6. Reading and writing data	Exam 1 Install R & R Studio
Wk 6	R Boot Camp II 1. Scripting & writing good code 2. Loops & if-then decision logic 3. R Studio 4. Functions 5. Libraries 6. Random numbers 7. Vectorized loops 8. Debugging 9. More basic stats 10. Base R plots	Assignment 5
Wk 7	R Boot Camp III 1. tidyverse 2. Basic reading & manipulating data 3. Basic computing statistics 4. Visualization of data w ggplot2	Assignment 6
Wk 8	R Boot Camp IV 1. Advanced tidyverse, pipelines 2. Manipulating & wrangling data	Assignment 7
	Theme III: Programming the Matrix	
Wk 9	Python Boot Camp I 1. Intro to Python 2. Data structures 3. Functions 4. Decision logic and loops 5. Reading and writing files	Exam 2 Install Miniconda
Wk 10	Python Boot Camp II 1. Writing code 2. Modules & Program Structure 3. Errors and exceptions 4. Debugging 5. Testing & Profiling	Assignment 9
Wk 11	Scientific Computing w/ Python 1. NumPy and SciPy 2. Pandas 3. Biopython	Assignment 10

	4. Other modules	
Wk 12	Scientific Typesetting w/ Latex 1. Latex document structure 2. Typsetting 3. Latex packages for biologists	Assignment 11
Wk 13	Putting It All Together	Assignment 12
Last Day of Classes (Dec 3)		Assignment 13
Final	Final Exam: Becoming THE ONE	

Note: Changes in this course schedule may be necessary and will be announced to the class by the instructor. The assignments and exams shown are directly related to the Student Learning Outcomes described in Section E.

I. COURSE POLICIES

Attendance/Tardiness

Attendance is expected. If you are late, don't make a disturbance and you will be responsible for catching yourself up to where we are. If you cannot attend a lecture, make arrangements with Dr. Bird

Late Work and Make-up Exams

10% of total possible score is deducted per day late. Inform professor as soon as you find out that you will miss and exam. Make arrangements with professor for make-up.

Extra Credit

None

Cell Phone Use

Required

Laptop Use

Required

Food in Class

Not allowed in computer lab

Participation

Attendance at lecture is mandatory. Make arrangements with Dr. Bird if you cannot attend.

J. UNIVERSITY & COLLEGE POLICIES

For information on:

- Campus Emergencies
- Statement of Academic Continuity
- Academic Integrity/Plagiarism
- Classroom/Professional Behavior
- Statement of Civility
- Civil Rights Reporting
- Disabilities Accommodations
- Mental Health and Well-Being Services
- Academic Advising
- Dropping a Class
- Student Grade Appeals
- Copy of Academic Calendar

Please visit <https://www.tamucc.edu/science/student-information/syllabi-policies.php> or scan:

**K. AI STATEMENT**

Students are expected to use “artificial intelligence” (e.g. large language models) in this course. When you submit work created using artificial intelligence, you are responsible for the content, not the ai. If you used ai in a novel fashion, you should describe how it was used to accomplish the task so that Dr. Bird can learn and incorporate it into future lectures/assignments.

L. GENERAL DISCLAIMER

I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.