

ADVANCED BIOLOGICAL DATA ANALYSIS, BIOL 668

Spring 2023

COURSE INFORMATION

Class Days: TTh and Friday	Mode of Delivery: Hybrid
Class Times: 1000-1050 (lecture)/1000-1250 (lab)	Instructor: Dr. Scott Kelley
Class Location: Online (lecture), NLS 126 (lab/online)	Email: skelley@sdsu.edu
	Office location: Zoom Link Below
	Office hours: By Appointment, TBD

Course Zoom Link: <https://SDSU.zoom.us/j/85681424766>

Meeting ID: 856 8142 4766

Instructor prefers to be addressed as “Dr. Kelley”, and emails should be addressed to “Dear Dr. Kelley,” (this is good general practice for faculty and future bosses). The preferred way of contacting the instructor by email. Email responses could take a few days. Preferred contact is via email or questions during class. Students should expect a response within a few days. Class will be virtual all semester because the instructor is immune compromised.

HELP CONTROL THE COVID-19 PANDEMIC:

Addressing the COVID-19 pandemic is a shared responsibility. Each of us has a role to play in keeping our learning environments and campus as safe as possible. To that effect, it is critical students are aware that SDSU policy requires the wearing of face coverings by faculty, staff, and students on campus except if you are alone in a private office or eating outside while maintaining physical distancing of at least 6 feet. All individuals on campus must also practice physical distancing, stay home if ill, care for common work spaces if you use them, and report if you receive a positive COVID-19 test. Instructions for caring for instructional spaces will be posted in each lab, clinic, or classroom; supplies will be available. Individuals are required to provide their own facial coverings. If students need assistance purchasing facial coverings, please contact the [Economic Crisis Response Team](#).

All SDSU community members are encouraged to make a commitment to health and safety, please consider signing the [SDSU Health Commitment](#). For additional COVID-19 information, visit the university’s [COVID website](#).

COURSE MATERIALS

Materials (including texts, readings, course fees, equipment, and any technology requirements)	Required or optional	Where and how it can be obtained
Linux Command Line	Req	Free pdf on Canvas
R Cookbook	Req	Free pdf on Canvas

A Little Book of R For Bioinformatics	Req	Free pdf on Canvas
Computer	Req	Student must provide

COURSE DESIGN

The format of the course will be 2 weekly lectures and a lab 1x/week all online. The lectures will present material that is important for understanding Bioinformatics algorithms and fundamentals behind the Biology. This course includes hands-on learning in lab. The first part of each lab will include a short problem, to introduce the students to biological database analysis programming language basics. The rest of the lab will then be spent practicing on the computer. The professor will be available during the lab time to provide additional instruction and help students debug their code during the completion of in-class exercises or class projects. Students will also be encouraged to help one another with concepts and exercises.

All information for the course will be posted on Canvas. Please be sure to consult Canvas for scores, PDF files, notes, etc. A separate document lists specific lecture topics and dates, including due dates for assignments and exams.

GRADING POLICIES

- Provide policies relating to course grading and final course grades.

Exams and Assignments

NOTE 1: ALL ASSIGNMENTS WILL POSTED ON CANVAS. FINISHED ASSIGNMENTS WILL ALSO BE TURNED IN ON CANVAS.

NOTE 2: YOU HAVE UP TO ONE WEEK AFTER A GRADE IS ASSIGNED TO ASK QUESTIONS ABOUT THE GRADING OF YOUR ASSIGNMENT.

The following table details the combined total assignments for lecture and lab. The labs are all started in class and are due by the beginning of lab the next week. These labs include both the web-based bioinformatics labs and the programming labs.

20% of the final grade will be based on the Final Research Project, which will include writing programs and analyzing a real biological dataset in collaboration with a faculty member at SDSU and involvement of the instructor.

LATE WORK: 10% of your grade will be deducted per day late. The final project will not be accepted if more than 3 days late due.

Assignment	Percentage
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Unix/Linux Assignment	20
R Project	20
Bioinfo Project	10
Python Project	30
Final Project	20

Grading Range

A: 93-100%

A-: 90-92%

B+: 88-89%

B: 83-87%

B-: 80-82%

C+: 78-79%

C: 73-77%

C-: 70-72%

D+: 68-69%

D: 60-67%

F: $\geq 59\%$

Grades are rounded to the nearest percent.

SCHEDULE

NOTE: All projects are due on the **FRIDAY** of the week indicated at **Midnight**.

Date	Topics	Reading	Project
1/19- 1/20	CLASS INTRO	Web	Software Installation
1/24- 1/27	Beginning Unix	LCL Ch. 1-4, 12	Unix Lab 1
1/31-2/3	Advanced Unix I	LCL Ch. 5-11, 16, 18	Unix Lab 2
2/7-2/10	Advanced Unix II	LCL Ch. 19, 24-30	Unix Lab 3 (BASH)
2/14- 2/17	Basic R Stats	R Cook	Unix Project (DUE FRIDAY @ MIDNIGHT)

2/21-2/24	R for Bioinformatics	R Bio	
2/28-3/3	Advanced Python I	APB	R Project (DUE FRIDAY @ MIDNIGHT)
3/7-3/10	Advanced Python II	APB	
3/14-3/17	Advanced Python III	APB	<i>OOP Wizard HOMEWORK (DUE BEFORE LECTURE ON TUES)</i>
3/21-3/24	Jupyter & Python Libraries (Pandas, Biopython, Scikit-learn)	<i>ARTICLE ON JUPYTER NOTEBOOKS: https://www.theatlantic.com/science/archive/2018/04/the-scientific-paper-is-obsolete/556676/</i>	Python part 1: OOP Project (DUE FRIDAY @ MIDNIGHT)
3/27-3/31	SPRING RECESS		
4/4-4/7	Marker Gene Microbial Communities (16S, ITS)	Readings*	QIIME 2 Python part 2: Adv. Libraries Proj (DUE FRIDAY @ MIDNIGHT)
4/11-4/14	RNA Seq Analysis	Readings*	RNA Seq Lab;
4/18-4/21	Shotgun Metagenomics & Assembly	Readings*	Metagenomics Lab Exercises
4/25-4/28	AI: Machine Learning	Readings*	Random Forests, Neural Networks
5/2-5/5	WORK ON PROJECTS (TBD)		Bioinfo Project & Exercises (DUE FRIDAY @ MIDNIGHT)
11-May	Last day of Final Exams		Final Project (DUE @ MIDNIGHT)

* Readings = Classic Papers on RNA Seq; 16S; Metagenomics and AI
MetagenomeClassicPapers.xlsx

STUDENT LEARNING OUTCOMES

- Provide 5 - 8 SLOs consistent with purpose / scope of course that specify measurable, assessable knowledge, skills and abilities.
- Understand architecture of operating systems and databases.
- Learn theory and practice of the Linux command line operating system.

- Learn the iPython and Jupyter notebook systems, and the sci-kit bio libraries.
- Understand the theory and utility of data structures and how to apply them to biological data analysis.
- Learn and apply basic theory behind artificial intelligence algorithms, supervised and unsupervised.
- Understand fundamentals of statistical theory and practice relevant to programming statistical software and learn statistical programming, scripting and bioinformatics applications in the R language.
- Learn the fundamentals of object-oriented programming in the Python language, how to write basic classes and use objects for biological data analysis and be able to apply these concepts to lab projects.
- Master and apply computational algorithms for biological research, including completing a research project using open-source biological data.

BIOLOGY DEGREE LEARNING OUTCOMES		LEVEL OF EMPHASIS
Concepts	Provide examples of the relation between form and function in biology, as expressed in molecular, cellular, and whole-organism physiology	Not Addressed
	Compare and contrast the major cellular processes in eukaryotes and prokaryotes	Not Addressed
	Explain how genetic information is transmitted, and the relationship between genetics and evolution	Reinforced
	Compare and contrast the primary mechanisms of evolutionary diversification	Reinforced
	Categorize the diversity of life in terms of the phylogenetic relationships among major organismal groups	Reinforced
	Describe how interactions among organisms and their environment influence populations, communities, and ecosystem function	Not Addressed
Skills	Quantitatively answer biological questions using mathematical or statistical tools	Major component

Design, conduct, and interpret experiments using common biological lab and field techniques	Not Addressed
Effectively and concisely present scientific ideas and the results of scientific research in written and oral form	Reinforced
Critique scientific papers, as demonstrated by written or oral summaries of hypotheses, methodology, and conclusions	Reinforced

UNIVERSITY POLICIES

Accommodations: If you are a student with a disability and are in need of accommodations for this class, please contact Student Ability Success Center at (619) 594-6473 as soon as possible. Please know accommodations are not retroactive, and I cannot provide accommodations based upon disability until I have received an accommodation letter from Student Ability Success Center.

Student Privacy and Intellectual Property: The [Family Educational Rights and Privacy Act](#) (FERPA) mandates the protection of student information, including contact information, grades, and graded assignments. I will use Canvas to communicate with you, and I will not post grades or leave graded assignments in public places. Students will be notified at the time of an assignment if copies of student work will be retained beyond the end of the semester or used as examples for future students or the wider public. Students maintain intellectual property rights to work products they create as part of this course unless they are formally notified otherwise.

Religious observances: According to the University Policy File, students should notify the instructors of affected courses of planned absences for religious observances by the end of the second week of classes.

Student Responsibility for Catalog Information: Students are held individually responsible for the university policy information contained in the [general catalog](#). The requirements listed in the Graduation Requirements section of the catalog are those requirements which the university will make every effort to preserve for students subject to this catalog. All other parts of the catalog, including the University Policies section, are subject to change from year to year as university rules, policies, and curricula change. Failure to keep informed of such changes will not exempt students from whatever penalties they may incur. Please refer to the university [general catalog](#) for any questions you may have that are not addressed in the course syllabus. Some information presented below is taken directly from the [general catalog](#).

Final Examinations: No final examination shall be given to individual students before the regular time. If you find it impossible to take a final examination on the date scheduled you must make arrangements with the instructor to have an incomplete grade reported and must take the deferred final examination within the time allowed for making up incomplete grades.

Expected time required for courses and outside study: You should expect to spend approximately three hours per week, in class and study time, for each unit of college work attempted. A normal 16-unit load, therefore, represents a 48-hour week. Note that

the majority of this time estimate is spent outside of class. You should also keep in mind that some courses require more than the average amount of time, and that your workload in all courses will vary throughout the semester as examinations and major papers or projects come due.

Student email addresses: Students are provided with an SDSU Gmail account for their official use. Per university policy, students are responsible for checking their official university email once per day.

Academic Honesty: The University adheres to a strict [policy prohibiting cheating and plagiarism](#). The California State University system requires instructors to report all instances of academic misconduct to the Center for Student Rights and Responsibilities. Academic dishonesty will result in disciplinary review by the University and may lead to probation, suspension, or expulsion. Instructors may also, at their discretion, penalize student grades on any assignment or assessment discovered to have been produced in an academically dishonest manner. ***You are expected to write your own programming code***, though I encourage you seek help or input from others and to seek tips and tricks from the online community of coders.

The university policy on academic dishonesty extends to this latest instance of intellectual misconduct. SDSU's Center for Student Rights and Responsibilities notes: *"Use of ChatGPT or similar entities [to represent human-authored work] is considered academic dishonesty and is a violation of the Student Code of Conduct. Students who utilize this technology will be referred to the Center for Student Rights and Responsibilities and will face student conduct consequences up to, and including, suspension."*

Cheating and Plagiarism: In preparing and submitting materials for academic courses and in taking examinations, a student shall not yield to cheating or plagiarism, which not only violate academic standards but also make the offender liable to penalties explicit in Section 41301 of Title 5, California Code of Regulations as follows:

Expulsion, Suspension, and Probation of Students. Any student of a campus may be expelled, suspended, placed on probation, or given a lesser sanction for one or more of the following causes that must be campus related.

Cheating is defined as the act of obtaining, or attempting to obtain, credit for academic work by the use of dishonest, deceptive, or fraudulent means. Examples of cheating include, but are not limited to:

- copying, in part or in whole, from another's test or other examination;
- discussing answers or ideas relating to the answers on a test or other examination without the permission of the instructor;
- obtaining copies of a test, an examination, or other course material without the permission of the instructor;
- using notes, cheat sheets, or other devices considered inappropriate under the prescribed testing condition;
- collaborating with another or others in work to be presented without the permission of the instructor;
- falsifying records, laboratory work, or other course data;
- submitting work previously presented in another course, if contrary to the rules of the course;
- altering or interfering with the grading procedures;

- plagiarizing, as defined; and
- knowingly and intentionally assisting another student in any of the above.

Plagiarism is defined as the act of incorporating ideas, words, or specific substance of another, whether purchased, borrowed, or otherwise obtained, and submitting same to the university as one's own work to fulfill academic requirements without giving credit to the appropriate source. Plagiarism shall include but not be limited to:

- submitting work, either in part or in whole, completed by another;
- omitting citations for ideas, statements, facts, or conclusions that belong to another;
- omitting quotation marks when quoting directly from another, whether it be a paragraph, sentence, or part thereof;
- close and lengthy paraphrasing of the writings of another;
- submitting another person's artistic works, such as drawings, musical compositions, paintings, photographs, or sculptures; and
- submitting as one's own work papers purchased from research companies.
- using sources verbatim or paraphrasing without giving proper attribution (this can include phrases, sentences, paragraphs and/or pages of work);
- copying and pasting work from an online or offline source directly and calling it your own;
- using information you find from an online or offline source without giving the author credit;
- replacing words or phrases from another source and inserting your own words or phrases.

Classroom Conduct Standards: SDSU students are expected to abide by the terms of the Student Conduct Code in classrooms and other instructional settings. Prohibited conduct includes:

- Willful, material and substantial disruption or obstruction of a University-related activity, or any on-campus activity.
- Participating in an activity that substantially and materially disrupts the normal operations of the University, or infringes on the rights of members of the University community.
- Unauthorized recording, dissemination, or publication (including on websites or social media) of lectures or other course materials.
- Conduct that threatens or endangers the health or safety of any person within or related to the University community, including
 1. physical abuse, threats, intimidation, or harassment.
 2. sexual misconduct.

Violation of these standards will result in referral to appropriate campus authorities.

Medical-related absences: Students are instructed to contact their professor/instructor/coach in the event they need to miss class, etc. due to an illness, injury or emergency. All decisions about the impact of an absence, as well as any arrangements for making up work, rest with the instructors. [Student Health Services](#) (SHS) does not provide medical excuses for short-term absences due to illness or injury. When a medical-related absence persists beyond five days, SHS will work with

students to provide appropriate documentation. When a student is hospitalized or has a serious, ongoing illness or injury, SHS will, at the student's request and with the student's consent, communicate with the student's instructors via the Vice President for Student Affairs and may communicate with the student's Assistant Dean and/or the [Student Ability Success Center](#).

Resources for students: A complete list of all academic support services--including the [Writing Center](#) and [Math Learning Center](#)--is available on the Student Affairs' [Academic Success](#) website. [Counseling and Psychological Services](#) (619-594-5220) offers confidential counseling services by licensed therapists; you can Live Chat with a counselor at http://go.sdsu.edu/student_affairs/cps/therapist-consultation.aspx between 4:00pm and 10:00pm, or call San Diego Access and Crisis 24-hour Hotline at (888) 724-7240.

SDSU Economic Crisis Response Team: If you or a friend are experiencing food or housing insecurity, technology concerns, or any unforeseen financial crisis, it is easy to get help! Visit sdsu.edu/ecrt for more information or to submit a request for assistance.

SDSU's Economic Crisis Response Team (ECRT) aims to bridge the gap in resources for students experiencing immediate food, housing, or unforeseen financial crises that impacts student success. Using a holistic approach to well-being, ECRT supports students through crisis by leveraging a campus-wide collaboration that utilizes on and off-campus partnerships and provides direct referrals based on each student's unique circumstances. ECRT empowers students to identify and access long term, sustainable solutions in an effort to successfully graduate from SDSU. Within 24 to 72 hours of submitting a referral, students are contacted by the ECRT Coordinator and are quickly connected to the appropriate resources and services.

For students who need assistance accessing technology for their classes, visit our ECRT website (sdsu.edu/ecrt) to be connected with the SDSU library's technology checkout program. The technology checkout program is available to both SDSU and Imperial Valley students.

Sexual violence / Title IX mandated reporting: As an instructor, one of my responsibilities is to help create a safe learning environment on our campus. I am a mandated reporter in my role as an SDSU employee. It is my goal that you feel able to share information related to your life experiences in classroom discussions, in your written work, and in our one-on-one meetings. I will seek to keep the information you share private to the greatest extent possible. However, I am required to share information regarding sexual violence on SDSU's campus with the Title IX coordinator, Jessica Rentto 619-594-6017. She (or her designee) will contact you to let you know about accommodations and support services at SDSU and possibilities for holding accountable the person who harmed you. Know that you will not be forced to share information you do not wish to disclose and your level of involvement will be your choice. If you do not want the Title IX Officer notified, instead of disclosing this information to your instructor, you can speak confidentially with the following people on campus and in the community. They can connect you with support services and discuss options for pursuing a University or criminal investigation. Sexual Violence Victim Advocate 619-594-0210 or Counseling and Psychological Services 619-594-5220, psycserv@sdsu.edu. For more information regarding your university rights and options as a survivor of sexual misconduct or sexual violence, please visit titleix.sdsu.edu or sdsutalks.sdsu.edu.