PURDUE
UNIVERSITY

Course Information

Course number and title: BCHM 49500BINF Practical Bioinformatics for Molecular Biologists
CRN: Lecture: 35359 and Lab: 35404
Course webpage: Brightspace
Instructional Modality: Face-to-Face
Course credit hours: 3
Prerequisites: Some knowledge or experience with programming and basic molecular biology.

Instructor(s) Contact Information

Name of the instructor: Dr. Feng Wang

Name of the teaching assistant: Thomas Sheeley

Course Description

This course introduces undergraduate and graduate students to the core concepts in modern sequencing technologies, widely used computational tools, and the practical analysis of biological data using real-world datasets. Through lectures, guided-labs, and mini-projects, students learn to perform tasks such as dataset acquisition, sequence alignment, omics data analysis, and basic protein bioinformatics workflows. By the end of the course, students will be able to independently apply core bioinformatics methods to seek answers for biological questions and interpret the results of their analysis.

Course Learning Outcomes

- Understand the design of omics studies.
- Know the core concepts in the modern high-throughput sequencing technologies.
- Read and write basic programming scripts in AWK, Python, and R for bioinformatic analysis.
- Analyze high-throughput sequencing datasets using computational tools.
- Properly interpret and communicate the results.
- Apply genomic, transcriptomic, and epigenomic approaches to biological questions.

How to Succeed in this Course

Following are some strategies and tips to complete this course successfully:

- Read this syllabus carefully and add the course schedule to your calendar.
- Be self-motivated.
- Read the course materials as soon as they become available.
- Finish assignments and quizzes on time.
- Be willing to ask questions if problems arise. Reaching out for assistance is a critical life skill.
- Be willing and able to commit to 4 to 6 hours per week for this course.

In contrast, these common issues will lead to inadequate success:

- Wait until the last day to begin assignments.
- Miss deadlines for assignments and course activities.
- Ignore the emails from the instructor and the teaching assistant.

Learning Resources, Technology & Texts

There are many resources available to learn bioinformatics. Textbooks are not required but are useful resources. Textbooks can be reserved at Purdue Libraries.

Textbooks (optional):

- Bioinformatics Data Skills: Reproducible and Robust Research with Open-Source Tools. Vince Buffalo, 2015.
- Bioinformatics Algorithms: An Active Learning Approach, Phillip Compeau and Pavel Pevzner, 2018.

Online resources:

- Biostar Forum, https://www.biostars.org/
- StackExchange, https://stackexchange.com/
- Rosalind, https://rosalind.info/problems/locations/

Brightspace

- The syllabus for the course, lecture notes, and grading keys for quizzes and exams will be available via the Purdue University Brightspace at https://purdue.brightspace.com/

Course Logistics

- All assignments are **due by 11:59 p.m. Eastern Standard Time on the due date** listed in the course schedule.
- Deadlines are an unavoidable part of being a professional and this course is no exception. Course requirements must be completed and posted or submitted on or before the specified due date and delivery time deadline. To encourage you to stay on schedule, due dates have been established for each assignment.
- An assignment file should be appended by your username, such as “assignment1-wang6914.doc.” This will make it easier for me to manage assignment files and provide feedback to you.

Instructor's Office Hours

By email appointment, meeting in-person or online via Zoom. Emails are read 9 a.m. to 5 p.m. daily and will be responded as soon as possible (generally within 24-48 hours).

Assignments and Points

Weekly, midterm, and final assignments have firm deadlines. The grading for this course will be as following:

Attendance	50 points (10%)
Quizzes	50 points (10%)
Assignments	200 points (40%)
Midterm project	75 points (15%)
Final project	125 points (25%)

If you have any disagreements with the way any of your quizzes or exams have been graded, please consult and discuss them with the TA. In the event this does not resolve your concerns, please take them up with the instructor. Requests for re-grades must be submitted no later than the end of the second-class period after the graded test or assignment has been returned.

Extra Credit

There will be several opportunities for extra credits.

Tentative Course Schedule

Week	Lecture topics	Hands-on Labs	Assignment	HW Due
1	Introduction	Getting Started on HPC		
	Molecular Biology and Bioinformatics	Unix Command Lines	**HW 1***	11:59 pm, Jan 23
2	No Class (MLK Day)			
	Genome Assembly and Annotation	Genome Browser	Quiz 1	
3	Sequencing Technologies	Fetch and Manage Datasets		
	Sequencing Data Sources and Formats	Data Processing by Awk	Quiz 2, **HW 2**	11:59 pm, Feb 6
4	Sequence Mapping and Alignment	Patterns and Regular Expression		
	Case Study 1: COVID19 Identification	BLAST	Quiz 3, **HW 3**	11:59 pm, Feb 13
5	Building a Workflow for NGS Data Analysis	Pre-alignment Data QC and Clean-up		
	Case Study 2: ChIP-Seq	Short Read Alignment	Quiz 4	
6	SAM and BAM	Post-alignment Clean-up		
	Data Visualization and Interpretation	Data Visualization: deepTools	**HW 4**	11:59 pm, Feb 27
7	Case Study 3: Small RNAs	Small RNA-seq Read Processing		
	RNA-seq Principles and Pipelines	Small RNA-seq Alignment	Quiz 5	

8	Discussion: Reproducibility	Reproducibility Evaluation: PCA analysis		
	Transcriptomic Data Quantification	sRNA Quantification and Visualization	Quiz 6, **HW 5**	11:59 pm, Mar 13
9	Mid-term Review (weeks 1-8)	Q&A for mid-term projects		
	Discussion: Applications of NGS		Mid-term Project	11:59 pm, Mar 27
10	No Class (Spring Break)			
11	Genome and Epigenome	Methylome Data Analysis		
	Epigenetic Regulation Mechanisms	Methylome Data Visualization	Quiz 7, **HW6**	11:59 pm, Apr 3
12	The 3D Genome	ATAC-seq Data Analysis		
	Limitations in NGS	A Glimpse into HiC Data	Quiz 8	
13	Single-cell RNA-seq	Pre-processing and Normalization		
		Dimension Reduction and Clustering	**HW7**	11:59 pm, Apr 17
14	Long-read Sequencing Technologies	POD5 Data Format		
		Base Calling	Quiz 9	
15	Long-read Sequencing Applications	Methylation Analysis		
		Nascent RNA Processing	Quiz 10	
16	Machine Learning Models	Q&A for Final Project		
	Summary	Q&A for Final Project Cont.	Final project	11:59 pm, May 4
17	Final Week (No class)			

Note: Exact schedule may be changed based on the progress of the class. *HW1 is worth 20 pts, all other HWs are worth 30 pts each. **All quizzes are due by 11:59 pm on Sunday of the week when they are assigned.**

Missed or Late Work

Missing a quiz or assignment deadlines will result in a **grade of 0** being recorded unless documented justification is presented. Any request to be excused from a quiz or exam must include official documentation (doctor's note, request from academic advisor, etc) explaining why the exam was or will be missed. Makeup tests will be scheduled in consultation with the TA and instructor.

Grading Scale

In this class grades reflect the sum of your achievement throughout the semester. You will accumulate points as described in the assignments portion above, with each assignment graded according to a rubric. At the end of the semester, final grades will be calculated by adding the total points earned and translating those numbers (out of 500) into the following letters (there will be no partial points or rounding).

A+: 480 – 500, A: 460 – 479, A-: 440 - 459

B+: 420 – 439, B: 400 – 419, B-: 380 - 399

C+: 360 – 379, C: 340 – 359, C-: 320 - 339

D+: 300 – 319, D: 280 – 299, D-: 260 - 279

F: 259 or below

Attendance Policy

This course follows the University Academic Regulations regarding class attendance, which state that students are expected to be present for every meeting of the classes in which they are enrolled. Attendance will be taken at the beginning of each class and lateness will be noted. When conflicts or absences can be anticipated, such as for many University-sponsored activities and religious observations, you should inform me of the situation as far in advance as possible. For unanticipated or emergency absences when advance notification to is not possible, contact me as soon as possible by Purdue email or phone. For absences that do not fall under excused absence regulations (see below), this course follows the following procedures:

1. Do not come to class if you are feeling ill but DO email me, with the subject line: BCHM49500BINF - [Your Name] - absence. I do not need details about your symptoms. Just let me know you are feeling ill and cannot come to class. If it is an emergency, please follow the University regulations on medical care (see below).
2. Unless it falls under the University excused absence regulations (see below), any work due should be submitted on time via our course Brightspace.
3. If that day's class involves assessed work such as a test or presentation, you and I will plan if and how you can make up the work, following the assignment guidelines. This plan must be done before the next class period, so again, email me immediately when you know that you will miss the class.
4. The most important consideration in any absence is how it will affect your achievement of the assignment objectives and the course learning outcomes.

For cases that fall under **excused absence regulations**, you or your representative should contact or go to the Office of the Dean of Students (ODOS) website to complete appropriate forms for instructor notification. Under academic regulations, excused absences may be granted by ODOS for cases of grief/bereavement, military service, jury duty, parenting leave, or certain types of medical care. The processes are detailed, so plan ahead.

Use of AI Policy

Artificial Intelligence (AI) language models, such as ChatGPT, may be used to help you develop or debug programming scripts for the assignments in this course. You need to specify, in any cases, where you have used AI. You are required to submit in an appendix of your assignment: 1) all prompts you have submitted to AI and 2) the output generated by AI. You are responsible for fact checking information provided by AI language models and are expected to use AI ethically and responsibly.

Use of AI language models to generate written report text is strictly prohibited. Students who do not disclose the use of AI in an assignment will be in violation of the academic integrity expectations for this course. Violations can include a failing grade on the assignment. All suspected incidents of academic dishonesty will also be referred to the Office of Student Rights and Responsibilities for further review of the student's status with the University.

Academic Integrity

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on the Academic Resources table on your Brightspace homepage.

Nondiscrimination Statement

Purdue University is committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her potential. A link to Purdue's full Nondiscrimination Policy Statement can be found here: *Link to Purdue's nondiscrimination policy statement*.

Accessibility

Every member of our course should be able to access, use, and learn from the materials we share. This includes all course-related digital content that you and I share in the course. This approach helps promote equal access for everyone at Purdue and is mandated federally by Title II of the Americans with Disabilities Act (ADA). We will work together to provide this access within our Brightspace course.

- My part, as instructor, is to make sure all course materials shared to Brightspace, such as documents, slides, videos and audio, and images, meet accessibility guidelines and to assist you in making sure anything you share is accessible.
- Your role, as a student, is to make sure anything you post for other students to engage with is also accessible, such as peer grading, peer feedback, and discussion board posts. This expectation is built into all course assignments that require you to post to Brightspace.
- A good starting place for you is to bookmark and review the Innovative Learning Accessibility Checklist for guidance on creating accessible materials.
- When selecting materials to share on our Brightspace from Purdue Libraries catalog or databases, best practices include choosing items that:
  - Can be downloaded in full
  - Are available in EPUB or HTML formats
  - Include alternative text for written materials or captions for audio/visual content

Purdue University strives to make learning experiences accessible to all participants. If you anticipate or experience physical or academic barriers based on disability, you are encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247, as soon as possible.

If the Disability Resource Center (DRC) has determined reasonable accommodations that you would like to utilize in my class, you must release your Course Accommodation Letter to me. Instructions on sharing your Course Accommodation Letter can be found by visiting: How To Use Your Course Accommodation Letter. Additionally, you are strongly encouraged to contact me as soon as possible to discuss implementation of your accommodation.

Mental Wellness Statement

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try Therapy Assistance Online (TAO), a web and app-based mental health resource available courtesy of Purdue Counseling and Psychological Services (CAPS)**.** TAO is available to all students at any time by creating an account on the TAO Connect website, or downloading the app from the App Store or Google Play. It offers free, confidential well-being resources through a self-guided program informed by psychotherapy research and strategies that may aid in overcoming anxiety, depression and other concerns. It provides accessible and effective resources including short videos, brief exercises, and self-reflection tools.

If you need support and information about options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 a.m.- 5 p.m.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc., sign up for free one-on-one virtual or in-person sessions in West Lafayette with a Purdue Wellness Coach at RecWell. Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is free and can be done on BoilerConnect. Students in Indianapolis will find support services curated on the Vice Provost for Student Life website.

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS offices in West Lafayette or Indianapolis.

Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

See Purdue's Information on Emergency Preparation and Planning. This website covers topics such as Severe Weather Guidance, Emergency Plans, and a place to sign up for the Emergency Warning Notification System. I encourage you to download and review the *Emergency Preparedness for Classrooms document*.

The first day of class, I will review the **Emergency Preparedness plan for our specific classroom**. Please make note of items like:

- The location to where we will proceed after evacuating the building if we hear a fire alarm.
- The location of our Shelter in Place in the event of a tornado warning.
- The location of our Shelter in Place in the event of an active threat such as a shooting.

Student-Related Policies

The Vice President for Ethics & Compliance website includes a list of Student Policies. Among those is the Violent Behavior policy, which explains that Purdue is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent behavior impedes such goals. Therefore, violent behavior is prohibited in or on any University facility or while participating in any university activity.

Basic Needs Program

If you are facing challenges securing basic needs such as food, housing, transportation, health services, or access to technology or childcare resources and believe this may affect your performance in the course, please contact the Office of the Dean of Students (ODOS) to help coordinate with community resources. These services vary by location. In **West Lafayette**, see the Basic Needs Program website, or email basicneeds@purdue.edu. To connect with a Student Support Generalist on the **Indianapolis** campus, contact them by phone at 765-495-7797 or email studentlifeindy@purdue.edu.

Course Evaluation

Toward the end of this semester, you will be provided with an opportunity to give feedback on this course and your instructor. Purdue uses an online course evaluation system, and I will not have access to this anonymous feedback until after final grades are submitted. You will receive an official email from evaluation administrators with a link to the online evaluation site and will receive a prompt to complete the survey when you login to Brightspace. The subject line will be: *Please take 2-5 minutes to complete the survey*. Check your "Junk E-mail" folder occasionally to be sure the evaluation emails were not accidentally routed there. Your participation is an integral part of this course, and your feedback is vital to improving education at Purdue University. I strongly urge you to participate in the evaluation system.

Disclaimer

This syllabus is subject to change. You will be notified of any changes as far in advance as possible via an announcement on Brightspace. Monitor your Purdue email daily for updates.