

Syllabus Spring Quarter 2022

Pabio 536: Bioinformatics, Gene Sequence Analysis and Beyond

Mondays & Wednesdays 10:00-11:20am, UW SLU C123 A&B

(Exceptions: on 4/13, 4/27, 5/11, 5/25, 6/8 meet in UW SLU E130 A&B)

Co-taught by:

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Office Hours & Practice Session: Fridays 12-1pm (Josh) and 2-3pm (Shuyi), Zoom.

Land Acknowledgment: The University of Washington acknowledges the Coast Salish people of this land, the land which touches the shared waters of all tribes and bands within the Duwamish, Suquamish, Tulalip and Muckleshoot nations.

Course Description: This class will introduce students to a set of bioinformatics tools they can use to further their future research. We will introduce the basics of python, and common python libraries for data handling, analysis, and presentation. We will then focus on tools for analyzing RNAseq data and various ways of describing data using networks. The last classes will cover bioinformatics approaches to dealing with the added complexity of proteins. We will wrap up the class with a self-guided project, where students use the tools from this class to solve a *reasonable* problem of interest to them or their lab. **Students need to bring laptops with them every class.**

Course Learning Objectives:

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

- code and read data analysis scripts in Python, R
 - data import and export (in Python)
 - mathematical and statistical functions (in Python)
 - RNAseq analysis (in R and RStudio)
 - plotting data, including heatmaps and dimensionality reduction (in Python)
- use Colaboratory Jupyter notebooks to create a personal set of bioinformatics tools
- understand and create figures of biological networks
- access and use online tools for analysis of protein structure

Grades:

Grades will be based on participation (10%), homework (70%), and the final project (20%).

Most classes will start with a brief lecture/tutorial, move to more hands on work. Homework will be assigned each week, which will be due by **midnight** the following Sunday. Your grade will be based on the work that you turn in. There will be a final project, but **there will not be any exams.** The class time set aside for finals will instead be used for presenting the final project.

COVID-related Expectations: Per UW policy, this class will be conducted in person. You should only register for this class if you can attend in person, or if you meet the criteria for an accommodation from Disability Resources for Students (DRS) or a special arrangement approved by the SPH Office of the Dean that allows you to take the course remotely.

- Please [contact UW Disability Resources for Students \(DRS\) \(Links to an external site.\)](#) directly if you feel you may be eligible for an accommodation based on your status as an immunocompromised individual or based on other diagnosed physical or mental health conditions that might prevent you from being able to take classes in-person.
- If you are a student enrolled in a program in SPH, and you are either living with an individual who is immunocompromised, OR you are unable to obtain a visa to travel to the US, you may be eligible for a “special arrangement” that will allow you to take this course remotely. To further clarify, immunocompromised refers to individuals with no/critically weakened immune response to the vaccines. Immune compromised is not the same as underlying health concerns which may lead to a more severe response to COVID. Requests for special arrangements to take the class remotely should have been submitted to and approved by the Students and Academic Services team in the Office of the Dean before the beginning of the quarter.

All UW students are expected to complete their [vaccine attestation \(Links to an external site.\)](#) before arriving on campus. [Per President Cauce’s message March 8, \(Links to an external site.\)](#) following changes to state and local health policies, masks will become optional inside most University facilities starting March 28, the first day of spring quarter. Masks will continue to be required in clinical and other health-care settings and on public transportation, including UW shuttles. We strongly recommend wearing masks indoors during the first two weeks of spring quarter. Please monitor yourself daily for symptoms and stay home if you are sick. It’s also strongly recommended to get tested after travel. Refer to the [UW Face Covering Policy \(Links to an external site.\)](#) for the latest guidance and follow the campus-wide face-covering policy at all times. You are expected to follow state, local, and UW COVID-19 policies and recommendations. If you feel ill or exhibit possible COVID symptoms, you should not come to class. If you need to temporarily quarantine or isolate per CDC guidance and/or [campus policy \(Links to an external site.\)](#), you are responsible for notifying your instructors as soon as possible by email. **If you receive a positive COVID-19 test result, you must report to campus Environmental Health & Safety (EH&S) by emailing covidehc@uw.edu or calling 206-616-3344.**

Please check your email daily BEFORE coming to class. If we need to conduct class remotely because the instructor or a guest speaker is complying with UW policies and unable to attend in person, we will send all registered students an email with a Zoom link for remote instruction.

Communication Skills: Communication through writing and speaking is an important transferable skill for all career pathways. Establishing a strong foundation in communication skills will help you be successful throughout your future course work and career. Therefore, this course includes assignments with the goal to help you identify areas of strength and improvement in your communication. If you feel that you could benefit from additional opportunities to improve your writing skills in particular, a list of resources at the UW and others accessible online can be found on the SPH website at <https://sph.washington.edu/sites/default/files/inline-files/Writing-Resources-4.3.19.pdf> [\(Links to an external site.\)](#).

Academic Integrity: Students at the University of Washington (UW) are expected to maintain the highest standards of academic conduct, professional honesty, and personal integrity.

The UW School of Public Health (SPH) is committed to upholding standards of academic integrity consistent with the academic and professional communities of which it is a part. Plagiarism, cheating, and other misconduct are serious violations of the University of Washington [Student Conduct Code \(WAC 478-121\) \(Links to an external site.\)](#). We expect you to know and follow the university's policies on cheating and plagiarism, and the [SPH Academic Integrity Policy \(Links to an external site.\)](#). Any suspected cases of academic misconduct will be handled according to University of Washington

regulations. For more information, see the University of Washington [Community Standards and Student Conduct \(Links to an external site.\)](#)

Access and Accommodations: Your experience in this class is important. It is the policy and practice of the University of Washington to create inclusive and accessible learning environments consistent with federal and state law. If you have already established accommodations with Disability Resources for Students (DRS), please activate your accommodations via myDRS so we can discuss how they will be implemented in this course.

If you have not yet established services through DRS, but have a temporary health condition or permanent disability that requires accommodations (conditions include but not limited to; mental health, attention-related, learning, vision, hearing, physical or health impacts), contact DRS directly to set up an Access Plan. DRS facilitates the interactive process that establishes reasonable accommodations. Contact DRS at <https://depts.washington.edu/uwdrs/> ([Links to an external site.](#)).

Religious Accommodation: Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at [Religious Accommodations Policy \(https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/\)](https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/) ([Links to an external site.](#)). Accommodations must be requested within the first two weeks of this course using the [Religious Accommodations Request form \(https://registrar.washington.edu/students/religious-accommodations-request/\)](https://registrar.washington.edu/students/religious-accommodations-request/) ([Links to an external site.](#)).

Commitment to Diversity & Classroom Climate: We seek to ensure all students are fully included in this course. We strive to overcome systemic racism and power imbalances by creating an environment that reflects community and mutual caring, while we ally with others in combating all forms of social oppression. This is a work in progress, as transformation is rarely a fully-completed project. In this course, we will look for opportunities to improve our performance as we seek to break down institutional racism. This can include course readings, class interactions, faculty performance, and/or the institutional environment.

Diverse backgrounds, embodiments and experiences are essential to the critical thinking endeavor at the heart of University education. In this course, instructors and students are expected:

1. To respect individual differences, which may include, but are not limited to, age, cultural background, disability, ethnicity, family status, gender, immigration status, national origin, race, religion, sex, sexual orientation, socioeconomic status and veteran status.
2. To engage respectfully in the discussion of diverse worldviews and ideologies embedded in course readings, presentations and artifacts, including those course materials that are at odds with personal beliefs and values.

On our first day of class we will create ground rules together to follow in promoting a productive learning environment for all members of the class. I am committed to making this class an equitable learning environment. Please talk with me right away if you experience disrespect in this class from other students and/or from me, and I will work to address it in an educational manner.

Pronouns: We share our pronouns because we strive to cultivate an inclusive environment where people of all genders feel safe and respected. We cannot assume we know someone's gender just by looking at them. So we invite everyone to share their pronouns.

Sexual Harassment: Sexual harassment is a form of harassment based on the recipient's sex that is characterized by:

1. Unwelcome sexual advances, requests for sexual favors, or other verbal or physical conduct of a sexual nature by a person who has authority over the recipient when:
 - o Submission to such conduct is an implicit or explicit condition of the individual's employment, academic status, or ability to use University facilities and services, or
 - o Submission to or rejection of the conduct affects tangible aspects of the individual's employment, academic status, or use of University facilities.
2. Unwelcome and unsolicited language or conduct that creates an intimidating, hostile, or offensive working or learning environment, or has the purpose or effect of unreasonably interfering with an individual's academic or work performance.

If you believe that you are being harassed, or have observed harassment, you can report it to SPH using the [bias concerns link \(Links to an external site.\)](#). The University also has designated offices to help you: [SafeCampus \(Links to an external site.\)](#); [Office of the Ombud \(Links to an external site.\)](#); [Title IX Investigation Office \(Links to an external site.\)](#); and [University Complaint Investigation and Resolution Office \(Links to an external site.\)](#).

Reporting Learning Environment Concerns: The School of Public Health (SPH) Office of the Dean has a [student concern policy \(Links to an external site.\)](#), a faculty concern policy and standard HR procedures for staff concerns. Our 2018 climate survey states that most people in SPH do not report bias incidents because they do not know where to go. Students are encouraged to report any incidents of bias to someone they feel comfortable with, including instructors, advisers or department staff.

Students are encouraged to report concerns in any of the following ways:

- Report the incident to someone you feel comfortable with, including teaching staff, an advisor or department staff;
- Contact Department of Global Health (DGH) leadership:
 - DGH Associate Chair for Academic Programs Susan Graham at grahamsm@uw.edu
 - The DGH Diversity, Equity & Inclusion (DEI) Committee and DEI director at dghdeicomm@uw.edu
- Contact School of Public Health (SPH) leadership – reports are tracked for resolution and areas for further training are identified.
- Email dcinfo@uw.edu for immediate follow-up.
- Bias concerns can be anonymously and confidentially reported at this link: [https://sph.washington.edu/about/diversity/bias-concerns \(Links to an external site.\)](https://sph.washington.edu/about/diversity/bias-concerns). Data is collected by the Assistant Dean for EDI and the Assistant Dean for Students and tracked for resolution and identifying areas for further training.

Feedback on this Course: The Department of Global Health provides an anonymous [Learning Feedback SurveyLinks to an external site.](#) for students in its courses to provide timely feedback to course instructors throughout the quarter in the following areas:

1. What is helping you learn in this course?
2. What is hindering your learning in this course?
3. What can your instructor do to improve your learning in this course?

You may elect to answer only those questions for which you have specific feedback. All feedback is provided weekly to instructors.

PABIO 536: Bioinformatics, Gene Sequence Analysis and Beyond

Class	Date	Title	Learning Objectives At the end of this class, you will be able to explain:
<i>Python as a bioinformatic tool (Primary Lecturer: Shuyi)</i>			
1	March 28	What is bioinformatics, and why?	Course overview; intro to the data paper; software installation
2	March 30	Importing, subsetting data	Import/export data; basic manipulation of lists, arrays, data frames
3	April 4	Manipulating data frames, calculating summary parameters	Data manipulation, calculating summary statistics with data frames
4	April 6	for loops, while loops, if-else conditionals, making functions	Setting up repetitive tasks; making functions
5	April 11	Basic statistics I	Performing basic statistical tests: finding differences between distributions; assessing enrichment
6	April 13	Basic statistics II	assessing correlation, multiple hypothesis correction
<i>Nucleic acids (Primary Lecturer: Fergal)</i>			
7	April 18	Intro to R – Importing data	Intro to RNAseq, Intro to R, working with R to import data, adding metadata
8	April 20	RNAseq II – Statistical testing	Intro to RNAseq, performing multiple statistical comparisons in R, Removing low count genes, normalize samples
9	April 25	RNAseq III- Analysis	Data preprocessing and normalization, calculating differentially expressed genes
<i>Data Visualization (Primary Lecturer: Andrew)</i>			
10	April 27	Dimensionality reduction	PCA and tSNE to visualize complex data
11	May 2	Basic Plotting	Introduce matplotlib, seaborn, and altair: generate figures, modify figure elements
12	May 4	Clustering/heatmaps	How to make heatmaps, better looking figures
13	May 9	Content Review (Primary Lecturer: Joshua); Propose Final Project	
<i>Network analysis (Primary Lecturer: Fred)</i>			
14	May 11	Introduction to networks	Types of networks; Network resources
15	May 16	Annotation enrichment analysis	How to map data of interest onto networks
16	May 18	Network analysis	How to interpret networks: network properties; motifs and modules
17	May 23	Network visualization: Cytoscape	How to draw a network from data
<i>Proteins (Primary Lecturers: Bart and Sandhya)</i>			
18	May 25	3D protein structures	Viewing 3D protein structures using several free online tools
	May 30	Memorial Day: no class	
19	June 1	Predicting protein structure from sequence	As described
<i>Final Project</i>			

20	June 6	Project presentation	Brief presentations of final project
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If you have not yet established services through DRS, but have a temporary health condition or permanent disability that requires accommodations (conditions include but not limited to; mental health, attention-related, learning, vision, hearing, physical or health impacts), you are welcome to contact DRS at 206-543-8924 or uwdrs@uw.edu or disability.uw.edu. DRS offers resources and coordinates reasonable accommodations for students with disabilities and/or temporary health conditions. Reasonable accommodations are established through an interactive process between you, your instructor(s) and DRS. It is the policy and practice of the University of Washington to create inclusive and accessible learning environments consistent with federal and state law.

Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at [Religious Accommodations Policy \(https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/\)](https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/). Accommodations must be requested within the first two weeks of this course using the [Religious Accommodations Request form \(https://registrar.washington.edu/students/religious-accommodations-request/\)](https://registrar.washington.edu/students/religious-accommodations-request/).

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Classroom Climate: The establishment of a supportive learning environment is fundamental to this course and to the university. Students and instructors are expected to share their knowledge, comments, critiques, feedback, and alternate opinions in a manner that is respectful to the many social and cultural differences among us. Creating a learning environment reflective of community and inclusion is the mutual responsibility of the instructors and the students; as such, we should engage in dialogue in a way that supports learning for all of us. This respectful environment will be fostered by listening to views other than your own with an open mind, being able to understand and appreciate another person's point of view, and the ability to articulate your own point of view using direct communication. We strive to remember and put these guidelines into practice during our learning:

- Students' and colleagues' viewpoints are important—listen to them. Recognize that each of us might miss things others see and see things others might miss
- Raise my views in such a way that encourages others to raise theirs
- Inquire into others' views while inviting them to inquire into mine
- Beware of either/or thinking
- Be willing to take risks and move outside my comfort zones
- Affirm others

We encourage students with concerns about the classroom climate to talk to your instructor, your advisor, a member of the departmental or SPH Diversity Committee and/or the program director, or to reach out to DCinfo@uw.edu with classroom climate concerns.