

Machine Learning in Genomics

CIS 6930

Class Periods: Tuesday 10:40-11:30am (T4), Thursday 10:40am-12:35pm (R4-5)

Location: T CSE220, R CSE221

Academic Term: Spring 2022

Instructor:

Kiley Graim

kgraim@ufl.edu

Office Hours: TBD

Course Description

3 Credits. Machine learning algorithms are prevalent in genomics: from random forests for disease prediction to convolutional neural networks for protein structure prediction. This course covers the fundamental theory and application of machine learning algorithms in the context of genomics. It will follow a project-based seminar format in which we will discuss in-class weekly readings of the foundational research papers that introduced these algorithms. Topics include precision medicine, pharmacogenomics, sequence and expression analysis, genotype to phenotype relationships, comparative genomics, regulatory network inference, and other machine learning applications in genomics.

Course Pre-Requisites / Co-Requisites

Exposure to R/Python is recommended, but extensive experience is not required.

Course Objectives

By the end of the course, students should have the ability to:

- Analyze primary literature in the computational biology field
- Identify and formulate a computational biology approach to solve a biological/medical question.
- Understand foundational concepts and problems in computational biology, including but not limited to: 3D protein structure modeling, enrichment analysis, and RNA-seq analysis.

Materials and Supply Fees

N/A

Required Textbooks and Software

There is no textbook for this course. We will be using free online materials and scientific literature. Students must have access to a computer (Mac, Unix, or Linux operating system) or HiPerGator. Readings will be posted on Perusall, accessible through Canvas.

Recommended Materials

Course Schedule

Week	Tues Date	Topic	Assignments
1	Jan 4	Introduction to the course	
2	Jan 11	The role of DNA, RNA, protein	
3	Jan 18	HiPerGator	
4	Jan 25	Next generation sequencing	Project Roadmap
5	Feb 1	Bulk RNA-seq analysis	
6	Feb 8	scRNA-seq analysis	
7	Feb 15	Mutation analysis	Project Intro
8	Feb 22	GSEA methods	
9	Mar 1	Genomic databases	
10	Mar 8	Shell scripting – bash, sed, awk, Makefiles	Project Methods
11	Mar 15	Making publication images	

12	Mar 22	3D modeling/prediction	
13	Mar 29	Integrative analysis	Project Final Paper
14	Apr 5		
15	Apr 12	Final Presentations	Project Presentation
	Apr 19		

Attendance Policy, Class Expectations, and Make-Up Policy

State whether attendance is required and if so, how will it be monitored? What are the penalties for absence, tardiness, cell phone policy, laptop policy, etc. What are the arrangements for missed homework, missed quizzes, and missed exams? This statement is required: Excused absences must be consistent with university policies in the [Graduate Catalog](#) and require appropriate documentation. Additional information can be found in [Attendance Policies](#).

Plagiarism and Cheating: All suspected plagiarism and cheating cases will be evaluated by the SCCR, consistent with University of Florida policy. A grade of zero will be given to all cases of plagiarism and cheating.

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Readings (20)	10 each	20%
Journal Club Lead	100	10%
Project Roadmap	100	10%
Project Introduction	50	5%
Project Methods	50	5%
Project Final Paper	300	30%
Project Presentation	200	20%
	1000	100%

Grading Policy

Percent	Grade	Grade Points
94 - 100	A	4.00
90.0 - 93.9	A-	3.67
87 - 89.9	B+	3.33
84 - 86.9	B	3.00
80.0 - 83.9	B-	2.67
77 - 79.9	C+	2.33
74 - 76.9	C	2.00
70.0 - 73.9	C-	1.67
67 - 69.9	D+	1.33
64 - 66.9	D	1.00
61 - 63.9	D-	0.67
0 - 60.9	F	0.00

More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Conduct Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

COVID-19

- You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated.
- If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 (or email covid@shcc.ufl.edu) to be evaluated for testing and to receive further instructions about returning to campus.
- If you are withheld from campus by the Department of Health through Screen, Test & Protect, you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.
- UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the [UF Health Screen, Test & Protect website](#) for more information.

- Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.