BSC6895C AI in Agricultural and Life Sciences (graduate course)

Academic Term: Fall 2025

3-credit hours asynchronous course

Instructor: Raquel Dias
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The best way to contact me is via E-learning mail, or I can set up a time for individual zoom sessions or in-person meetings.

Course Description

Artificial intelligence (AI) is used to solve problems in research and industry. This course provides students with an understanding of AI systems and how they can be applied to answer challenging questions in life sciences. Through online study materials and hands on exercises, students will obtain the skills and knowledge they need to use AI to solve real world life sciences problems.

Course Structure

Quizzes (44%) + Assignments (34%) + final project (22%) = 100%

This course consists of the following primary activities:

- Course readings and tutorials delivered via e-learning.
- Assigned programing exercises delivered as Jupyter notebooks.
- Weekly office hours for troubleshooting and answering questions via Zoom.
- Quizzes, assignments, and final project delivered through e-learning.

Quizzes: The quizzes consist of multiple choice and fill in the blank questions based on the readings and hands-on exercises. Most of the quizzes are very short and take a few minutes to be completed. The quizzes represent 139 points, which represents 44% of the total possible points (319).

Final project: The final project consists of using the AI methods learned in the course to propose a scientific hypothesis and analytical methodology to study associations between human gut microbiome and disease. The students will design, conduct and evaluate the results of an AI approach to predict disease risk using gut-associated microbiome data. The final project (70 points) represents 22% of the grade. The final project should take a few hours to be completed for students that have the prerequisite skills.

Assignments: In addition to the final project assignment, the graduate version of this course consists of 3 additional assignments based on recommended readings and on what was learned in the class. The recommended article list will be used as examples for two review writing assignments. The first one focuses on what are the main applications of AI, and the second one focuses on what are the major limitations of AI and how to overcome them for better AI dissemination. In addition to the 2 review/discussion assignments, there is one research proposal assignment where the graduate student will describe aims, hypothesis, and approach for a PhD project that applies AI to the biological data that they are planning to acquire during their PhD. Alternatively, students will be allowed to use public repository data for their research proposal assignments. The 3 assignments included in the graduate version of the course consist of 20, 30, and 60 points, which is in total 34% of the maximum points (319). Each of the assignments should take a few hours to be completed for students that have the prerequisite skills.

Prerequisite skills

There is no official prerequisite course, but it is highly recommended that students taking this course have at least one of the following skills at beginner level: python programming, statistics, or machine learning. If you don't have any of the skills, you will spend much longer taking the quizzes, working on the assignments, and trying to understand the hands-on exercises.

Course learning objectives

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

- Implement multi-neuron layers and multi-layer networks to build general nonlinear neural networks in TensorFlow.

- Diagnose model overfitting in TensorFlow using validation data, and implement and evaluate standard methods to mitigate overfitting in TensorFlow.

- Use Google Colaboratory (Google Colab) and Jupyter Notebooks to build and train neural networks.

- Apply correct vocabulary to characterize neural networks, modern AI and the history of AI development.

- Identify important applications of phenotype prediction in agricultural and life sciences.

- Define overfitting and use AI vocabulary to describe how overfitting is evaluated in practice.

Course weekly topics and quizzes:

week	topic	quiz	pts	%
1	introduction to AI in Agricultural and Life Sciences	1	2	0.6
		2	2	0.6
		3	2	0.6
		4	2	0.6
		5	2	0.6
		6	4	1.3
2	getting started with neural networks	7	5	1.6
		8	3	0.9
		9	9	2.8
3	foundations of neural network modeling	10	2	0.6
		11	4	1.3
		12	2	0.6
4	fundamentals of model overfitting	13	3	0.9
		14	2	0.6
		15	4	1.3
5	fixing overfitting with data and training	16	2	0.6
		17	3	0.9
		18	2	0.6
6	fixing overfitting with modeling	19	3	0.9
		20	4	1.3
		21	4	1.3
7	case study - quantitative phenotype prediction from genomic variation	22	4	1.3
		23	6	1.9
8	classification problems	24	3	0.9
		25	3	0.9
		26	4	1.3
9	convolutions and image classification	27	3	0.9
		28	3	0.9
		29	4	1.3
10	case study - landscape classification	30	4	1.3
		31	6	1.9

		32	6	1.9
11	recurrent networks	33	3	0.9
		34	3	0.9
		35	3	0.9
12	case study - microbiome disease association using recurrent networks	36	6	1.9
		37	3	0.9
13	transformers	38	4	1.3
		39	5	1.6
14 15	final project			
	Total points from quizzes		**139**	**44**

In addition to quizzes, there are 4 assignments/projects:

week	topic	assignment / project	pts	%
3	foundations of neural network modeling	1	20	6.3
8	classification problems	2	30	9.4
12	case study - microbiome disease association using recurrent networks	3	60	18.8
14 15	final project	4	70	21.9
	Total points from assignments and projects:		**180**	**56**

Total points from quizzes (139) + assignments and projects (180) = 319

Required and recommended textbooks

There is no required or recommended textbook for this course. All course materials will be provided by the instructor. A reading list is provided below.

Recommended scientific articles for the review write up assignment 1:

- Dias R, Torkamani A. Artificial intelligence in clinical and genomic diagnostics. Genome Medicine. 2019 Dec;11(1):1-2.
- Eli-Chukwu NC. Applications of artificial intelligence in agriculture: A review. Engineering, Technology & Applied Science Research. 2019 Aug 10;9(4):4377-83.
- Haleem A, Javaid M, Khan IH. Current status and applications of artificial intelligence (AI) in medical field: An overview. Current Medicine Research and Practice. 2019 Nov 1;9(6):231-7.
- Nichols JA, Herbert Chan HW, Baker MA. Machine learning: applications of artificial intelligence to imaging and diagnosis. Biophysical Reviews. 2019 Feb;11(1):111-8.
- Richards B, Tsao D, Zador A. The application of artificial intelligence to biology and neuroscience. Cell. 2022 Jul 21;185(15):2640-3.
- Smith KP, Wang H, Durant TJ, Mathison BA, Sharp SE, Kirby JE, Long SW, Rhoads DD. Applications of artificial intelligence in clinical microbiology diagnostic testing. Clinical Microbiology Newsletter. 2020 Apr 15;42(8):61-70.
- Koromina M, Pandi MT, Patrinos GP. Rethinking drug repositioning and development with artificial intelligence, machine learning, and omics. Omics: A Journal of Integrative Biology. 2019 Nov 1;23(11):539-48.
- Cong Y, Endo T. Multi-omics and artificial intelligence-guided drug repositioning: Prospects, challenges, and lessons learned from COVID-19. OMICS: A Journal of Integrative Biology. 2022 Jul 1;26(7):361-71.
- Cui M, Zhang DY. Artificial intelligence and computational pathology. Laboratory Investigation. 2021 Apr;101(4):412-22.

Recommended scientific articles for the review write up assignment 2:

- Naudé W. Artificial intelligence vs COVID-19: limitations, constraints and pitfalls. AI & Society. 2020 Sep;35(3):761-5.
- Antoniades C, Oikonomou EK. Artificial intelligence in cardiovascular imaging—principles, expectations, and limitations. European Heart Journal. 2021 Sep 24.
- Xu J, Yang P, Xue S, Sharma B, Sanchez-Martin M, Wang F, Beaty KA, Dehan E, Parikh B. Translating cancer genomics into precision medicine with artificial intelligence: applications, challenges and future perspectives. Human Genetics. 2019 Feb;138(2):109-24.
- Koumakis L. Deep learning models in genomics; are we there yet?. Computational and Structural Biotechnology Journal. 2020 Jan 1;18:1466-73.
- Petch J, Di S, Nelson W. Opening the black box: the promise and limitations of explainable machine learning in cardiology. Canadian Journal of Cardiology. 2022 Feb 1;38(2):204-13.

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- John-Mathews JM. Some critical and ethical perspectives on the empirical turn of AI interpretability. Technological Forecasting and Social Change. 2022 Jan 1;174:121209.
- Gunning D, Stefik M, Choi J, Miller T, Stumpf S, Yang GZ. XAI—Explainable artificial intelligence. Science Robotics. 2019 Dec 18;4(37):eaay7120.
- Confalonieri R, Coba L, Wagner B, Besold TR. A historical perspective of explainable Artificial Intelligence. Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery. 2021 Jan;11(1):e1391.
- Arrieta AB, Díaz-Rodríguez N, Del Ser J, Bennetot A, Tabik S, Barbado A, García S, Gil-López S, Molina D, Benjamins R, Chatila R. Explainable Artificial Intelligence (XAI): Concepts, taxonomies, opportunities and challenges toward responsible AI. Information Fusion. 2020 Jun 1;58:82-115.

Grading Scale

Course grades will be determined based on percentage of 319 total possible points. The following grading scale will be used:

Letter grade	% of total points	Necessary points
A	90.00 – 100.0	287.10-319.00
B+	85.00 – 89.99	271.15-287.07
B	80.00 – 84.99	255.20-271.12
C+	75.00 – 79.99	239.25-255.17
C	70.00 – 74.99	223.30-239.22
D+	65.00 – 69.99	207.35-223.27
D	55.00 – 64.99	175.45-207.32
E	0.00 – 54.99	0.00-175.42

Grades and Grade Points

For information on current UF policies for assigning grade points, see:

https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/ (Links to an external site.)

Attendance and Make-Up Work

Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at:

https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/ (Links to an external site.)

Online Course Evaluation Process

Student assessment of instruction is an important part of efforts to improve teaching and learning. At the end of the semester, students are expected to provide feedback on the quality of instruction in this course using a standard set of university and college criteria. 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/ (Links to an external site.)

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/ (Links to an external site.)

Summaries of course evaluation results are available to students at:

https://gatorevals.aa.ufl.edu/public-results/ (Links to an external site.)

Academic Honesty

As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: "*We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity."* You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit 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*."

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see:

http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code (Links to an external site.)

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.

Services for Students with Disabilities

The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.

0001 Reid Hall, 352-392-8565

https://disability.ufl.edu/ (Links to an external site.)

Campus Helping Resources

Students experiencing crises or personal problems that interfere with their general well- being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- *University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575,* **www.counseling.ufl.edu** (Links to an external site.)

Counseling Services Groups and Workshops Outreach and Consultation Self-Help Library Wellness Coaching

- U Matter We Care, **www.umatter.ufl.edu** (Links to an external site.)
- *Career Connections Center, First Floor JWRU, 352-392-1601*, https://career.ufl.edu/ (Links to an external site.)
- UF Student Success initiative: https://studentsuccess.ufl.edu/
- Student Complaints:
    - Residential Course: https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/ (Links to an external site.)
    - Online Course: http://www.distance.ufl.edu/student-complaint-process (Links to an external site.)

Diversity, Inclusion and Equity

This class fully supports the University of Florida's commitment to diversity, inclusion, and equity. By fostering a sense of belonging for students, staff and faculty while leveraging the uniqueness of the people who study and work at the university, we believe our campus community is enriched and enhanced by diversity, including but not limited to race, ethnicity, national origin, gender, gender identity, sexuality, class and religion. Our course will help foster an understanding of the diversity of our campus community, locally and globally.

We will strive to create a learning environment for our students that support a diversity of thoughts, perspectives and experiences while honoring your identities. To accomplish this, please let us know:

- If you have a name and/or set of pronouns that differ from those that appear in your official university records
- If you believe your performance in the class is being impacted by your experiences outside of class. Do not hesitate to reach out and talk with us. We want to be a resource for you. Anonymous feedback may be submitted, which may lead us to make a general announcement to the class, if necessary, to address your concerns.
- We, like many people, are still in the process of learning about diverse perspectives and identities. If something was said in class (by anyone) that makes you feel uncomfortable, please talk to us about it.

Contact us with any concerns regarding inclusion and equity, including accessibility of learning materials, equipment, and software.