

Data Sciences Applications for Biomechanics

PET5936 | Class # 25820 | 3 Credits | Spring 2023

Course Info

INSTRUCTOR

Diego L. Guarin, Ph.D.
Office: FLG (Florida Gym) 132
Office Phone:
Email: d.guarinlopez@ufl.edu
Preferred Method of Contact: email

OPEN DOOR HOURS

Monday 10:00 am – 12:00 pm (zoom or in-person)

MEETING TIME/LOCATION

Thursday 8:30-11:30 am
FLG 235

COURSE DESCRIPTION

This class will provide students with basic knowledge and skills to acquire and process data related to human movement and extract clinically relevant information employing modern data science techniques.

PREREQUISITE KNOWLEDGE AND SKILLS

APK 3220C/instructor approval.

REQUIRED AND RECOMMENDED MATERIALS

There are no required books for this class. Class material will be posted online.

These books were used when developing this class, so they might provide additional insight and resources and might be available from the instructor upon request.

Python

- Matthes, Eric. "Python crash course: A hands on, project-based introduction to programming." no starch press, 2019.
- Kong, Qingkai, Siau, Timmy, and Bayen, Alexandre. "Python Programming and Numerical Methods: A Guide for Engineers and Scientists." Elsevier, 2020.

Data Science

- Raschka, Sebastian, and Vahid, Mirjalili. "Machine learning with Pytorch and Scikit - Learn." Packt Publishing, 2022
(Available online: <https://github.com/rasbt/machine-learning-book>)
- Howard, Jeremy, and Sylvain Gugger. "Deep Learning for Coders with fastai and PyTorch." O'Reilly Media, 2020.
(Available only: <https://course.fast.ai/Resources/book.html>)

Biomechanics

- Winter, David A. "Biomechanics and motor control of human movement." John Wiley & Sons, 2009.
- Uchida, Thomas K., and Scott L. Delp. "Biomechanics of movement: the science of sports, robotics, and rehabilitation." MIT Press, 2021.

COURSE FORMAT

The course format will be Live Coding Session. Course topics will be covered using slides/white board during the lecture and code will be used to demonstrate the application of the different concepts. Students are encouraged to actively participate in the coding sessions to gain practical experience during the class.

COURSE LEARNING OBJECTIVES:

At the end of this course students should be able to:

1. Use the Python programming language to solve basic programming challenges
2. Analyze biomechanics data using the Python programming language
3. Identify and use data science algorithms for inferring relationships between data
4. Formulate and develop a solution to analyze biomechanical data employing data science approaches

Course & University Policies

ATTENDANCE POLICY

Attendance is not mandatory. However, the course includes in-class activities and exercises; students will benefit from attending each lecture.

PERSONAL CONDUCT 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 Honor Code (<http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions.

Furthermore, you are obliged to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult the instructor or TA in this class.

EXAM MAKE-UP POLICY

A student experiencing an illness should visit the UF Student Health Care Center or their preferred healthcare provider to seek medical advice and obtain documentation. If you have an illness, family emergency or death, please contact the Dean of Students Office (www.dso.ufl.edu) and follow the DSO Care Team procedures for documentation and submission of a request for make-up assignment (<https://care.dso.ufl.edu/instructor-notifications/>). The DSO will contact the instructor. Do not provide any documentation to the instructor

regarding illness or family emergency. This is your personal and protected information. The DSO is qualified to receive and verify the documents you provide. The instructor will follow the recommendations from the DSO.

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found in the online catalog at: <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>."

ACCOMMODATING STUDENTS WITH DISABILITIES

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the Disability Resource Center by visiting their Get Started page at <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 EVALUATIONS

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/>.

Getting Help

HEALTH & WELLNESS

- U Matter, We Care: If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575
- Counseling and Wellness Center: <https://counseling.ufl.edu/>, 352-392-1575
- Sexual Assault Recovery Services (SARS) - Student Health Care Center, 392-1161
- University Police Department, 392-1111 (or 9-1-1 for emergencies) <http://www.police.ufl.edu/>

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 Connections 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. <http://teachingcenter.ufl.edu/>
- Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <http://writing.ufl.edu/writing-studio/>
- Student Complaints On-Campus: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/> On-Line Students Complaints: <http://distance.ufl.edu/student-complaint-process/>

INCLUSION, DIVERSITY, EQUITY, AND ACCESSIBILITY RESOURCES

For suggestions or concerns related to IDEA, please reach out to any of the following:

- Dr. Linda Nguyen, APK IDEA Liaison, linda.nguyen@hhp.ufl.edu
- Dr. Rachael Seidler, APK Graduate Coordinator, rachaelseidler@ufl.edu

- Dr. Joslyn Ahlgren, APK Undergraduate Coordinator, jahlgren@ufl.edu

Grading

Evaluation Components (Number of each)	Points Per Component	% of Total Grade
In-class Quizzes (5)	2 pts each = 10 pts	10%
Homework (5)	10 pts each = 50 pts	50%
Project Presentation (1)	15 pts each = 15 pts	15%
Final Project (1)	25 pts each = 25 pts	25%
Extra Credit (1)	10 pts	10%

In-class Quizzes – Short programming quizzes that will be performed during class. Students will be provided with a simple problem that should be solved individually. Quizzes dates will be programmed at least one week in advance.

Homework – Homework is due two weeks after posting it online.

Homework will be a challenging project meant to consolidate the concepts and techniques discussed in class. Homework will give students a chance to have firsthand experience using different approaches related to data processing and visualization.

Group discussions are encouraged, and students are expected to work on the problems with other class members. That said, **students are expected to provide original solutions to the problems.**

All homework will involve coding and students must provide a written report along with their code. The code should be easy to interpret and well documented. Moreover, students should ensure that their code can be executed by others (that is, provide a list of dependencies and all necessary data).

It is not prudent to leave the homework for the last minute as it might take a considerable amount of time depending on your coding skills. *Late submissions of homework will not be accepted.*

Project Presentation – Students will present their project to the class during a 15-minute presentation. Presentations must summarize the research project and present preliminary results.

The presentations will be held on the last day of class.

Final Project – in the final project, students are expected to employ the different techniques discussed in class to solve a problem related to biomechanics. Students must:

1. Identify a problem related to data science + biomechanics
2. Research what solutions are available in the literature
3. Find/record data related to the problem
4. a. Implement one of the proposed solutions
b. Propose a new solution to the problem
5. Write a report summarizing the problem and the proposed solution. The report should be written as a research paper including the following sections:
 - Introduction
 - Methods

- Results
- Discussion

The report must include appropriate citations using the APA style.

The code and data employed during the project must be submitted as well. Students must ensure that the code can be executed by others.

The final project is due by the end of the day on the Monday of the Exams Week.

Extra Credit - Students can earn up to 10 points of extra credit on this course. Extra credit will be provided to students who acquire their own data for the homework and project. Students might work in teams (up to two students) for data collection, each student must submit individual homework/project.

GRADING SCALE

More detailed information regarding current UF grading policies can be found here:

<https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/>.

Any requests for additional extra credit or special exceptions to these grading policies will be interpreted as an honor code violation (i.e., asking for preferential treatment) and will be handled accordingly.

Letter Grade	Percent of Total Points Associated with Each Letter Grade	GPA Impact of Each Letter Grade
A	90.00-100%	4.0
A-		3.67
B+	87.00-89.99%	3.33
B	80.00-86.99%	3.0
B-		2.67
C+	77.00-79.99%	2.33
C	70.00-76.99%	2.0
C-		1.67
D+	67.00-69.99%	1.33
D	60.00-66.99%	1.0
D-		0.67
E	0-59.99%	0

Weekly Course Schedule

CRITICAL DATES & UF OBSERVED HOLIDAYS

- January 16: Martin Luther King, Jr. Day (Monday)
- March 13 – 18: UF Spring Break (Monday - Friday)
- April 27– 28: UF Spring Semester Reading Days (Thursday – Friday)

Complete list available here: <https://catalog.ufl.edu/UGRD/dates-deadlines/pdfs/calendar2223.pdf>

WEEKLY SCHEDULE

Week	Dates	Assigned Module & Schedule Notes	Assessments and Quizzes
1	January 9 – 13	Introduction to Python	

2	January 16 – 20	Introduction to Python	Quiz # 1
3	January 23 – 27	Introduction to Python	Assignment 1 – posted
4	January 30 – Feb 3	Biomechanical Data Visualization	
5	February 6– 10	Acquiring and Visualizing Data	
6	February 13 – 17	Acquiring and Visualizing Data	Assignment 2 – posted
7	February 20 – 24	Introduction to Machine Learning	Quiz # 2
8	February 27 – Mar 3	Ensemble Methods	Assignment 3 – posted
9	March 6 – 10	Ensemble Methods	Quiz # 3
10	March 20 – 18	No class	Spring Break
11	March 20 – 24	Neural Networks	Assignment 4 – posted
12	March 27 – 31	Markerless Motion	Quiz # 4
13	April 3 – 7	Markerless Motion	Assignment 5 – posted
14	April 10 – 14	Applications	Quiz # 5
15	April 17 – 21	Students Presentation	
16	April 24 – 28	No Class	Reading Days

SUCCESS AND STUDY TIPS

This class will provide hands-on experience with different methods to analyze and visualize biomechanical data. The following tips will help you succeed in this class:

- Actively participating in the in-class live-coding sessions will help you to cement the concepts discussed during the lecture
- Take enough time to complete the assignments. The homework problems can be challenging depending on your coding experience. Working in groups is strongly suggested and encouraged. However, remember that you must produce original solutions to the problems
- Make sure that your code is readable and well documented. Also, when you submit your code, please include all the necessary files to make sure it runs in the instructor computer
- The final project is an opportunity to display the skill that you acquired in the course. It is best to choose a project that you are passionate about, so make sure to carefully select your topic
- You will find out that data availability is the most important aspect of your project. If you cannot easily find or acquire the data to process, then you will not be able to complete your project on time. Make sure that you have identified your data source before picking a project topic
- Make sure to use the Open Door Hours. I am here to help you fulfill the class objectives.
- If there are some majorly overwhelming things happening during your semester, send me an email; we will work together to figure out what steps you should take to help get you through the course.

PRIVACY

Our class sessions may be audio-visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. **As in all courses, unauthorized sharing of recorded materials is prohibited.**