

**UNIVERSITY OF FLORIDA**  
**COLLEGE OF MEDICINE SYLLABUS**  
**NEUROSCIENCE**  
**GMS6XXX Computational Skills for Neuroscience**  
**(2 credit)**  
Spring 2023  
**Delivery Format: In person.** Time: TBD

Instructors:

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Office Hours: By Appointment  
Graduate Assistant: TBD  
Preferred Course Communications:  
Teams  
Prerequisites: Doctoral students

**Course Description:**

Teaches basic software skills for neuroscience graduate students and how computing can enhance and accelerate neuroscience research. Students will learn to use basic programming skills for quantitative analyses of datasets, as well as edit and understand code done by others. Students will also be exposed to basic concepts in Artificial Intelligence as they relate to neuroscience.

**Purpose and Outcome:**

The purpose of this course is to prepare students to use basic computational tools on MATLAB and Python with direct relevance to neuroscience research. At the end of this course, students should be able to adapt their basic programming skills to basic tasks from literature searches to quantitative analyses of their own datasets, as well as edit and understand code done by other lab members. Students will also be exposed to basic concepts in Artificial Intelligence as they related to neuroscience.

**Course Overview:**

Computational skills are becoming more necessary for all biomedical research, including neuroscience. Computational proficiency can facilitate multiple facets of graduate student research and education including facilitating statistical analyses, analysis of large data sets, use of

the high-performance computer on campus and adapting existing open-source tools for the needs of a scientific project. Programming skills particularly can automate data processing and decrease human bias in scientific projects. However, computer programming is not incorporated in the predoctoral education of all biological science or neuroscience degrees. Therefore, the purpose of this course is to take a novice student and provide them with the basic understanding of MATLAB and Python programming, gradually working through more complex exercises with relevance to neuroscience. Students will be required to bring their own computer to every class to do the exercises.

**Relation to Program Outcomes:** This course fulfills the requirements for Academic Credits for graduate students in the Neuroscience program.

### **Course Objectives and/or Goals:**

By the end of each semester, students will be able to:

- Understand the basics of MATLAB and Python
- Read and edit basic programming scripts
- Be able to create scripts to transform and visualize common datasets
- Be able to understand and implement open source code towards common datasets
- Become aware of the local computing resources at the University of Florida
- Become aware Artificial Intelligence tools utilized for neuroscience.
- Experience using common packages to perform machine learning analyses.

### **Instructional Methods:**

As programming is often “trial and error”, this class will provide both instruction and time to apply the concepts real time in class. Students are expected to come to class with their laptops prepared to work through exercises and additional supplementary problems. In the first half of each lecture the instructors will explain the concepts necessary, and in the second part of the lecture students will dive into programming exercises. Instructors will be present to explain, facilitate and help with problems that emerge as students complete their programming exercises. A small portion of the lectures will be didactic, with guest lectures offering expansion on what Artificial Intelligence could offer if they continue beyond the current course. Through the course students will workshop scripts to improve good general coding habits and reproducibility of science. In addition, at the end of the semester students will complete a data analysis project and present their projects.

### **Description of Course Content:**

#### **Topical Outline/Course Schedule**

- 1) Discussion of Data Science and how it is used in Neuroscience.
  - Why MATLAB and Python,
  - Discussion of <https://www.jneurosci.org/content/jneuro/38/7/1601.full.pdf>
  - The elephant in the room, ChatGPT:  
<https://neuraljojo.medium.com/how-i-use-chatgpt3-as-a-scientist-12832caf5048>

- 2) Preparing our environments to code
  - Downloading MATLAB (via apps), Python and JupyterLab Notebooks
  - Download a library manager (conda, etc.)
  - Hipergator resources
- 3) “Hello worlds”- basics of programming (ch.2)
  - Basics of Matlab vs Python (appendix A of book)
  - Dictionary of variable types for Matlab vs Python
  - What is a function and how you use them and make them
  - Useful libraries for neuroscience
- 4) Loops, conditionals, and nested loops (Ch 3)
  - You’ll learn what are loops and conditionals and how to make them
  - But also when avoiding loops is better for speed
  - <https://medium.com/analytics-vidhya/day-1-making-matlab-fun-ad850eaffbde>
  - <https://medium.com/python-pandemonium/never-write-for-loops-again-91a5a4c84baf>
  - Assignment 1: Reduce the number of loops on assigned script
- 5) Make your first script with data transformation and plotting (ch.2)
  - Avoiding ugly plots please!
  - <https://medium.com/analytics-vidhya/day-7-where-does-my-data-go-and-matlabs-most-useful-hidden-plotting-property-d00d9d12045e>
  - <https://medium.com/geekculture/create-beautiful-graphs-with-python-4235f50b2adb>
- 6) Workshop scripts: learn how to use and improve someone else’s code and final project explanation.
  - Students will bring code generated in their home labs and provide critical feedback on how to improve it.
- 7) Common packages for statistical testing, t-tests and ANOVAs
- 8) Time series and signal processing (ch.5)
  - Library for signal processing in Matlab and Python
  - Power spectrum and coherence analyses
- 9) Presentations of mid-semester assignment 2 project “How I improved code from my lab”
- 10) How to do Regressions and correlations in Matlab and Python (ch. 7)
- 11) Dimensionality Reduction uses in neuroscience (ch. 8)
  - <https://www.visual-design.net/post/linear-algebra-for-ml-part2-principal-component-analysis>
  - Hands on exercise to reduce dimensionality of dataset
- 12) Intro to Artificial intelligence and Machine Learning Part 1
  - Students will do ch. 9 independently
  - lecture
- 13) Intro to Artificial intelligence and Machine Learning Part 2
  - Hands on exercises
- 14) Student presentations of datasets
- 15) Student presentations of datasets

*Assignment 1: Improve the provided script specifically reduce unnecessary loops. This assignment will be submitted via canva.*

*Assignment 2: Improve someone else's code: This assignment will be presented in class by each student. Pick a script that has been created by someone else in your lab, or by yourself in the past, and apply the concepts of the class to improve the readability of the code, minimize loops, lines of code and annotate code.*

*Assignment 3: Final project (Datasets <http://archive.ics.uci.edu/ml/datasets.php>)*

*Write a well annotated script that can be batched process to do the following:*

- 1. Run a regression on your dataset and identify the most and the least correlated variables*
- 2. Do k-means or hierarchical clustering using the least correlated variables*
- 3. Do k-means or hierarchical clustering using the most correlated variables*
- 4. Write a paragraph on how correlation affects clustering and general observations on clustering and variance.*

### **Canvas usage:**

Canvas will be used to submit programming exercise homework and for a discussion forum for debugging code errors. If students participate in helping others debug code they will get up to 5 extra credit points.

### **Course Materials and Technology:**

Neural Data Science: A Primer with MATLAB and Python, Erik Lee Nylen, Pascal Wallisch (2017)  
Additional reading resources will be provided

A computer

For technical support for this class, please contact the UF Help Desk at:

- [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu)
- (352) 392-HELP - select option 2
- [UF eLearning](#)

### **Academic Requirements and Grading:**

#### **Assignments:**

Each student is expected to present on their data analysis project during the semester and actively participate in the discussion every week. Student presenters order will be selected by the instructors. Several coding projects from the book will be submitted as problem sets.

#### **Grading:**

Requirement	Percent Final Grade
Attendance	40%
Assignment 1	10%
Assignment 2	20 %
Final project	30%

**Point system used (i.e., how do course points translate into letter grades).**

Percentage Earned	Letter Grade
93-100	A
90-92	A-
87-89	B+
83-86	B
80-82	B-
77-79	C+
73-76	C
70-72	C-
67-69	D+
63-66	D
60-62	D-
Below 60	E

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

**Exam Policy:** No exams

**Policy Related to Required Class Attendance:**

Requirements for class attendance and assignments, and other work in this course are consistent with university policies that can be found at:

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

Excused absences must be consistent with university policies in the Graduate Catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>). Additional information can be found here:

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

**Academic Integrity:**

Students are expected to act in accordance with the University of Florida policy on academic integrity. 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 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 additional information regarding Academic Integrity, please see Student Conduct and Honor Code or the Graduate Student Website for additional details:

<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>

<http://gradschool.ufl.edu/students/introduction.html>

**Please remember cheating, lying, misrepresentation, or plagiarism in any form is unacceptable and inexcusable behavior.**

### **Online Faculty Course Evaluation Process:**

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/>.

### **Policy Related to Guests Attending Class:**

Only registered students are permitted to attend class. However, we recognize that students who are caretakers may face occasional unexpected challenges creating attendance barriers.

Therefore, by exception, a department chair or his or her designee (e.g., instructors) may grant a student permission to bring a guest(s) for a total of two class sessions per semester. This is two sessions total across all courses. No further extensions will be granted. Please note that guests

are **not** permitted to attend either cadaver or wet labs. Students are responsible for course material regardless of attendance. For additional information, please review the [Classroom Guests of Students policy](#) in its entirety.

## **Support Services:**

### **Accommodations for 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 <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. The College is committed to providing reasonable accommodations to assist students in their coursework.

### **Counseling and Student Health:**

Students sometimes experience stress from academic expectations and/or personal and interpersonal issues that may interfere with their academic performance. If you find yourself facing issues that have the potential to or are already negatively affecting your coursework, you are encouraged to talk with an instructor and/or seek help through University resources available to you.

- The Counseling and Wellness Center 352-392-1575 offers a variety of support services such as psychological assessment and intervention and assistance for math and test anxiety. Visit their web site for more information: <http://www.counseling.ufl.edu>. On line and in person assistance is available.



- You Matter We Care website: <http://www.umatter.ufl.edu/>. If you are feeling overwhelmed or stressed, you can reach out for help through the You Matter We Care website, which is staffed by Dean of Students and Counseling Center personnel.
- The Student Health Care Center at UF Health is a satellite clinic of the main Student Health Care Center located on Fletcher Drive on campus. Student Health at UF Health offers a variety of clinical services. The clinic is located on the second floor of the Dental Tower in the Health Science Center. For more information, contact the clinic at 392-0627 or check out the web site at: <https://shcc.ufl.edu/>
- UF Health Emergency Room / Trauma Center: For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32698, [ufhealth.org/emergency-room-trauma-center](http://ufhealth.org/emergency-room-trauma-center).
- University Police Department: Visit [police.ufl.edu/](http://police.ufl.edu/) or call 352-392-1111 (or 9-1-1 for emergencies).
- Crisis intervention is always available 24/7 from:

Alachua County Crisis Center:

(352) 264-6789

<http://www.alachuacounty.us/DEPTS/CSS/CRISISCENTER/Pages/CrisisCenter.aspx>

Do not wait until you reach a crisis to come in and talk with us. We have helped many students through stressful situations impacting their academic performance. You are not alone so do not be afraid to ask for assistance.

## Academic Resources

**E-learning technical support:** Contact the UF Computing Help Desk at 352-392-4357 or via e-mail at [helpdesk@ufl.edu](mailto:helpdesk@ufl.edu).

**Career Connections Center:** Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services [career.ufl.edu/](http://career.ufl.edu/).

**Library Support:** [cms.uflib.ufl.edu/](http://cms.uflib.ufl.edu/) ask various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center:** Broward Hall 352-392-2010 or to make an appointment 352 392-6420. General study skills and tutoring. [teachingcenter.ufl.edu/](http://teachingcenter.ufl.edu/)

**Writing Studio:** 2215 Turlington Hall, 352-846-1138. Help brainstorming, formatting, and writing papers. [writing.ufl.edu/writing-studio/](http://writing.ufl.edu/writing-studio/)

**Student Complaints On-Campus:** [sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/](https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/)

**On-Line Students Complaints:** [distance.ufl.edu/student-complaint-process](https://distance.ufl.edu/student-complaint-process)

**Note regarding respect for diverse ideas:** At times your instructors may make provocative statements related to course content to spark discussion. This is not an endorsement of a position. We welcome and have respect for dissenting opinions. Moreover, we feel that hearing and sharing diverse ideas is an essential component of the active learning process. Please discuss with course faculty if you ever feel that your ideas are not being heard or respected.

