PSYC 3803/8803 Programming for Brain and Behavior

(a.k.a. Introduction to Programming for Data Science)

Instructor: Eunbee Kim
Semester: Spring 2025

Course Description

This course introduces students to programming in Python and R, emphasizing their applications in data science, statistical analysis, and machine learning. Students will gain practical experience through hands-on coding, real-world projects, and comparative analysis of the two languages.

Course Objectives

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

- Understand and apply core programming concepts in both Python and R.
- Perform data manipulation and analysis using appropriate libraries in each language.
- Visualize data effectively using Python and R.
- Apply statistical models and machine learning algorithms in Python and R.
- Select the appropriate language for specific data analysis tasks.

Prerequisites

- No prior programming experience required.
- Basic understanding of statistics is recommended.

Textbooks and Resources

- Online resources (tutorials, documentation) for Python and R
    - https://scipy-lectures.org/_downloads/ScipyLectures-simple.pdf (free)
    - http://openbookproject.net/thinkcs/python/english3e/index.html (free)
- *Python for Data Analysis* by Wes McKinney ($10-44)
- *R for Data Science* by Hadley Wickham and Garrett Grolemund ($12-50)

Course Schedule

Week 1: Introduction to Programming and Course Overview

- Overview of course objectives and expectations
- Introduction to programming concepts (variables, data types, control structures)
- Setting up Python and R environments

Week 2 - 3: Python Basics

- Python syntax and data structures (lists, tuples, dictionaries)
- Control flow: loops and conditionals

Week 4 - 6: Data Manipulation in Python

- Introduction to Pandas and NumPy
- Data cleaning and transformation techniques

Week 7: Statistical analysis in Python

- Introduction to Statistics, SciPy, and StatsModels
- Descriptive and Inferential statistics, Hypothesis Testing

Week 8: Data Visualization in Python

- Introduction to Matplotlib and Seaborn
- Creating plots and visualizations

Week 9: Introduction and Data Manipulation in R

- R syntax and basic data structures (vectors, data frames, lists)
- Control flow in R: if statements and loops
- Introduction to dplyr and tidyr
- Data cleaning and transformation techniques

Week 10: Statistical Analysis in R

- Introduction to statistical concepts (hypothesis testing, regression)
- Performing statistical analyses in R

Week 11: Data Visualization in R

- Introduction to ggplot2
- Creating plots and visualizations

Week 12: Advanced Data Visualization Techniques

- Advanced plotting techniques in Python (interactive plots)
- Advanced plotting techniques in R (interactive visualizations)

Week 13: Comparative Analysis of Python and R

- Strengths and weaknesses of each language
- Use cases for Python and R in data science
- Introduction to machine learning concepts

Week 14: Integrating Python and R

- Using R and Python together in data analysis
- Tools for interoperability (e.g., reticulate)

Week 15: Final Project Preparation

- Guidelines for the final project
- Work time for project development and instructor feedback
- Student presentations of final projects
- Peer feedback and discussion

Assessment

- Attendance: 14.3%
- In-Class Activity & Quizzes: 14.3%
- Homework Assignments: 14.3%
- Ed Discussion: 14.3%
- Midterm Project/Report: 14.3%
- Final Project: 28.6%

Grading Scale

- A: 90-100%

- B: 80-89%
- C: 70-79%
- D: 60-69%
- F: Below 60%

Course Policies

All work for this class is to be done individually. You are strongly urged to familiarize yourselves with the GT Student Honor CodeLinks to an external site. rules. Specifically, the following is not allowed:

- Copying, with or without modification, someone else's work when this work is not meant to be publicly accessible *(e.g., a classmate's program or solution)*.
- Submission of material that is wholly or substantially identical to that created or published by another person or persons, without adequate credit notations indicating authorship *(plagiarism)*.
- Putting your projects on public Github. Otherwise, if a student *(in the future)* copies your codes/projects, the student obviously violates the honor code but you will also be implicated.

Academic Integrity

Students are expected to uphold the highest standards of academic integrity. Any form of cheating, plagiarism, or dishonesty will not be tolerated and may result in disciplinary action.

Zero Tolerance Policy on Cheating and AI Assistance (e.g., Chat GPT, Gemini)

We maintain a strict zero-tolerance policy regarding academic dishonesty, including the use of ChatGPT and other AI tools. Any student found using AI to complete assignments/quizzes/exams will be reported immediately, receive a grade of zero for the submission, and risk a final grade of F.

Disability Accommodations

If you require any accommodation due to a disability, please inform the instructor at the beginning of the course to ensure that appropriate arrangements can be made.

LECTURE ATTENDANCE: From past experience teaching various courses, we have found a strong statistical relationship between class attendance and overall course performance. To that end, attendance will be counted as a small part of the course grade to help students perform better overall.

Beginning on the second week of class, attendance will be taken at all lecture sessions. To receive points, students are expected to arrive on time and stay for the entire class period. Arriving more than five minutes late, leaving class early, or acting in a disruptive manner during class will forfeit the points. Students must attend the lecture for which they are officially registered to earn attendance points.

This attendance policy is designed to promote class participation; therefore, no makeups will be permitted under any circumstances, and no absences will be classified as "excused" without documentations. However, to accommodate valid reasons for missing class, **students can still earn full attendance points even with up to two absences without documentation**.

Attendance will be strictly monitored, and points for a session will be annulled for the entire class if the number of respondents exceeds the total number of students present on that day, so please do not have another student sign in for you, and do not sign in for another student.

Class disruptions of ANY kind will NOT be tolerated and may result in your removal from the classroom and/or loss of participation points for that day. Please show courtesy to your fellow classmates and instructor or teaching assistant by adhering to the following class rules:

• Come to class on time and stay for the entire class period.

• Refrain from conversing with your fellow students.

• Put away any reading materials, cellular phones, and other electronic devices unrelated to the course.

IN-CLASS ACTIVITIES/QUIZZES/PARTICIPATION: You are expected to come prepared and actively participate in the class sessions. **In the event of an absence, you are responsible for all missed materials, quizzes, assignments, and any additional announcements or schedule changes given in class**.

Attendance is expected for this course. To further encourage active learning and ensure your understanding of the material, a series of unannounced in-class activities will be

administered throughout the semester. Some activities will be completed individually, whereas others will be completed in a group. Activities will be given at different points during class time (beginning, middle, or end), so it is important that you arrive to class on time and stay for the entire duration of the class. This should encourage you to attend class on time, keep up with your readings and assignments, and engage in class discussion.

All the Quizzes/Exams are closed-notes and closed-books; cheat sheets are NOT allowed.The work on all exams must be your OWN work, that is, they are not to be complete d with the help or aid of others or outside materials.
See http://www.catalog.gatech.edu/policies/honor-code/Links to an external site.Links to an external site. or http://www.catalog.gatech.edu/rules/18/Links to an external site.Links to an external site. for information on Georgia Tech's Academic Honor Code.

Make-Up Assessments (Quizzes/Exams/Presentations): Make-up assessments may be arranged only with an Institute-Approved Absence or an official letter from the Dean of Students. Documentation must be provided prior to the scheduled quiz/exam date and before arranging the make-up exam.

ASSIGNMENTS: Credit for assignments will be based on your individual contribution to the in- class activity and the accuracy of your responses.

Missed assignments can only be made up with an Institute Approved Absence or an official letter from the Dean of Students and must be completed within 7 days of the original in-class activity day. No exceptions will be made to this policy. It is your responsibility to contact the instructor via email to make up missed activities.

ED DISCUSSION: While in-class participation will be encouraged, this course also includes an asynchronous discussion component via Ed Discussion. This platform is designed to provide fast and efficient support from classmates, the TA, and myself.

To earn full credit for the Ed Discussion portion of your grade, you must average at least one post per week, either by asking a question or answering a classmate's question. A total of 12 posts is required by April 20th to receive full credit. Posts can include programming questions, psychological concepts, problem-solving inquiries, approaches to assignments, or any other course-related topics. Simple posts that ask about logistics (e.g., "When is the exam?", "Do we have a class tomorrow?") rather than

course content generally wouldn't count towards the requirement unless they stimulate further discussion on course-related topics.

You are encouraged to actively engage by answering each other’s questions; however, course instructors will also participate, and particularly insightful or notable posts may be highlighted during lectures or labs for further discussion.

Most of your Ed Discussion posts should be made to the full class. The exception is if you have a question about a particular assignment, quiz, or anything else that could spoil answers for classmates. In these cases, you should post to instructors only. Please post these messages rather than email or DM them, as we may determine they are OK to make public (with your permission) if we think it would be helpful to others.