Syllabus

Mathematical Programming with Python

MATH 2604: Advanced Scientific Computing 4
Spring 2025
Monday/Wednesday/Friday, 1:00-1:50pm

Refer to `https://people.sc.fsu.edu/∼jburkardt/classes/python_2025/python_2025.html`

Description: This course teaches you how to carry out your mathematical work with the aid of the computer language Python. No previous knowledge of Python is assumed. You will learn how to write programs that can represent, illustrate, or solve various common mathematical problems. You will write these programs on your personal laptop. We will sample basic problems from a variety of mathematical areas. We will be introduced to a number of Python libraries, particularly `numpy` for numerics and `matplotlib` for graphics.

Classes will be selected from the following topics

- Access to Python
- Interactive calculations
- Control with **if** and **while**
- Iteration using **for**
- Defining user functions
- Storing lists of values
- Finding prime numbers
- The Collatz conjecture
- Defining vectors
- Graphics using matplotlib
- Defining matrices
- Creating a magic matrix
- The reduced row echelon form
- Referring to ChatGPT
- Searching text files
- Linear algebra
- The PageRank algorithm
- Random numbers
- Sampling
- Simulation
- Grids
- Simulation on Grids
- Differential equations
- Euler's ODE solver
- Systems of differential equations
- Using scipy to solve ODE's
- Conservation laws for ODE's
- Boundary value problems
- Animation
- Working with text files
- Using the dictionary datatype
- Graph algorithms
- The Traveling Salesperson problem

- The Knapsack problem
- More Graphics Options
- The scipy scientific library
- The pandas library for data science
- Basketball bucks
- Symbolic computation
- Hull, Voronoi, Delaunay geometry tools

Prerequisite: No previous computing experience is required. The mathematics will be at an introductory level, and all details will be explained, so students from other scientific disciplines should also be able to handle the material.

Grading: A problem list will be presented each week, and you will be allowed to choose a subset of those problems to work on. At the end of the semester, you will also present some programming project based on a topic of interest to you. Your grade will be based on the programming problems and the project. There will be no quizzes, tests, or exams.

Text: Christian Hill, *Learning Scientific Programming with Python,* Cambridge University Press, Second Edition, 2020, ISBN: 978-1108745918.

You may also find a useful introduction by working through the initial part of the *Python Tutorial* at

https://docs.python.org/3/tutorial/

Access to Python: You can install Python on your laptop, available at

https://www.anaconda.com/products.individual

or work online, using your browser to access Google Colab at:

https://colab.research.google.com/

Getting Help: The Pitt IT Help Desk may be able to assist you if you have trouble installing Anaconda on your laptop. Send email to

helpdesk@pitt.edu

or check the web page at

https://www.technology.pitt.edu/247-it-help-desk

Office Hours: Office hours will be 10:00 to 10:50pm, Monday and Wednesday. My office is room 618, Thackeray Hall. My university email is `jvb45@pitt.edu`.

Disability Resource Services: If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and the Office of Disability Resources and Services, 216 William Pitt Union (412) 624-7890 as early as possible in the term.

Academic Integrity: Cheating and plagiarism will not be tolerated. Students suspected of violating the University of Pittsburgh Policy on Academic Integrity will incur a minimum sanction of a zero score for the work in question. Additional sanctions may be imposed, depending on the severity of the infraction.