Python for Scientific Computing

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Course Outline & Objectives

- What is this course about?
- Who does it target?
- Why should they learn this material
- How do they benefit from it

Get civil engineering students started with Python programming language for use in their courses and projects.

Why Programming?

- Most civil engineers use specialized computational tools
  - Spreadsheets for routine calculations and charting
  - Canned programs for advanced modeling (HEC-RAS, HEC-HMS)
  - GUI based GIS and other visualization tools (QGIS, ArcGIS)

- Some knowledge of programming can help enhance your analysis with these tools
  - Help take the output and create better visualizations
  - Perform advanced data analysis from the outputs of the models
  - Automate routine tasks
  - Help see the logic behind the calculations

There are both analysis and learning benefits from programming

Why Python?

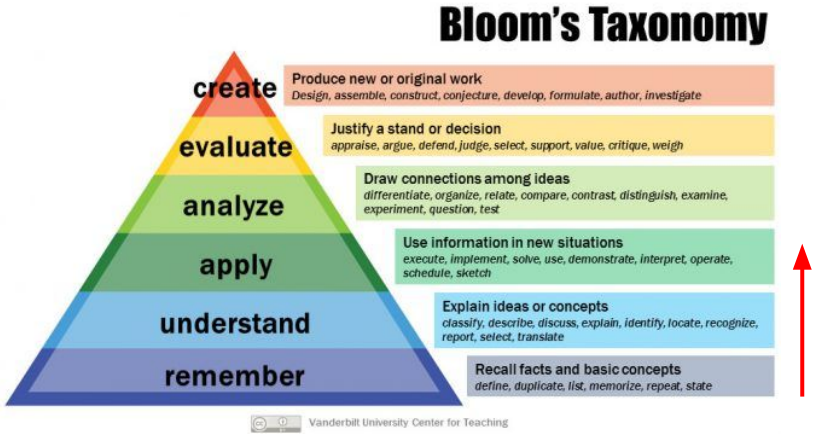
- Python is a general-purpose programming language
  - Widely used for scientific computing
    - A large ecosystem of libraries and functions
  - Is Free and Open-Source Software
  - Easier to learn than many other programming languages like C, C++

Generative AI tools like ChatGPT can help with coding

- Python is often integrated with tools that civil engineers use
  - Excel now has support for Python
  - QGIS, ArcGIS and other GIS software offer Python support for automation and analysis
  - Python by itself has several advanced tools for modeling and data analysis
    - Machine learning, Artificial Intelligence, etc.

Learning Outcomes

- At the end of this series, a student should be able to:
  - Remember basic syntax of Python
  - Understand various data types and their use in Python
  - Apply basic structural programming concepts
  - Read tabular data into Python
  - Create simple charts for data visualization
  - Use built-in libraries for engineering mathematics calculations:



You should be able to use Python to do the Math expected of a Civil Engineering Student (Junior/Senior standing)

How to Learn Python

- The best way to learn Python is by Writing Code
  - Reading or watching videos will do very little to your learning

- Remember your code may not work the first time
  - This is normal - No point beating yourself up
  - You need to embrace this learning moment

- You need to be patient and avoid taking short-cuts
  - Be smart in using Gen AI to help your learning
  - Use his tool for learning not finishing your work

Requirements

- We shall use an Python on the cloud:
  - Google Colaboratory: https://colab.research.google.com/
    - Need to have a Gmail account to sign in
    - You can use the one you already have

- Google Colab removes the need to install libraries
  - Helps you focus on your learning
    - Data can be uploaded from Google Drive
    - Programs can be stored on Google Drive
    - Coding support using Gen AI

- You can share your code with others
  - Easy to store it on Github
    - Github is a repository for codes (www.github.com)
    - You can create a free account

Jupyter couples text (HTML, LaTEX) and Coding (Python) to create an interactive Notebook of your work

Google Colab is a cloud implementation of Jupyter Notebook

Useful Links

- You can find the materials for this video series at the following Github link:
  - https://github.com/vuddameri/Python-I
  - Should also have some self-study exercises

- Please find a link to a short quiz in the description box
  - Anonymous (responses not collected)
  - Use it to test your understanding

Happy Learning!!