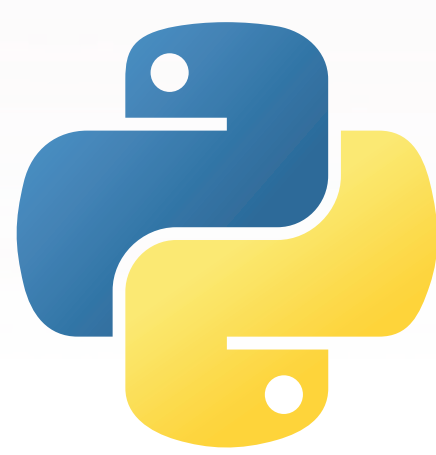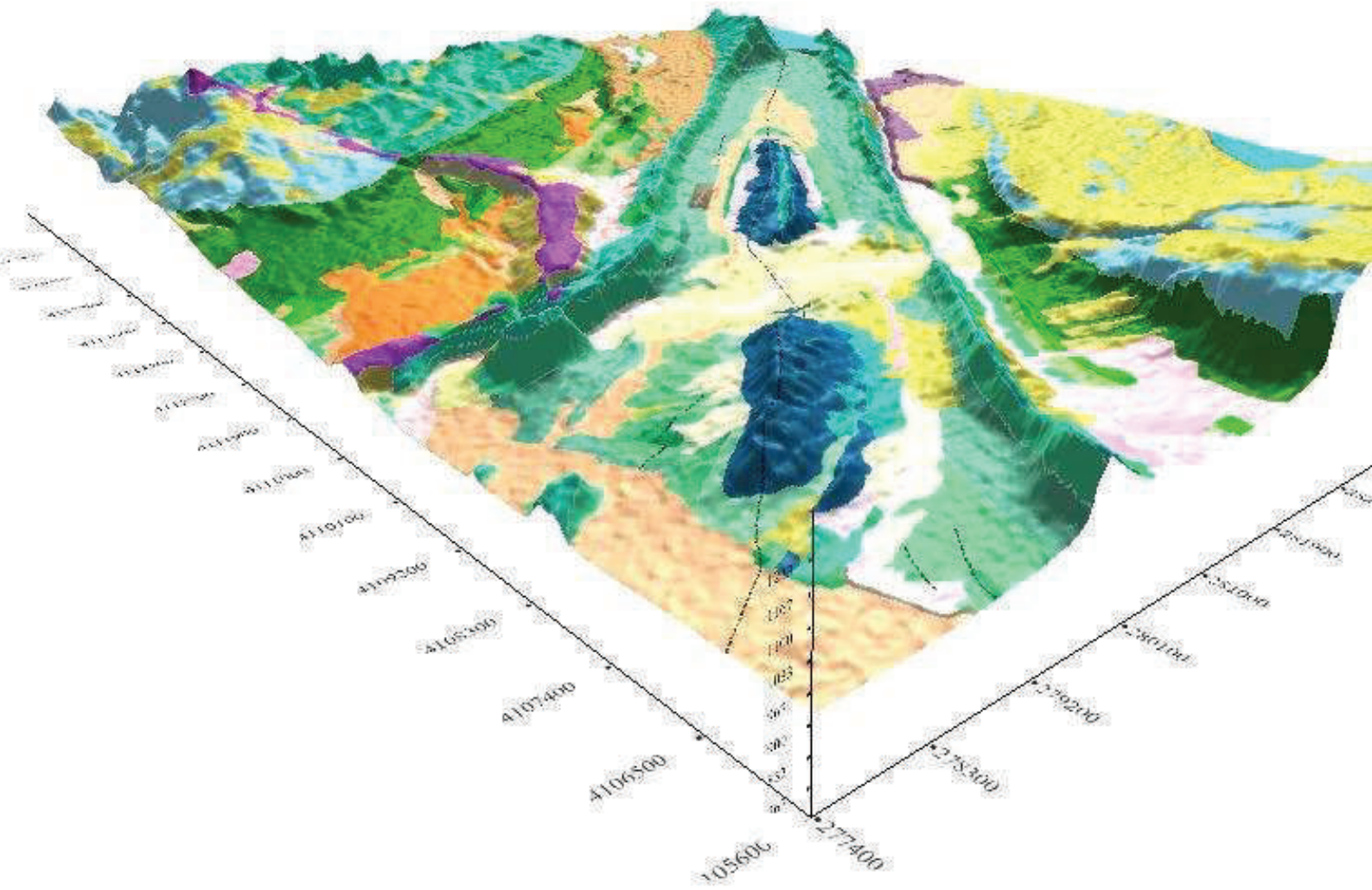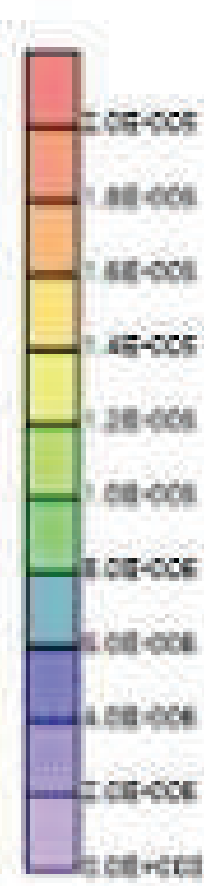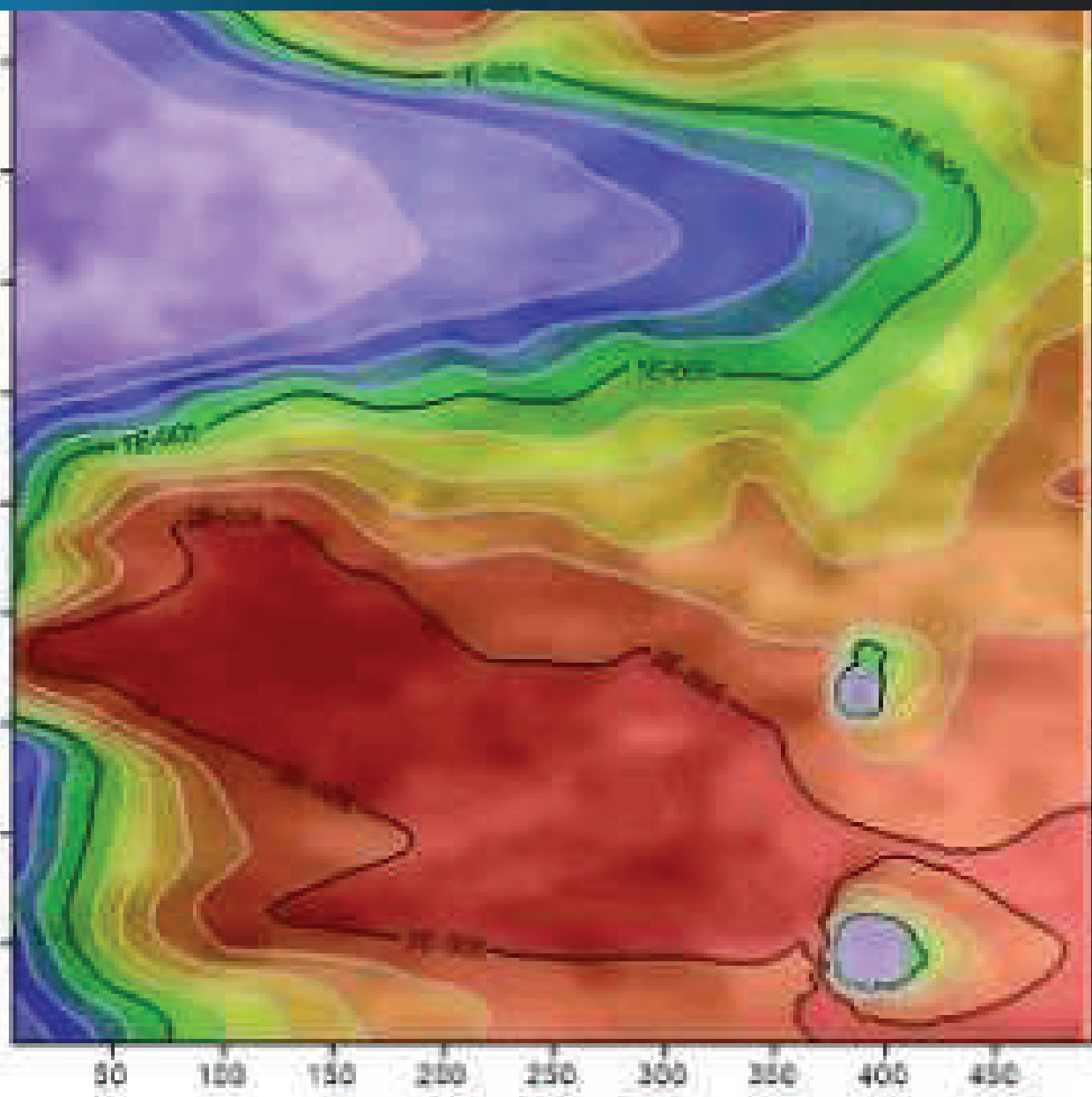**PEA**
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```python
print('Hello, World!')
```

python™

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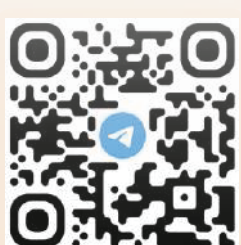WWW.PEASSOCIATIONS.COM

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GEO-PYTHON

In the field of Geology, quantitative modeling and simulation of physical phenomena is quickly becoming a necessary tool for all geoscientists to understand how our planet works. Simulating quantitative Geology models make it necessary for all geoscientists to have computer programming skills. Unfortunately, Geology professionals and students alike, at present, have to learn to program on the job which often becomes challenging and stressful.

In the industrial sector, geoscientists have to work with complex, expensive commercial software and open-source software which have a steep learning curve. Geology industry spends a lot of time and money to train their professionals in the software they use and for someone with no background in computer programming it can be a challenging enterprise. In academia, research groups often use a combination of commercial software and open-source programming languages like Fortran, C, C++, and many others to carry out their modeling and simulation work. Often these codes are kept within the company or the particular research group for a whole host of reasons. Researchers almost always come into a project with no background in programming in a specific language used by the research group or with any experience in programming at all. Although there exists computer code for geologic modeling, they are often in different programming languages and are limited to within research groups. Therefore, to use any pre-existing code it becomes necessary to learn the specific programming language after acquiring the code, which is non-trivial.
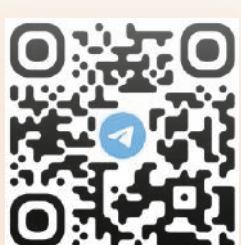
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GEO-PYTHON

In recent times, the programming language called Python has come to the forefront of scientific computing due to several reasons:

- Python has a syntax similar to human communication.
- Ability to perform complex calculations, data analysis and figure plotting from within the same code i.e., no need to write different code to plot/visualize your data.
- Numerous helpful and active forums.
- Dedicated libraries for scientific work with a very active developer group working on building and updating libraries.
- Can be made faster by calling C-type functions from within Python.
- Open-source and completely Free.

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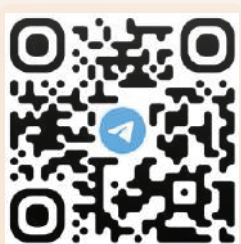# 1 MONTHS VILT HANDS ON EXPERIENCE TRAINING ON

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GEO-PYTHON

Geoscientists have recently hopped on the python programming train but the dissemination of application of python in geology is restricted to only a handful of research groups in universities and commercial organizations who protect their workflow, do not share their algorithms, techniques, and data. In summary, there is no introductory course on modeling and simulation for Geology students and beginners. PEA's mission to offer python programming courses that are specifically developed keeping in mind Geology problems for all upcoming Geology students and professionals. Therefore all courses use Geology examples and models to help learn programming easier and a more enjoyable experience.

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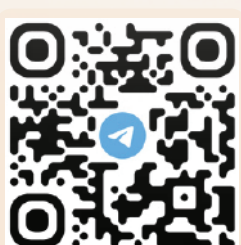# PYTHON FOR GEOLOGY & GEOSCIENCE

ABOUT THE TRAINING

This hands-on programming course assumes that the participant has no previous experience in writing a computer program. We start from the very basics and help develop the skills to successfully perform simple geologic simulations. The entire course is hands-on and uses geologic examples with real-life scenarios and real-life data.

COURSE REQUIREMENT

The participant is expected to have a Bachelor's / Master's Degree in Geology or related field.

COURSE OUTCOME

1. Define variables and data types for Python program in geological problems
2. Use logical operations and various functions for creating, editing, opening, writing etc. in python program.
3. Develop functions of Geological Models from different python program.
4. Introductory skills in data analysis and plotting using Python.

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COURSE CONTENTS

- Introduction to Variable, Data Types, Formatted Printing using Geothermal Gradient, Change in Pressure inside the Earth.
- Introduction to Lists and Dictionaries using Geothermal Gradient, Change inPressure inside the Earth. Creating, opening, and editing of lists and dictionaries.
- Logical Operations, tab use, if-else, if-elif using Geothermal Gradient, Change in Pressure inside the Earth.
- File handling with creating, opening, writing, extracting, editing blank data file;opening, editing, deletion of content in files Pressure-Temperature-Depth data files.
- For – loop, while – loop, loop with conditional execution, nested loops, infinite loops using change in acceleration due to gravity change, pressure change, and thermal change examples.
- Developing Functions of Geological Models that can be called from a different python program.
- Using Numpy, Pandas, and Matplotlib libraries to perform mathematical calculation, data analysis, and plotting of Geodynamic Models
  - Pressure Inside Planets
  - Stress Analysis
  - Flow through porous media
  - Fold-wavelength.

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Module 1:
Introduction to Python for Geoscientists

- Understanding the role of Python in quantitative geoscience modeling and simulation.

- Benefits of Python over other programming languages and software.

- Setting up your Python environment for geological applications.

Module 2:
Fundamental Python Syntax and Data Types

- Variables and data types relevant to geological data (integers, floats, strings).

- Geothermal gradient and pressure change examples to illustrate variable usage.

- Introduction to operators and expressions for manipulating geological data.

Module 3:
Working with Lists and Dictionaries

- Creating, accessing, and manipulating lists to store and analyze geological datasets.

- Applying dictionaries to represent and manage geological features and properties.

- Geothermal gradient and pressure change examples for hands-on practice.

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Module 4:
Python Control Flow and Logic

- Implementing logical operations (and, or, not) for decision-making in geological analyses.

- Mastering conditional statements (if-else, if-elif) for scenario-based evaluations.

- Geothermal gradient and pressure change examples to demonstrate conditional logic.

Module 5:
File Handling for Geological Data

- Opening, reading, and writing geological data files (e.g., pressure-temperature-depth data).

- Extracting, editing, and deleting content within geological data files.

- Practical exercises using real-life geological data files.

Module 6:
Python Loops and Iterations

- For-loop and while-loop implementation for repetitive tasks in geological modeling.

- Loop execution with conditional statements for dynamic geological simulations.
Nested loops for handling multi-dimensional geological datasets.

- Examples using gravity, pressure, and thermal change scenarios.

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Module 7:
Python Functions for Geological Modeling

- Defining and calling functions to encapsulate reusable geological model components.
- Functions with parameters and return values for flexible geological model development.
- Best practices for function organization and documentation in geological projects.

Module 8:
Introduction to NumPy for Geoscience

- Overview of the NumPy library and its significance in scientific computing.
- Creating and manipulating NumPy arrays for efficient storage and processing of geological data.
- Performing mathematical calculations relevant to geological models using NumPy functions.

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Module 9:
Data Analysis and Visualization with Pandas & Matplotlib

- Introduction to the Pandas library for data manipulation and analysis.
- Working with Pandas DataFrames to represent and analyze geological datasets.
- Plotting geodynamic models and geological data using the Matplotlib library.
- Creating various plot types (line, scatter, contour) to visualize geological phenomena.

Module 10:
Advanced Geological Modeling in Python

- Modeling pressure distribution inside planets.
- Simulating stress analysis for geological formations.
- Implementing models for fluid flow through porous media.
- Analyzing and visualizing fold-wavelength patterns in geological structures.

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