python_class_test_2015-sqt

August 24, 2016

1 2.18 Programming for Geoscientists class test - 14:30-16:30 31st August 2016

2 Test instructions

- This test contains **4** questions each of which should be answered.
- Write your program in a Python cell just under each question.
- You can write an explanation of your solution as comments in your code.
- You should work with the two data files (VostokStation.txt and last_months_earthquakes.csv) in their original form. They must **not** be modified.
- In each case your solution program must fulfil all of the instructions - please check the instructions carefully and double check that your program fulfils all of the given instructions.
- Save your work regularly.
- At the end of the test you should email your IPython notebook document (i.e. this document) to Gerard J. Gorman at g.gorman@imperial.ac.uk

2.1 Question 1

1. Generate x coordinates between -1.0 and 1.0 (inclusive) with spacing 0.01, using two different methods: (a) use a Python *for* loop to create a Python *list*; (b) create a numpy array directly (i.e. avoid the use of a Python list).
2. Use a formatted print statement to print out all the values in the list.

```
In [ ]:
```

2.2 Question 2

The longitudinal wave velocity in a material is given by the equation:

$$V_p = \sqrt{\frac{k + 4\mu/3}{\rho}},$$

where V_p is the longitudinal wave velocity, k is the bulk modulus, μ is the shear modulus and ρ is the density. The shear wave velocity is given by the equation:

$$V_s = \sqrt{\frac{\mu}{\rho}},$$

where V_s is the shear velocity.

1. Write a *function* that takes as arguments k, μ and ρ, and returns V_p and V_s.
2. Use this function to calculate the longitudinal and shear wave velocities for quartz, clay and water using parameters from the table below. Print out the results using a formatted print statement.

Material	Shear modulus (GPa)	Bulk modulus (GPa)	Density (kg/mˆ3)
Granite	27	70	2900
Marble	27	54	2700
Water	0	2.29	1000

In [ ]:

2.3 Question 3

The file VostokStation.txt contains data derived from ice core data at Vostok Station. Each line contains the age of the ice, temperature at which the ice formed, the concentration of carbon dioxide and concentration of methane.

1. Write a program to read in the data and store each column in its own numpy array.
2. Create three plots: temperature versus years; carbon dioxide level versus years; and methane level versus years. Ensure that the plots are clearly labeled.

In [ ]:

2.4 Question 4

The file last_months_earthquakes.csv contains a list of earthquakes from around the world over the past month. Each field is delimited by a comma.

1. Write a program that reads in the latitude-longitude coordinates, the depth and the magnitude (written as "mag" in the header) of each earthquake and stores the results in a numpy array.
2. Use the coordinates to plot the position of each earthquake as an individual point. Clearly label the plots.
3. Ensure that the x-axis is bounded between -180 and 180, and the y-axis is bounded between -90 and 90.
4. Compute the minimum, mean and maximum earthquake depth and magnitude.

In [ ]: