IRIS 2022 Seismology Skill Building Workshop OSL

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Started on	Thursday, August 11, 2022, 6:58 AM
State	Finished
Completed on	Thursday, August 11, 2022, 8:47 AM
Time taken	1 hour 48 mins
Marks	36.42/39.00
Grade	**93.38** out of 100.00

Question 1

Correct

1.00 points out of 1.00

Flag question

In this activity, you are going to continue learning and using Python to help with a few different tasks, including constructing a cross-section through a subduction zone. Login to OSL and move into your folder named **python** and then create a folder inside of it named **xsect** and then move into this directory. What is the correct order of commands below to create, check, and then enter this **xsect** directory?

mkdir xsect	2 ✓
cd xsect	4 ✓
ls xsect	3 ✓
cd ~/python	1 ✓

Check

Correct
Marks for this submission: 1.00/1.00.

Question 2

Correct

1.00 points out of 1.00

Flag question

To start this assignment, we will create a very simple program to demonstrate how to execute system commands from inside a Python program. Create a file named `adele.py` and open it for editing. We will need to load an extra library to be able to execute system commands, and you can learn about this here:

https://www.geeksforgeeks.org/python-os-system-method/

What command will load the library we need within Python?

Select one:

- a. import os ✓ Correct. Go ahead and add this to the beginning of your adele.py program.
- b. pip install os
- c. pip import os
- d. install os as os
- e. import os as os
- f. install os

Check

Correct
Marks for this submission: 1.00/1.00.

Question 3

Correct

1.00 points out of 1.00

Flag question

To put a different spin on the "Hello, world" activity we did in our first Python tutorial, in this Python program we will ask the Linux system to print "Hello from the other side". I know this seems like overkill because you can just print text using Python with no help from the Linux system, but bear with my request as we practice. Plus hopefully it's funny to people who like Adele's song Hello. Ok, back to business, how would you actually get the program to make the Linux system do this?

Select one:

- a. echo 'Hello from the other side'
- b. print('Hello from the other side')
- c. os.system('echo "Hello from the other side"') ✓ Correct. Add this line to your adele.py program.
- d. print("Hello from the other side")
- e. os('echo "Hello from the other side"')
- f. os.system(echo "Hello from the other side")
- g. echo "Hello from the other side"

Check

Correct
Marks for this submission: 1.00/1.00.

Question 4

Correct

1.00 points out of 1.00

Flag question

As you may have seen in the website I provided to learn about the os.system() function, you can use a variable to store the Linux command text. The Linux command I would like you to run in this script is the one we use to look around, `ls`. However, I don't think we have talked about using two of the key options:

-l (lowercase letter L) that prints more detail about the files and directories

-t that prints the files and directories in time order (modification time) from newest to oldest.

Which two lines of code would store this command as a variable and then execute the command from within Python using the variable?

Select one:

- a. cmd = 'ls -lt'
  os.system(cmd) ✓ Correct. Add both of these lines to your adele.py program.
- b. os.system(cmd)
  cmd = 'ls -lt'
- c. cmd = 'ls -lt'
  os.system('cmd')
- d. cmd = ls -lt
  os.system('ls -lt')
- e. os.system('cmd')
  cmd = 'ls -lt'
- f. cmd = 'ls -lt'
  os.system('ls -lt')

Check

Correct
Marks for this submission: 1.00/1.00.

Question 5

Correct

1.00 points out of 1.00

Flag question

Let's run the program with Python now to make sure it works. How would you run your program?

Answer: python adele.py ✓

Check

Correct. Go ahead and run `python adele.py &` to help preserve your command line interface.

Correct
Marks for this submission: 1.00/1.00.

Question 6

Correct

1.00 points out of 1.00

Flag question

What does the output look like? Make sure you have the commands in the same order as was listed in the questions!

Select one:

- a. It only lists the contents of the directory.
- b. It only prints `Hello from the other side`.
- c. It prints `Hello from the other side` and then lists the contents of the directory. ✓ Correct. I hope you enjoyed this as much as I did.
- d. It lists the contents of the directory and then prints `Hello from the other side`.

Check

Correct
Marks for this submission: 1.00/1.00.

Question 7

Correct

0.67 points out of 1.00

Flag question

Today we will return to looking at earthquakes from the subduction zone beneath southern Mexico that we examined using the IRIS Earthquake Browser. Here is a link to review a portion of those earthquakes.

We will build a program to create a publication quality cross-section that shows depth versus horizontal distance. An earthquake catalog readily has depth in it, so we just need to decide how to approximate the horizontal distance. In subduction zones, the most common style of cross-section is one that goes perpendicular to the trench plate boundary. Which direction is closest to going perpendicular to the trench and follows the downward direction of the subducting plate? Hint 1: Find the trench with the plate boundaries turned on. Hint 2: Use the depth of the earthquakes to help determine which direction the earthquakes go downward into the earth.

Select one:

- a. North ✓
- b. South
- c. East
- d. West

Check

Correct
Marks for this submission: 1.00/1.00. Accounting for previous tries, this gives **0.67/1.00**.

Question 8

Correct

0.33 points out of 1.00

Flag question

So in southern Mexico, which value in the earthquake catalog would be a good proxy for plotting the increasing horizontal distance from the trench (convergent plate boundary) in a cross section?

Select one:

- a. increasing depth
- b. increasing latitude ✓
- c. decreasing depth
- d. decreasing longitude
- e. increasing longitude
- f. decreasing latitude

Check

Correct
Marks for this submission: 1.00/1.00. Accounting for previous tries, this gives **0.33/1.00**.

Question 9

Correct

1.00 points out of 1.00

Flag question

Now you can return to the Linux command line to start building a program to plot a cross-section through this area of Mexico. Start by opening a file called `xsect.py` for editing. We need to read earthquake hypocenter data into our Python program to make the cross-section plot, and we will use the **pandas** library to accomplish this. There are many online resources to learn about **pandas**, but I am going to recommend that you start with this one:

https://www.learndatasci.com/tutorials/python-pandas-tutorial-complete-introduction-for-beginners/

It is a bit longer than you will need for this assignment, but I think you can learn some important things from the beginning of the article. This article does a nice job of describing DataFrames, which are a key aspect of what we will use **pandas** for in this assignment. What is a **pandas** DataFrame?

Select one:

- a. a column of data
- b. a library of data functions
- c. a row of data
- d. a data table ✓

Check

Correct
Marks for this submission: 1.00/1.00.

Question 10
Correct
1.00 points out of 1.00
Flag question

What is the most common way to load the **pandas** library in to your Python program?

Select one:
- a. import pandas as pd ✓ Correct. Add this to your xsect.py file.
- b. install pandas as pd
- c. pip install pandas
- d. import pandas
- e. module load pandas
- f. module load pandas as pd

Check

Correct
Marks for this submission: 1.00/1.00.

Question 11
Correct
1.00 points out of 1.00
Flag question

We are going to make a plot of the data, so we will need the plotting functionality from matplotlib. How do you load this library? Review the last tutorial if needed to recall this.

Answer: import matplotlib.pyplot as plt ✓

Check

Correct. Add this to your xsect.py file.
Correct
Marks for this submission: 1.00/1.00.

Question 12
Correct
1.00 points out of 1.00
Flag question

Next we need to load the library needed to execute system commands. What is that command again?

Answer: import os ✓

Check

Correct. Add this to your xsect.py file.
Correct
Marks for this submission: 1.00/1.00.

Question 13
Correct
0.67 points out of 1.00
Flag question

Next you should use the IRIS FetchEvent tool to download the hypocenters for a thin slice of earthquakes in the Oaxaca area of Mexico. I would recommend a longitude range restricted to between -94.5 and -94, while the latitude range would be from 14 to 19. Magnitudes greater than 4 should help to keep the location quality relatively high (smaller earthquakes are harder to locate because the signals are weaker). You should download these hypocenters to a file called oaxaca.eve for this. If you have trouble remembering the format of the FetchEvent command option, you can just type FetchEvent at the command line. Which of the following FetchEvent options would be needed to request this data?

Select one or more:
- a. --lon -94:-94.5
- b. | oaxaca.eve
- c. -o oaxaca.eve ✓ 1 of 4 correct answers.
- d. --lat 14-19
- e. --lon -94.5:-94 ✓ 1 of 4 correct answers.
- f. --lat 14:19 ✓ 1 of 4 correct answers.
- g. --mag >4
- h. --mag 4:10 ✓ 1 of 4 correct answers.

Check

Correct
Marks for this submission: 1.00/1.00. Accounting for previous tries, this gives **0.67/1.00**.

Question 14
Correct
1.00 points out of 1.00
Flag question

Now we need to add a line to your xsect.py file to make sure it runs your FetchEvent command to retrieve the data. Which of the following lines would accomplish this?

Select one:
- a. 'FetchEvent --lon -94.5:-94 --lat 14:19 --mag 4:10 -o oaxaca.eve'
- b. os.system(FetchEvent --lon -94.5:-94 --lat 14:19 --mag 4:10 -o oaxaca.eve)
- c. system(FetchEvent --lon -94.5:-94 --lat 14:19 --mag 4:10 -o oaxaca.eve)
- d. FetchEvent --lon -94.5:-94 --lat 14:19 --mag 4:10 -o oaxaca.eve
- e. os.system('FetchEvent --lon -94.5:-94 --lat 14:19 --mag 4:10 -o oaxaca.eve') ✓ Correct. Add this to your xsect.py file.
- f. cmd='FetchEvent --lon -94.5:-94 --lat 14:19 --mag 4:10 -o oaxaca.eve'
- g. cmd="FetchEvent --lon -94.5:-94 --lat 14:19 --mag 4:10 -o oaxaca.eve"
- h. system('FetchEvent --lon -94.5:-94 --lat 14:19 --mag 4:10 -o oaxaca.eve')

Check

Correct
Marks for this submission: 1.00/1.00.

Question 15
Correct
1.00 points out of 1.00
Flag question

Let's run the program with Python now to make sure it works. How would you run your program?

Answer: python xsect.py ✓

Check

Correct. Go ahead and run `python xsect.py &` to help preserve your command line interface.
Correct
Marks for this submission: 1.00/1.00.

Question 16
Correct
1.00 points out of 1.00
Flag question

It has been some time since we used FetchEvent, so you may want to review the contents of the retrieved file to remember the format of this file. What command could run from the Linux command line to just show the first 10 lines of the fetched file?

Note: If you had trouble with the FetchEvent command where it would not complete the download successfully, you can obtain the output file using the following command:
`wget "https://www.users.miamioh.edu/brudzimr/classes/oaxaca.eve"`

Select one:
- a. more oaxaca.eve
- b. FetchEvent | more
- c. more FetchEvent
- d. head FetchEvent
- e. oaxaca.eve | more
- f. head oaxaca.eve ✓ Correct. Go ahead and run this now on the Linux command line.

Check

Correct
Marks for this submission: 1.00/1.00.

Question 17
Correct
1.00 points out of 1.00
Flag question

What is the column delimiter for the oaxaca.eve file?

Answer: ✓

Check

Correct
Marks for this submission: 1.00/1.00.

Question 18
Correct
1.00 points out of 1.00
Flag question

How many "header" lines are there that describes what is in the columns of data?

Answer: 0 ✓

Check

Yes, unfortunately FetchEvent does not provide any header information to describe what is in each column.
Correct
Marks for this submission: 1.00/1.00.

Question 19
Correct
1.00 points out of 1.00
Flag question

Although the oaxaca.eve file is not a comma separated values (csv) file, you can still use the `read_csv` function within pandas for reading from a text delimited file. There was some description of this command in the earlier website I provided, but you can read more about the function here too:

https://www.geeksforgeeks.org/python-read-csv-using-pandas-read_csv/

What parameter is absolutely required by the **read_csv** function?

Select one:
- a. header
- b. filename or URL ✓
- c. field separator
- d. skip rows
- e. use columns
- f. index column

Check

Correct
Marks for this submission: 1.00/1.00.

Question 20
Correct
1.00 points out of 1.00
Flag question

Which of the following would successfully specify the field separator for the oaxaca.eve file?

Select one:
- a. -F="|"
- b. sep="|" ✓
- c. -F=,
- d. sep=|
- e. -F="oaxaca.eve"
- f. sep=","

- g. -F=oaxaca.eve
- h. sep=,

Check

Correct
Marks for this submission: 1.00/1.00.

Question 21
Correct
1.00 points out of 1.00
Flag question

Which of the following would successfully specify the number of header lines?

Select one:
- a. head=1
- b. header=0
- c. head=0
- d. header=1
- e. head=None
- f. header=None ✓

Check

Correct
Marks for this submission: 1.00/1.00.

Question 22
Correct
1.00 points out of 1.00
Flag question

Now let's put it all together in a single read_csv command that imports the data into a DataFrame called df. Which of the following would accomplish this?

Select one:
- a. df = pd.read_csv("oaxaca.eve",sep="|",header=None) ✓ Correct. Add this to your xsect.py file.
- b. df.read_csv([oaxaca.eve,sep="|",header=None])
- c. df.read_csv("oaxaca.eve",sep="|",header=None)
- d. df = pd.read_csv(oaxaca.eve,sep="|",header=None)
- e. df.read_csv(oaxaca.eve,sep="|",header=None)
- f. df = pd.read_csv(["oaxaca.eve",sep="|",header=None])

Check

Correct
Marks for this submission: 1.00/1.00.

Question 23
Correct
0.75 points out of 1.00
Flag question

To make sure this command loads the data correctly, we should check the first few lines of the DataFrame. Taking a moment to review the panda resources I provided earlier, which of the following commands would output the first few lines of the DataFrame when we run our program?

Select one:
- a. print(head())
- b. df.head()
- c. head()
- d. print(df.head()) ✓ Correct. Add this to your xsect.py file.
- e. print(head)
- f. df.head
- g. print(df.head)

Check

Correct
Marks for this submission: 1.00/1.00. Accounting for previous tries, this gives **0.75/1.00**.

Question 24
Correct
0.67 points out of 1.00
Flag question

Now save your xsect.py file and run it again. The head() function in Python will print the index number of each column of data along the top of the DataFrame. What is the largest index number for this data set?

Answer: 9 ✓

Check

Correct
Marks for this submission: 1.00/1.00. Accounting for previous tries, this gives **0.67/1.00**.

Question 25
Correct
1.00 points out of 1.00
Flag question

Unfortunately, most windows sizes are small enough that the head() function cannot print all of the column information within the window width. As a result, it prints "..." for the middle columns. This will make it difficult to figure out the index number of the key columns that have latitude and depth in them. However, there is a function we can use to tell the pandas library functions that we want to see all of the columns (no maximum number):

```
pd.set_option('display.max_columns', None)
```

Go ahead and add this line to your xsect.py file right before the `print(df.head())` command. Then run your program again to see what the output looks like with this option adjusted. Briefly describe how it displays all of the columns?

Answer: All columns are displayed ✓

Check

Correct
Marks for this submission: 1.00/1.00.

Question 26
Correct
1.00 points out of 1.00
Flag question

Which index number is the latitude information stored under? Hint: You might want to look back at your IEB map from earlier in this assignment to see what the range of latitude values should be.

Answer: 2 ✓

Check

Correct
Marks for this submission: 1.00/1.00.

Question 27
Correct
1.00 points out of 1.00
Flag question

Which index number is the depth information stored under? Hint: You might want to look back at your IEB map from earlier in this assignment to see what the range of depth values should be.

Answer: 4 ✓

Check

Correct
Marks for this submission: 1.00/1.00.

Question 28
Correct
1.00 points out of 1.00
Flag question

Now that we know where the latitude and depth information are stored in the DataFrame, we are finally ready to plot them! Which matplotlib function will allow us to plot this data? You may want to review the previous assignment to recall this.

Select one:
- a. matplotlib.plt.psxy()
- b. plt.plot() ✓
- c. matplotlib.plot()
- d. psxy()
- e. plt.psxy()
- f. matplotlib.psxy()
- g. matplotlib.plt.plot()
- h. plot()

Check

Correct
Marks for this submission: 1.00/1.00.

Question 29
Correct
1.00 points out of 1.00
Flag question

In our last assignment, we plotted a line, so no symbol was necessary. Since we will be plotting earthquake locations today, we need to plot our data as a scatter plot with a specific symbol type. There are a lot of options for specifying symbol types, so I would recommend review the matplotlib.pyplot.plot manual page online:

https://matplotlib.org/api/_as_gen/matplotlib.pyplot.plot.html

Scrolling down to the Format Markers, which of the following would allow us to specify symbols as circles?

Select one:
- a. '.'
- b. '.'
- c. 'o' ✓
- d. 'c'
- e. 'cross'

Check

Correct
Marks for this submission: 1.00/1.00.

Question 30
Correct
1.00 points out of 1.00
Flag question

Now let's try to put the information together as a single command we can add to our program. Which of the following would plot the latitude on the x-axis, depth on the y-axis, and use a circle for the symbol type?

Select one:
- a. plt.plot(df[4],df[2],'o')
- b. plt.plot(df[2],df[4],'o') ✓ Correct. Add this to your xsect.py file.
- c. plot(df[2],df[4],'o')
- d. plot(df[4],df[2],'o')
- e. plot(df[2],df[4],'c')
- f. plt.plot(df[2],df[4],'c')
- g. plot(df[4],df[2],'c')
- h. plt.plot(df[4],df[2],'c')

Check

Correct
Marks for this submission: 1.00/1.00.

Question 31
Correct
1.00 points out of 1.00
Flag question

To help us read the plot, we should add some axis labels. Taking a moment to review the last assignment, the matplotlib resources I provided on it, or the sine.py program you made last time, which of the following would be needed to add some axis labels?

Select one or more:
- a. ylabel('Depth')

b. xaxis('Latitude')

c. plt.yaxis('Depth')

d. plt.xlabel('Latitude') ✓ 1 of 2 correct answers. Add this to your xsect.py file.

e. xlabel('Latitude')

f. plt.xaxis('Latitude')

g. yaxis('Depth')

h. plt.ylabel('Depth') ✓ 1 of 2 correct answers. Add this to your xsect.py file.

Check

Correct
Marks for this submission: 1.00/1.00.

Question 32
Correct
1.00 points out of 1.00
Flag question

The last line to add would be the command to bring up a graphics window that shows the plot. Using that same information from the last assignment, which of the following would be the correct command to accomplish this?

Answer: plt.show() ✓

Check

Correct. Add this line to your xsect.py file.

Correct
Marks for this submission: 1.00/1.00.

Question 33
Correct
1.00 points out of 1.00
Flag question

Now you are ready, so go ahead and run the xsect.py file with python. When viewing the output, consider that cross-sections are supposed to visualize a slice through the Earth. What is the key problem with the plot you made?

Select one:

a. north goes to the right instead of to the left

b. there are no symbols

c. north goes to the left instead of to the right

d. depth goes down instead of up

e. depth goes up instead of down ✓

Check

Correct
Marks for this submission: 1.00/1.00.

Question 34
Correct
1.00 points out of 1.00
Flag question

We can fix the problem in the previous question by specifying the limits (range) of the x and y axes. The pyplot collection you loaded in as the plt structure has a variety of functions to adjust the plot. You can see a summary of these function choices here:
https://matplotlib.org/api/pyplot_summary.html
When reviewing those choices, which of the following would you need to specifying the limits (range) of the x and y axes?

Select one or more:

a. plot()

b. yscale()

c. ylim() ✓ 1 of 2 correct answers.

d. xlim() ✓ 1 of 2 correct answers.

e. xrange()

f. yrange()

g. xscale()

Check

Correct
Marks for this submission: 1.00/1.00.

Question 35
Correct
1.00 points out of 1.00
Flag question

If you click on the functions on that webpage, it will give you additional information about how to specify the arguments to set the limits on the axes. It will help if we choose our x and y ranges to represent the same amount of distance to ensure there is no vertical exaggeration in your cross-section. I would recommend that you set your x-axis to run from 14.5 to 18 to go from the trench to the edge of deep seismicity. Go ahead and add this to your xsect.py file right before you "show" the plot:

```
plt.xlim(14.5,18)
```

Note that the range of distance is 3.5 degrees for the x-axis, so what is the equivalent distance we should use for the range of depth on the y-axis to prevent vertical exaggeration? (I'm asking you to convert from degrees to kilometers).

Answer: 388.5 ✓

Check

Correct
Marks for this submission: 1.00/1.00.

Question 36
Correct
1.00 points out of 1.00
Flag question

Using information from the previous question, what should the command be to change the y-axis limit? Remember that we want to switch the order of the y-axis so depth goes down on our plot.

Select one:

a. ylim(0,3.5)

b. ylim(0,390)

c. plt.ylim(0,390)

d. plt.ylim(390,0) ✓ # Correct. Add this line to your xsect.py file right after the plt.xlim(14.5,18)

e. plt.ylim(0,3.5)

f. ylim(390,0)

g. plt.ylim(3.5,0)

h. ylim(3.5,0)

Check

Correct
Marks for this submission: 1.00/1.00.

Question 37
Correct
0.67 points out of 1.00
Flag question

Go ahead and run the adjusted xsect.py file with python3. Hopefully, increasing depth will go down on your plot now and the x-axis will be a bit more zoomed in on where the primary seismicity is occurring. For some folks, plotting the x-axis on top of the plot would make it look more like the surface along the top of the plot. If you would like to do this, you can add the following two lines to your xsect.py file and re-run the program:

```
plt.gca().xaxis.tick_top()
plt.gca().xaxis.set_label_position("top")
```

In any case, the plot should show a linear cluster of earthquakes (dots) that illustrate the trajectory of the subducting plate. The subducting plate dives beneath the overriding plate at the trench (upper left) and the seismicity in the subducting plate occurs down to what depth further inland beneath Mexico? Hint 1: Ignore the isolated individual circles and focus on where the circles are clustered together. Hint 2: When your mouse pointer occurs inside the axes of your plot, it should display the x and y coordinates in the lower right of your plot window.

Answer: 194 ✓

Check

Correct
Marks for this submission: 1.00/1.00. Accounting for previous tries, this gives **0.67/1.00**.

Question 38
Correct
1.00 points out of 1.00
Flag question

It might help to see the precise depths of these earthquakes by using a different symbol since the circles are a bit large. Reviewing the earlier question that gave you a link to see the various symbol plotting options on the matplotlib.pyplot.plot reference page, what option would allow you to specify the symbol as a cross? Plotting symbols as crosses is common in seismology as it reminds us there is some horizontal and vertical uncertainty in the hypocenter location estimates.

Select one:

a. 'cross'

b. 'c'

c. 'o'

d. '.'

e. '+' ✓ Correct. Go ahead and adjust your program line to look like this: `plt.plot(df[2],df[4],'+')`

Check

Correct
Marks for this submission: 1.00/1.00.

Question 39
Correct
0.67 points out of 1.00
Flag question

After you run the program again, the seismicity patterns should look similar but perhaps not as densely clustered. The last feature I would like you to consider is the seismicity that occurs outside the relatively dense linear cluster that is the subducting plate. How would you describe the amount of seismicity above the subducting plate versus the seismicity below the subducting plate?

Select one:

a. It is impossible to evaluate the amount of seismicity above and below the subducting plate

b. More seismicity above than below the subducting plate ✓ Correct. We think this is because the overriding plate is colder, more brittle, and under more stress than the material beneath the subducting plate.

c. More seismicity below than above the subducting plate

d. There are equal amounts of seismicity above and below the subducting plate

Check

Correct
Marks for this submission: 1.00/1.00. Accounting for previous tries, this gives **0.67/1.00**.

Finish review