MODULES IN PYTHON

Modules Python Introduction

In the world of programming, we care a lot about making code reusable. In most cases, we write code so that it can be reusable for ourselves. But sometimes we share code that's helpful across a broad range of situations.

In this lesson, we'll explore how to use tools other people have built in Python that are not included automatically for you when you install Python. Python allows us to package code into files or sets of files called *modules*.

A module is a collection of Python declarations intended broadly to be used as a tool. Modules are also often referred to as "libraries" or "packages" — a package is really a directory that holds a collection of modules.

Usually, to use a module in a file, the basic syntax you need at the top of that file is:

```
from module_name import object_name
```

Often, a library will include a lot of code that you don't need that may slow down your program or conflict with existing code. Because of this, it makes sense to only import what you need.

One common library that comes as part of the Python Standard Library is `datetime`. `datetime` helps you work with dates and times in Python.

Let's get started by importing and using the `datetime` module. In this case, you'll notice that `datetime` is both the name of the library *and* the name of the object that you are importing.

Instructions

1.

In *script.py* import the `datetime` type from the `datetime` library.

2.

Create a variable `current_time` and set it equal to `datetime.now()`.

3.

Print out `current_time`.

script.py

```
# Import datetime from datetime below:
from datetime import datetime
```

```
current_time = datetime.now()
print(current_time)
```

```
2023-01-29 14:59:08.924414
```

Modules Python Random

`datetime` is just the beginning. There are hundreds of Python modules that you can use. Another one of the most commonly used is `random` which allows you to generate numbers or select items at random.

With `random`, we'll be using more than one piece of the module's functionality, so the import syntax will look like:

```
import random
```

We'll work with two common `random` functions:

- `random.choice()` which takes a list as an argument and returns a number from the list
- `random.randint()` which takes two numbers as arguments and generates a random number between the two numbers you passed in

Let's take randomness to a whole new level by picking a random number from a list of randomly generated numbers between 1 and 100.

Instructions

1.

In **script.py** import the `random` library.

Hint

To do this:

```
import random
```

2.

Create a variable `random_list` and set it equal to an empty list

3.

Turn the empty list into a list comprehension that uses `random.randint()` to generate a random integer between 1 and 100 (inclusive) for each number in `range(101)`.

Hint
Remember: Python list comprehensions look like this:

```
[what_will_replace_i for i in some_list_or_range]
```

And note that `random.randint` is inclusive while `range()` is not.

4.

Create a new variable `randomer_number` and set it equal to `random.choice()` with `random_list` as an argument.

5.

Print `randomer_number` out to see what number was picked!

script.py

```
# Import random below:
import random

# Create random_list below:
random_list = [random.randint(1, 100) for i in range(101)]

# Create randomer_number below:
randomer_number = random.choice(random_list)

# Print randomer_number below:
print(randomer_number)
```

```
48
```

Modules Python Namespaces

Notice that when we want to invoke the `randint()` function we call `random.randint()`. This is default behavior where Python offers a *namespace* for the module. A namespace isolates the functions, classes, and variables defined in the module from the code in the file doing the importing. Your *local namespace*, meanwhile, is where your code is run.

Python defaults to naming the namespace after the module being imported, but sometimes this name could be ambiguous or lengthy. Sometimes, the

module's name could also conflict with an object you have defined within your local namespace.

Fortunately, this name can be altered by *aliasing* using the `as` keyword:

```
import module_name as name_you_pick_for_the_module
```

Aliasing is most often done if the name of the library is long and typing the full name every time you want to use one of its functions is laborious.

You might also occasionally encounter `import *`. The `*` is known as a "wildcard" and matches anything and everything. This syntax is considered dangerous because it could *pollute* our local namespace. Pollution occurs when the same name could apply to two possible things. For example, if you happen to have a function `floor()` focused on floor tiles, using `from math import *` would also import a function `floor()` that rounds down floats.

Let's combine your knowledge of the `random` library with another fun library called `matplotlib`, which allows you to plot your Python code in 2D.

You'll use a new `random` function `random.sample()` that takes a range and a number as its arguments. It will return the specified number of random numbers from that range.

```
#random.sample takes a list and randomly selects k items from it
new_list = random.sample(list, k)
#for example:
nums = [1, 2, 3, 4, 5]
sample_nums = random.sample(nums, 3)
print(sample_nums) # 2, 5, 1
```

Instructions

1.

Below `import codecademylib3_seaborn`, import `pyplot` from the module `matplotlib` with the alias `plt`.

Hint

The import statement will use this format:

```
from module_name import object_name as name_you_pick
```

2.

Import `random` below the other import statements. It's best to keep all imports at the top of your file.

3.

Create a variable `numbers_a` and set it equal to the range of numbers 1 through 12 (inclusive).

4.

Create a variable `numbers_b` and set it equal to a random sample of twelve numbers within `range(1000)`.

Feel free to print `numbers_b` to see your random sample of numbers.

5.

Now let's plot these number sets against each other using `plt`.
Call `plt.plot()` with your two variables as its arguments.

6.

Now call `plt.show()` and run your code!

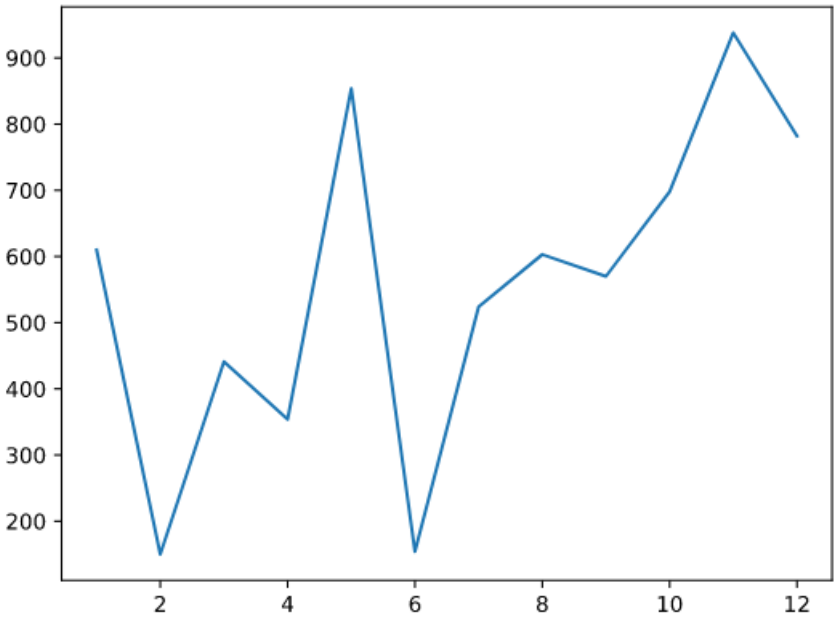
You should see a graph of random numbers displayed. You've used two Python modules to accomplish this (`random` and `matplotlib`).

script.py

```
import codecademylib3_seaborn
from matplotlib import pyplot as plt
import random

# Add your code below:
numbers_a = range(1, 13)
numbers_b = random.sample(range(1000), 12)

plt.plot(numbers_a, numbers_b)
plt.show()
```



Modules Python Decimals

Let's say you are writing software that handles monetary transactions. If you used Python's built-in floating-point arithmetic to calculate a sum, it would result in a weirdly formatted number.

```
cost_of_gum = 0.10
cost_of_gumdrop = 0.35

cost_of_transaction = cost_of_gum + cost_of_gumdrop
# Returns 0.44999999999999996
```

Being familiar with rounding errors in floating-point arithmetic you want to use a data type that performs decimal arithmetic more accurately. You could do the following:

```
from decimal import Decimal

cost_of_gum = Decimal('0.10')
cost_of_gumdrop = Decimal('0.35')

cost_of_transaction = cost_of_gum + cost_of_gumdrop
# Returns 0.45 instead of 0.44999999999999996
```

Above, we use the `decimal` module's `Decimal` data type to add 0.10 with 0.35. Since we used the `Decimal` type the arithmetic acts much more as expected.

Usually, modules will provide functions or data types that we can then use to solve a general problem, allowing us more time to focus on the software that we are building to solve a more specific problem.

Ready, set, fix some floating point math by using decimals!

Instructions

1.
Run your code to see the weird floating point math that occurs.

2.
In **script.py** import `Decimal` from the `decimal` module.

3.
Use `Decimal` to make `two_decimal_points` only have two decimals points and `four_decimal_points` to only have four decimal points.

Hint
The number of decimal points will adjust to the correct number when you use `Decimal` as shown in the example.

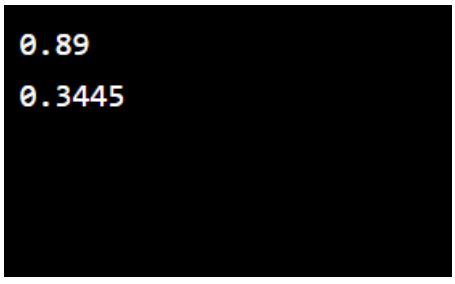
Make sure to use quotes around the floats. Each number will need to be converted with Decimal BEFORE performing the operations.

script.py

```
# Import Decimal below:
from decimal import Decimal

# Fix the floating point math below:
two_decimal_points = Decimal('0.2') + Decimal('0.69')
print(two_decimal_points)

four_decimal_points = Decimal('0.53') * Decimal('0.65')
print(four_decimal_points)
```



Modules Python Files and Scope
You may remember the concept of *scope* from when you were learning about functions in Python. If a variable is defined *inside* of a function, it will not be accessible *outside* of the function.

Scope also applies to *classes* and to the *files* you are working within.

Files have scope? You may be wondering.

Yes. Even files inside the *same directory* do not have access to each other's variables, functions, classes, or any other code. So if I have a file **sandwiches.py** and another file **hungry_people.py**, how do I give my hungry people access to all the sandwiches I defined?

Well, *files are actually modules*, so you can give a file access to another file's content using that glorious `import` statement.

With a single line of `from sandwiches import sandwiches` at the top of **hungry_people.py**, the hungry people will have all the sandwiches they could ever want.

Instructions

1.
Tab over to **library.py** and define a function `always_three()` with no parameters that returns 3.

Hint
Make sure that you define the `always_three()` function in **library.py** not in **script.py**

2.
Call your `always_three()` function in script.py. Check out that error message you get in the output terminal and the consequences of file scope.

3.
Resolve the error with an import statement at the top of **script.py** that imports your function from `library`. Run your code and watch `import` do its magic!

Hint

```
from library import always_three
```

script.py

```
# Import library below:
from library import always_three


# Call your function below:
print(always_three())
```

library.py

```
# Add your always_three() function below:
def always_three():
  return 3
```

Modules Python Review
You've learned:

- what modules are and how they can be useful
- how to use a few of the most commonly used Python libraries
- what namespaces are and how to avoid polluting your local namespace
- how scope works for files in Python

Programmers can do great things if they are not forced to constantly reinvent tools that have already been built. With the power of modules, we can import any code that someone else has shared publicly.

In this lesson, we covered some of the Python Standard Library, but you can explore all the modules that come packaged with every installation of Python at the Python Standard Library documentation.

This is just the beginning. Using a package manager (like conda or pip3), you can install any modules available on the Python Package Index.

The sky's the limit!