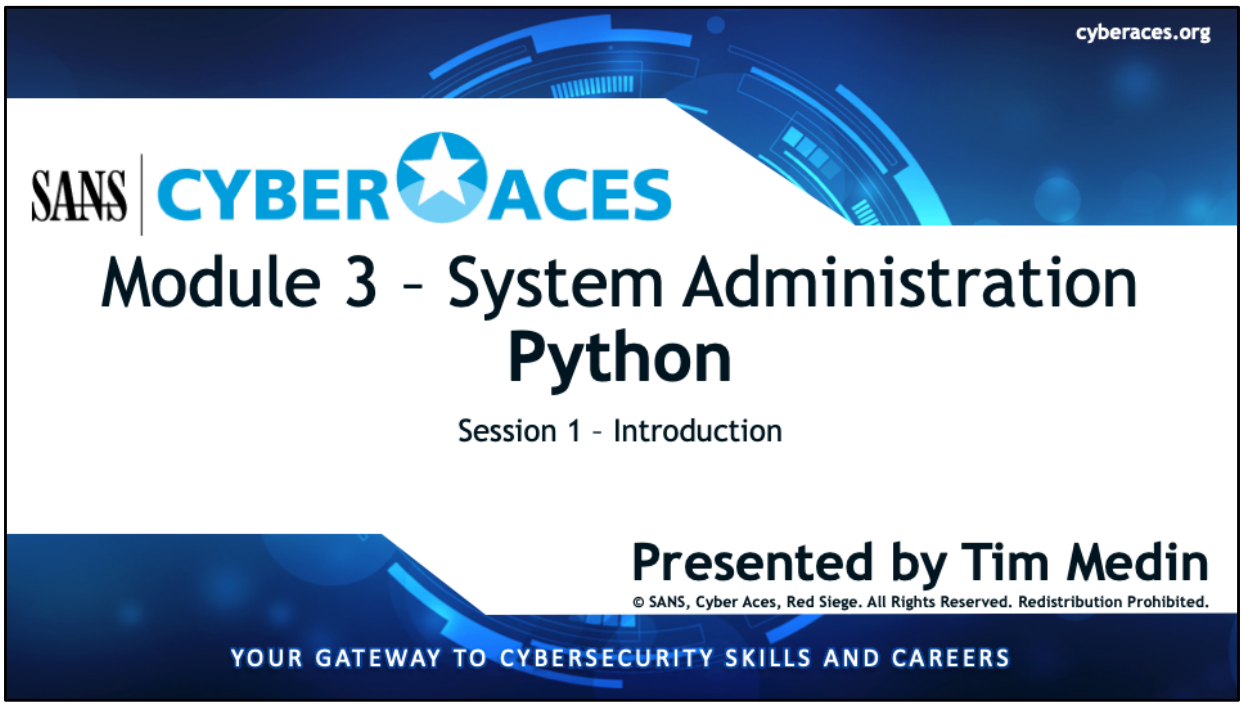
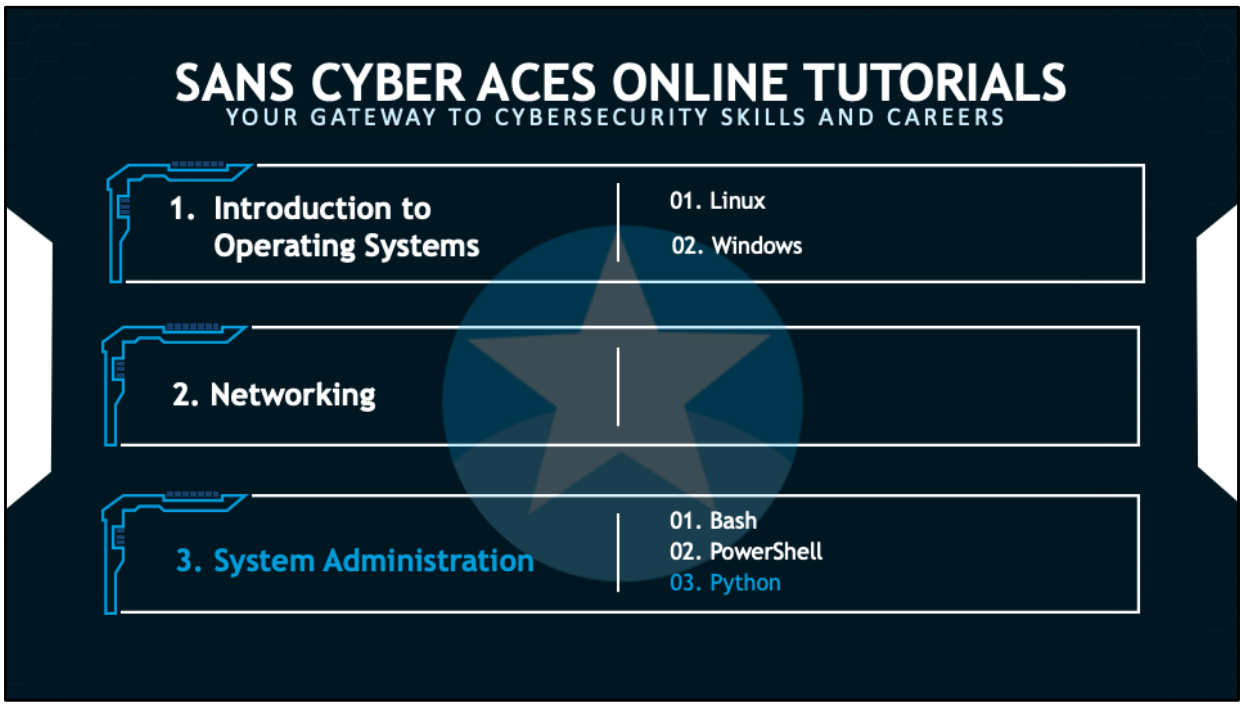


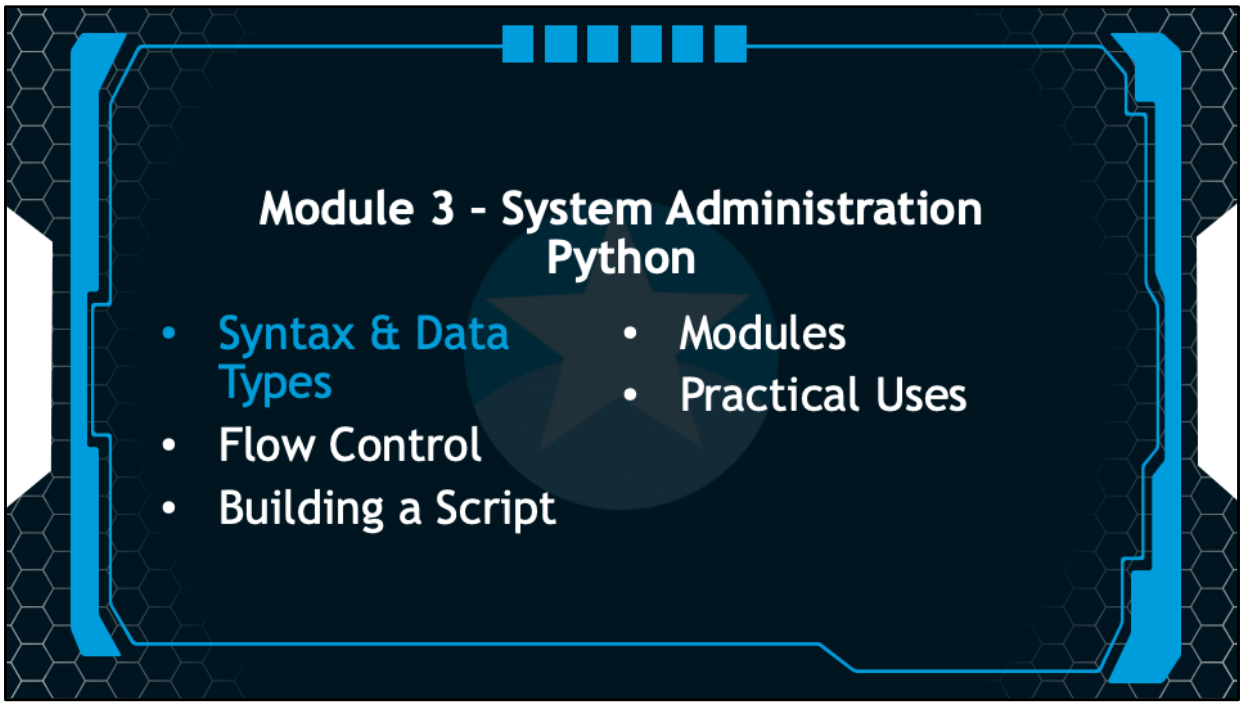
Welcome to the Module 3, System Administration. In this sub-section we'll be discussing Python. First, let's get you introduced to this scripting and programming language.



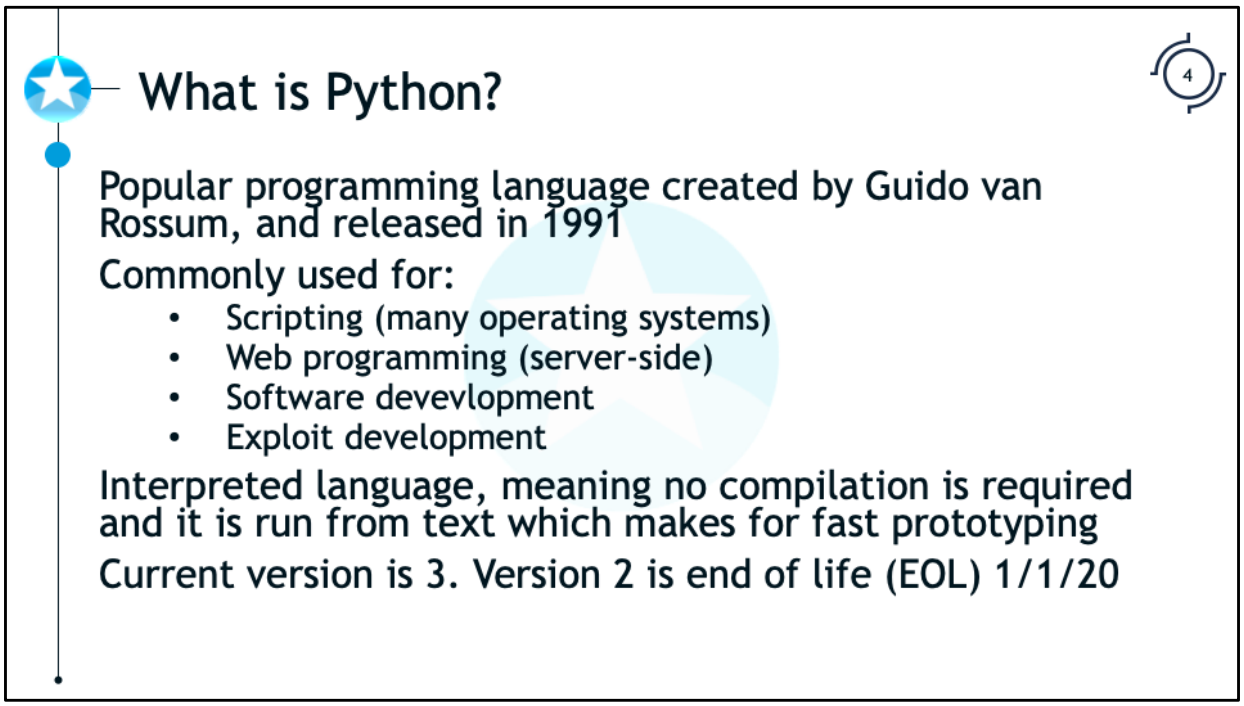
This training material was originally developed to help students, teachers, and mentors prepare for the Cyber Aces Online Competition. This module focuses on the basics of system administration and scripting. . This session is part of Module 3, System Administration. This module is split into three sections, Bash, PowerShell, and Python. In this session, we will begin our examination of Python.

The three modules of Cyber Aces Online are Operating Systems, Networking, and System Administration.

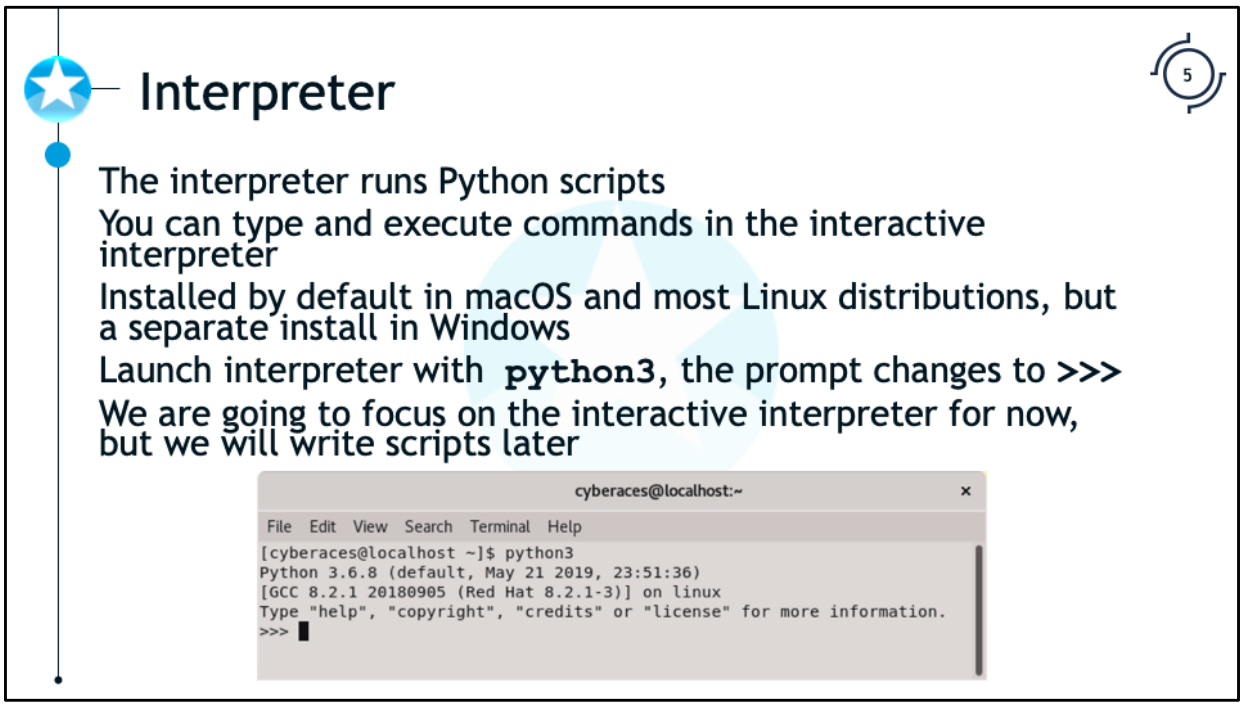
For more information about the Cyber Aces program, please visit the Cyber Aces website at https://CyberAces.org/.



Is this section, you will be introduced to Python.

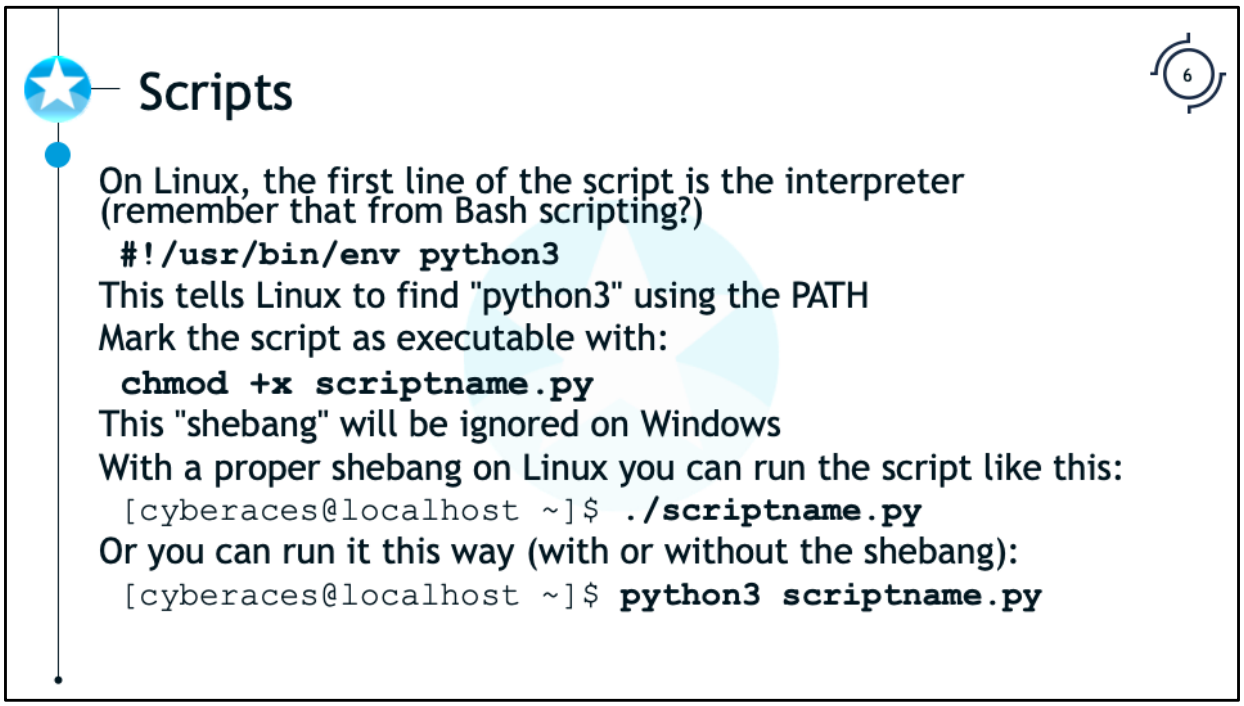


Python is a programming language that was created by Guido van Rossum in 1991. It is a very popular language for scripting as it runs on many operating systems. In fact, many operating systems come with a Python interpreter installed by default (Windows is a notable exception and does not come with a pre-installed interpreter). Python is an interpreted language meaning it does not need to be compiled into native code to be executed. The interpreter takes the text and turns it into byte code which is then executed. Not having to compile the code makes python a language that is great for quick prototyping. Python is commonly used for scripting and automation on Linux and Windows systems. It is also used to run server-side code on web servers. Many organizations use Python to develop software. In addition, Python is commonly used by people in security, especially exploit developers. The current version of Python is 3. Python 2 is end of life (EOL) as of January 1, 2020.



The interpreter runs the Python scripts. You can also launch the interpreter interactively and run commands right in the interpreter. We are focusing on version 3 and will use the **`python3`** executable. Python comes preinstall in macOS and most Linux distributions. It is not installed by default in Windows, but there is an installer. We will be using Python in Linux for this reason.

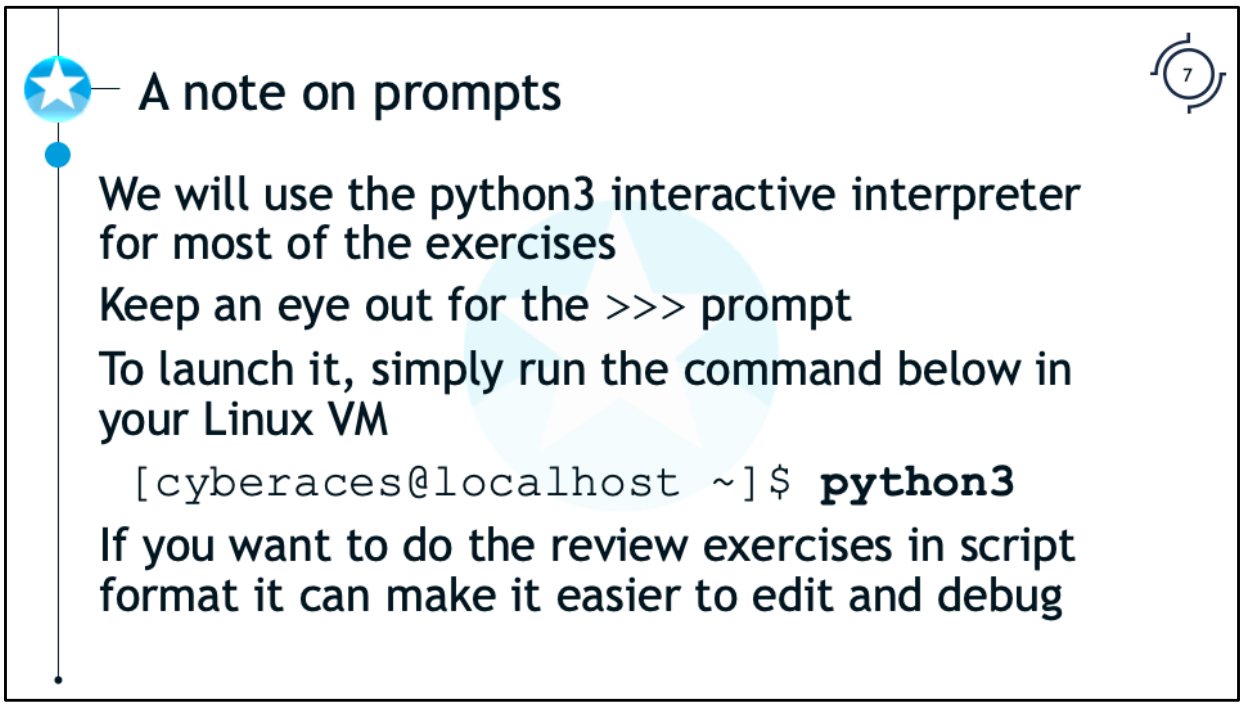
To launch the interpreter you can type **`python3`** and hit enter. The prompt will change to **>>>** indicating that you are in the interpreter. We will focus on the interpreter for now. We will write scripts later in this module.



To turn our code into a script we need to add a line to the top of the script so when we execute the script Linux can find the correct interpreter. The line looks like this:

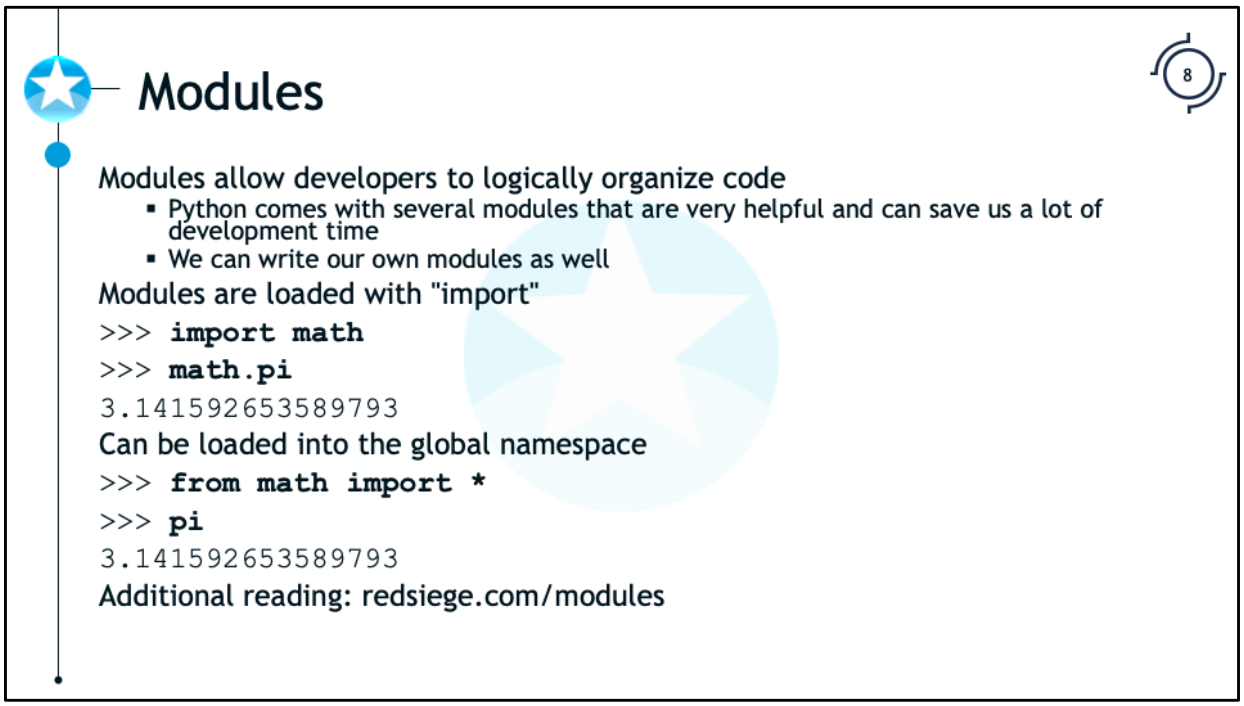
```
#!/usr/bin/env python3
```

The "env" executable tells Linux to search it's PATH to find "python3". This line is ignored on Windows. The slight exception is that the Windows Python interpreter will examine any additional options we provide to python3, but in this example we have not presented any.



For most of the demonstrations and review questions, we will use the python interpreter. The prompt is shown as >>>. To launch the interpreter just type "python3" in your Linux shell.

We will show the interactive interpreter in the slides, but feel free to write a script to solve the review challenges. You can use "gedit" to edit the python scripts and then execute them.



Modules can be used to logically organize code. The organization allows us to use different "namespaces" so that objects do no collide names. We can load the modules using "import". For example, the "math" module allows us to perform additional mathematics functions.

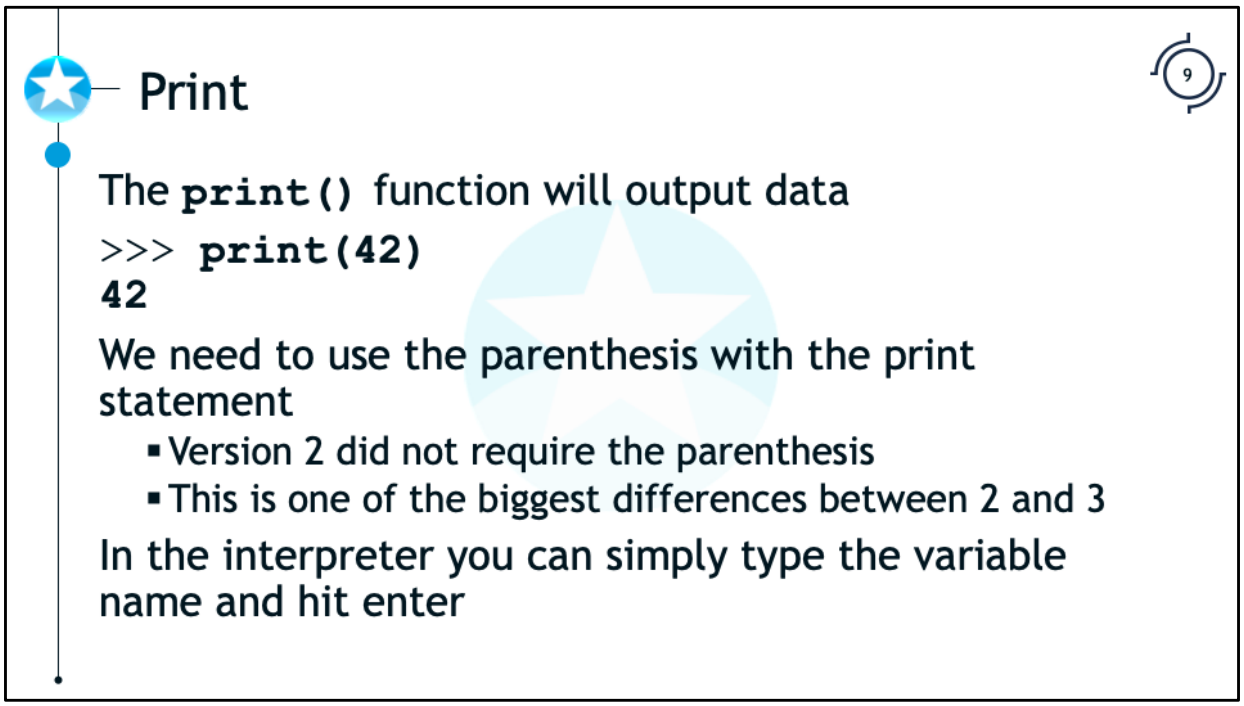
We can load the "math" module and get the value for pi.

```
>>> import math
>>> math.pi
3.141592653589793
```

You'll notice, that we had to reference the module name. We can load the members into the global namespace (although be careful of name collisions).

```
>>> from math import *
>>> pi
3.141592653589793
```

Additional reading: redsiege.com/modules



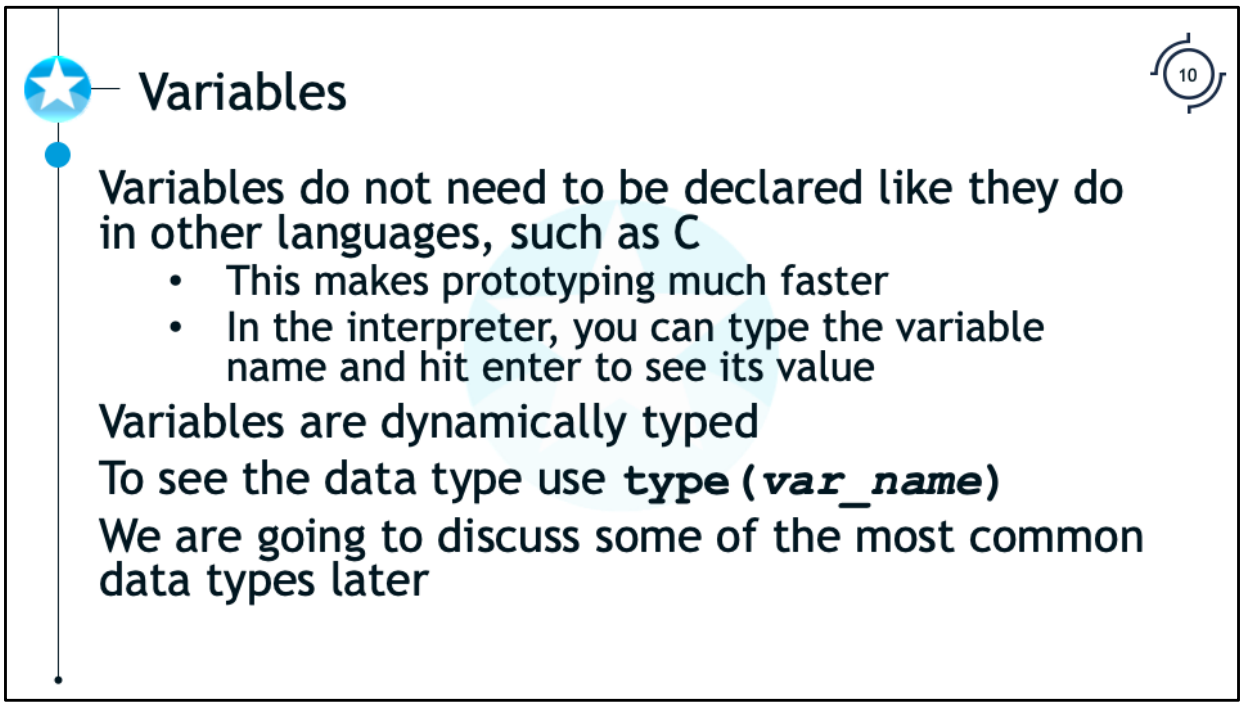
The "print" function is how we output data. The function requires that you use parenthesis with the print statement. For example to output the number 42 you'd type this:

```
>>> print(42)
42
```

Prior to Python version 3, you didn't need to use the parenthesis and could simply type:

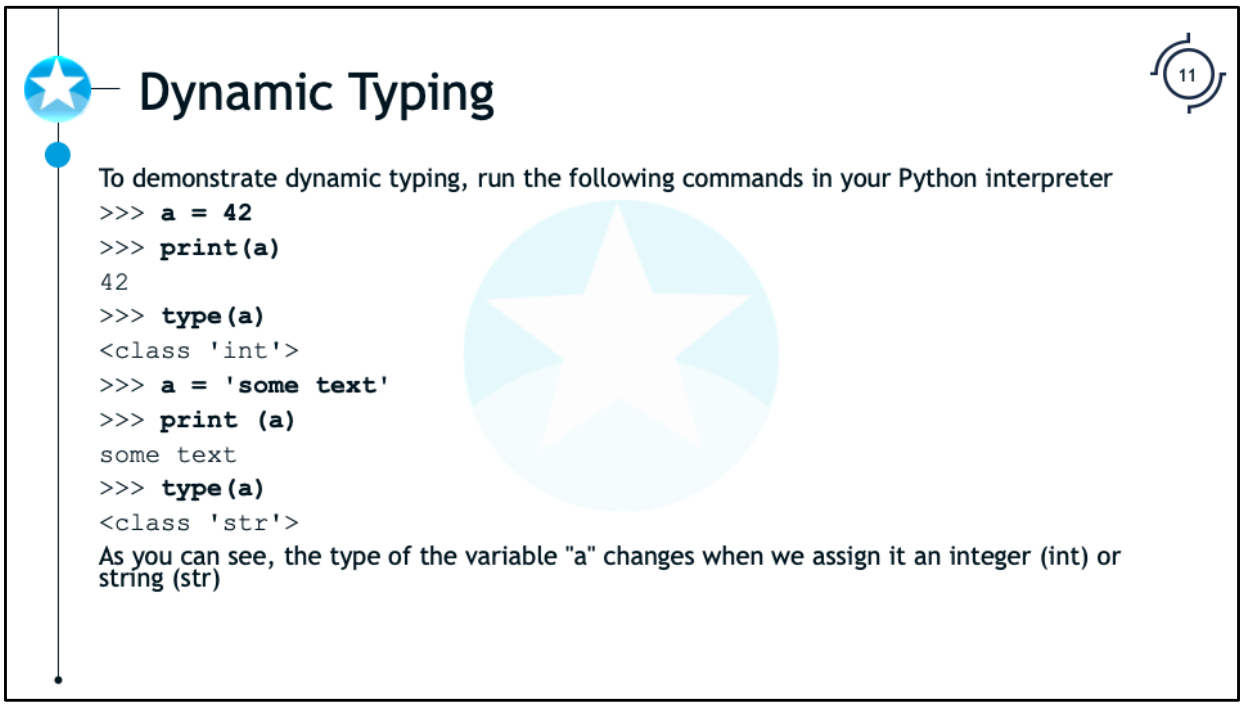
```
>>> print 42
```

This change is one of the most significant differences between version 2 and 3.



Unlike other many other languages, especially compiled ones like C and C++, you do not need to declare variables before you use them. You can simply assign the variable and then immediately use it. Of course, if you try to reference the variable before it is assigned then that will cause an error.

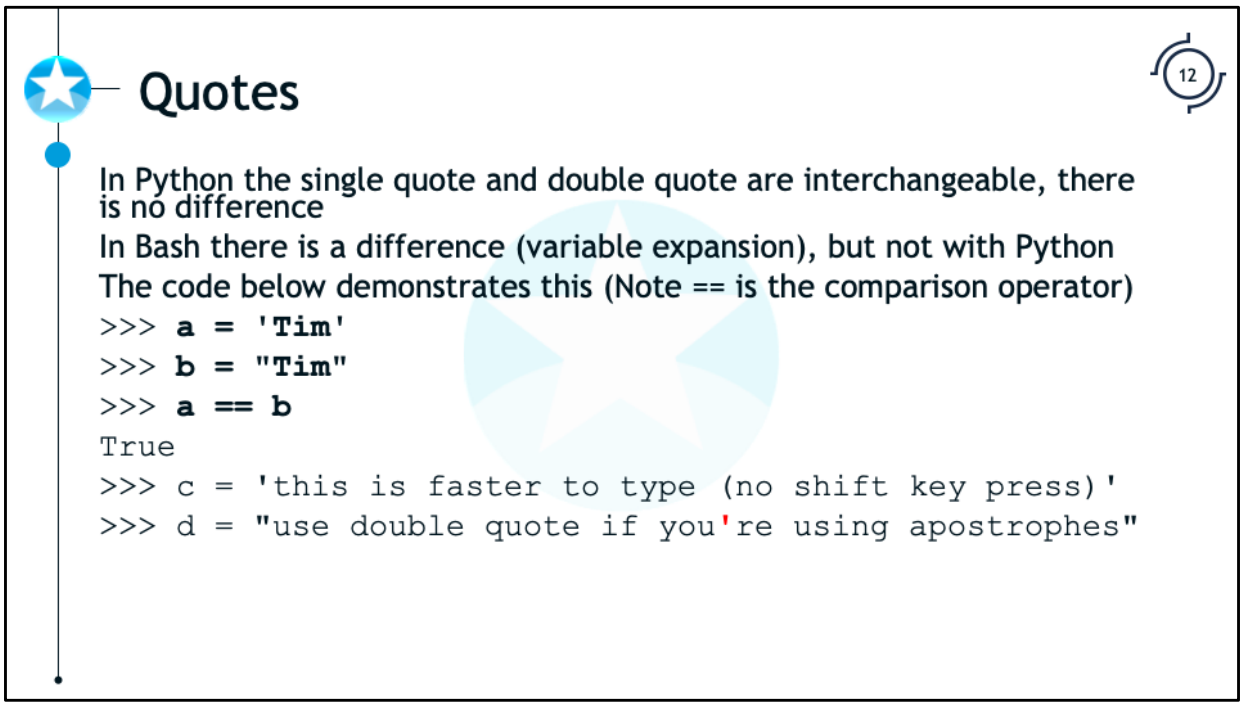
Variables in Python are dynamically typed, meaning they are defined as a string or an integer when they are set. To see the type of a variable use `type()`.



To demonstrate dynamic typing, run the following commands in your Python interpreter

```
>>> a = 42
>>> print(a)
42
>>> type(a)
<class 'int'>
>>> a = 'some text'
>>> print (a)
some text
>>> type(a)
<class 'str'>
```

As you can see, the type of the variable "a" changes when we assign it an integer (int) or string (str)



The single quote (') and double quote (") serve exactly the same purpose in Python. Remember, Bash would expand a variable in the double quote but not single quotes, but that is not the case with Python.

The python below demonstrates this (Note that the == is the comparison operator)

```
>>> a = 'Tim'
>>> type(a)
<class 'str'>
>>> b = "Tim"
>>> type(b)
<class 'str'>
>>> a == b
True
```

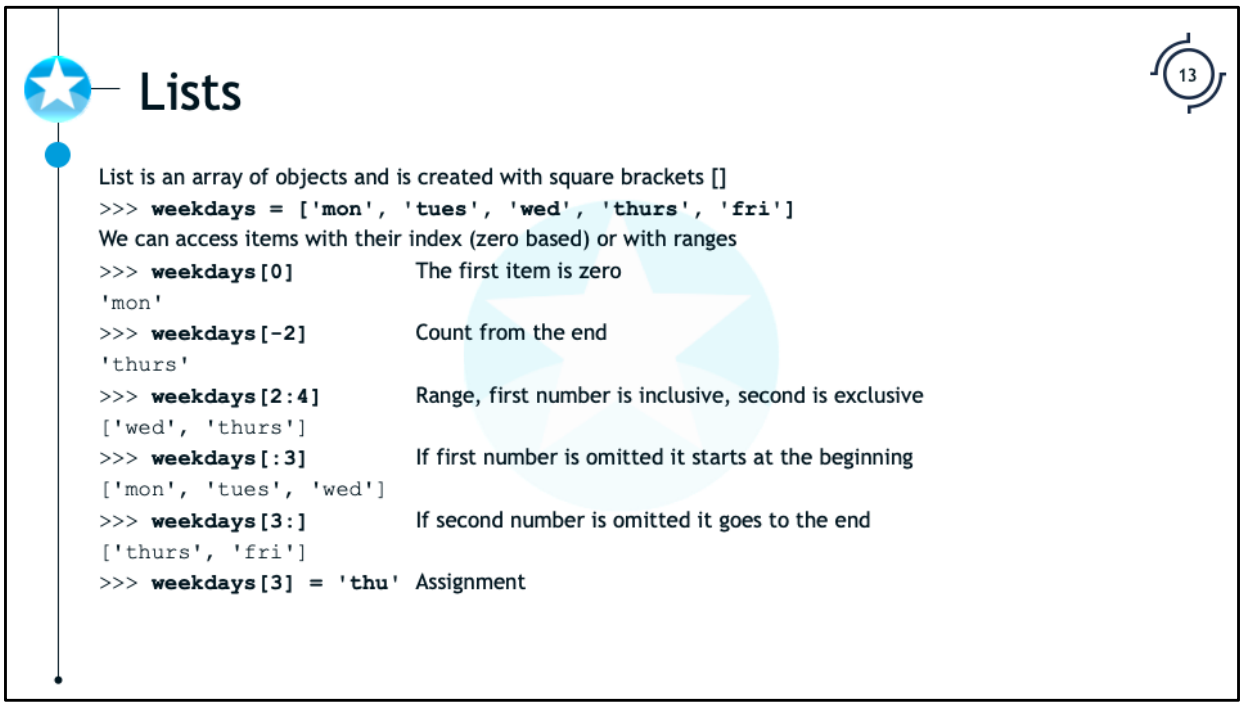
As we can see above, there is no difference between the single and double quote. Many developers will use the single quotes most of the time since it saves an extra keypress of the shift key.

```
>>> c = 'this is easier to type since I do not have to use the shift key'
```

If you need the apostrophe (single quote) in your text then it is easier to use the double quotes do define your string.

```
>>> d = "If you're going to use apostrophes, you'll
```

definitely want to use double quotes"



Lists is an array of objects and is created with square brackets [].

```
>>> weekdays = ["mon", "tues", "wed", "thurs", "fri"]
```

We can access items in the array by using [indexnumber]. The first item in the list uses and index of zero.

We can count from the end using negative numbers.

```
>>> weekdays[2]
'thurs'
```

We can use a range by using the start number and an end number (note: negatives work here too). The start number is inclusive, but the end number is exclusive. Another way to say the range is up to, but not including the second number.

```
>>> weekdays[2:4]
['wed', 'thurs']
```

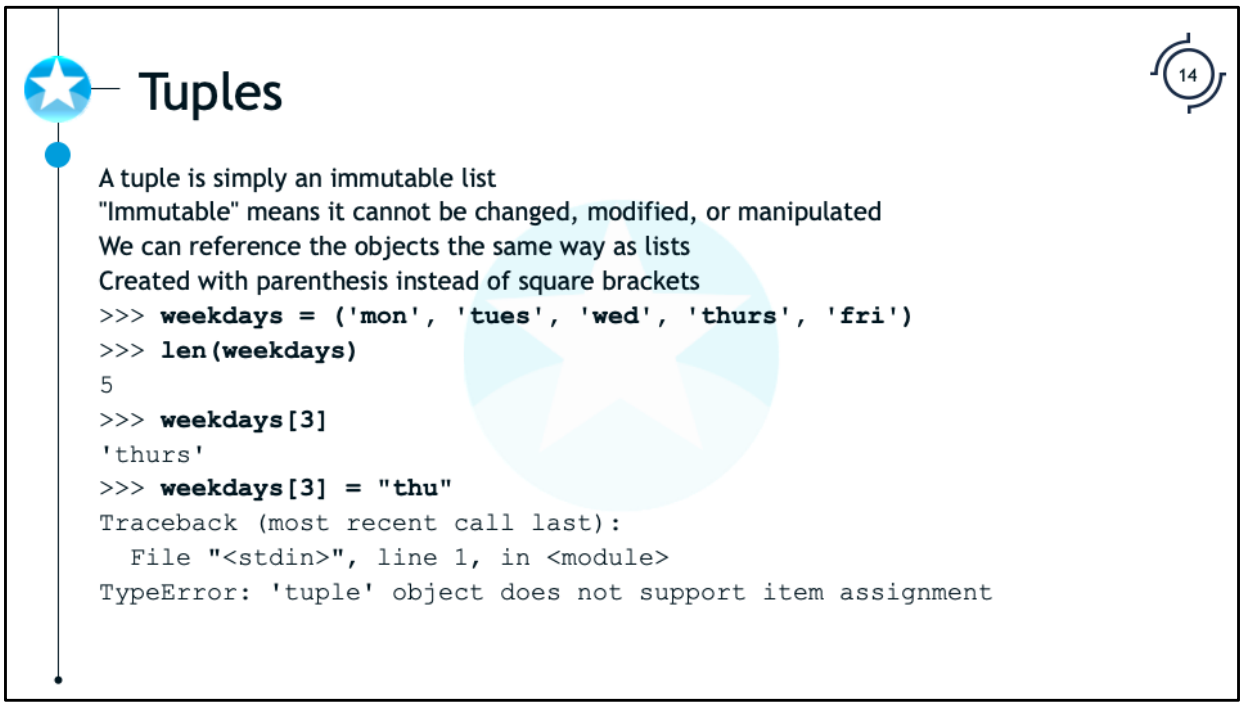
If the 4 was inclusive, we would see three items (2, 3, 4) instead of just two (2, 3).

We can omit the numbers to start at the beginning or to to the end

```
>>> weekdays[:3]
['mon', 'tues', 'wed']
>>> weekdays[3:]
['thurs', 'fri']
```

We can assign items using the index.

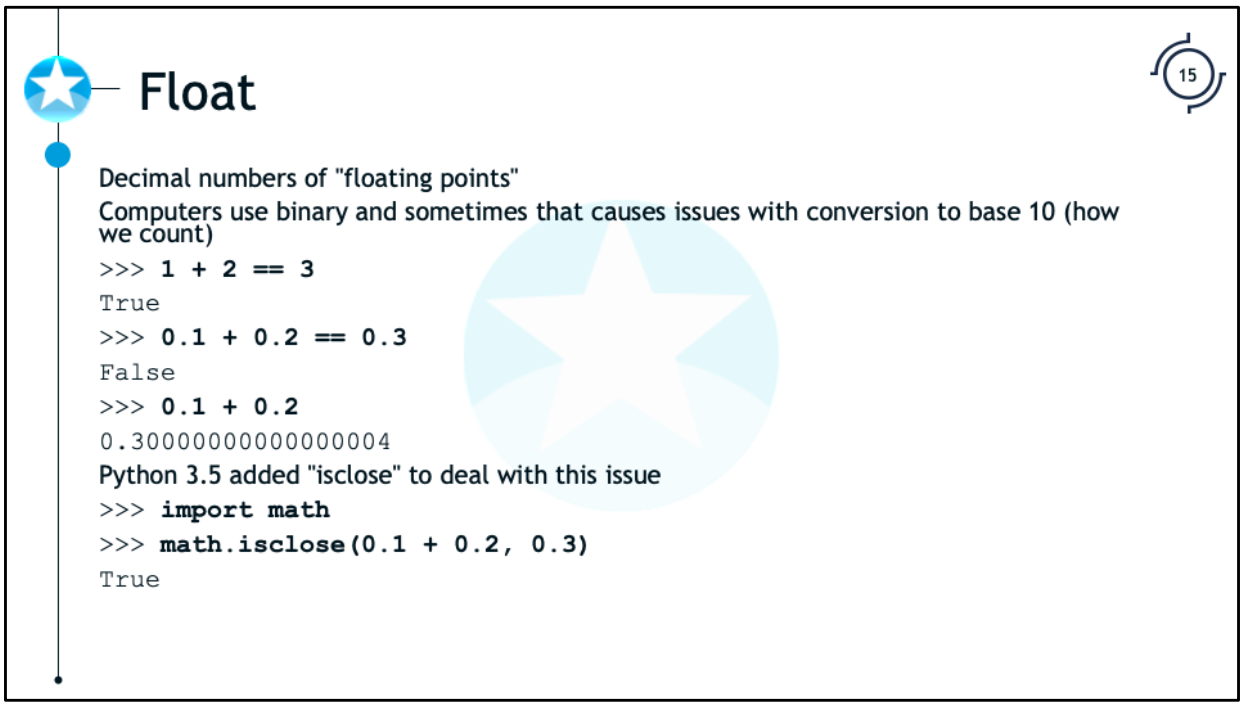
```
>>> weekdays[3] = 'thu'
```



A tuple is very similar to a list. The big difference is that it is immutable, meaning we can't change modify, or manipulate it. We create a tuple in much the same way that we create a list, but instead of square brackets we use parenthesis. Below, we demonstrate creating a tuple and its immutability.

```
>>> weekdays = ("mon", "tues", "wed", "thurs", "fri")
>>> len(weekdays)
5
>>> weekdays[3]
'thurs'
>>> weekdays[3] = "thu"
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: 'tuple' object does not support item
assignment
```

As you can see, the assignment cause an error.

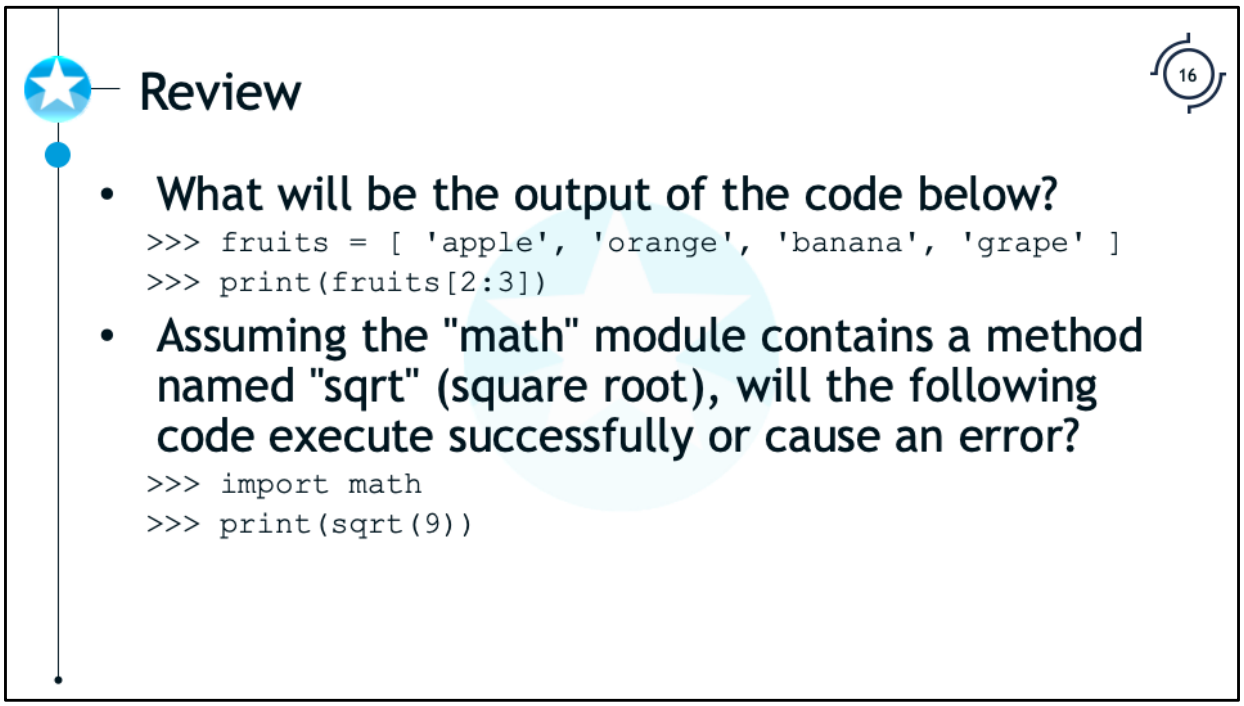


The "float" data type is used to hold decimals or "floating point" numbers. Humans count in base 10, but computers use base 2 (ones and zeros). Sometimes this base conversion means we can have unexpected results.

```
>>> 1 + 2 == 3
True
>>> 0.1 + 0.2 == 0.3
False
>>> 0.1 + 0.2
0.30000000000000004
```

To deal with this issue, Python 3.5 added "isclose" method to the "math" module (we'll discuss modules shortly).

```
>>> import math
>>> math.isclose(0.1 + 0.2, 0.3)
True
```

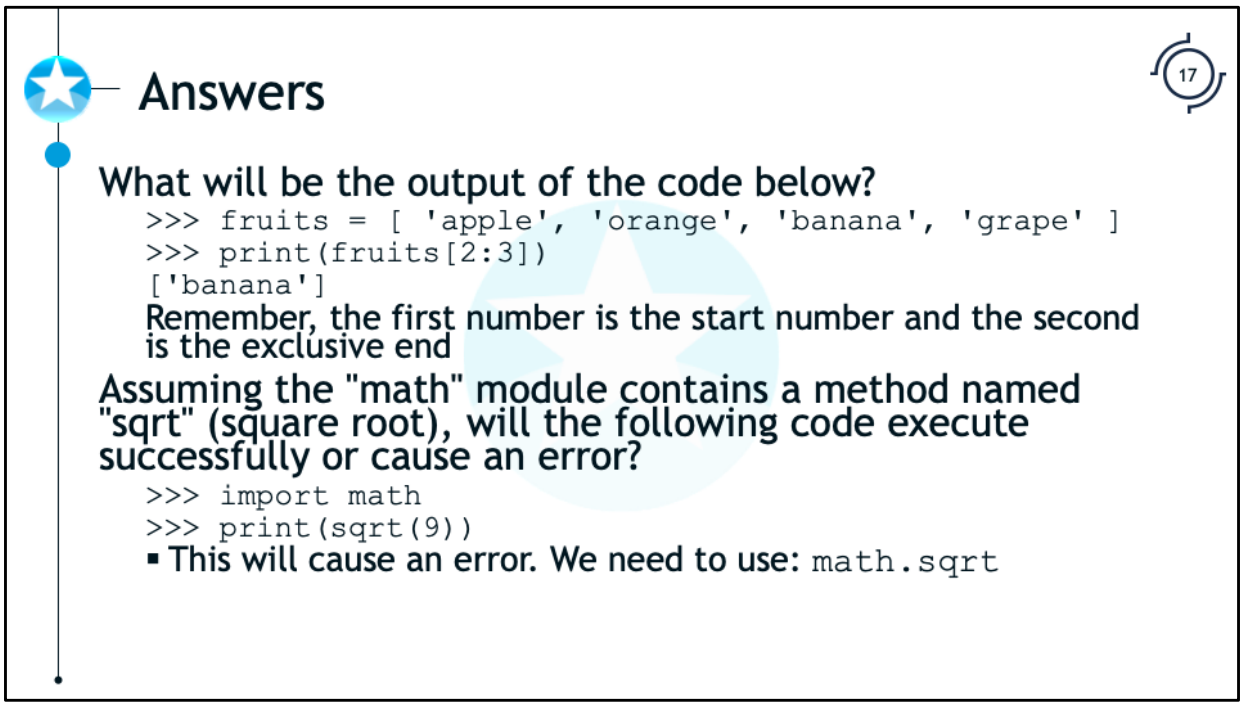


What will be the output of the code below?

```
>>> fruits = [ 'apple', 'orange', 'banana', 'grape' ]
>>> print(fruits[2:3])
```

Assuming the "math" module contains a method named "sqrt" (square root), will the following code execute successfully or cause an error?

```
>>> import math
>>> print(sqrt(9))
```



What will be the output of the code below?

```
>>> fruits = [ 'apple', 'orange', 'banana', 'grape' ]
>>> print(fruits[2:3])
```

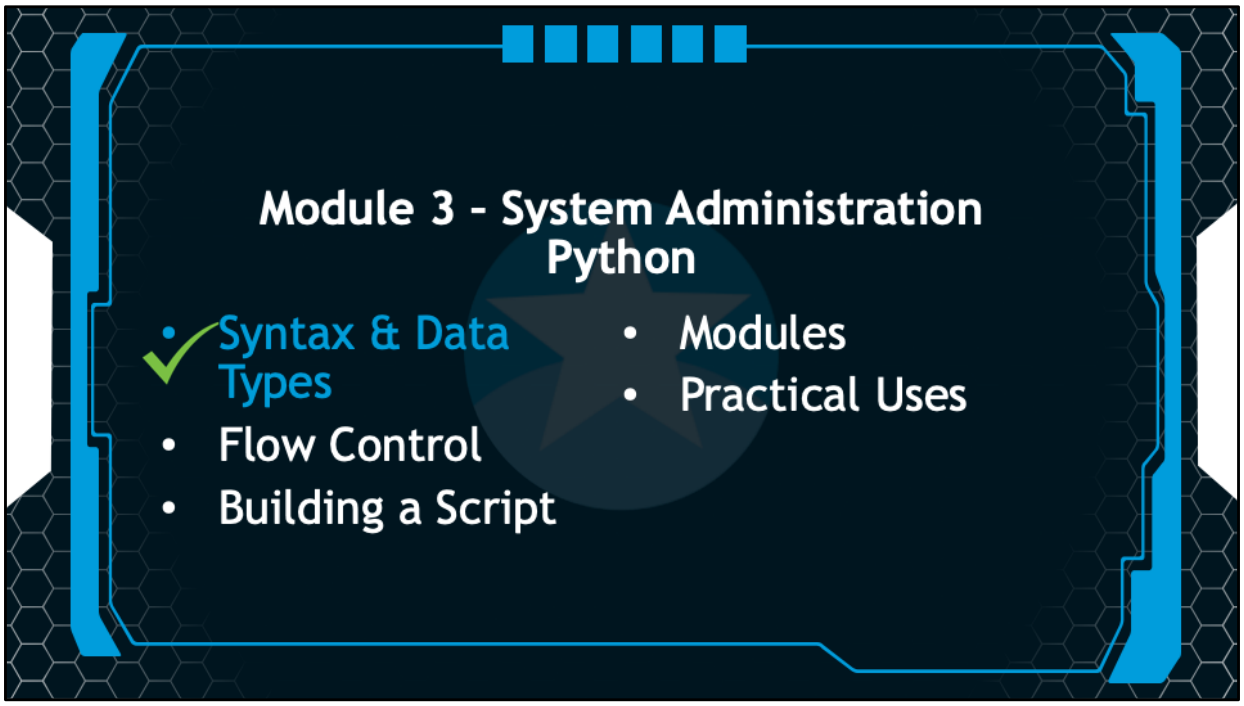
The output will be "banana". Remember, the second number is not included in the output. It will then be the second item up to, but not included the third, which means it will just output the second item.

Assuming the "math" module contains a method named "sqrt" (square root), will the following code execute successfully or cause an error?

```
>>> import math
>>> print(sqrt(9))
```

This will cause an error since the method is in the "math" namespace and not the global namespace. The code below would work:

```
>>> from math import *
>>> print(sqrt(9))
```



You've completed the introduction to Python and learned about syntax and data types. In the next session, we will discuss flow control.