Working with Data

Data is everything. It's more valuable than gold or oil. With data, governments can change the world, politicians can rise or fall and companies, large or small, can impact our future in ways we wouldn't have imagined just a few years ago. Data is power, and learning how to manipulate and control it are essential aspects of any coding language.

We take a look at how you can use date and time functions, write to files in your system and even create graphical user interfaces that will take your coding skills to new levels and open more doors for you.

Lists

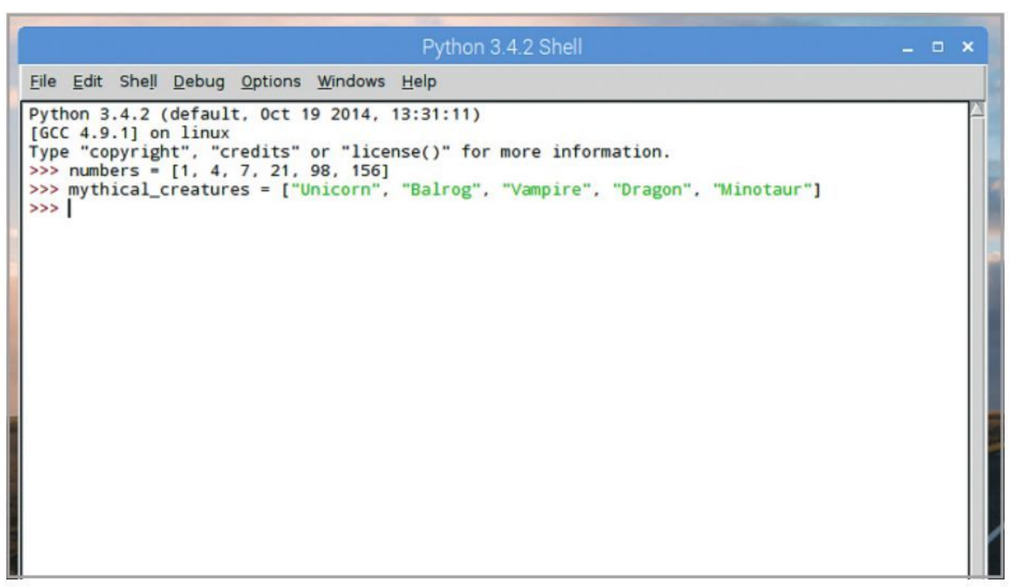
Lists are one of the most common types of data structures you will comes across in Python. A list is simply a collection of items, or data if you prefer, that can be accessed as a whole, or individually if wanted.

WORKING WITH LISTS

Lists are extremely handy in Python. A list can be strings, integers and also variables. You can even include functions in lists, and lists within lists.

STEP 1 A list is a sequence of data values called items. You create the name of your list followed by an equals sign, then square brackets and the items separated by commas; note that strings use quotes:

```
numbers = [1, 4, 7, 21, 98, 156]
mythical_creatures – [“Unicorn”, “Balrog”,
“Vampire”, “Dragon”, “Minotaur”]
```



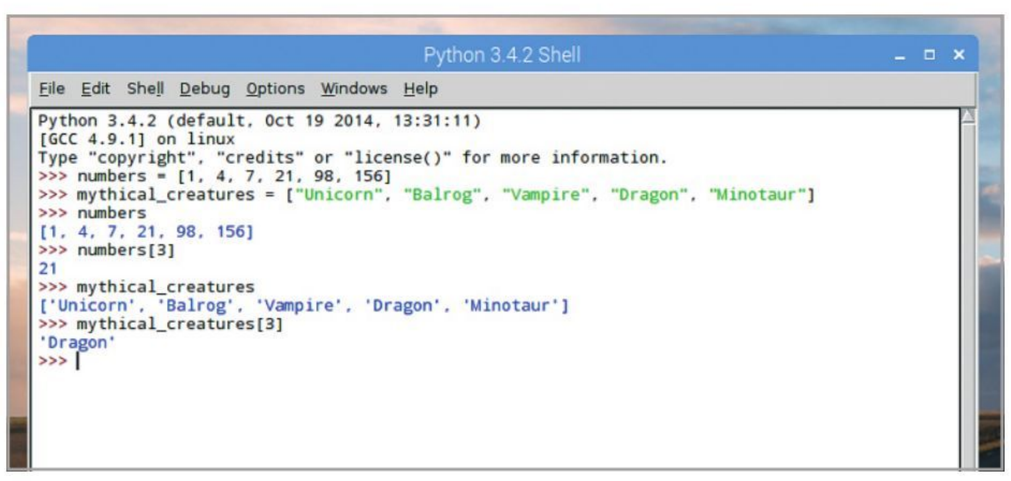
STEP 2 Once you’ve defined your list you can call each by referencing its name, followed by a number. Lists start the first item entry as 0, followed by 1, 2, 3 and so on. For example:

```
numbers
```

To call up the entire contents of the list.

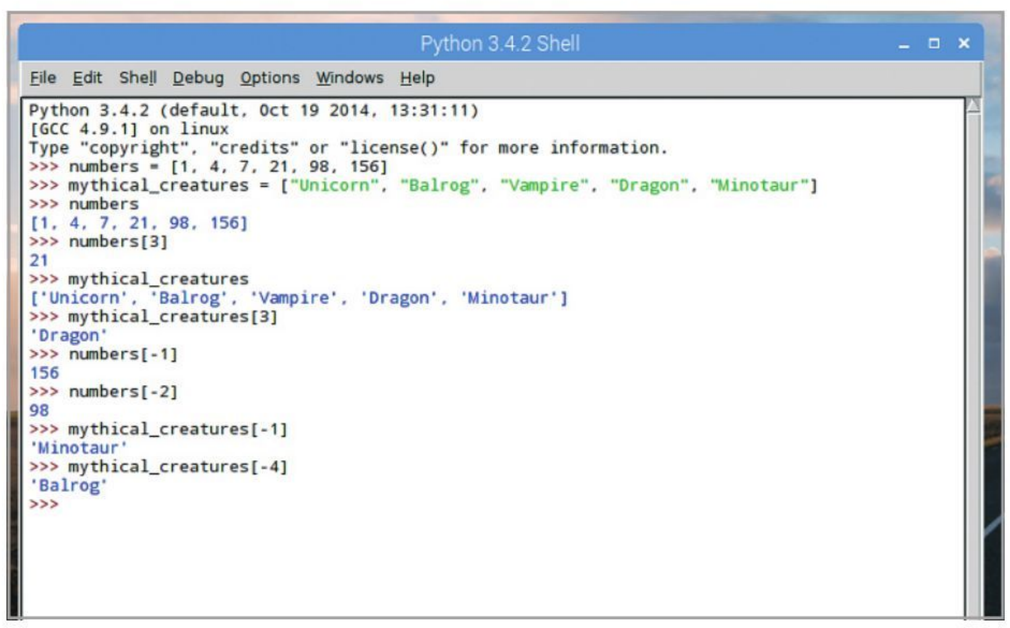
```
numbers[3]
```

To call the third from zero item in the list (21 in this case).



STEP 3 You can also access, or index, the last item in a list by using the minus sign before the item number [-1], or the second to last item with [-2] and so on. Trying to reference an item that isn’t in the list, such as [10] will return an error:

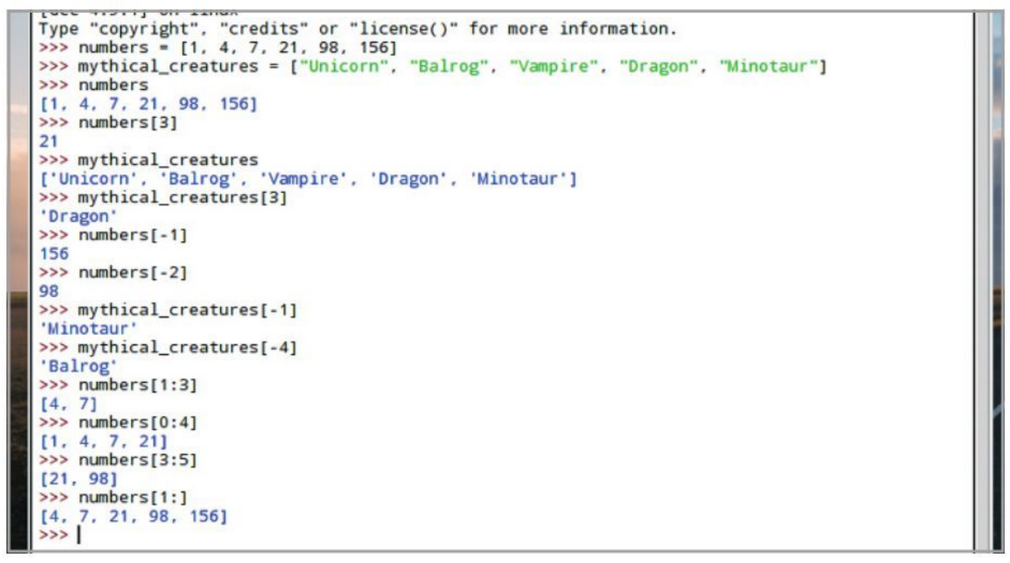
```
numbers[-1]
mythical_creatures[-4]
```



STEP 4 Slicing is similar to indexing but you can retrieve multiple items in a list by separating item numbers with a colon. For example:

```
numbers[1:3]
```

Will output the 4 and 7, being item numbers 1 and 2. Note that the returned values don’t include the second index position (as you would numbers[1:3] to return 4, 7 and 21).

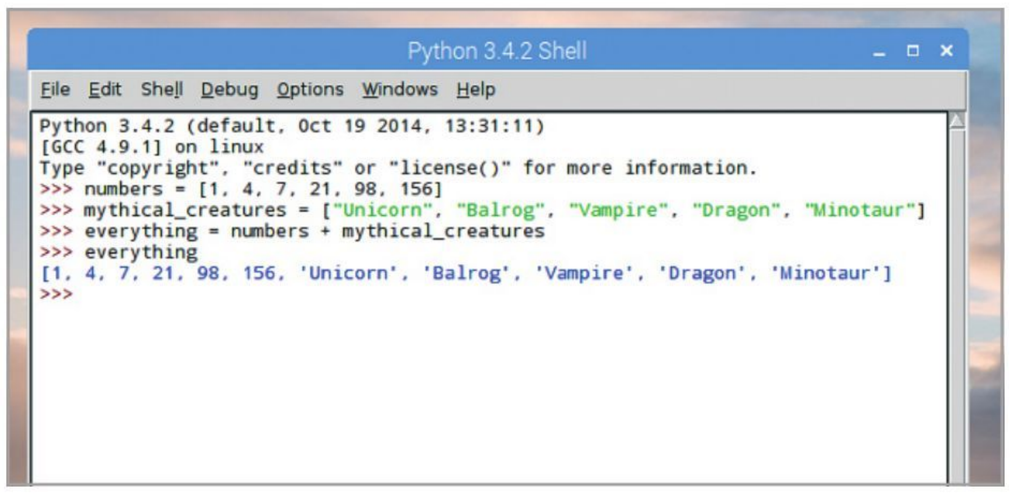


STEP 5 You can update items within an existing list, remove items and even join lists together. For example, to join two lists you can use:

```
everything = numbers + mythical_creatures
```

Then view the combined list with:

```
everything
```



STEP 6 Items can be added to a list by entering:

```
numbers=numbers+[201]
```

Or for strings:

```
mythical_creatres=mythical_creatures+[“Griffin”]
```

Or by using the append function:

```
mythical_creatures.append(“Nessie”)
numbers.append(278)
```

STEP 7 Removal of items can be done in two ways. The first is by the item number:

```
del numbers[7]
```

Alternatively, by item name:

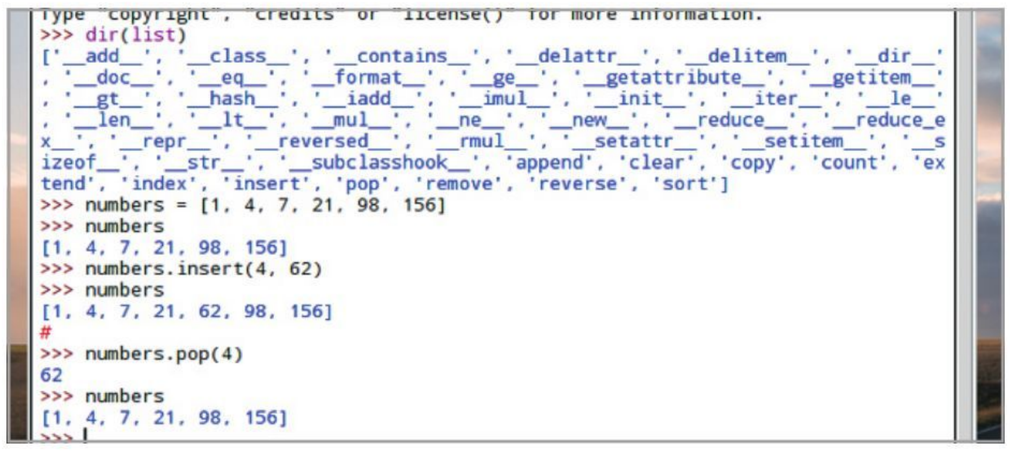
```
mythical_creatures.remove(“Nessie”)
```

STEP 8 You can view what can be done with lists by entering dir(list) into the Shell. The output is the available functions, for example, insert and pop are used to add and remove items at certain positions. To insert the number 62 at item index 4:

```
numbers.insert(4, 62)
```

To remove it:

```
numbers.pop(4)
```

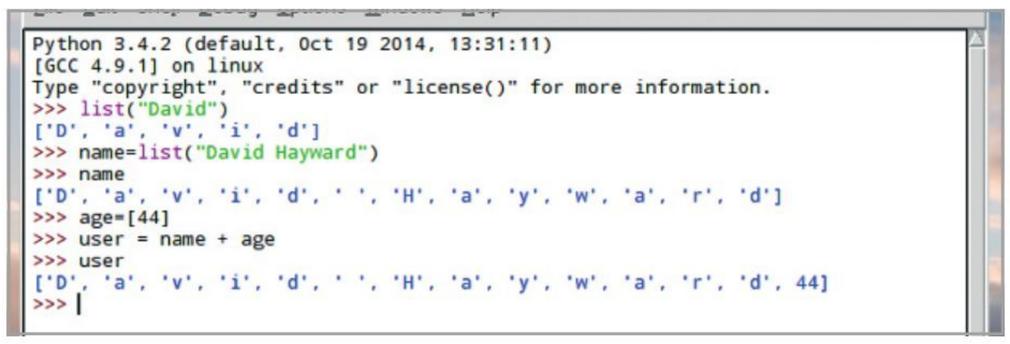


STEP 9 You also use the list function to break a string down into its components. For example:

```
list(“David”)
```

Breaks the name David into ‘D’, ‘a’, ‘v’, ‘i’, ‘d’. This can then be passed to a new list:

```
name=list(“David Hayward”)
name
age=[44]
user = name + age
user
```

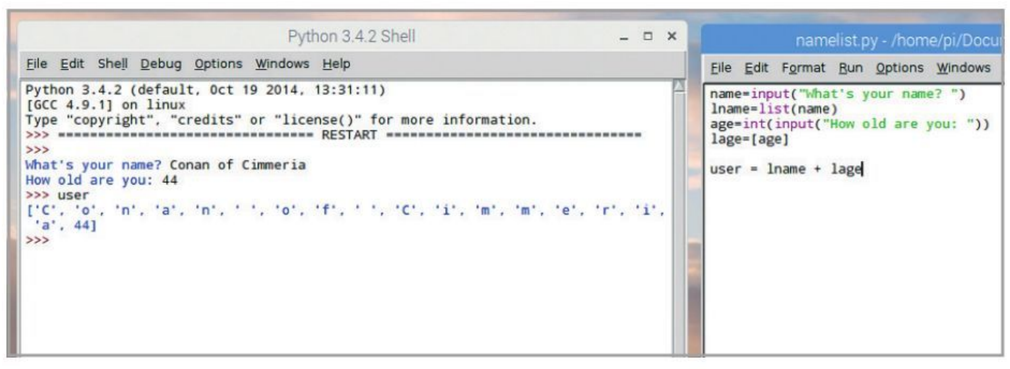


STEP 10 Based on that, you can create a program to store someone’s name and age as a list:

```
name=input(“What’s your name? “)
lname=list(name)
age=int(input(“How old are you: “))
lage=[age]

user = lname + lage
```

The combined name and age list is called user, which can be called by entering user into the Shell. Experiment and see what you can do.



Tuples

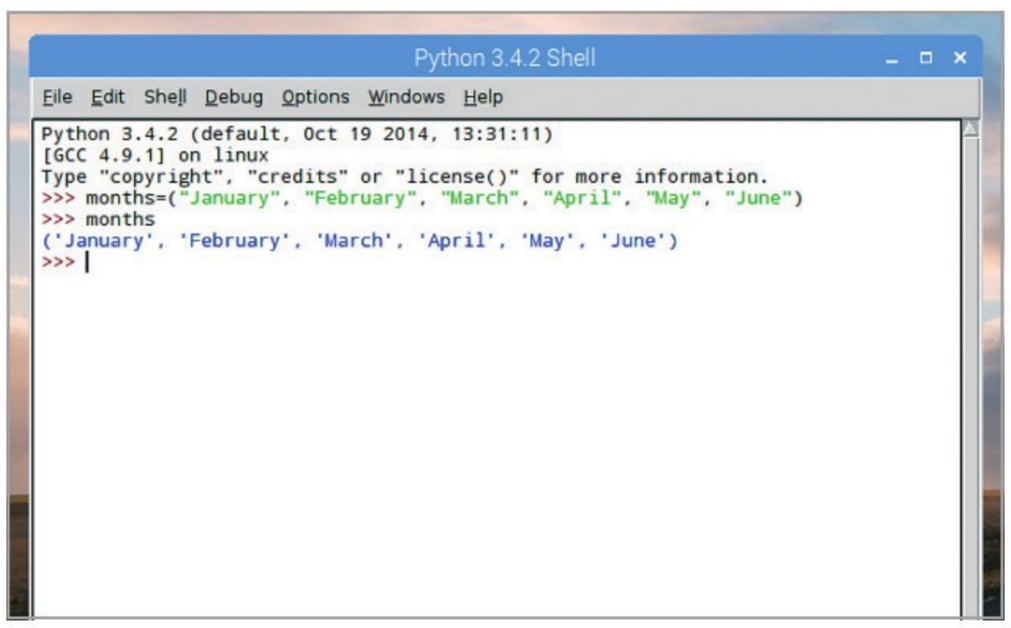
Tuples are very much identical to lists. However, where lists can be updated, deleted or changed in some way, a tuple remains a constant. This is called immutable and they're perfect for storing fixed data items.

THE IMMUTABLE TUPLE

Reasons for having tuples vary depending on what the program is intended to do. Normally, a tuple is reserved for something special but they're also used for example, in an adventure game, where non-playing character names are stored.

STEP 1 A tuple is created the same way as a list but in this instance you use curved brackets instead of square brackets. For example:

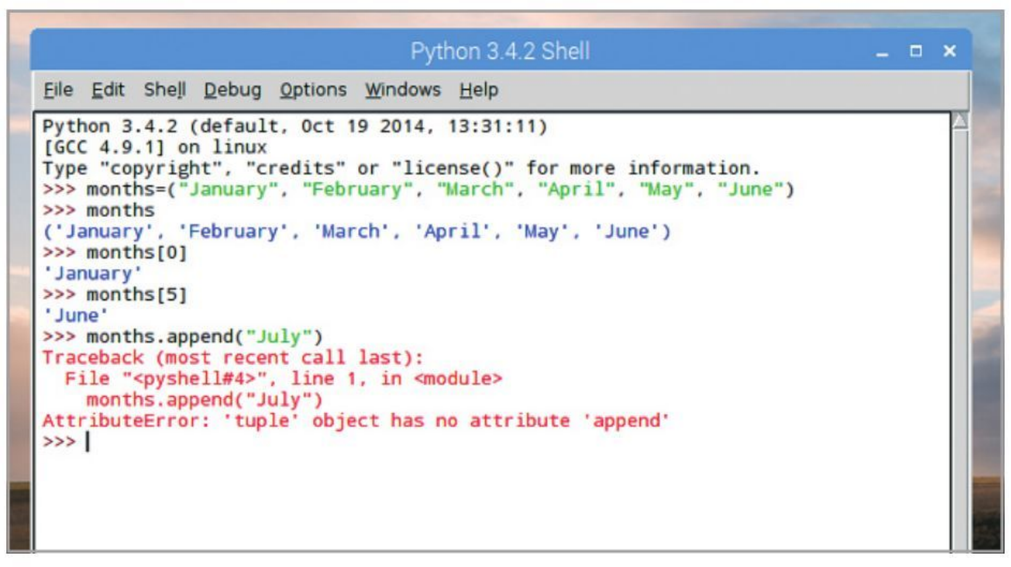
```
months=("January", "February", "March", "April",
"May", "June")
months
```



STEP 2 Just as with lists, the items within a named tuple can be indexed according to their position in the data range, i.e.:

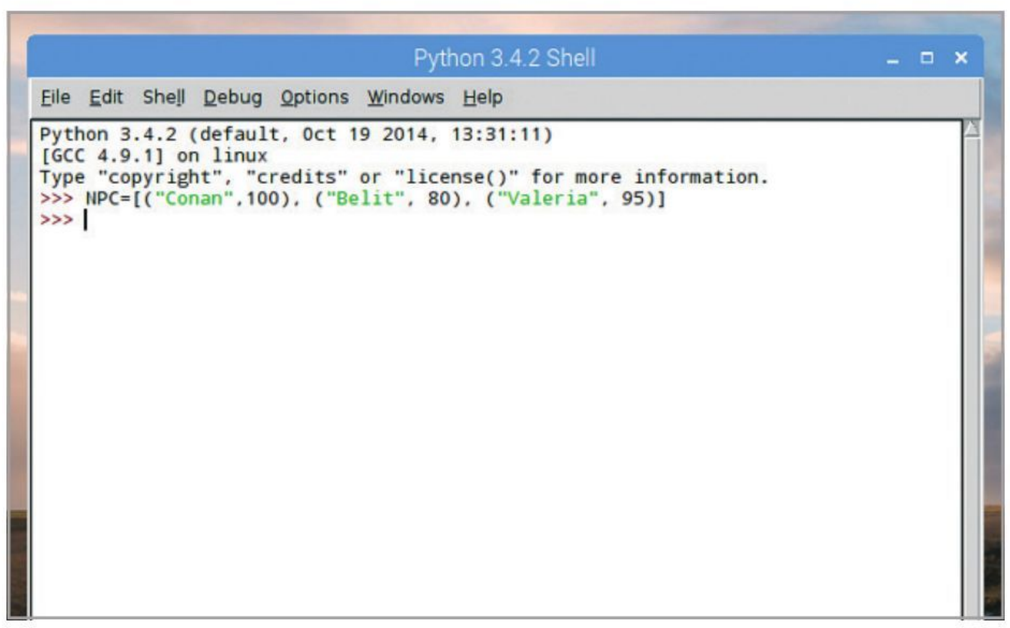
```
months[0]
months[5]
```

However, any attempt at deleting or adding to the tuple will result in an error in the Shell.



STEP 3 You can create grouped tuples into lists that contain multiple sets of data. For instance, here is a tuple called NPC (Non-Playable Characters) containing the character name and their combat rating for an adventure game:

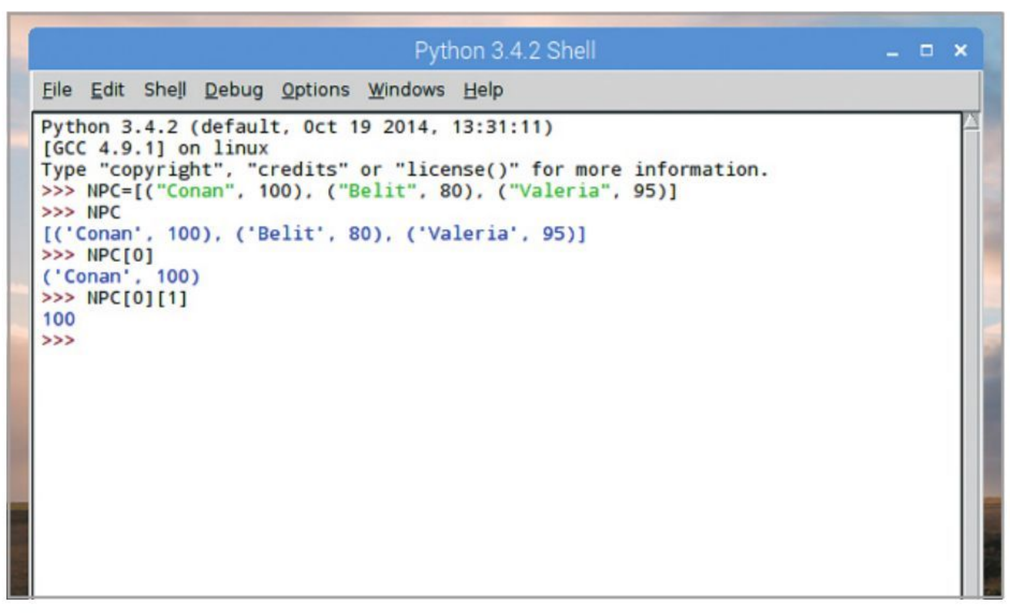
```
NPC=[("Conan", 100), ("Belit", 80),
("Valeria", 95)]
```



STEP 4 Each of these data items can be accessed as a whole by entering NPC into the Shell; or they can be indexed according to their position NPC[0]. You can also index the individual tuples within the NPC list:

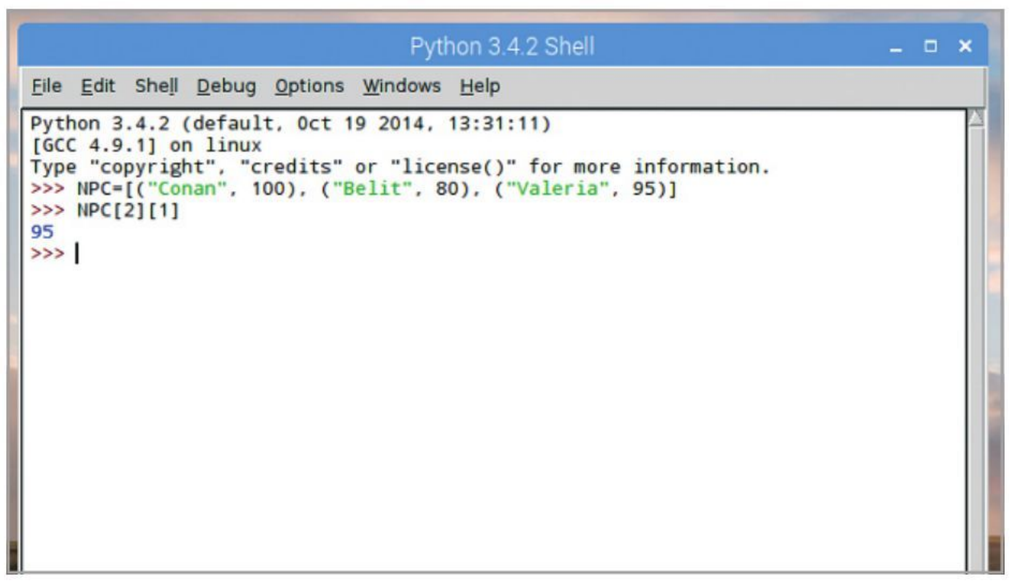
```
NPC[0][1]
```

Will display 100.



STEP 5 It's worth noting that when referencing multiple tuples within a list, the indexing is slightly different from the norm. You would expect the 95 combat rating of the character Valeria to be NPC[4][5], but it's not. It's actually:

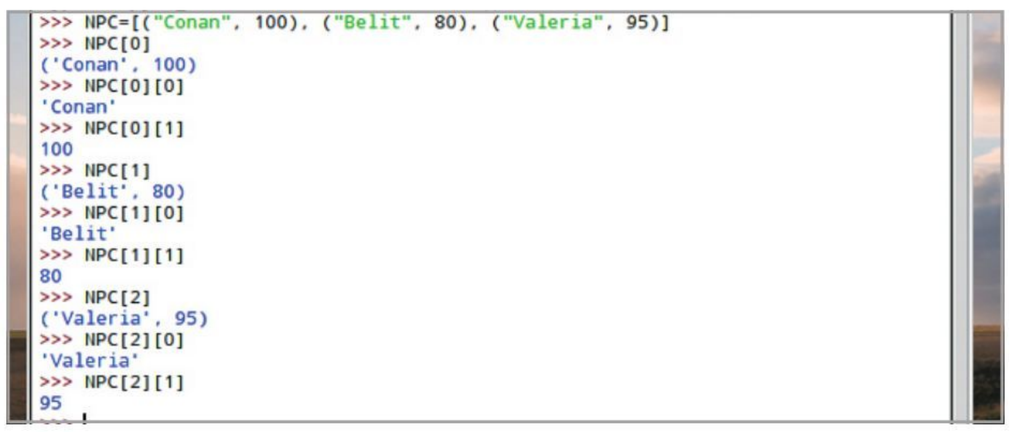
```
NPC[2][1]
```



STEP 6 This means of course that the indexing follows thus:

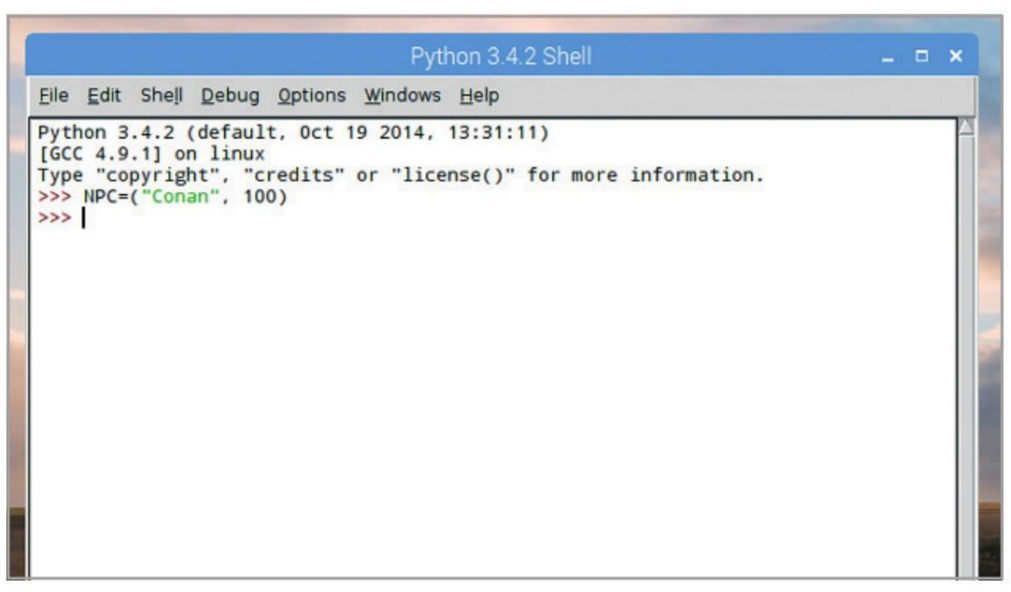
```
0              1, 1
0, 0           2
0, 1           2, 0
1              2,1
1, 0
```

Which as you can imagine, gets a little confusing when you've got a lot of tuple data to deal with.



STEP 7 Tuples though utilise a feature called unpacking, where the data items stored within a tuple are assigned variables. First create the tuple with two items (name and combat rating):

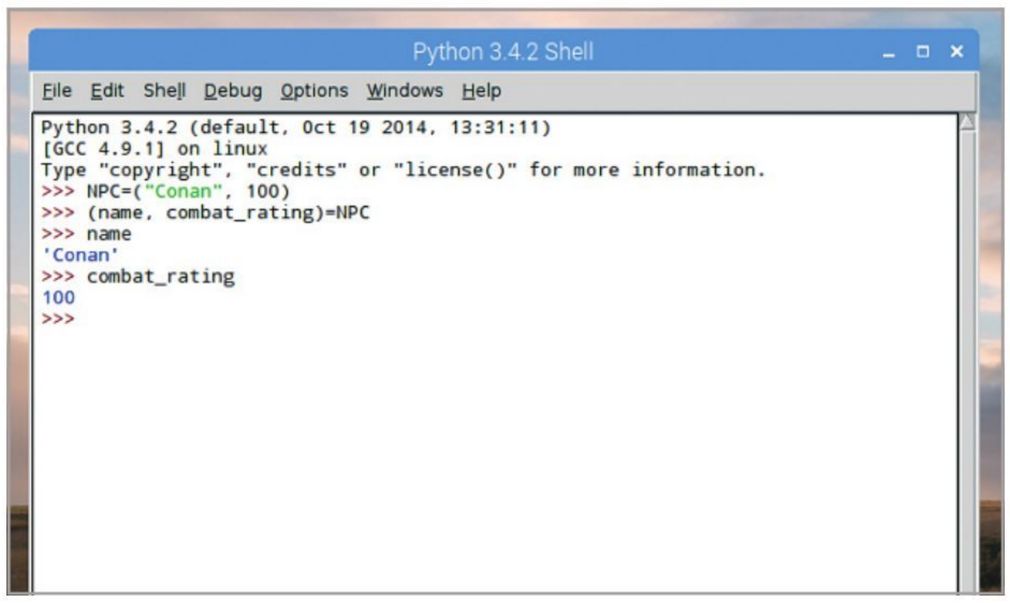
```
NPC=("Conan", 100)
```



STEP 8 Now unpack the tuple into two corresponding variables:

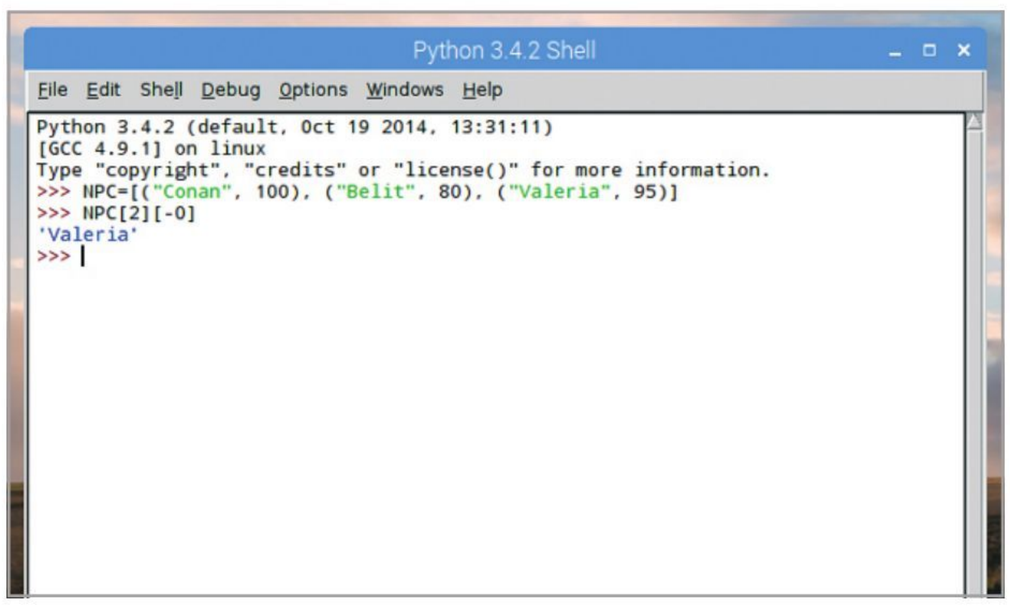
```
(name, combat_rating)=NPC
```

You can now check the values by entering name and combat_rating.



STEP 9 Remember, as with lists, you can also index tuples using negative numbers which count backwards from the end of the data list. For our example, using the tuple with multiple data items, you would reference the Valeria character with:

```
NPC[2][-0]
```

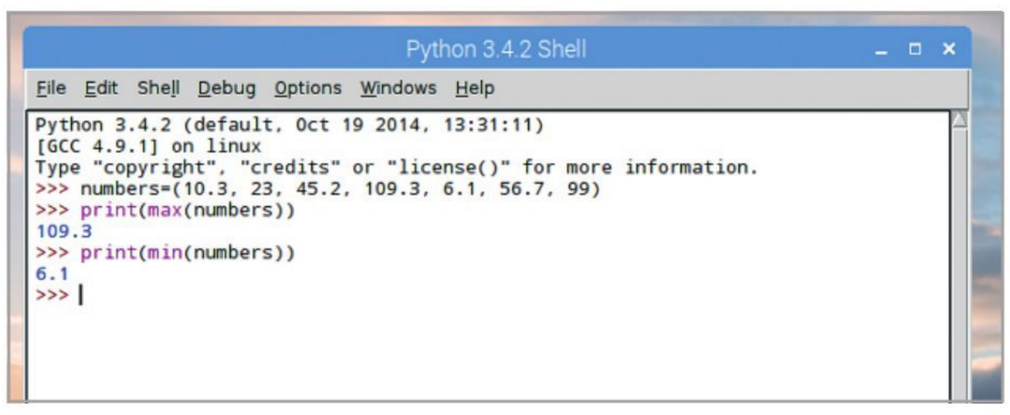


STEP 10 You can use the max and min functions to find the highest and lowest values of a tuple composed of numbers. For example:

```
numbers=(10.3, 23, 45.2, 109.3, 6.1, 56.7, 99)
```

The numbers can be integers and floats. To output the highest and lowest, use:

```
print(max(numbers))
print(min(numbers))
```



Dictionaries

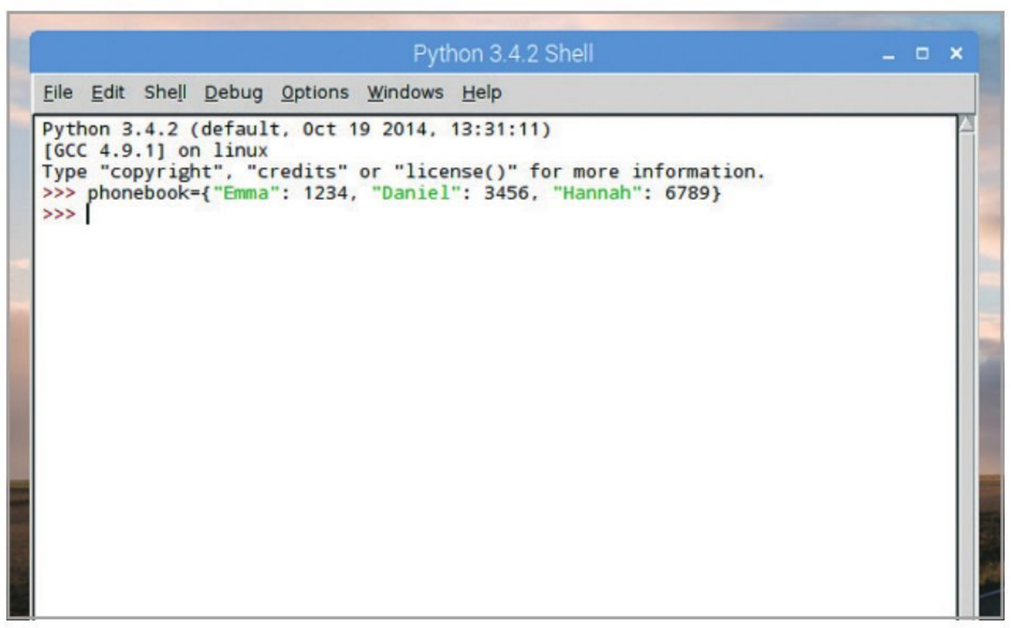
Lists are extremely useful but dictionaries in Python are by far the more technical way of dealing with data items. They can be tricky to get to grips with at first but you'll soon be able to apply them to your own code.

KEY PAIRS

A dictionary is like a list but instead each data item comes as a pair, these are known as Key and Value. The Key part must be unique and can either be a number or string whereas the Value can be any data item you like.

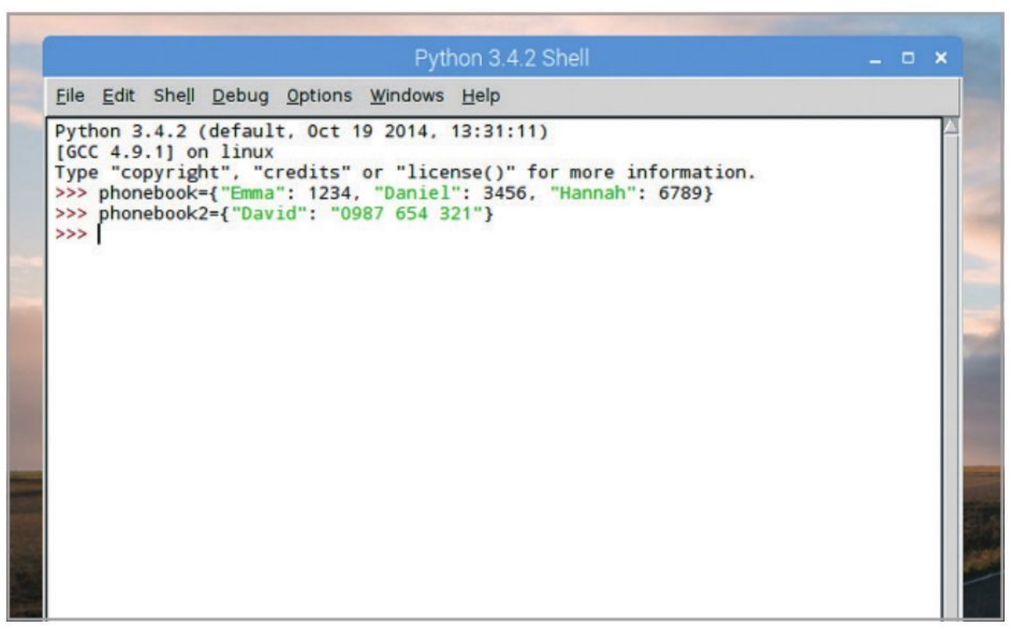
STEP 1 Let's say you want to create a phonebook in Python. You would create the dictionary name and enter the data in curly brackets, separating the key and value by a colon `Key:Value`. For example:

```
phonebook={"Emma": 1234, "Daniel": 3456,
"Hannah": 6789}
```

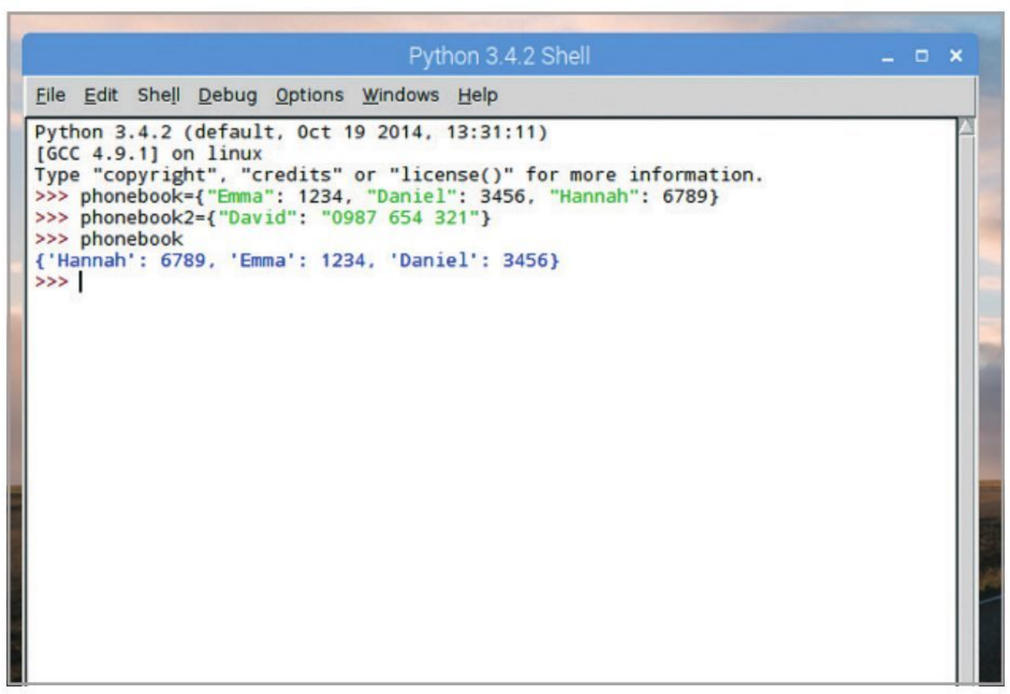


STEP 2 Just as with most lists, tuples and so on, strings need be enclosed in quotes (single or double), whilst integers can be left open. Remember that the value can be either a string or an integer, you just need to enclose the relevant one in quotes:

```
phonebook2={"David": "0987 654 321"}
```

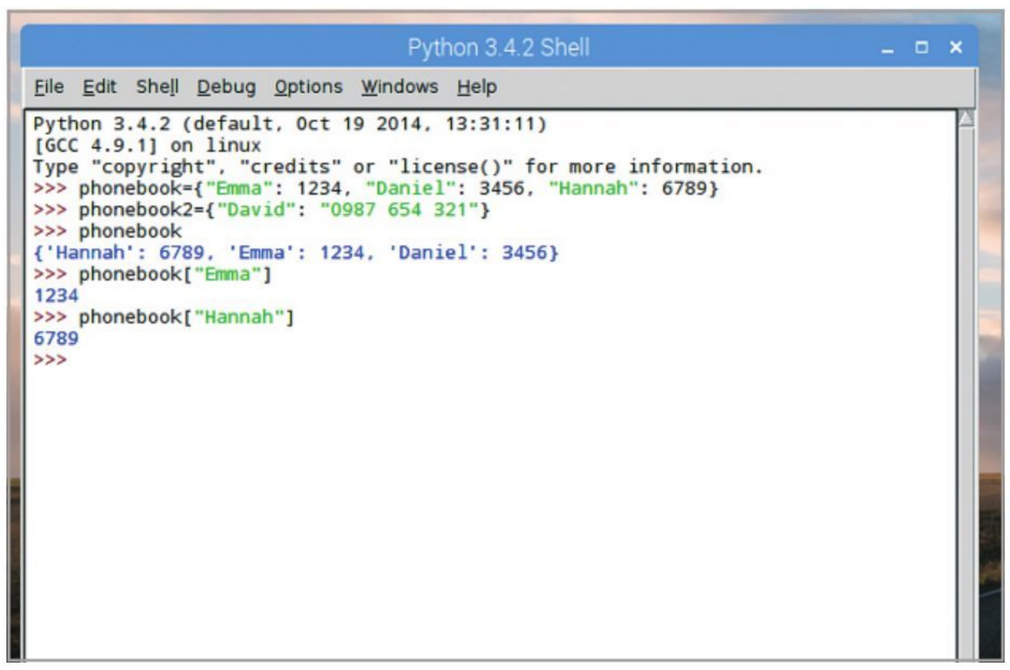


STEP 3 As with lists and tuples, you can check the contents of a dictionary by giving the dictionary a name: phonebook, in this example. This will display the data items you've entered in a similar fashion to a list, which you're no doubt familiar with by now.



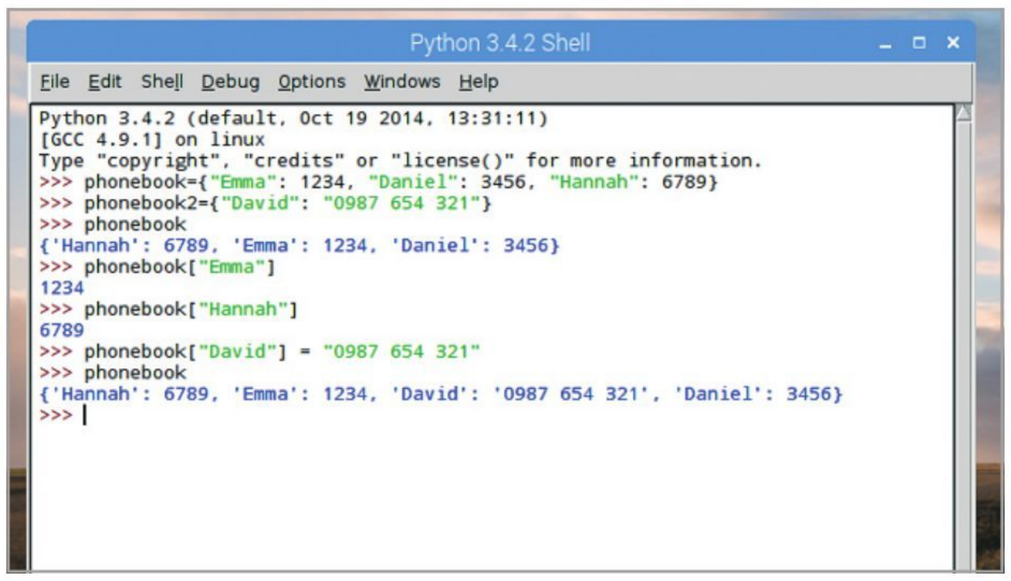
STEP 4 The benefit of using a dictionary is that you can enter the key to index the value. Using the phonebook example from the previous steps, you can enter:

```
phonebook["Emma"]
phonebook["Hannah"]
```



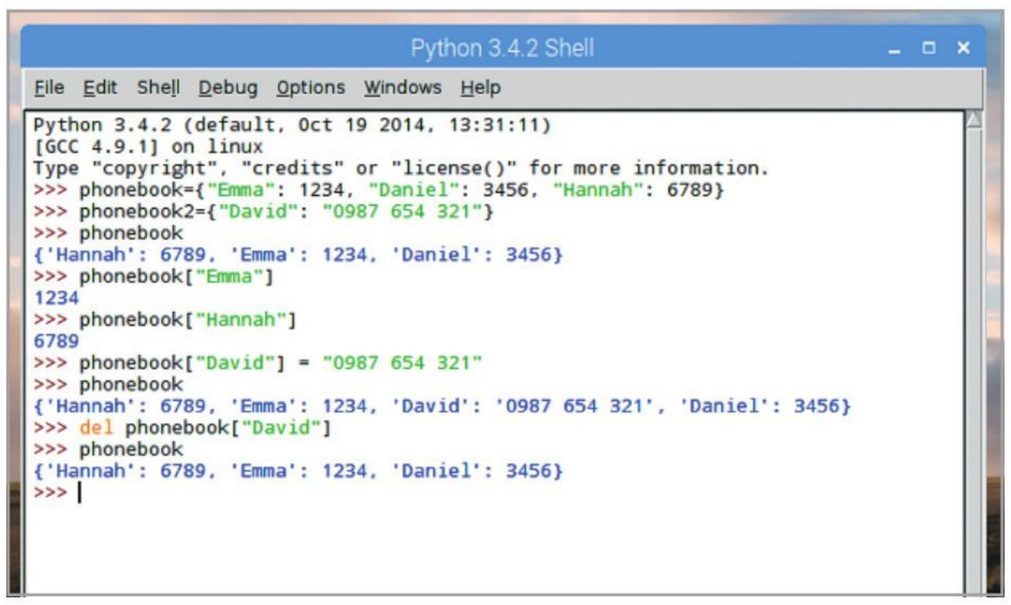
STEP 5 Adding to a dictionary is easy too. You can include a new data item entry by adding the new key and value items like:

```
phonebook[“David”] = “0987 654 321”
phonebook
```



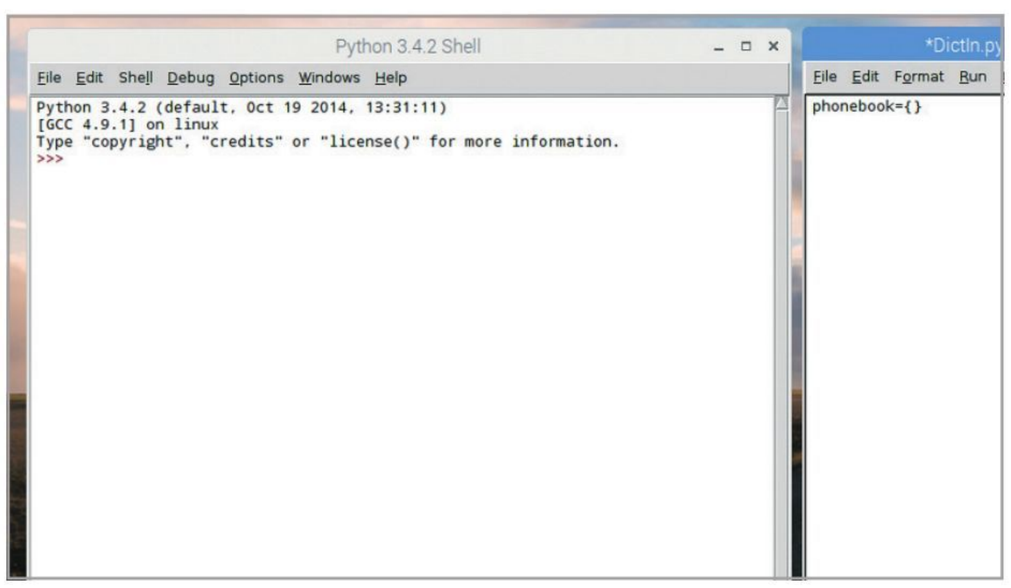
STEP 6 You can also remove items from a dictionary by issuing the del command followed by the item’s key; the value will be removed as well, since both work as a pair of data items:

```
del phonebook[“David”]
```



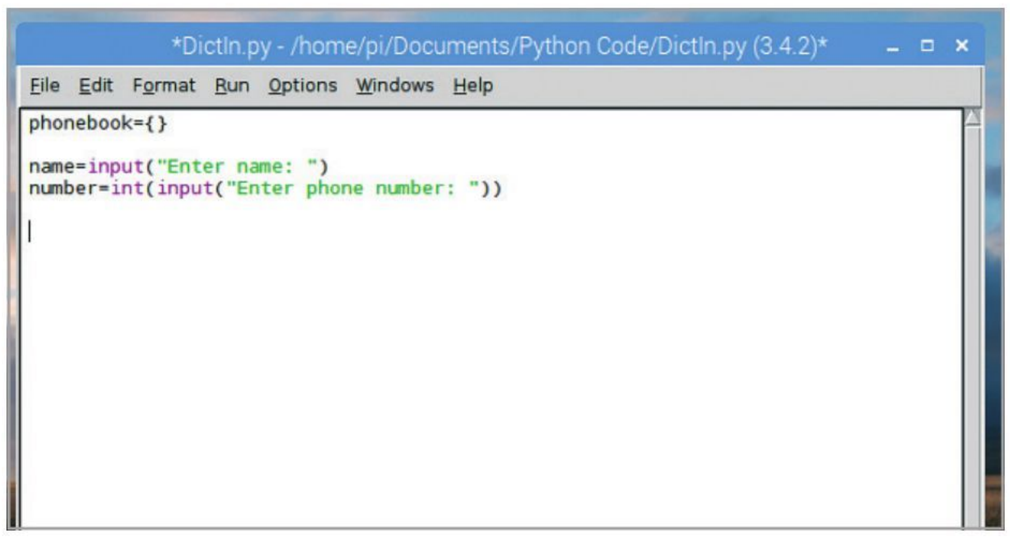
STEP 7 Taking this a step further, how about creating a piece of code that will ask the user for the dictionary key and value items? Create a new Editor instance and start by coding in a new, blank dictionary:

```
phonebook={}
```



STEP 8 Next, you need to define the user inputs and variables: one for the person’s name, the other for their phone number (let’s keep it simple to avoid lengthy Python code):

```
name=input(“Enter name: “)
number=int(input(“Enter phone number: “))
```



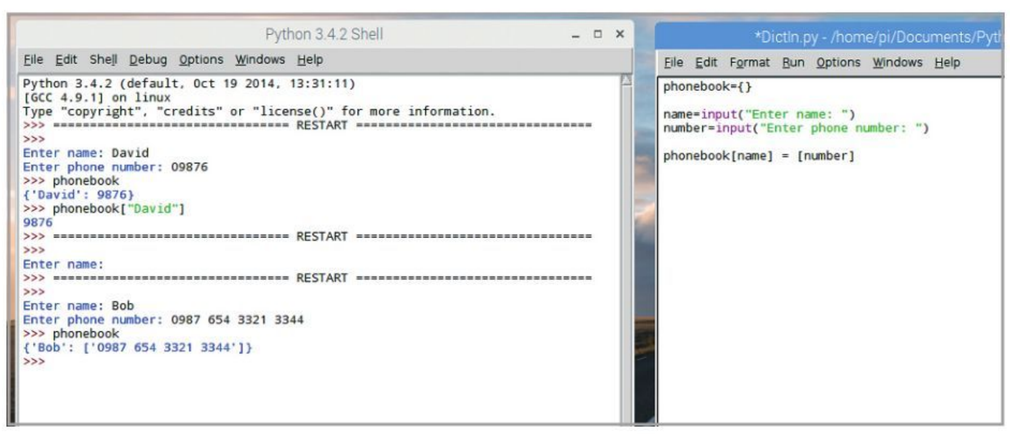
STEP 9 Note we’ve kept the number as an integer instead of a string, even though the value can be both an integer or a string. Now you need to add the user’s inputted variables to the newly created blank dictionary. Using the same process as in Step 5, you can enter:

```
phonebook[name] = number
```

STEP 10 Now when you save and execute the code, Python will ask for a name and a number. It will then insert those entries into the phonebook dictionary, which you can test by entering into the Shell:

```
phonebook
phonebook[“David”]
```

If the number needs to contain spaces you need to make it a string, so remove the int part of the input.



Splitting and Joining Strings

When dealing with data in Python, especially from a user's input, you will undoubtedly come across long sets of strings. A useful skill to learn in Python programming is being able to split those long strings for better readability.

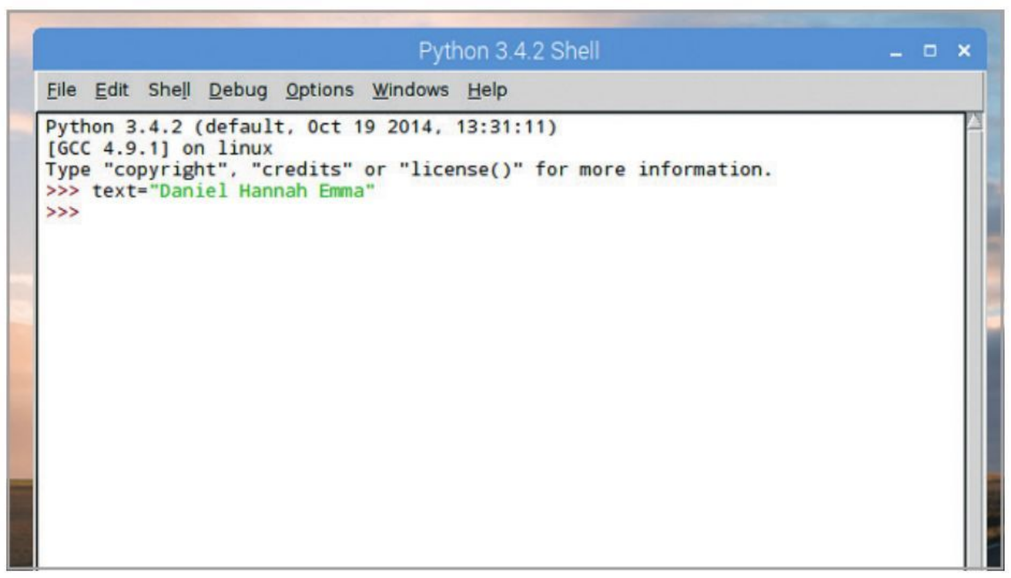
STRING THEORIES

You've already looked at some list functions, using .insert, .remove, and .pop but there are also functions that can be applied to strings.

STEP 1

The main tool in the string function arsenal is .split(). With it you're able to split apart a string of data, based on the argument within the brackets. For example, here's a string with three items, each separated by a space:

```
text="Daniel Hannah Emma"
```

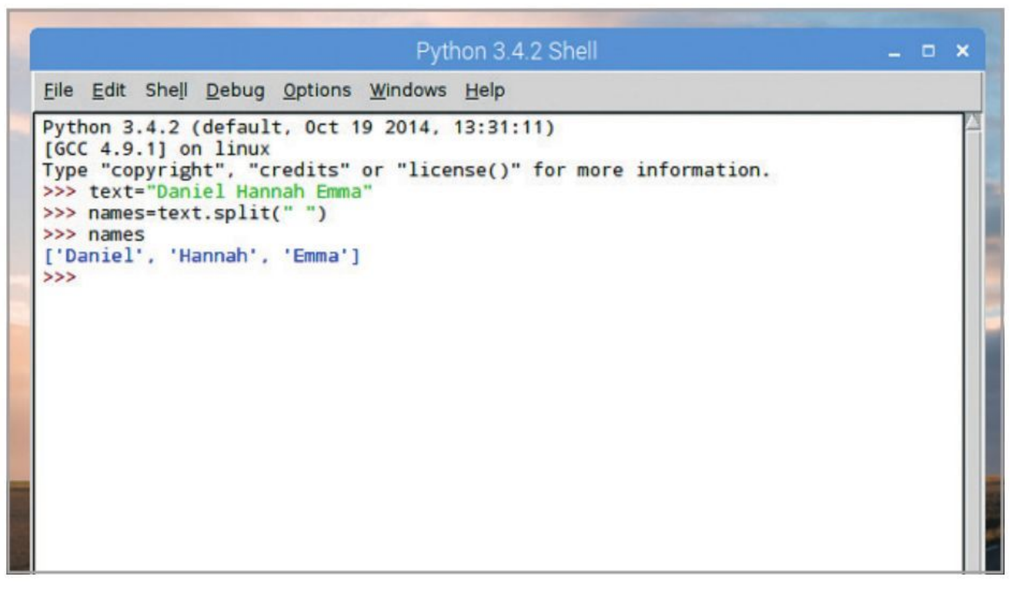


STEP 2

Now let's turn the string into a list and split the content accordingly:

```
names=text.split(" ")
```

Then enter the name of the new list, names, to see the three items.



STEP 3

Note that the text.split part has the brackets, quotes, then a space followed by closing quotes and brackets. The space is the separator, indicating that each list item entry is separated by a space. Likewise, CSV (Comma Separated Value) content has a comma, so you'd use:

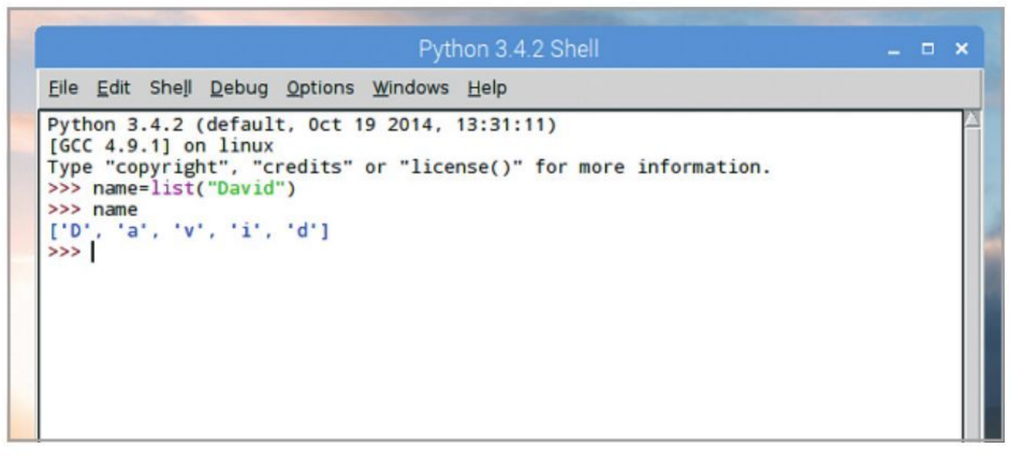
```
text="January,February,March,April,May,June"
months=text.split(",")
months
```

STEP 4

You've previously seen how you can split a string into individual letters as a list, using a name:

```
name=list("David")
name
```

The returned value is 'D', 'a', 'v', 'i', 'd'. Whilst it may seem a little useless under ordinary circumstances, it could be handy for creating a spelling game for example.

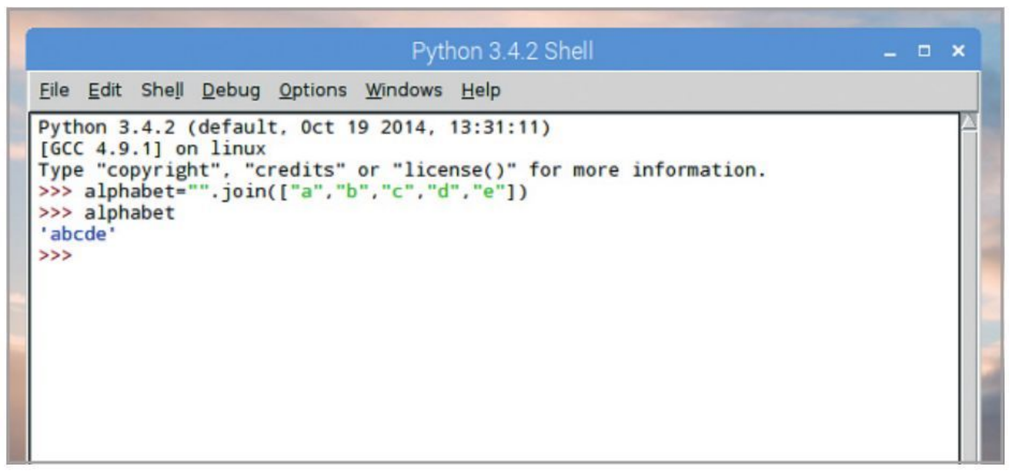


STEP 5

The opposite of the .split function is .join, where you will have separate items in a string and can join them all together to form a word or just a combination of items, depending on the program you're writing. For instance:

```
alphabet="".join(["a","b","c","d","e"])
alphabet
```

This will display 'abcde' in the Shell.

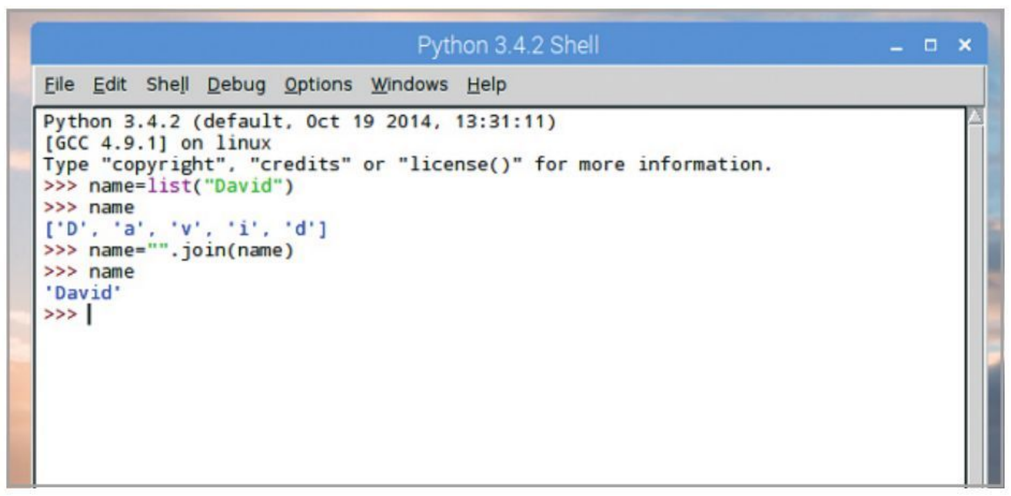


STEP 6

You can therefore apply .join to the separated name you made in Step 4, combining the letters again to form the name:

```
name="".join(name)
name
```

We've joined the string back together, and retained the list called name, passing it through the .join function.

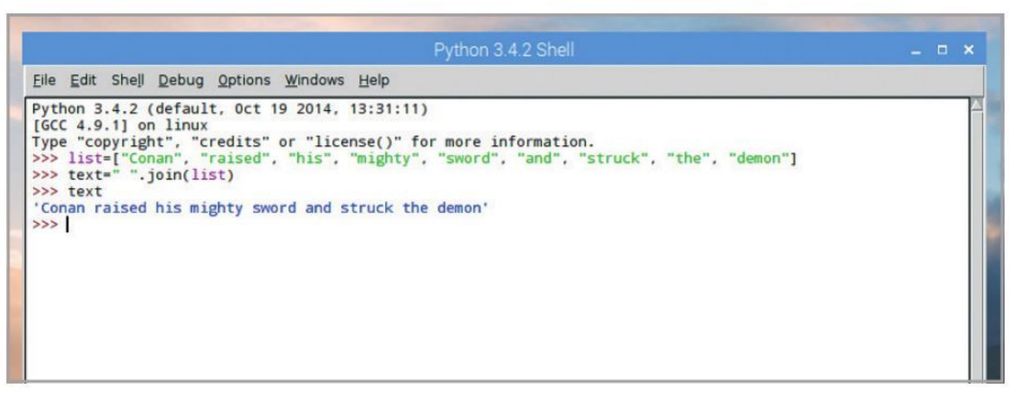


STEP 7

A good example of using the .join function is when you have a list of words you want to combine into a sentence:

```
list=["Conan", "raised", "his", "mighty", "sword",
"and", "struck", "the", "demon"]
text=" ".join(list)
text
```

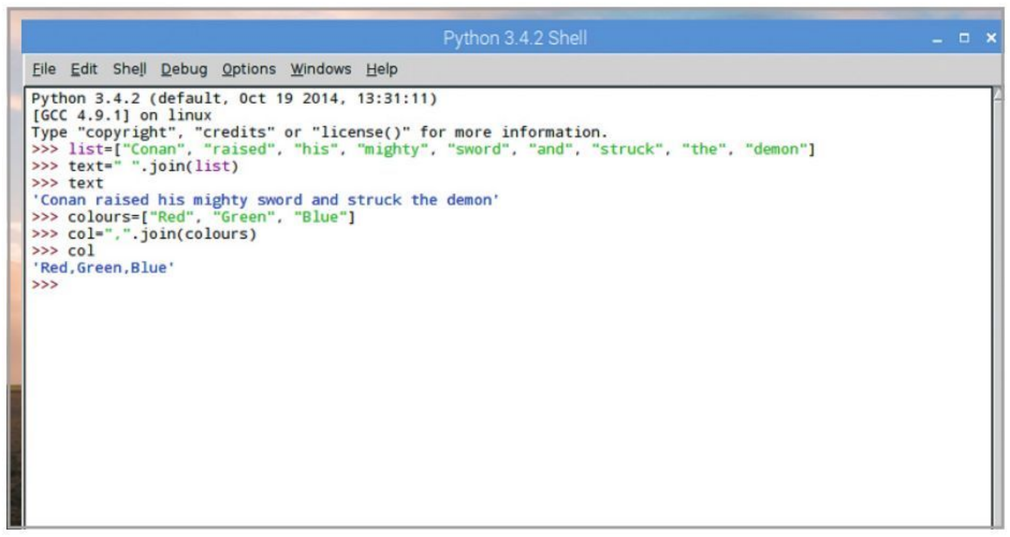
Note the space between the quotes before the .join function (where there were no quotes in Step 6's .join).



STEP 8

As with the .split function, the separator doesn't have to be a space, it can also be a comma, a full stop, a hyphen or whatever you like:

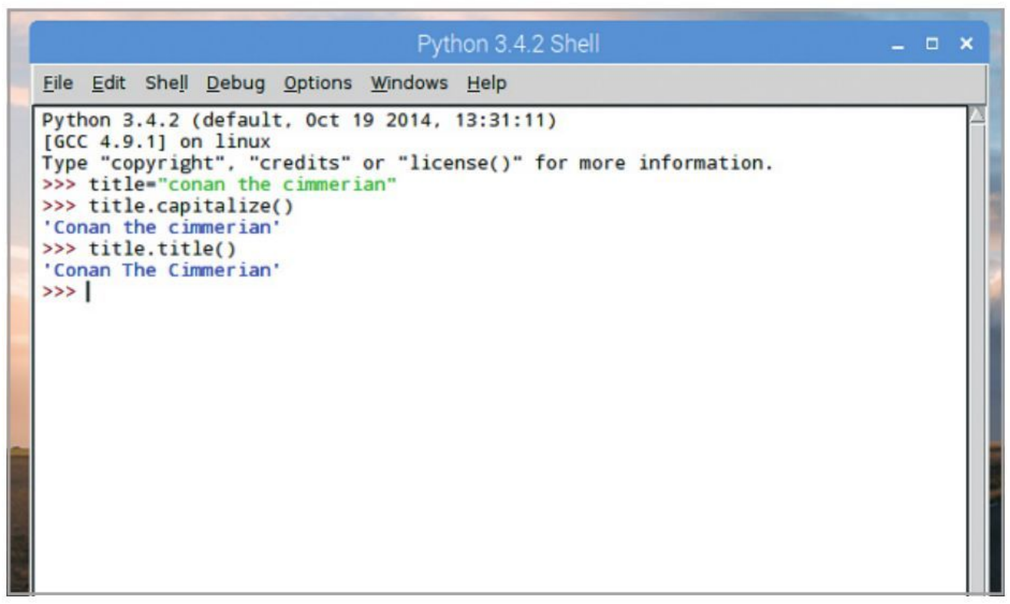
```
colours=["Red", "Green", "Blue"]
col=",".join(colours)
col
```



STEP 9

There's some interesting functions you apply to a string, such as .capitalize and .title. For example:

```
title="conan the cimmerian"
title.capitalize()
title.title()
```



STEP 10

You can also use logic operators on strings, with the 'in' and 'not in' functions. These enable you to check if a string contains (or does not contain) a sequence of characters:

```
message="Have a nice day"
"nice" in message

"bad" not in message
"day" not in message
"night" in message
```

Formatting Strings

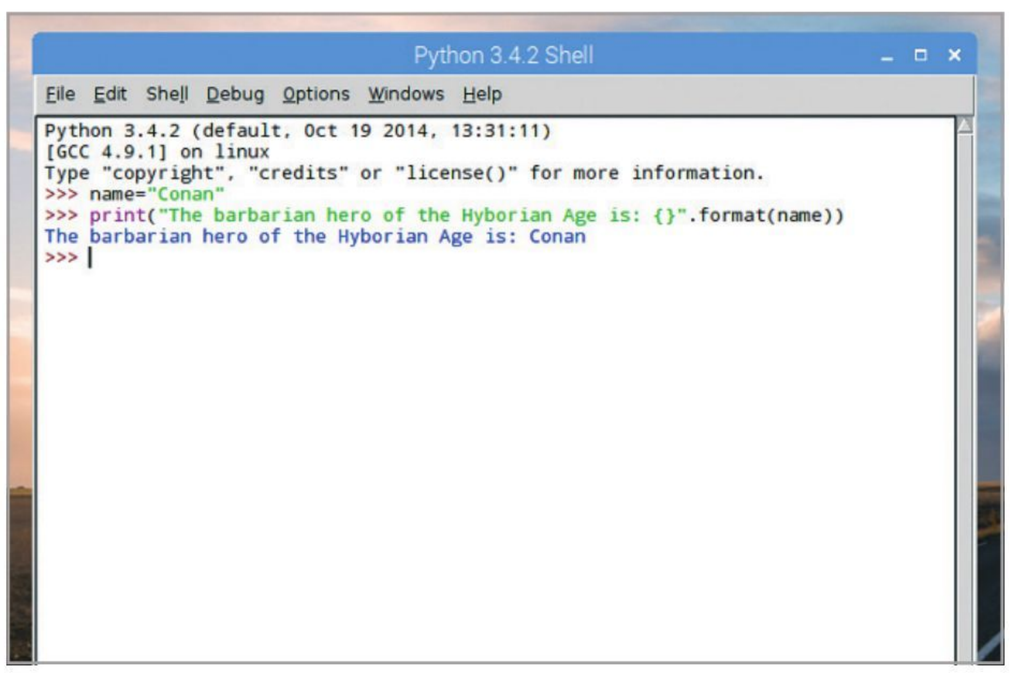
When you work with data, creating lists, dictionaries and objects you may often want to print out the results. Merging strings with data is easy especially with Python 3, as earlier versions of Python tended to complicate matters.

STRING FORMATTING

Since Python 3, string formatting has become a much neater process, using the .format function combined with curly brackets. It's a more logical and better formed approach than previous versions.

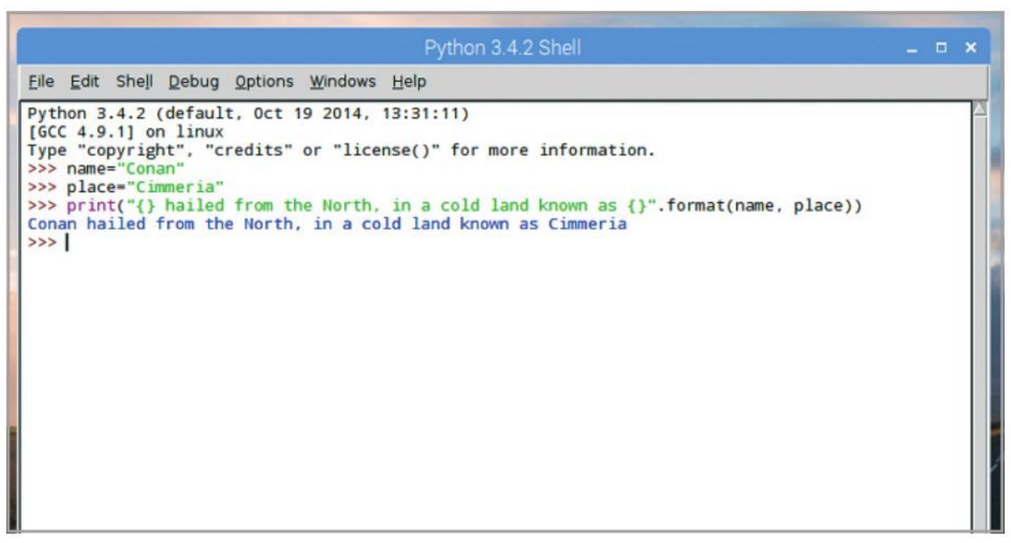
STEP 1 The basic formatting in Python is to call each variable into the string using the curly brackets:

```
name=”Conan”
print(“The barbarian hero of the Hyborian Age is: {}”.format(name))
```



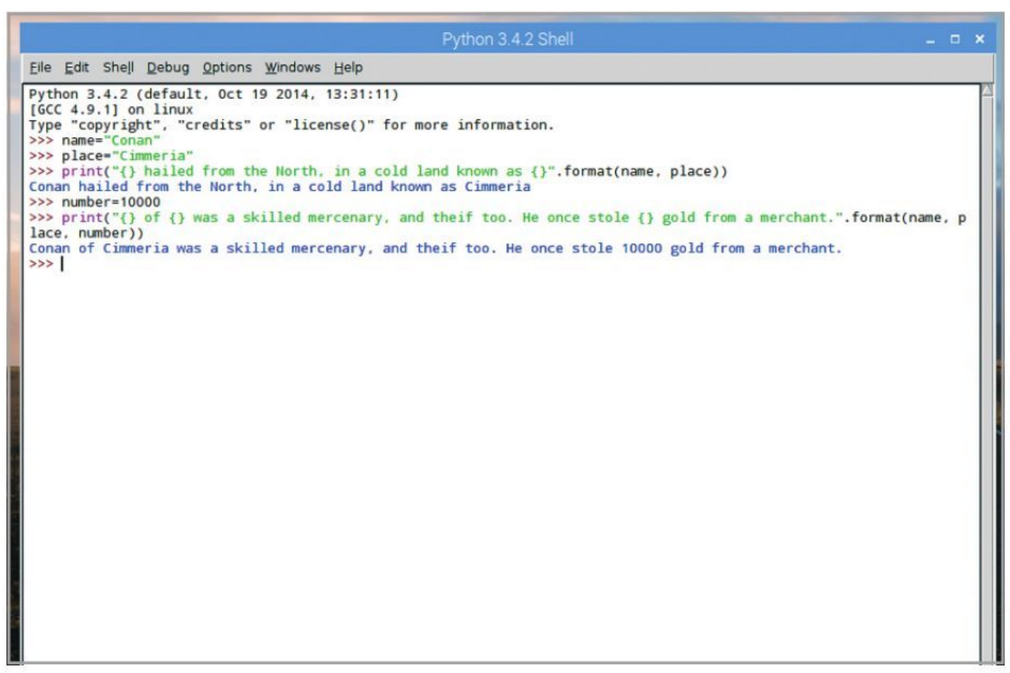
STEP 2 Remember to close the print function with two sets of brackets, as you've encased the variable in one, and the print function in another. You can include multiple cases of string formatting in a single print function:

```
name=”Conan”
place=”Cimmeria”
print(“{} hailed from the North, in a cold land known as {}”.format(name, place))
```

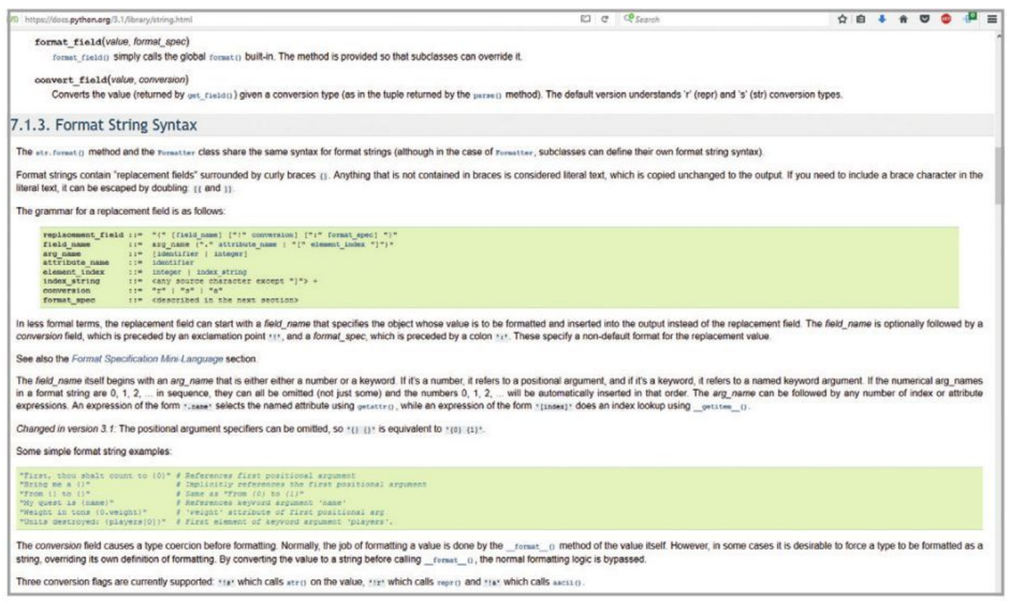


STEP 3 You can of course also include integers into the mix:

```
number=10000
print(“{} of {} was a skilled mercenary, and thief too. He once stole {} gold from a merchant.”.format(name, place, number))
```

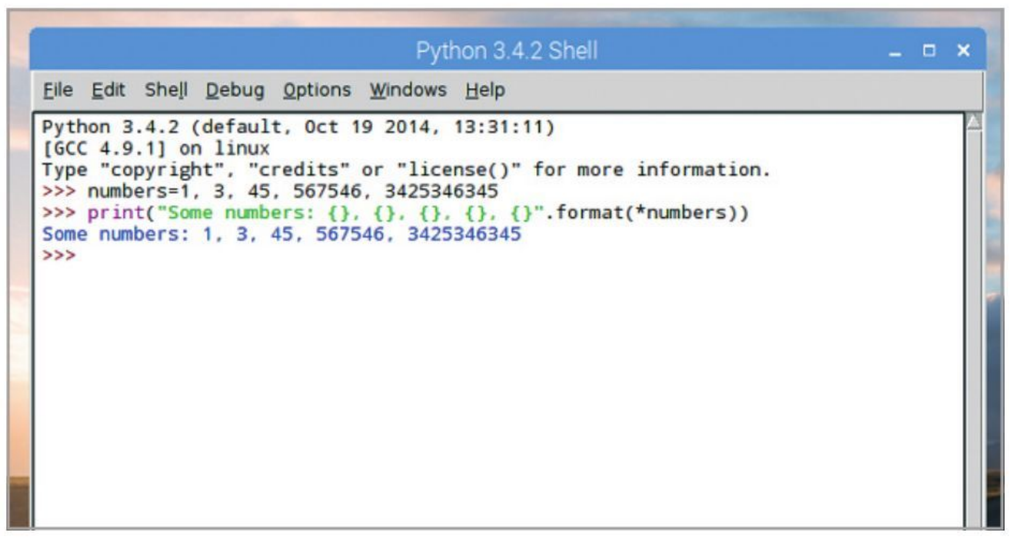


STEP 4 There are many different ways to apply string formatting, some are quite simple, as we've shown you here; others can be significantly more complex. It all depends on what you want from your program. A good place to reference frequently regarding string formatting is the Python Docs webpage, found at www.docs.python.org/3.1/library/string.html. Here, you will find tons of help.



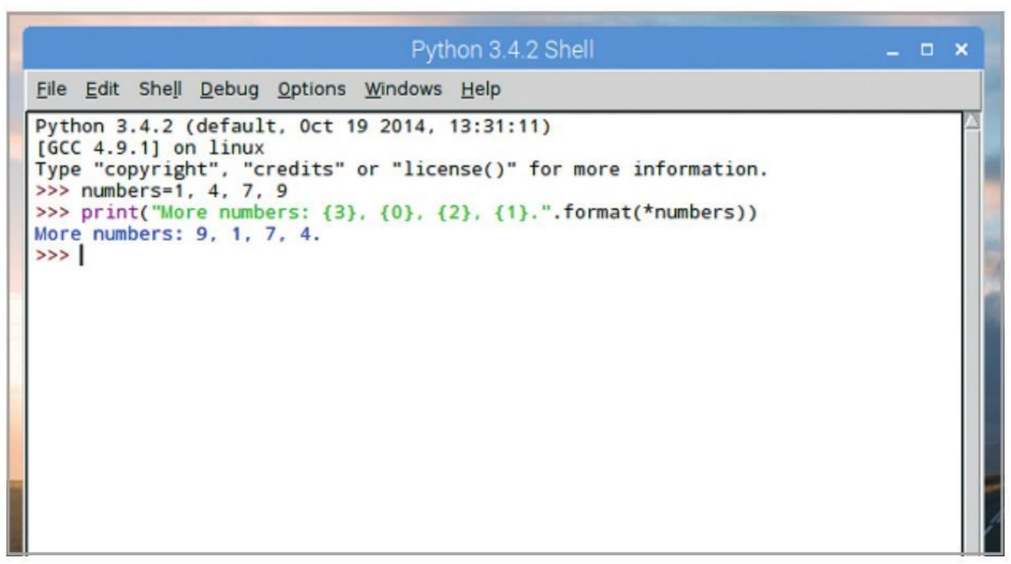
STEP 5 Interestingly you can reference a list using the string formatting function. You need to place an asterisk in front of the list name:

```
numbers=1, 3, 45, 567546, 3425346345
print("Some numbers: {}, {}, {}, {}, {}".
format(*numbers))
```



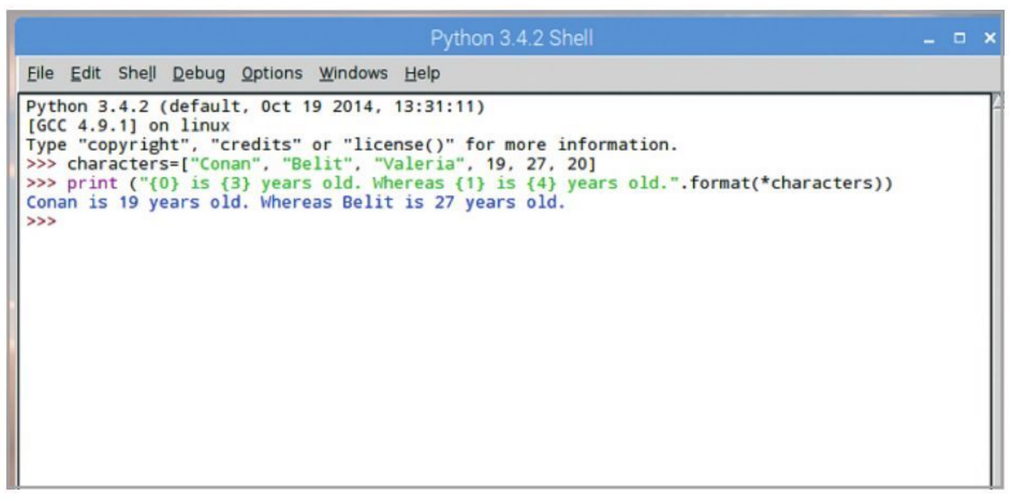
STEP 6 With indexing in lists, the same applies to calling a list using string formatting. You can index each item according to its position (from 0 to however many are present):

```
numbers=1, 4, 7, 9
print("More numbers: {3}, {0}, {2},
{1}.".format(*numbers))
```



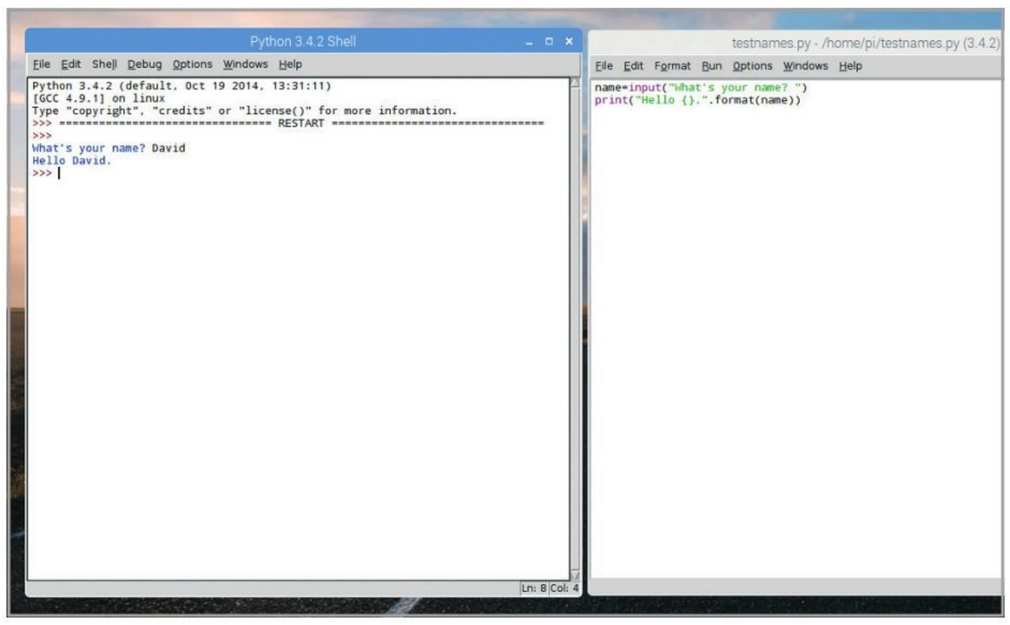
STEP 7 And as you probably suspect, you can mix strings and integers in a single list to be called in the .format function:

```
characters=["Conan", "Belit", "Valeria",
19, 27, 20]
print ("{0} is {3} years old. Whereas {1} is {4}
years old.".format(*characters))
```



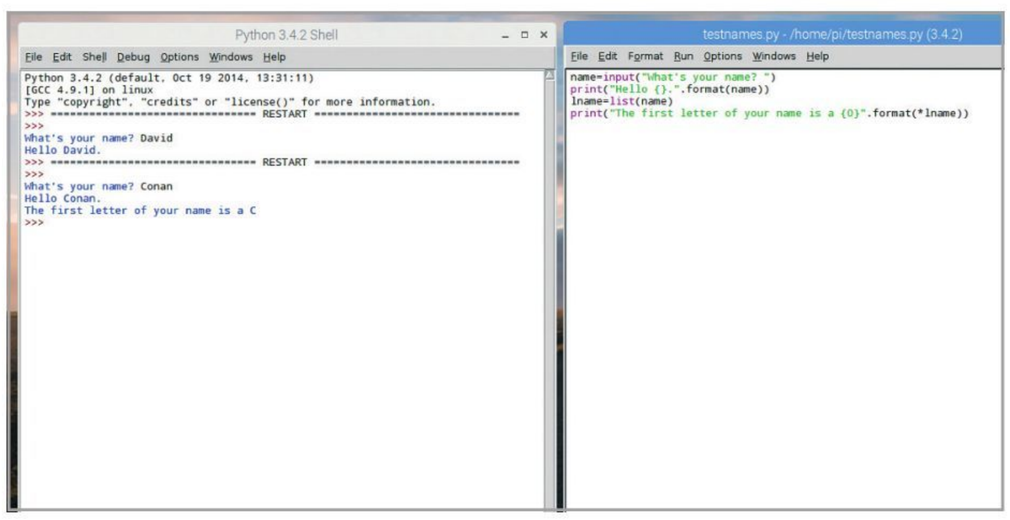
STEP 8 You can also print out the content of a user's input in the same fashion:

```
name=input("What's your name? ")
print("Hello {}.".format(name)
```



STEP 9 You can extend this simple code example to display the first letter in a person's entered name:

```
name=input("What's your name? ")
print("Hello {}.".format(name))
lname=list(name)
print("The first letter of your name is a {0}".
format(*lname))
```



STEP 10 You can also call upon a pair of lists and reference them individually within the same print function. Looking back the code from Step 7, you can alter it with:

```
names=["Conan", "Belit", "Valeria"]
ages=[25, 21, 22]
```

Creating two lists. Now you can call each list, and individual items:

```
print("{0[0]} is {1[0]} years old. Whereas {0[1]}
is {1[1]} years old.".format(names, ages))
```