

**Learn Python in One Day and Learn It Well Python for Beginners with Hands-on Project The only book you need to start coding in Python immediately**

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<http://www.learncodingfast.com/python>

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**Preface**

This book is written to help you learn Python programming FAST and learn it WELL. If you are an absolute beginner in Programming, you'll find that this book explains complex concepts in an easy to understand manner. Examples are carefully chosen to demonstrate each concept so that you can gain a deeper understand of the language. If you are an experienced coder, this book gives you a good base from which to explore Python. The appendices at the end of the book will also provide you with a convenient reference for some of the commonly used   
functions in Python.

In addition, as Richard Branson puts it: "The best way of learning about anything is by doing". At the end of the course, you'll be guided through a project that gives you a chance to put what you've learned to use.

You can download the source code for the project and the appendices at <http://www.learncodingfast.com/python>.

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**Chapter 1: Python, what Python?**

Welcome to the exciting world of programming. I'm so glad you picked up this book and I sincerely hope this book can help you master the Python language and experience the exhilaration of programming. Before we dive into the nuts and bolts of Python programming, let us first answer a few questions.

**What is Python?**

Python is a widely used high-level programming language created by Guido van Rossum in the late 1980s. The language places strong emphasis on code readability and simplicity, making it possible for programmers to develop applications rapidly.

Like all high level programming languages, Python code resembles the English language which computers are unable to understand. Codes that we write in Python have to be interpreted by a special program known as the Python interpreter, which we’ll have to install before we can code, test and execute our Python programs. We'll look at how to install the Python interpreter in Chapter 2.

There are also a number of third-party tools, such as Py2exe or   
Pyinstaller that allow us to package our Python code into stand-alone executable programs for some of the most popular operating systems like Windows and Mac OS. This allows us to distribute our Python programs without requiring the users to install the Python interpreter.

**Why Learn Python?**

There are a large number of high level programming languages available, such as C, C++, and Java. The good news is all high level programming languages are very similar to one another. What differs is mainly the syntax, the libraries available and the way we access those libraries. A library is simply a collection of resources and pre-written codes that we can use when we write our programs. If you learn one language well, you can easily learn a new language in a fraction of the time it took you to learn the first language.

If you are new to programming, Python is a great place to start. One of the key features of Python is its simplicity, making it the ideal language for beginners to learn. Most programs in Python require considerably fewer lines of code to perform the same task compared to other   
languages such as C. This leads to fewer programming errors and reduces the development time needed. In addition, Python comes with an extensive collection of third party resources that extend the capabilities of the language. As such, Python can be used for a large variety of tasks, such as for desktop applications, database applications, network   
programming, game programming and even mobile development. Last but not least, Python is a cross platform language, which means that code written for one operating system, such as Windows, will work well on Mac OS or Linux without making any changes to the Python code.

Convinced that Python is THE language to learn? Let’s get started...

**Chapter 2: Getting ready for Python**

**Installing the Interpreter**

Before we can write our first Python program, we have to download the appropriate interpreter for our computers.

We’ll be using Python 3 in this book because as stated on the official Python site “*Python 2.x is legacy, Python 3.x is the present and future of the language*”. In addition, “*Python 3 eliminates many quirks that can unnecessarily trip up beginning programmers*”.

However, note that Python 2 is currently still rather widely used. Python 2 and 3 are about 90% similar. Hence if you learn Python 3, you will likely have no problems understanding codes written in Python 2.

To install the interpreter for Python 3, head over to   
<https://www.python.org/downloads/>. The correct version should be   
indicated at the top of the webpage. Click on the version for Python 3 and the software will start downloading.



Alternatively if you want to install a different version, scroll down the page and you’ll see a listing of other versions. Click on the release version that you want. We’ll be using version 3.4.2 in this book. You’ll be redirected to the download page for that version.

Scroll down towards the end of the page and you’ll see a table listing various installers for that version. Choose the correct installer for your

computer. The installer to use depends on two factors:

1. The operating system (Windows, Mac OS, or Linux) and 2. The processor (32-bit vs 64-bit) that you are using.

For instance, if you are using a 64-bit Windows computer, you will likely be using the "**Windows** x86-**64** MSI installer". Just click on the link to download it. If you download and run the wrong installer, no worries. You will get an error message and the interpreter will not install. Simply download the correct installer and you are good to go.

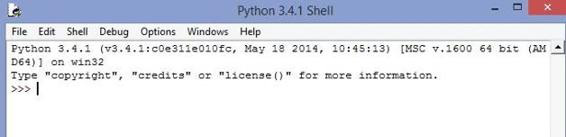
Once you have successfully installed the interpreter, you are ready to start coding in Python.

**Using the Python Shell, IDLE and Writing our FIRST program**

We’ll be writing our code using the IDLE program that comes bundled with our Python interpreter.

To do that, let’s first launch the IDLE program. You launch the IDLE program like how you launch any other programs. For instance on Windows 8, you can search for it by typing “IDLE” in the search box.

Once it is found, click on IDLE (Python GUI) to launch it. You’ll be presented with the Python Shell shown below.



The Python Shell allows us to use Python in interactive mode. This means we can enter one command at a time. The Shell waits for a command from the user, executes it and returns the result of the execution. After this, the Shell waits for the next command.

Try typing the following into the Shell. The lines starting with >>> are the commands you should type while the lines after the commands show the results.

>>> 2+3   
5   
>>> 3>2   
True   
>>> print (‘Hello World’)   
Hello World

When you type 2+3, you are issuing a command to the Shell, asking it to evaluate the value of 2+3. Hence, the Shell returns the answer 5. When you type 3>2, you are asking the Shell if 3 is greater than 2. The Shell replies True. Finally, print is a command asking the Shell to display the line Hello World.

The Python Shell is a very convenient tool for testing Python commands, especially when we are first getting started with the language. However, if you exit from the Python Shell and enter it again, all the commands you type will be gone. In addition, you cannot use the Python Shell to create an actual program. To code an actual program, you need to write your code in a text file and save it with a .py extension. This file is known as a Python script.

To create a Python script, click on File > New File in the top menu of our Python Shell. This will bring up the text editor that we are going to use to write our very first program, the “Hello World” program. Writing the “Hello World” program is kind of like the rite of passage for all new   
programmers. We’ll be using this program to familiarize ourselves with the IDLE software.

Type the following code into the text editor (not the Shell).

#Prints the Words “Hello World”print (“Hello World”)

You should notice that the line #Prints the Words “Hello World”is in red while the word “print” is in purple and “Hello World” is in green. This is the software’s way of making our code easier to read. The words “print” and “Hello World” serve different purposes in our program, hence they are displayed using different colors. We’ll go into more details in later chapters.

The line #Prints the Words “Hello World” (in red) is actually not part of the program. It is a comment written to make our code more readable for other programmers. This line is ignored by the Python interpreter. To add comments to our program, we type a # sign in front of each line of comment, like this:

#This is a comment   
#This is also a comment   
#This is yet another comment

Alternatively, we can also use three single quotes (or three double quotes) for multiline comments, like this:

’’’  
This is a comment   
This is also a comment   
This is yet another comment  
’’’

Now click File > Save As… to save your code. Make sure you save it with the .py extension.

Done? Voilà! You have just successfully written your first Python program.

Finally click on Run > Run Module to execute the program (or press F5). You should see the words Hello World printed on your Python Shell.

To see these steps in action, you can check out this excellent tutorial by mybringback:   
<https://www.youtube.com/watch?v=pEFr1eYIePw>.

However, note that he used Python 2 in the video, so some commands will give you an error. If you want to try his codes, you need to add ( ) for

the print statements. Instead of writing print ‘Hello World’, you have to write print (‘Hello World’). In addition, you have to change raw\_input() to input(). We’ll cover print() and input() in Chapter 5.

**Chapter 3: The World of Variables and Operators**

Now that we’re done with the introductory stuff, let’s get down to the real stuff. In this chapter, you’ll learn all about variables and operators. Specifically, you’ll learn what variables are and how to name and declare them. We’ll also learn about the common operations that we can perform on them. Ready? Let’s go.

**What are variables?**

Variables are names given to data that we need to store and manipulate in our programs. For instance, suppose your program needs to store the age of a user. To do that, we can name this data userAge and define the variable userAge using the following statement.

userAge = 0

After you define the variable userAge, your program will allocate a certain area of your computer's storage space to store this data. You can then access and modify this data by referring to it by its name, userAge. Every time you declare a new variable, you need to give it an initial value. In this example, we gave it the value 0. We can always change this value in our program later.

We can also define multiple variables at one go. To do that simply write

userAge, userName = 30, ‘Peter’

This is equivalent to

userAge = 30   
userName = ‘Peter’

**Naming a Variable**

A variable name in Python can only contain letters (a - z, A - B), numbers or underscores (\_). However, the first character cannot be a number.

Hence, you can name your variables userName, user\_name or userName2 but not 2userName.

In addition, there are some reserved words that you cannot use as a variable name because they already have preassigned meanings in Python. These reserved words include words like print, input, if, while*etc.* We’ll learn about each of them in subsequent chapters.

Finally, variable names are case sensitive. username is not the same as userName.

There are two conventions when naming a variable in Python. We can either use the camel case notation or use underscores. Camel case is the practice of writing compound words with mixed casing (e.g.

thisIsAVariableName). This is the convention that we’ll be using in the rest of the book. Alternatively, another common practice is to use underscores (\_) to separate the words. If you prefer, you can name your variables like this: this\_is\_a\_variable\_name.

**The Assignment Sign**

Note that the = sign in the statement userAge = 0 has a different meaning from the = sign we learned in Math. In programming, the = sign is known as an assignment sign. It means we are assigning the value on the right side of the = sign to the variable on the left. A good way to understand the statement userAge = 0 is to think of it as userAge <-0.

The statements x = y and y = x have very different meanings in programming.

Confused? An example will likely clear this up.

Type the following code into your IDLE editor and save it.

x = 5   
y = 10   
x = y   
print ("x = ", x)   
print ("y = ", y)

Now run the program. You should get this output:

x = 10   
y = 10

Although x has an initial value of 5 (declared on the first line), the third line x = y assigns the value of y to x (x <- y), hence changing the value of x to 10 while the value of y remains unchanged.

Next, modify the program by changing ONLY ONE statement: Change

the third line from x = y to y = x. Mathematically, x = y and y = x mean the same thing. However, this is not so in programming.

Run the second program. You will now get

x = 5   
y = 5

You can see that in this example, the x value remains as 5, but the value of y is changed to 5. This is because the statement y = x assigns the value of x to y (y <- x). y becomes 5 while x remains unchanged as 5.

**Basic Operators**

Besides assigning a variable an initial value, we can also perform the usual mathematical operations on variables. Basic operators in Python include +, -, *, , /, % and* \* which represent addition, subtraction,   
multiplication, division, floor division, modulus and exponent respectively.

Example:

Suppose x = 5, y = 2

Addition: x + y = 7

Subtraction: x - y = 3

Multiplication: x\*y = 10

Division: x/y = 2.5

Floor Division: x//y = 2 (rounds down the answer to the nearest whole number)   
Modulus: x%y = 1 (gives the remainder when 5 is divided by 2) Exponent: x\*\*y = 25 (5 to the power of 2)

**More Assignment Operators**

Besides the = sign, there are a few more assignment operators in Python (and most programming languages). These include operators like +=, -= and \*=.

Suppose we have the variable x, with an initial value of 10. If we want to increment x by 2, we can write   
x = x + 2

The program will first evaluate the expression on the right (x + 2) and assign the answer to the left. So eventually the statement above   
becomes x <- 12.

Instead of writing x = x + 2, we can also write x += 2 to express the same meaning. The += sign is actually a shorthand that combines the assignment sign with the addition operator. Hence, x += 2 simply means x = x + 2.

Similarly, if we want to do a subtraction, we can write x = x - 2 or x -= 2. The same works for all the 7 operators mentioned in the section above.

**Chapter 4: Data Types in Python**

In this chapter, we’ll first look at some basic data types in Python,   
specifically the integer, float and string. Next, we’ll explore the concept of type casting. Finally, we’ll discuss three more advanced data types in Python: the list, tuple and dictionary.

**Integers**   
Integers are numbers with no decimal parts, such as -5, -4, -3, 0, 5, 7 etc.

To declare an integer in Python, simply write variableName =

initial value

Example:

userAge = 20, mobileNumber = 12398724

**Float**   
Float refers to numbers that have decimal parts, such as 1.234, -0.023,

12.01.

To declare a float in Python, we write variableName = initial

value

Example:

userHeight = 1.82, userWeight = 67.2

**String**

String refers to text.

To declare a string, you can either use variableName = ‘initial value’ (single quotes) or variableName = “initial value”(double quotes)

Example:   
userName = ‘Peter’, userSpouseName = “Janet”, userAge = ‘30’

In the last example, because we wrote userAge = ‘30’, userAge is a string. In contrast, if you wrote userAge = 30 (without quotes),   
userAge is an integer.

We can combine multiple substrings by using the concatenate sign (+). For instance, “Peter” + “Lee” is equivalent to the string  
“PeterLee”.

Built-In String Functions

Python includes a number of built-in functions to manipulate strings. A function is simply a block of reusable code that performs a certain task. We’ll discuss functions in greater depth in Chapter 7.

An example of a function available in Python is the upper() method for strings. You use it to capitalize all the letters in a string. For instance,‘Peter’.upper() will give us the string “PETER”. You can refer to Appendix A for more examples and sample codes on how to use   
Python’s built-in string methods.

Formatting Strings using the % Operator

Strings can also be formatted using the % operator. This gives you greater control over how you want your string to be displayed and stored.

The syntax for using the % operator is

“string to be formatted” %(values or variables to be inserted into string, separated by commas)

There are three parts to this syntax. First we write the string to be formatted in quotes. Next we write the % symbol. Finally, we have a pair of round brackets ( ) within which we write the values or variables to be inserted into the string. This round brackets with values inside is actually known as a tuple, a data type that we’ll cover in the chapter later.

Type the following code in IDLE and run it.

brand = ‘Apple’  
exchangeRate = 1.235235245

message = ‘The price of this %s laptop is %d USD and the exchange rate is %4.2f USD to 1 EUR’ %(brand, 1299, exchangeRate)

print (message)

In the example above, the string ‘The price of this %s laptop is %d USD and the exchange rate is %4.2f USD to 1 EUR’is the string that we want to format. We use the %s, %d and %4.2f formatters as placeholders in the string.

These placeholders will be replaced with the variable brand, the value 1299 and the variable exchangeRate respectively, as indicated in the

round brackets. If we run the code, we’ll get the output below.

The price of this Apple laptop is 1299 USD and the exchange rate is 1.24 USD to 1 EUR

The %s formatter is used to represent a string (“Apple” in this case) while the %d formatter represents an integer (1299). If we want to add spaces before an integer, we can add a number between % and d to indicate the desired length of the string. For instance “%5d” %(123) will give us “123” (with 2 spaces in front and a total length of 5).

The %f formatter is used to format floats (numbers with decimals). Here we format it as %4.2f where 4 refers to the total length and 2 refers to 2 decimal places. If we want to add spaces before the number, we can format is as %7.2f, which will give us “ 1.24” (with 2 decimal places, 3 spaces in front and a total length of 7).

Formatting Strings using the format() method

In addition to using the % operator to format strings, Python also provides us with the format() method to format strings. The syntax is

“string to be formatted”.format(values or variables to be inserted into string, separated by commas)

When we use the format method, we do not use %s, %f or %d as placeholders. Instead we use curly brackets, like this:

message = ‘The price of this **{0:s}** laptop is **{1:d}** USD and the exchange rate is **{2:4.2f}** USD to 1   
EUR’.format(‘Apple’, 1299, 1.235235245)

Inside the curly bracket, we first write the position of the parameter to

use, followed by a colon. After the colon, we write the formatter. There should not be any spaces within the curly brackets.

When we write format(‘Apple’, 1299, 1.235235245), we are passing in three parameters to the format() method. Parameters are data that the method needs in order to perform its task. The parameters are ‘Apple’, 1299 and 1.235235245.

The parameter ‘Apple’ has a position of 0, 1299 has a position of 1 and   
1.235235245 has a position of 2.

Positions always start from ZERO.

When we write {0:s}, we are asking the interpreter to replace {0:s} with the parameter in position 0 and that it is a string (because the formatter is‘s’).

When we write {1:d}, we are referring to the parameter in position 1, which is an integer (formatter is d).

When we write {2:4.2f}, we are referring to the parameter in position 2, which is a float and we want it to be formatted with 2 decimal places and a total length of 4 (formatter is 4.2f).

If we print message, we’ll get   
The price of this Apple laptop is 1299 USD and the exchange rate is 1.24 USD to 1 EUR

Note: If you do not want to format the string, you can simply write

message = ‘The price of this {} laptop is {} USD and the exchange rate is {} USD to 1 EUR’.format(‘Apple’,

1299, 1.235235245)

Here we do not have to specify the position of the parameters. The interpreter will replace the curly brackets based on the order of the parameters provided. We’ll get

The price of this Apple laptop is 1299 USD and the exchange rate is 1.235235245 USD to 1 EUR

The format() method can be kind of confusing to beginners. In fact, string formatting can be more fanciful than what we’ve covered here, but what we’ve covered is sufficient for most purposes. To get a better understanding of the format() method, try the following program.

message1 = ‘{0} is easier than {1}’.format(‘Python’,‘Java’)   
message2 = ‘{1} is easier than {0}’.format(‘Python’,‘Java’)   
message3 = ‘{:10.2f} and {:d}’.format(1.234234234, 12) message4 = ‘{}’.format(1.234234234)

print (message1)   
#You’ll get ‘Python is easier than Java’

print (message2)   
#You’ll get ‘Java is easier than Python’

print (message3)   
#You’ll get ‘ 1.23 and 12’  
#You do not need to indicate the positions of the parameters.

print (message4)   
#You’ll get 1.234234234. No formatting is done.

You can use the Python Shell to experiment with the format() method. Try typing in various strings and see what you get.

**Type Casting In Python**

Sometimes in our program, it is necessary for us to convert from one data type to another, such as from an integer to a string. This is known as type casting.

There are three built-in functions in Python that allow us to do type casting. These are the int(), float(), and str() functions.

The int() function in Python takes in a float or an appropriate string and converts it to an integer. To change a float to an integer, we can type int(5.712987). We’ll get 5 as the result (anything after the decimal point is removed). To change a string to an integer, we can type int (“4”) and we’ll get 4. However, we cannot type int (“Hello”) or int (“4.22321”). We’ll get an error in both cases.

The float() function takes in an integer or an appropriate string and changes it to a float. For instance, if we type float(2) or float(“2”), we’ll get 2.0. If we type float(“2.09109”), we’ll get 2.09109 which is a float and not a string since the quotation marks are removed.

The str() function on the other hand converts an integer or a float to a string. For instance, if we type str(2.1), we’ll get “2.1”.

Now that we’ve covered the three basic data types in Python and their casting, let’s move on to the more advanced data types.

**List**

List refers to a collection of data which are normally related. Instead of storing these data as separate variables, we can store them as a list. For instance, suppose our program needs to store the age of 5 users. Instead of storing them as user1Age, user2Age, user3Age, user4Age and user5Age, it makes more sense to store them as a list.

To declare a list, you write listName = [initial values]. Note that we use square brackets [ ] when declaring a list. Multiple values are separated by a comma.

Example:   
userAge = [21, 22, 23, 24, 25]

We can also declare a list without assigning any initial values to it. We simply write listName = []. What we have now is an empty list with no items in it. We have to use the append() method mentioned below to add items to the list.

Individual values in the list are accessible by their indexes, and indexes always start from ZERO, not 1. This is a common practice in almost all programming languages, such as C and Java. Hence the first value has an index of 0, the next has an index of 1 and so forth. For instance, userAge[0] = 21, userAge[1] = 22

Alternatively, you can access the values of a list from the back. The last item in the list has an index of -1, the second last has an index of -2 and so forth. Hence, userAge[-1] = 25, userAge[-2] = 24.

You can assign a list, or part of it, to a variable. If you write userAge2 = userAge, the variable userAge2 becomes [21, 22, 23, 24, 25].

If you write userAge3 = userAge[2:4], you are assigning items with index 2 to index 4-1 from the list userAge to the list userAge3. In other words, userAge3 = [23, 24].

The notation 2:4 is known as a slice. Whenever we use the slice notation in Python, the item at the start index is always included, but the item at the end is always excluded. Hence the notation 2:4 refers to items from index 2 to index 4-1 (i.e. index 3), which is why userAge3 = [23, 24] and not [23, 24, 25].

The slice notation includes a third number known as the stepper. If we write userAge4 = userAge[1:5:2], we will get a sub list consisting of every second number from index 1 to index 5-1 because the stepper is 2. Hence, userAge4 = [22, 24].

In addition, slice notations have useful defaults. The default for the first number is zero, and the default for the second number is size of the list being sliced. For instance, userAge[ :4] gives you values from index 0 to index 4-1 while userAge[1: ] gives you values from index 1 to index 5-1 (since the size of userAge is 5, *i.e.*userAge has 5 items).

To modify items in a list, we write listName[index of item to be modified] = new value. For instance, if you want to modify the second item, you write userAge[1] = 5. Your list becomes userAge = [21, 5, 23, 24, 25]

To add items, you use the append() function. For instance, if you write userAge.append(99), you add the value 99 to the end of the list. Your list is now userAge = [21, 5, 23, 24, 25, 99]

To remove items, you write del listName[index of item to be deleted]. For instance, if you write del userAge[2], your list now becomes userAge = [21, 5, 24, 25, 99] (the third item is

deleted)   
To fully appreciate the workings of a list, try running the following program.

#declaring the list, list elements can be of different data types myList = [1, 2, 3, 4, 5, “Hello”]

#print the entire list.

print(myList)   
#You’ll get [1, 2, 3, 4, 5, “Hello”]

#print the third item (recall: Index starts from zero).

print(myList[2])   
#You’ll get 3

#print the last item.   
print(myList[-1])   
#You’ll get “Hello”

#assign myList (from index 1 to 4) to myList2 and print myList2   
myList2 = myList[1:5]   
print (myList2)   
#You’ll get [2, 3, 4, 5]

#modify the second item in myList and print the updated list myList[1] = 20   
print(myList)   
#You’ll get [1, 20, 3, 4, 5, 'Hello']

#append a new item to myList and print the updated list myList.append(“How are you”)   
print(myList)   
#You’ll get [1, 20, 3, 4, 5, 'Hello', 'How are you']

#remove the sixth item from myList and print the updated list del   
myList[5]   
print(myList)   
#You’ll get [1, 20, 3, 4, 5, 'How are you']

There are a couple more things that you can do with a list. For sample codes and more examples on working with a list, refer to Appendix B.

**Tuple**

Tuples are just like lists, but you cannot modify their values. The initial values are the values that will stay for the rest of the program. An example where tuples are useful is when your program needs to store the names of the months of the year.

To declare a tuple, you write tupleName = (initial values). Notice that we use round brackets ( ) when declaring a tuple. Multiple values are separated by a comma.

Example:   
monthsOfYear = (“Jan”, “Feb”, “Mar”, “Apr”, “May”,“Jun”, “Jul”, “Aug”, “Sep”, “Oct”, “Nov”, “Dec”)

You access the individual values of a tuple using their indexes, just like with a list.

Hence, monthsOfYear[0] = “Jan”, monthsOfYear[-1] =“Dec”.

For more examples of what you can do with a tuple, check out Appendix C.

**Dictionary**

Dictionary is a collection of related data PAIRS. For instance, if we want to store the username and age of 5 users, we can store them in a dictionary.

To declare a dictionary, you write dictionaryName = {dictionary key : data}, with the requirement that dictionary keys must be unique (within one dictionary). That is, you cannot declare a dictionary like this myDictionary = {“Peter”:38, “John”:51, “Peter”:13}.

This is because “Peter” is used as the dictionary key twice. Note that we use curly brackets { } when declaring a dictionary. Multiple pairs are separated by a comma.

Example:   
userNameAndAge = {“Peter”:38, “John”:51, “Alex”:13,“Alvin”:“Not Available”}

You can also declare a dictionary using the dict( ) method. To declare the userNameAndAge dictionary above, you write

userNameAndAge = dict(Peter = 38, John = 51, Alex = 13, Alvin = “Not Available”)

When you use this method to declare a dictionary, you use round brackets ( ) instead of curly brackets { } and you do not put quotation marks for the dictionary keys.

To access individual items in the dictionary, we use the dictionary key, which is the first value in the {dictionary key : data} pair. For instance, to get John’s age, you write userNameAndAge[“John”].

You’ll get the value 51.

To modify items in a dictionary, we write   
dictionaryName[dictionary key of item to be modified] = new data. For instance, to modify the “John”:51 pair, we write userNameAndAge[“John”] = 21. Our dictionary now becomes userNameAndAge = {“Peter”:38, “John”:21, “Alex”:13,“Alvin”:“Not Available”}.

We can also declare a dictionary without assigning any initial values to it. We simply write dictionaryName = { }. What we have now is an empty dictionary with no items in it.

To add items to a dictionary, we write dictionaryName[dictionary key] = data. For instance, if we want to add “Joe”:40 to our dictionary, we write userNameAndAge[“Joe”] = 40. Our dictionary now becomes userNameAndAge = {“Peter”:38, “John”:21,“Alex”:13, “Alvin”:“Not Available”, “Joe”:40}

To remove items from a dictionary, we write del   
dictionaryName[dictionary key]. For instance, to remove the“Alex”:13 pair, we write del userNameAndAge[“Alex”]. Our dictionary now becomes userNameAndAge = {“Peter”:38,“John”:21, “Alvin”:“Not Available”, “Joe”:40}

Run the following program to see all these in action.

#declaring the dictionary, dictionary keys and data can be of different data types   
myDict = {“One”:1.35, 2.5:”Two Point Five”, 3:”+”, 7.9:2}

#print the entire dictionary

print(myDict)   
#You’ll get {2.5: 'Two Point Five', 3: '+', 'One': 1.35, 7.9: 2}   
#Note that items in a dictionary are not stored in the same order as the way you declare them.

#print the item with key = “One”. print(myDict[“One”])   
#You’ll get 1.35

#print the item with key = 7.9. print(myDict[7.9])   
#You’ll get 2

#modify the item with key = 2.5 and print the updated dictionary   
myDict[2.5] = “Two and a Half”  
print(myDict)   
#You’ll get {2.5: 'Two and a Half', 3: '+', 'One': 1.35, 7.9: 2}

#add a new item and print the updated dictionary myDict[“New item”] = “I’m new”   
print(myDict)   
#You’ll get {'New item': 'I’m new', 2.5: 'Two and a Half', 3: '+', 'One': 1.35, 7.9: 2}

#remove the item with key = “One” and print the updated dictionary   
del myDict[“One”]   
print(myDict)   
#You’ll get {'New item': 'I’m new', 2.5: 'Two and a Half', 3: '+', 7.9: 2}

For more examples and sample codes of working with a dictionary, you

can refer to Appendix D.

**Chapter 5: Making Your Program Interactive**

Now that we’ve covered the basics of variables, let us write a program that makes use of them. We’ll revisit the “Hello World” program we wrote in Chapter 2, but this time we’ll make it interactive. Instead of just saying hello to the world, we want the world to know our names and ages too. In order to do that, our program needs to be able to prompt us for   
information and display them on the screen.

Two built-in functions can do that for us: input() and print().

For now, let’s type the following program in IDLE. Save it and run it.

myName = input("Please enter your name: ") myAge = input("What about your age: ")

print ("Hello World, my name is", myName, "and I am", myAge, "years old.")

The program should prompt you for your name.

Please enter your name:

Supposed you entered James. Now press Enter and it’ll prompt you for your age.

What about your age:

Say you keyed in 20. Now press Enter again. You should get the following statement:

Hello World, my name is James and I am 20 years old.

**Input()**

In the example above, we used the input() function twice to get our user’s name and age.

myName = input("Please enter your name: ")   
The string “Please enter your name: ” is the prompt that will be displayed on the screen to give instructions to the user. After the user enters the relevant information, this information is stored **as a string** in the variable myName. The next input statement prompts the user for his age and stores the information **as a string** in the variable myAge.

The input() function differs slightly in Python 2 and Python 3. In Python 2, if you want to accept user input as a string, you have to use the   
raw\_input() function instead.

**Print()**   
The print() function is used to display information to users. It accepts

zero or more expressions as parameters, separated by commas.

In the statement below, we passed 5 parameters to the print()

function. Can you identify them?

print ("Hello World, my name is", myName, "and I am",

myAge, "years old.")

The first is the string ”Hello World, my name is”

The next is the variable myName declared using the input function earlier.

Next is the string “and I am”, followed by the variable myAge and

finally the string “years old.”.

Note that we do not use quotation marks when referring to the variables

myName and myAge. If you use quotation marks, you’ll get the output

Hello World, my name is myName and I am myAge years

old.

instead, which is obviously not what we want.

Another way to print a statement with variables is to use the % formatter

we learned in Chapter 4. To achieve the same output as the first print

statement above, we can write

print ("Hello World, my name is %s and I am %s years

old." %(myName, myAge))

Finally, to print the same statement using the format() method, we

write

print (“Hello World, my name is {} and I am {} years old”.format(myName, myAge))

The print() function is another function that differs in Python 2 and Python 3. In Python 2, you’ll write it without brackets, like this:

print "Hello World, my name is " + myName + " and I am " + myAge + " years old."

**Triple Quotes**   
If you need to display a long message, you can use the triple-quote

symbol (‘’’ or “””) to span your message over multiple lines. For instance,

print (‘’’Hello World.

My name is James and I am 20 years old.’’’)

will give you

Hello World.

My name is James and I am 20 years old.

This helps to increase the readability of your message.

**Escape Characters**

Sometimes we may need to print some special “unprintable” characters such as a tab or a newline. In this case, you need to use the \ (backslash) character to escape characters that otherwise have a different meaning.

For instance to print a tab, we type the backslash character before the letter t, like this: \t. Without the \ character, the letter t will be printed. With it, a tab is printed. Hence, if you type print (‘Hello\tWorld’), you’ll get Hello World

Other common uses of the backslash character are shown below. >>> shows the command and the following lines show the output.

\n (Prints a newline)

>>> print (‘Hello\nWorld’)   
Hello   
World

\\ (Prints the backslash character itself)

>>> print (‘\\’)

\

\” (Prints double quote, so that the double quote does not signal the end of the string)

>>> print (“I am 5'9\" tall”) I am 5’9” tall

\’ (Print single quote, so that the single quote does not signal the end of the string)

>>> print (‘I am 5\’9” tall’) I am 5’9” tall

If you do not want characters preceded by the \ character to be   
interpreted as special characters, you can use raw strings by adding an r before the first quote. For instance, if you do not want \t to be interpreted as a tab, you should type print (r‘Hello\tWorld’). You will get Hello\tWorld as the output.

**Chapter 6: Making Choices and Decisions**

Congratulations, you’ve made it to the most interesting chapter. I hope you’ve enjoyed the course so far. In this chapter, we’ll look at how to make your program smarter, capable of making choices and decisions. Specifically, we’ll be looking at the if statement, for loop and while loop. These are known as control flow tools; they control the flow of the program. In addition, we’ll also look at the try, except statement that determines what the program should do when an error occurs.

However, before we go into these control flow tools, we have to first look at condition statements.

**Condition Statements**

All control flow tools involve evaluating a condition statement. The program will proceed differently depending on whether the condition is met.

The most common condition statement is the comparison statement. If we want to compare whether two variables are the same, we use the == sign (double =). For instance, if you write x == y, you are asking the program to check if the value of x is equals to the value of y. If they are equal, the condition is met and the statement will evaluate to True. Else, the statement will evaluate to False.

Other comparison signs include != (not equals), < (smaller than), > (greater than), <= (smaller than or equals to) and >= (greater than or equals to). The list below shows how these signs can be used and gives examples of statements that will evaluate to True.

Not equals: 5 != 2

Greater than: 5>2

Smaller than: 2<5

Greater than or equals to: 5>=2   
5>=5

Smaller than or equals to: 2 <= 5   
2 <= 2

We also have three logical operators, and, or, not that are useful if we want to combine multiple conditions.

The and operator returns True if all conditions are met. Else it will return False. For instance, the statement 5==5 and 2>1 will return True since both conditions are True.

The or operator returns True if at least one condition is met. Else it will return False. The statement 5 > 2 or 7 > 10 or 3 == 2 will return True since the first condition 5>2 is True.

The not operator returns True if the condition after the not keyword is false. Else it will return False. The statement not 2>5 will return True since 2 is not greater than 5.

**If Statement**

The if statement is one of the most commonly used control flow   
statements. It allows the program to evaluate if a certain condition is met, and to perform the appropriate action based on the result of the   
evaluation. The structure of an if statement is as follows:   
if condition 1 is met: do A   
elif condition 2 is met: do B   
elif condition 3 is met: do C   
elif condition 4 is met: do D   
else:   
 do E

elif stands for “else if” and you can have as many elif statements as you like.

If you’ve coded in other languages like C or Java before, you may be surprised to notice that no parentheses ( ) are needed in Python after the if, elif and else keyword. In addition, Python does not use curly { } brackets to define the start and end of the if statement. Rather, Python uses indentation. Anything indented is treated as a block of code that will be executed if the condition evaluates to true.

To fully understand how the if statement works, fire up IDLE and key in the following code.

userInput = input('Enter 1 or 2: ')   
if userInput == "1": print ("Hello World") print (“How are you?”) elif userInput == "2": print ("Python   
Rocks!") print (“I love Python”) else:   
 print ("You did not enter a valid number")   
The program first prompts the user for an input using the input function. The result is stored in the userInput variable as a string.

Next the statement if userInput == "1": compares the   
userInput variable with the string “1”. If the value stored in userInput is “1”, the program will execute all statements that are indented until the indentation ends. In this example, it’ll print “Hello World”, followed by“How are you?”.

Alternatively, if the value stored in userInput is “2”, the program will print “Python Rocks”, followed by “I love Python”.

For all other values, the program will print “You did not enter a valid number”.

Run the program three times, enter 1, 2 and 3 respectively for each run. You’ll get the following output:   
Enter 1 or 2: 1   
Hello World   
How are you?

Enter 1 or 2: 2   
Python Rocks!   
I love Python

Enter 1 or 2: 3   
You did not enter a valid number

**Inline If**   
An inline if statement is a simpler form of an if statement and is more

convenient if you only need to perform a simple task. The syntax is:

do Task A if condition is true else do Task B

For instance,

num1 = 12 if myInt==10 else 13

This statement assigns 12 to num1 (Task A) if myInt equals to 10. Else it

assigns 13 to num1 (Task B).

Another example is

print (“This is task A” if myInt == 10 else “This is

task B”)

This statement prints “This is task A” (Task A) if myInt equals to

10. Else it prints “This is task B” (Task B).

**For Loop**   
Next, let us look at the for loop. The for loop executes a block of code

repeatedly until the condition in the for statement is no longer valid.

*Looping through an iterable*

In Python, an iterable refers to anything that can be looped over, such as

a string, list or tuple. The syntax for looping through an iterable is as

follows:

for a in iterable:

print (a)

Example:

pets = ['cats', 'dogs', 'rabbits', 'hamsters']

for myPets in pets:

print (myPets)

In the program above, we first declare the list pets and give it the

members 'cats', 'dogs', 'rabbits' and 'hamsters'. Next the

statement for myPets in pets: loops through the pets list and

assigns each member in the list to the variable myPets.

The first time the program runs through the for loop, it assigns ‘cats’

to the variable myPets. The statement print (myPets) then prints the

value ‘cats’. The second time the programs loops through the for

statement, it assigns the value ‘dogs’ to myPets and prints the value

‘dogs’. The program continues looping through the list until the end of

the list is reached.

If you run the program, you’ll get

cats   
dogs   
rabbits   
hamsters

We can also display the index of the members in the list. To do that, we use the enumerate() function.

for index, myPets in enumerate(pets): print (index, myPets)

This will give us the output

0 cats   
1 dogs   
2 rabbits   
3 hamster

The next example shows how to loop through a string.

message = ‘Hello’

for i in message:   
print (i)

The output is

H   
e   
l

l   
o

*Looping through a sequence of numbers*

To loop through a sequence of numbers, the built-in range() function comes in handy. The range() function generates a list of numbers and has the syntax range (start, end, step).

If start is not given, the numbers generated will start from zero.

Note: A useful tip to remember here is that in Python (and most   
programming languages), unless otherwise stated, we always start from zero.

For instance, the index of a list and a tuple starts from zero.

When using the format() method for strings, the positions of parameters start from zero.

When using the range() function, if start is not given, the numbers generated start from zero.

If step is not given, a list of consecutive numbers will be generated (i.e. step = 1). The end value must be provided. However, one weird thing about the range() function is that the given end value is never part of the generated list.

For instance,   
range(5) will generate the list [0, 1, 2, 3, 4]

range(3, 10) will generate [3, 4, 5, 6, 7, 8, 9] range(4, 10, 2) will generate [4, 6, 8]

To see how the range() function works in a for statement, try running the following code:

for i in range(5):   
 print (i)

You should get   
0   
1   
2   
3   
4

**While Loop**

The next control flow statement we are going to look at is the while loop. Like the name suggests, a while loop repeatedly executes instructions inside the loop while a certain condition remains valid. The structure of a while statement is as follows:   
while condition is true:   
 do A

Most of the time when using a while loop, we need to first declare a variable to function as a loop counter. Let’s just call this variable   
counter. The condition in the while statement will evaluate the value of counter to determine if it smaller (or greater) than a certain value. If it is, the loop will be executed. Let’s look at a sample program.

counter = 5

while counter > 0:   
 print (“Counter = “, counter) counter = counter -1

If you run the program, you’ll get the following output Counter = 5   
Counter = 4   
Counter = 3   
Counter = 2   
Counter = 1

At first look, a while statement seems to have the simplest syntax and should be the easiest to use. However, one has to be careful when using while loops due to the danger of infinite loops. Notice that in the   
program above, we have the line counter = counter - 1? This line is crucial. It decreases the value of counter by 1 and assigns this new

value back to counter, overwriting the original value.

We need to decrease the value of counter by 1 so that the loop   
condition while counter > 0 will eventually evaluate to False. If we forget to do that, the loop will keep running endlessly resulting in an infinite loop. If you want to experience this first hand, just delete the line counter = counter - 1 and try running the program again. The program will keep printing counter = 5 until you somehow kill the program. Not a pleasant experience especially if you have a large   
program and you have no idea which code segment is causing the infinite loop.

**Break**

When working with loops, sometimes you may want to exit the entire loop when a certain condition is met. To do that, we use the break keyword. Run the following program to see how it works.

j = 0   
for i in range(5): j = j + 2   
 print (‘i = ’, i, ‘, j = ’, j) if j == 6: break You should get the following output.

i = 0 , j = 2   
i = 1 , j = 4   
i = 2 , j = 6

Without the break keyword, the program should loop from i = 0 to i = 4 because we used the function range(5). However with the break keyword, the program ends prematurely at i = 2. This is because when i = 2, j reaches the value of 6 and the break keyword causes the loop to end.

In the example above, notice that we used an if statement within a for loop. It is very common for us to ‘mix-and-match’ various control tools in programming, such as using a while loop inside an if statement or using a for loop inside a while loop. This is known as a nested control statement.

**Continue**

Another useful keyword for loops is the continue keyword. When we use continue, the rest of the loop after the keyword is skipped for that iteration. An example will make it clearer.

j = 0   
for i in range(5): j = j + 2   
 print (‘\ni = ’, i, ‘, j = ’, j) if j == 6: continue print (‘I will be skipped over if j=6’) You will get the following output:   
i = 0 , j = 2   
I will be skipped over if j=6

i = 1 , j = 4   
I will be skipped over if j=6

i = 2 , j = 6

i = 3 , j = 8   
I will be skipped over if j=6

i = 4 , j = 10   
I will be skipped over if j=6

When j = 6, the line after the continue keyword is not printed. Other than that, everything runs as per normal.

**Try, Except**

The final control statement we’ll look at is the try, except statement. This statement controls how the program proceeds when an error occurs.

The syntax is as follows:   
try:   
 do something   
except:   
 do something else when an error occurs   
For instance, try running the program below   
try:   
 answer =12/0   
 print (answer)   
except:   
 print (“An error occurred”)   
When you run the program, you’ll get the message “An error occurred”. This is because when the program tries to execute the statement answer =12/0 in the try block, an error occurs since you cannot divide a number by zero. The remaining of the try block is ignored and the statement in the except block is executed instead.

If you want to display more specific error messages to your users depending on the error, you can specify the error type after the except keyword. Try running the program below.

try:   
 userInput1 = int(input("Please enter a number: ")) userInput2 = int(input("Please enter another number: ")) answer =userInput1/userInput2   
 print ("The answer is ", answer) myFile =   
open("missing.txt", 'r') except ValueError:   
 print ("Error: You did not enter a number") except ZeroDivisionError: print ("Error: Cannot divide by zero") except Exception as e:

print ("Unknown error: ", e)   
The list below shows the various outputs for different user inputs. >>> denotes the user input and => denotes the output.

>>> Please enter a number: m => Error: You did not enter a number   
Reason: User entered a string which cannot be cast into an integer. This is a ValueError. Hence, the statement in the except ValueError block is displayed.

>>> Please enter a number: 12   
>>> Please enter another number: 0   
=> Error: Cannot divide by zero   
Reason: userInput2 = 0. Since we cannot divide a number by zero, this is a ZeroDivisionError. The statement in the except   
ZeroDivisionError block is displayed.

>>> Please enter a number: 12   
>>> Please enter another number: 3   
=> The answer is 4.0   
=> Unknown error: [Errno 2] No such file or directory: 'missing.txt'

Reason: User enters acceptable values and the line print ("The answer is ", answer) executes correctly. However, the next line raises an error as missing.txt is not found. Since this is not a   
ValueError or a ZeroDivisionError, the last except block is executed.

ValueError and ZeroDivisionError are two of the many pre-defined error types in Python. ValueError is raised when a built-in operation or function receives a parameter that has the right type but an inappropriate value. ZeroDivisionError is raised when the program tries to divide by zero. Other common errors in Python include

IOError:   
Raised when an I/O operation (such as the built-in open() function) fails for an I/O-related reason, e.g., “file not found”.

ImportError:   
Raised when an import statement fails to find the module definition IndexError:   
Raised when a sequence (e.g. string, list, tuple) index is out of range.

KeyError:   
Raised when a dictionary key is not found.

NameError:   
Raised when a local or global name is not found.

TypeError:   
Raised when an operation or function is applied to an object of inappropriate type.

For a complete list of all the error types in Python, you can refer to <https://docs.python.org/3/library/exceptions.html>.

Python also comes with pre-defined error messages for each of the different types of errors. If you want to display the message, you use the as keyword after the error type. For instance, to display the default ValueError message, you write:   
except ValueError as e: print (e)

e is the variable name assigned to the error. You can give it some other names, but it is common practice to use e. The last except statement in our program   
except Exception as e:   
 print ("Unknown error: ", e)   
is an example of using the pre-defined error message. It serves as a final

attempt to catch any unanticipated errors.

**Chapter 7: Functions and Modules**

In our previous chapters, we’ve briefly mentioned functions and modules. In this chapter, let’s look at them in detail. To reiterate, all programming languages come with built-in codes that we can use to make our lives easier as programmers. These codes consist of pre-written classes, variables and functions for performing certain common tasks and are saved in files known as modules. Let’s first look at functions.

**What are Functions?**

Functions are simply pre-written codes that perform a certain task. For an analogy, think of the mathematical functions available in MS Excel. To add numbers, we can use the sum() function and type sum(A1:A5) instead of typing A1+A2+A3+A4+A5.

Depending on how the function is written, whether it is part of a class (a class is a concept in object-oriented programming which we will not cover in this book) and how you import it, we can call a function simply by typing the name of the function or by using the dot notation. Some   
functions require us to pass data in for them to perform their tasks. These data are known as parameters and we pass them to the function by enclosing their values in parenthesis ( ) separated by commas.

For instance, to use the print() function for displaying text on the screen, we call it by typing print(“Hello World”) where print is the name of the function and “Hello World” is the parameter.

On the other hand, to use the replace() function for manipulating text strings, we have to type “Hello World”.replace(“World”,  
“Universe”) where replace is the name of the function and “World”and “Universe” are the parameters. The string before the dot (i.e.

“Hello World”) is the string that will be affected. Hence, “Hello World” will be changed to “Hello Universe”.

**Defining Your Own Functions**

We can define our own functions in Python and reuse them throughout the program. The syntax for defining a function is as follows:   
def functionName(parameters): code detailing what the function should do return [expression]

There are two keywords here, def and return.

def tells the program that the indented code from the next line onwards is part of the function. return is the keyword that we use to return an answer from the function. There can be more than one return   
statements in a function. However, once the function executes a return statement, the function will exit. If your function does not need to return any value, you can omit the return statement. Alternatively, you can write return or return None.

Let us now define our first function. Suppose we want to determine if a given number is a prime number. Here’s how we can define the function using the modulus (%) operator we learned in Chapter 3 and the for loop and if statement we learned in Chapter 6.

def checkIfPrime (numberToCheck): for x in range(2, numberToCheck): if (numberToCheck%x == 0):   
 return False return True   
In the function above, lines 2 and 3 uses a for loop to divide the given parameter numberToCheck by all numbers from 2 to numberToCheck- 1 to determine if the remainder is zero. If the remainder is zero,   
numberToCheck is not a prime number. Line 4 will return False and the function will exit.

If by last iteration of the for loop, none of the division gives a remainder of zero, the function will reach Line 5, and return True. The function will

then exit.

To use this function, we type checkIfPrime(13) and assign it to a variable like this   
answer = checkIfPrime(13)   
Here we are passing in 13 as the parameter. We can then print the answer by typing print(answer). We’ll get the output: True.

**Variable Scope**

An important concept to understand when defining a function is the concept of variable scope. Variables defined inside a function are treated differently from variables defined outside. There are two main differences.

Firstly, any variable declared inside a function is only accessible within the function. These are known as local variables. Any variable declared outside a function is known as a global variable and is accessible anywhere in the program.

To understand this, try the code below: message1 = "Global Variable"

def myFunction():   
 print(“\nINSIDE THE FUNCTION”) #Global variables are accessible inside a function print (message1) #Declaring a local variable message2 = “Local Variable”  
 print (message2)

#Calling the function myFunction()

print(“\nOUTSIDE THE FUNCTION”)   
#Global variables are accessible outside function print (message1)

#Local variables are NOT accessible outside function. print (message2)

If you run the program, you will get the output below.

INSIDE THE FUNCTION

Global Variable   
Local Variable

OUTSIDE THE FUNCTION   
Global Variable   
NameError: name 'message2' is not defined   
Within the function, both the local and global variables are accessible.

Outside the function, the local variable message2 is no longer   
accessible. We get a NameError when we try to access it outside the function.

The second concept to understand about variable scope is that if a local variable shares the same name as a global variable, any code inside the function is accessing the local variable. Any code outside is accessing the global variable. Try running the code below   
message1 = "Global Variable (shares same name as a local variable)"

def myFunction():   
 message1 = "Local Variable (shares same name as a global variable)"   
 print(“\nINSIDE THE FUNCTION”) print   
(message1)

# Calling the function myFunction()

# Printing message1 OUTSIDE the function print (“\nOUTSIDE THE FUNCTION”) print (message1)

You’ll get the output as follows:   
INSIDE THE FUNCTION   
Local Variable (shares same name as a global variable) OUTSIDE THE FUNCTION   
Global Variable (shares same name as a local variable) When we print message1 inside the function, it prints "Local

Variable (shares same name as a global variable)" as it is printing the local variable. When we print it outside, it is accessing the global variable and hence prints "Global Variable (shares same name as a local variable)".

**Importing Modules**

Python comes with a large number of built-in functions. These functions are saved in files known as modules. To use the built-in codes in Python modules, we have to import them into our programs first. We do that by using the import keyword. There are three ways to do it.

The first way is to import the entire module by writing import moduleName.

For instance, to import the random module, we write import random. To use the randrange() function in the random module, we write random.randrange(1, 10).

If you find it too troublesome to write random each time you use the function, you can import the module by writing import random as r (where r is any name of your choice). Now to use the randrange() function, you simply write r.randrange(1, 10).

The third way to import modules is to import specific functions from the module by writing from moduleName import name1[, name2[, ... nameN]].

For instance, to import the randrange() function from the random module, we write from random import randrange. If we want to import more than one functions, we separate them with a comma. To import the randrange() and randint() functions, we write from random import randrange, randint. To use the function now, we do not have to use the dot notation anymore. Just write randrange(1, 10).

**Creating our Own Module**

Besides importing built-in modules, we can also create our own modules. This is very useful if you have some functions that you want to reuse in other programming projects in future.

Creating a module is simple. Simply save the file with a .py extension and put it in the same folder as the Python file that you are going to import it from.

Suppose you want to use the checkIfPrime() function defined earlier in another Python script. Here’s how you do it. First save the code above as prime.py on your desktop. prime.py should have the following code.

def checkIfPrime (numberToCheck):   
 for x in range(2, numberToCheck): if (numberToCheck%x == 0): return False   
 return True

Next, create another Python file and name it useCheckIfPrime.py. Save it on your desktop as well. useCheckIfPrime.py should have the following code.

import prime   
answer = prime.checkIfPrime(13) print (answer)

Now run useCheckIfPrime.py. You should get the output True. Simple as that.

However, suppose you want to store prime.py and

useCheckIfPrime.py in different folders. You are going to have to add some codes to useCheckIfPrime.py to tell the Python interpreter where to find the module.

Say you created a folder named ‘MyPythonModules’ in your C drive to store prime.py. You need to add the following code to the top of your useCheckIfPrime.py file (before the line import prime).

import sys

if 'C:\\MyPythonModules' not in sys.path: sys.path.append('C:\\MyPythonModules')

sys.path refers to your Python’s system path. This is the list of   
directories that Python goes through to search for modules and files. The code above appends the folder ‘C:\MyPythonModules’ to your system path.

Now you can put prime.py in C:\MyPythonModules and checkIfPrime.py in any other folder of your choice.

**Chapter 8: Working with Files**

Cool! We’ve come to the last chapter of the book before the project. In this chapter, we’ll look at how to work with external files.

In Chapter 5 previously, we learned how to get input from users using the input() function. However, in some cases, getting users to enter data into our program may not be practical, especially if our program needs to work with large amounts of data. In cases like this, a more convenient way is to prepare the needed information as an external file and get our programs to read the information from the file. In this chapter, we are going to learn to do that. Ready?

**Opening and Reading Text Files**

The first type of file we are going to read from is a simple text file with multiple lines of text. To do that, let’s first create a text file with the following lines.

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Save this text file as myfile.txt to your desktop. Next, fire up IDLE and type the code below. Save this code as fileOperation.py to your desktop too.

f = open (‘myfile.txt’, 'r')

firstline = f.readline()   
secondline = f.readline()   
print (firstline)   
print (secondline)

f.close()

The first line in the code opens the file. Before we can read from any file, we have to open it (just like you need to open this ebook on your kindle device or app to read it). The open() function does that and requires two parameters:

The first parameter is the path to the file. If you did not save   
fileOperation.py and myfile.txt in the same folder (desktop in this case), you need to replace ‘myfile.txt’ with the actual path where you stored the text file. For instance, if you stored it in a folder

named ‘PythonFiles’ in your C drive, you have to write  
‘C:\\PythonFiles\\myfile.txt’ (with double backslash \\).

The second parameter is the mode. This specifies how the file will be used. The commonly used modes are

'r' mode:   
For reading only.

'w' mode:   
For writing only.

If the specified file does not exist, it will be created.

If the specified file exists, any existing data on the file will be erased.

'a' mode:   
For appending.

If the specified file does not exist, it will be created.

If the specified file exist, any data written to the file is automatically added to the end

'r+' mode:   
For both reading and writing.

After opening the file, the next statement firstline =   
f.readline() reads the first line in the file and assigns it to the variable firstline.

Each time the readline() function is called, it reads a new line from the file. In our program, readline() was called twice. Hence the first two lines will be read. When you run the program, you’ll get the output:

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You’ll notice that a line break is inserted after each line. This is because the readline() function adds the ‘\n’ characters to the end of each line. If you do not want the extra line between each line of text, you can do print(firstline, end = ‘’). This will remove the ‘\n’characters. After reading and printing the first two lines, the last sentence f.close() closes the file. You should always close the file once you finish reading it to free up any system resources.

**Using a For Loop to Read Text Files**

In addition to using the readline() method above to read a text file, we can also use a for loop. In fact, the for loop is a more elegant and efficient way to read text files. The following program shows how this is done.

f = open (‘myfile.txt’, 'r') for line in f:   
 print (line, end = ‘’) f.close()

The for loop loops through the text file line by line. When you run it, you’ll get   
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http://www.learncodingfast.com/python

**Writing to a Text File**

Now that we’ve learned how to open and read a file, let’s try writing to it. To do that, we’ll use the ‘a’ (append) mode. You can also use the ‘w’mode, but you’ll erase all previous content in the file if the file already exists. Try running the following program.

f = open (‘myfile.txt’, 'a')   
f.write(‘\nThis sentence will be appended.’) f.write(‘\nPython is Fun!’)   
f.close()

Here we use the write() function to append the two sentences ‘This sentence will be appended.’ and ‘Python is Fun!’ to the file, each starting on a new line since we used the escape characters‘\n’. You’ll get   
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http://www.learncodingfast.com/python This sentence will be appended.

Python is Fun!

**Opening and Reading Text Files by Buffer Size**

Sometimes, we may want to read a file by buffer size so that our program does not use too much memory resources. To do that, we can use the read() function (instead of the readline() function) which allows us to specify the buffer size we want. Try the following program:   
inputFile = open (‘myfile.txt’, 'r') outputFile = open (‘myoutputfile.txt’, 'w')   
msg = inputFile.read(10)   
while len(msg):  
 outputFile.write(msg) msg = inputFile.read(10) inputFile.close() outputFile.close()   
First, we open two files, the inputFile.txt and outputFile.txt files for reading and writing respectively.

Next, we use the statement msg = inputFile.read(10) and a while loop to loop through the file 10 bytes at a time. The value 10 in the parenthesis tells the read() function to only read 10 bytes. The while condition while len(msg): checks the length of the variable msg. As long as the length is not zero, the loop will run.

Within the while loop, the statement outputFile.write(msg) writes the message to the output file. After writing the message, the statement msg = inputFile.read(10) reads the next 10 bytes and keeps doing it until the entire file is read. When that happens, the program closes both files.

When you run the program, a new file myoutputfile.txt will be created. When you open the file, you’ll notice that it has the same content as your input file myfile.txt. To prove that only 10 bytes is read at a time, you can change the line outputFile.write(msg) in the   
program to outputFile.write(msg + ‘\n’). Now run the program again. myoutputfile.txt now contains lines with at most 10

characters. Here’s a segment of what you’ll get.

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**Opening, Reading and Writing Binary Files**   
Binary files refer to any file that contains non-text, such as image or video

files. To work with binary files, we simply use the ‘rb’ or ‘wb’ mode. Copy

a jpeg file onto your desktop and rename it myimage.jpg. Now edit the

program above by changing the first two line lines

inputFile = open (‘myfile.txt’, 'r')

outputFile = open (‘myoutputfile.txt’, 'w')

to

inputFile = open (‘myimage.jpg’, 'rb')

outputFile = open (‘myoutputimage.jpg’, 'wb')

Make sure you also change the statement outputFile.write(msg +

'\n') back to outputFile.write(msg).

Run the new program. You should have an additional image file named

myoutputimage.jpg on your desktop. When you open the image file, it

should look exactly like myimage.jpg.

**Deleting and Renaming Files**

Two other useful functions we need to learn when working with files are the remove() and rename() functions. These functions are available in the os module and have to be imported before we can use them.

The remove() function deletes a file. The syntax is   
remove(filename). For instance, to delete myfile.txt, we write remove(‘myfile.txt’).

The rename() function renames a file. The syntax is rename (old name, new name). To rename oldfile.txt to newfile.txt, we write rename(‘oldfile.txt’, ‘newfile.txt’).

**Project: Math and BODMAS**

Congratulations! We’ve now covered enough fundamentals of Python (and programming in general) to start coding our first full program. In this chapter, we’re going to code a program that tests our understanding of the BODMAS rule of arithmetic calculation. If you are unsure what BODMAS is, you can check out this site   
<http://www.mathsisfun.com/operation-order-bodmas.html>.

Our program will randomly set an arithmetic question for us to answer. If we get the answer wrong, the program will display the correct answer and ask if we want to try a new question. If we get it correct, the program will compliment us and ask if we want a new question. In addition, the program will keep track of our scores and save the scores in an external text file. After each question, we can key “-1” to terminate the program.

I’ve broken down the program into small exercises so that you can try coding the program yourself. Try the exercises before referring to the answers. Answers are provided in Appendix E or you can go to   
<http://www.learncodingfast.com/python> to download the Python files. I would strongly encourage you to download the source code as the formatting in Appendix E may result in the distortion of some indentation which makes the code difficult to read.

Remember, learning the Python syntax is easy but boring. Problem solving is where the fun lies. If you encounter difficulties when doing these exercises, try harder. This is where the reward is the greatest.

Ready? Let’s go!

**Part 1: myPythonFunctions.py**   
We will be writing two files for our programs. The first file is

myPythonFunctions.py and the second is mathGame.py. Part 1 will

focus on writing the code for myPythonFunctions.py.

To start, let’s first create the file myPythonFunctions.py. We’ll be

defining three functions in this file.

Exercise 1: Importing Modules

We need to import two modules for myPythonFunctions.py: the

random module and the os module.

We’ll be using the randint() function from the random module. The

randint() function generates a random integer within the range

provided by us. We’ll use that to generate numbers for our questions

later.

From the os module, we’ll be using the remove() and rename()

functions.

Try importing these two modules.

Exercise 2: Getting the User’s Score

Here we’ll define our first function. Let’s call it getUserPoint(). This

function accepts one parameter, userName. It then opens the file

‘userScores.txt’ in ‘r’ mode.

userScores.txt looks something like this:

Ann, 100

Benny, 102

Carol, 214

Darren, 129

Each line records the information of one user. The first value is the user’s username and the second is the user’s score.

Next, the function reads the file line by line using a for loop. Each line is then split using the split() function (refer to Appendix A for an   
example on using the split() function).

Let’s store the results of the split() function in the list content.

Next, the function checks if any of the lines has the same username as the value that is passed in as the parameter. If there is, the function closes the file and returns the score beside that username. If there isn’t, the function closes the file and returns the string ‘-1’.

Clear so far? Try coding the function.

Done?

Now we need to make some modifications to our code. When opening our file previously, we used the ‘r’ mode. This helps to prevent any accidental changes to the file. However, when opening a file in ‘r’ mode, an IOError occurs if the file does not already exist. Hence when we run the program for the first time, we’ll end up with an error since the file userScores.txt does not exist previously. To prevent this error, we can do either of the following:   
Instead of opening the file in ‘r’ mode, we can open it in ‘w’ mode. When opening in ‘w’ mode, a new file will be created if the file does not exist previously. The risk with this method is we may accidentally write to the file, which results in all previous content being erased. However, since our program is a small program, we can check through our code carefully to prevent any accidental writing.

The second method is to use a try, except statement to handle the IOError. To do that, we need to put all our previous codes in the try block, then use except IOError: to handle the ‘File not found’ error. In the except block, we’ll inform users that the file is not found and then proceed to create the file. We’ll use the open() function with ‘w’ mode to create it. The difference here is we use the ‘w’ mode only when the file is not found. Since the file does not exist initially, there is no risk of erasing any previous content. After creating the file, close the file and return the string “-1”.

You can choose either of the above methods to complete this exercise. The answer provided uses the second method. Once you are done, let’s move on to Exercise 3.

Exercise 3: Updating the User’s Score   
In this exercise, we’ll define another function called   
updateUserPoints(), which takes in three parameters: newUser, userName and score.

newUser can either be True or False. If newUser is True, the function will open the file userScores.txt in append mode and append the user’s userName and score to the file when he or she exits the game.

if newUser is False, the function will update the user’s score in the file. However, there is no function in Python (or most programming languages for that matter) that allows us to update a text file. We can only write or append to it, but not update it.

Hence, we need to create a temporary file. This is a fairly common practice in programming. Let’s call this file userScores.tmp and open it in ‘w’ mode. Now, we’ll need to loop through userScore.txt and copy the data line by line to userScores.tmp. However, before copying, we’ll check if the userName on that line is the same as the one provided as the parameter. If it is the same, we’ll change the score to the new score

before writing it to the temporary file.

For instance, if the parameters provided to the function are False,‘Benny’ and ‘158’ (i.e. updateUserPoints(False, ‘Benny’,‘158’)), the table below shows the difference between the original userScores.txt and the new userScores.tmp.

userScores.txt

Ann, 100   
**Benny, 102**   
Carol, 214   
Darren, 129

userScores.tmp

Ann, 100   
**Benny, 158**   
Carol, 214   
Darren, 129

After we finish writing to userScore.tmp, we’ll close both files and delete userScores.txt. Finally, we’ll rename userScores.tmp to userScores.txt.

Clear? Try coding it...

Exercise 4: Generating the Questions   
We’ve now come to the most important part of the program, generating the mathematical questions. Ready?

To generate the questions, let’s first declare three variables: two lists and one dictionary.

We shall name the two lists operandList and operatorList.

operandList should store five numbers, with 0 as their initial values.

operatorList should store four strings, with ‘ ’ as their initial values.

The dictionary consists of 4 pairs, with integers 1 to 4 as the dictionary

keys, and “+”, “-”, “*”, “*\*” as the data. Let’s call this operatorDict.

[Exercise 4.1: Updating operandList with Random Numbers]

First we need to the replace the initial values of our operandList with

random numbers generated by the randint() function.

The randint() takes in two parameters, start and end, and returns a

random integer N such that start <= N <= end.

For instance, if randint(1, 9) is called, it’ll randomly return an integer

from the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9.

To update our operandList variable with random numbers, we can do

this one by one since operandList only has five members. We can

write

operandList[0] = randint(1, 9) operandList[1] =

randint(1, 9) operandList[2] = randint(1, 9)

operandList[3] = randint(1, 9) operandList[4] =

randint(1, 9)

Each time randint(1, 9) is called, it’ll randomly return an integer from

the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9.

However, this is not the most elegant way of updating our operandList.

Imagine how cumbersome it’ll be if operandList has 1000 members.

The better alternative is to use a for loop.

Try using a for loop to accomplish the same task.

Done? Great!

[Exercise 4.2: Updating operatorList with Mathematical Symbols]

Now that we have the numbers to operate on, we need to randomly generate the mathematical symbols (+, -, *,* \*) for our questions. To do that, we’ll use the randint() function and the operatorDict dictionary.

randint() will generate the dictionary key, which will then be mapped to the correct operator using the operatorDict dictionary. For instance, to assign the symbol to operatorList[0], we write   
operatorList[0] = operatorDict[randint(1, 4)]

Similar to Exercise 4.1, you should use a for loop to complete this task. However, there is one problem that makes this exercise harder than Exercise 4.1.

Recall that in Python, \*\* stands for exponent (i.e. 2\*\*3 = 2^3)?

The problem is, when we have two consecutive exponent operators in Python, such as 2\*\*3\*\*2, Python interprets it as 2\*\*(3\*\*2) instead of (2\*\*3)\*\*2. In the first case, the answer is 2 to the power of 9 (i.e. 29) which is 512. In the second case, the answer is 8 to the power of 2 (i.e. 82) which is 64. Hence when we present a question like 2\*\*3\*\*2, the user will get the answer wrong if he interprets it as (2\*\*3)\*\*2.

To prevent this problem, we’re going to modify our code so that we do not get two consecutive \*\* signs. In other words, operatorList = [‘+’,‘+’, ‘-’, ‘\*\*’] is fine but operatorList = [‘+’, ‘-’, ‘\*\*’,‘\*\*’] is not.

This exercise is the hardest among all the exercises. Try coming up with a solution to prevent two consecutive \*\* signs. Once you are done, we can proceed to Exercise 4.3.

Hint: If you are stuck, you can consider using an if statement within the for loop.

[Exercise 4.3: Generating a Mathematical Expression]

Now that we have our operators and operands, we are going to try to generate the mathematical expression as a string. This expression users the five numbers from our operandList and the four mathematical symbols from our operatorList to form a question.

We have to declare another variable called questionString and assign the mathematical expression to questionString. Examples of questionString include   
6 – 2\*3 – 2\*\*1   
4 + 5 – 2\*6 + 1   
8 – 0\*2 + 5 – 8

Try to generate this expression yourself.

Hint: You can use a for loop to concatenate the individual substrings from operandList and operatorList to get the mathematical expression.

[Exercise 4.4: Evaluating the Result]

We should now have a mathematical expression as a string, assigned to the variable questionString. To evaluate the result of this expression, we’re going to use a brilliant built-in function that comes with Python, eval().

eval() interprets a string as a code and executes the code. For instance, if we write eval(“1+2+4”), we’ll get the number 7.

Hence to evaluate the result of our mathematical expression, we pass in questionString to the eval() function and assign the result to a new variable named result.

This exercise is pretty straight forward and can be completed in one step.

[Exercise 4.5: Interacting with the User]

Finally, we’re going to interact with our user. In this exercise, we’ll be doing a few things:   
Step 1: Displaying the question to the user Step 2: Prompting the user for an answer Step 3: Evaluating the answer, displaying the appropriate message and returning the user’s score.

For step 1, we need to use a built-in function for manipulating strings. As mentioned earlier, in Python, the \*\* symbol stands for exponent. That is, 2\*\*3 = 8. However, to most users, \*\* has no meaning. Hence if we display a question as 2\*\*3 + 8 -5, the user will likely be confused. To prevent that, we’ll replace any \*\* symbol in questionString with the ^ symbol.

To do that, we’ll use the built-in function replace(). Using it is pretty straightforward, just write questionString =   
questionString.replace("\*\*", "^"). Now you can print the resulting expression to the user.

For step 2, you can use the input() function to accept user input.

For step 3, you should use an if statement to evaluate the answer and display the correct message. If the user gets it correct, we’ll compliment the user and return the value 1. If the user gets it wrong, we’ll display the correct answer and return the value 0.

Recall that the input() function returns user input as a string? Hence, when you compare the user’s input with the correct answer (obtained in Exercise 4.4), you have to do some type casting to change the user input to an integer. When changing the user input to an integer, you should use a try, except statement to check if the user typed in a number. If the user typed in a string instead, the program should inform the user of the error and prompt the user to type in a number.

You can use a while True loop to keep prompting the user for a number as long as he/she fails to do so. Writing while True is equivalent to writing something like while 1==1. Since 1 is always equals to 1 (hence always True), the loop will run indefinitely.

Here’s a suggestion on how you can use a while True loop for this exercise.

while True:   
 try:   
 cast user’s answer to an integer and evaluate the answer return user score based on the answer except:   
 print error message if casting fails prompt user to key in the answer again   
The while True loop will keep looping since the while condition is always True. The loop will exit only when the try block executes correctly and reaches the return statement.

Try this exercise. Once you are done, we can proceed to Part 2 where we write the actual program.

**Part 2: mathGame.py**

Congratulations for completing Part 1 and welcome to Part 2. Part 2 is going to be a breeze as we’ll mainly just be calling the functions we defined earlier.

Exercise 5: Writing the Main Program   
First, let’s enclose our main program in a try, except statement. We want to handle any unforeseen errors when running the main program.

We’ll start by writing the code for the try block.

Firstly, we need to import the myPythonFunctions module. Next, let’s prompt the user for his/her username and assign the value to the variable userName. Pass this variable as a parameter to the function   
getUserScore().

getUserScore() will either return the score of the user or return ‘-1’ (if the user is not found). Let’s cast this result into an integer and assign it to the variable userScore.

Now, we need to set the value of another variable newUser. If the user is not found, newUser = True, else newUser = False. If newUser = True, we need to change userScore from -1 to 0.

The next part of our program involves a while loop. Specifically, our program will prompt for input from our user to determine if it should terminate the program or do something else.

Step 1:   
You need to declare another variable userChoice and give it an initial value of 0.

Step 2:   
Next, using a while loop, compare userChoice with a string of your choice, say “-1”. If userChoice is not the same as “-1”, call the function generateQuestion() to generate a new question.

Step 3:   
generateQuestion() will return the score that the user got for that question. Use this result to update the variable userScore.

Step 4:   
Finally, in order to prevent an infinite loop, we need to use the input() function again within the while loop to accept user input and use it to update the value of userChoice.

Got that? Try coding it. Doing the actual coding will make everything clearer.

Finally, after the while loop terminates, the next step is to update the userScores.txt file. To do that, we simply call the   
updateUserPoints() function.

That’s all for the try block. Now for the except block, we simply inform the user that an error has occurred and the program will exit.

That’s it! Once you finish this step, you’ll have a complete program, your first program in Python. Try running the program mathGame.py. Does it work as expected? Excited? I sure hope you are as excited about it as I am. :)

**Challenge Yourself**

We’ve come to the end of this chapter and hopefully you have   
successfully coded your first program. If you have problems completing any exercise, you can study the answers in Appendix E. You will learn a lot by studying other people’s codes.

In this section, I have three additional exercises for you to challenge yourself.

Challenge Exercise 1

In the program that we’ve coded so far, I’ve avoided using the division operator. Can you modify the program so that it’ll generate questions with the division sign too? How would you check the user’s answer against the correct answer?

Hint: Check out the round() function.

Challenge Exercise 2

Sometimes, the question generated may result in an answer that is very large or very small. For instance, the question 6\*(8^9/1)^3 will give the answer 1450710985375550096474112.

It is very inconvenient for users to calculate and key in such a large number. Hence, we want to avoid answers that are too big or small. Can you modify the program to prevent questions that result in answers greater than 50 000 or smaller than -50000?

Challenge Exercise 3

The last challenge exercise is the most difficult.

So far, brackets are missing in the questions generated. Can you modify

the program so that the questions use brackets too? An example of a

question will be 2 + (3\*7 -1) + 5.

Have fun with these exercises. The suggested solution is provided in

Appendix E.

**Thank You**

We’ve come to the end of the book. Thank you for reading this book and I hope you have enjoyed the book. More importantly, I sincerely hope the book has helped you master the fundamentals of Python programming.

I know you could have picked from a dozen of books on Python Programming, but you took a chance with this book. Thank you once again for downloading this book and reading all the way to the end. Please do try the exercises and challenges. You’ll learn a lot by doing.

Now I’d like to ask for a “small” favor. Could you please take a few minutes or two to leave a review for this book on Amazon?

This feedback will help me tremendously and will help me continue to write more guides on programming. If you like the book or have any suggestions for improvement, please let me know. I will be deeply grateful. :)

Last but not least, remember you can download the source code for the project and the appendices at <http://www.learncodingfast.com/python>.

You can also contact me at [jamie@learncodingfast.com](mailto:jamie@learncodingfast.com).

**Appendix A: Working With Strings**

Note: The notation [start, [end]] means *start* and *end* are optional parameters. If only one number is provided as the parameter, it is taken to be *start*.

# marks the start of a comment  
‘’’ marks the start and end of a multiline comment The actual code is in monotype font.

=> marks the start of the output   
**count (sub, [start, [end]])**

Return the number of times the substring *sub* appears in the string. This function is case-sensitive.

[Example]

# In the examples below, ‘s’ occurs at index 3, 6 and 10

# count the entire string  
‘This is a string’.count(‘s’) => 3

# count from index 4 to end of string ‘This is a string’.count(‘s’, 4) => 2

# count from index 4 to 10-1  
‘This is a string’.count(‘s’, 4, 10 ) => 1

# count ‘T’. There’s only 1 ‘T’ as the function is case sensitive.‘This is a string’.count(‘T’)   
=> 1

**endswith (suffix, [start, [end]])**   
Return True if the string ends with the specified *suffix*, otherwise return False.

*suffix* can also be a tuple of suffixes to look for.

This function is case-sensitive.

[Example]

# ’man’ occurs at index 4 to 6

# check the entire string  
‘Postman’.endswith(‘man’)   
=> True

# check from index 3 to end of string ‘Postman’.endswith(‘man’, 3) => True

# check from index 2 to 6-1  
‘Postman’.endswith(‘man’, 2, 6) => False

# check from index 2 to 7-1  
‘Postman’.endswith(‘man’, 2, 7) => True

# Using a tuple of suffixes (check from index 2 to 6-1)‘Postman’.endswith((‘man’, ‘ma’), 2, 6) => True

**find/index (sub, [start, [end]])**   
Return the index in the string where the first occurrence of the substring *sub* is found.

find() returns -1 if *sub* is not found.

index() returns ValueError is *sub* is not found.

This function is case-sensitive.

[Example]

# check the entire string  
‘This is a string’.find(‘s’) => 3

# check from index 4 to end of string ‘This is a string’.find(‘s’, 4) => 6

# check from index 7 to 11-1  
‘This is a string’.find(‘s’, 7,11 ) => 10

# Sub is not found   
'This is a string'.find(‘p’) => -1

'This is a string'.index(‘p’) => ValueError

**isalnum()**

Return true if all characters in the string are alphanumeric and there is at least one character, false otherwise.

Alphanumeric does not include whitespaces.

[Example]

‘abcd1234’.isalnum()   
=> True

‘a b c d 1 2 3 4’.isalnum()   
=> False

‘abcd’.isalnum()   
=> True

‘1234’.isalnum()   
=> True

**isalpha()**

Return true if all characters in the string are alphabetic and there is at least one character, false otherwise.

[Example]

‘abcd’.isalpha()   
=> True

‘abcd1234’.isalpha()   
=> False

‘1234’.isalpha()   
=> False

‘a b c’.isalpha()   
=> False

**isdigit()**

Return true if all characters in the string are digits and there is at least one character, false otherwise.

[Example]

‘1234’.isdigit()   
=> True

‘abcd1234’.isdigit()   
=> False

‘abcd’.isdigit()   
=> False

‘1 2 3 4’.isdigit()   
=> False

**islower()**

Return true if all cased characters in the string are lowercase and there is at least one cased character, false otherwise.

[Example]

‘abcd’.islower()   
=> True

‘Abcd’.islower()   
=> False

‘ABCD’.islower()   
=> False

**isspace()**

Return true if there are only whitespace characters in the string and there is at least one character, false otherwise.

[Example]

‘ ’.isspace()   
=> True

‘a b’.isspace()   
=> False

**istitle()**

Return true if the string is a titlecased string and there is at least one character   
[Example]

‘This Is A String’.istitle() => True

‘This is a string’.istitle() => False

**isupper()**

Return true if all cased characters in the string are uppercase and there is at least one cased character, false otherwise.

[Example]

‘ABCD’.isupper()   
=> True

‘Abcd’.isupper()   
=> False

‘abcd’.isupper()

=> False

**join()**

Return a string in which the parameter provided is joined by a separator.

[Example]

sep = ‘-’

myTuple = (‘a’, ‘b’, ‘c’)

myList = [‘d’, ‘e’, ‘f’]

myString = “Hello World”

sep.join(myTuple)

=> ‘a-b-c’

sep.join(myTuple)

=> ‘d-e-f’

sep.join(myString)

=> ‘H-e-l-l-o- -W-o-r-l-d’’

**lower()**

Return a copy of the string converted to lowercase.

[Example]

‘Hello Python’.lower()

=> ‘hello python’

**replace(old, new[, count])**

Return a copy of the string with all occurrences of substring old replaced by new.

*count* is optional. If given, only the first *count* occurrences are replaced. This function is case-sensitive.

[Example]

# Replace all occurences  
‘This is a string’.replace(‘s’, ‘p’) => 'Thip ip a ptring'

# Replace first 2 occurences  
‘This is a string’.replace(‘s’, ‘p’, 2) => 'Thip ip a string'

**split([sep [,maxsplit]])**

Return a list of the words in the string, using *sep* as the delimiter string. *sep* and *maxsplit* are optional.

If *sep* is not given, whitespace is used as the delimiter.

If *maxsplit* is given, at most *maxsplit* splits are done. This function is case-sensitive.

[Example]

‘’’  
Split using comma as the delimiter Notice that there’s a space before the words ‘is’, ‘a’ and ‘string’ in the output.

‘’’  
‘This, is, a, string’.split(‘,’) => ['This', ' is', ' a', ' string']

# Split using whitespace as delimiter ‘This is a string’.split()

=> ['This', 'is', 'a', 'string']

# Only do 2 splits  
‘This, is, a, string’.split(‘,’ 2) => ['This', ' is', ' a, string']

**splitlines ([keepends])**

Return a list of the lines in the string, breaking at line boundaries.

Line breaks are not included in the resulting list unless *keepends* is given and true.

[Example]

# Split lines separated by \n  
‘This is the first line.\nThis is the second   
line’.splitlines() => ['This is the first line.', 'This is the second line.']

# Split multi line string (e.g. string that uses the ‘’’ mark) ‘’’This is the first line.

This is the second line.’’’.splitlines() => ['This is the first line.', 'This is the second line.']

# Split and keep line breaks   
'This is the first line.\nThis is the second line.'.splitlines(True) => ['This is the first line.\n', 'This is the second line.']

‘’’This is the first line.

This is the second line.’’’.splitlines(True) => ['This is the first line.\n', 'This is the second line.']

**startswith (prefix[, start[, end]])**

Return True if string starts with the prefix, otherwise return False. *prefix* can also be a tuple of prefixes to look for.   
This function is case-sensitive.

[Example]

# ’Post’ occurs at index 0 to 3

# check the entire string  
‘Postman’.startswith(‘Post’) => True

# check from index 3 to end of string ‘Postman’.startswith(‘Post’, 3) => False

# check from index 2 to 6-1  
‘Postman’.startswith(‘Post’, 2, 6) => False

# check from index 2 to 6-1  
‘Postman’.startswith(**‘stm’**, 2, 6) => True

# Using a tuple of prefixes (check from index 3 to end of string)‘Postman’.startswith((‘Post’, ‘tma’), 3) => True

**strip ([chars])**

Return a copy of the string with the leading and trailing characters *char* removed.

If *char* is not provided, whitespaces will be removed. This function is case-sensitive.

[Example]

# Strip whitespaces  
‘ This is a string ’.strip() => 'This is a string'

# Strip ‘s’. Nothing is removed since ‘s’ is not at the start or end of the string 'This is a string'.strip('s')   
=> 'This is a string'

# Strip ‘g’.

‘This is a string’.strip(‘g’) => ‘This is a strin’

**upper()**

Return a copy of the string converted to uppercase.

[Example]

‘Hello Python’.upper()   
=> ‘HELLO PYTHON’

**Appendix B: Working With Lists** => marks the start of the output

**append( )**

Add item to the end of a list

[Example]

myList = [‘a’, ‘b’, ‘c’, ‘d’]

myList.append(‘e’) print (myList)

=> [‘a’, ‘b’, ‘c’, ‘d’, ‘e’]

**del**

Remove items from a list

[Example]

myList = [‘a’, ‘b’, ‘c’, ‘d’, ‘e’, ‘f’, ‘g’, ‘h’, ‘i’,

‘j’, ‘k’, ‘l’]

#delete the third item (index = 2) del myList[2]

print (myList)

=> [‘a’, ‘b’, ‘d’, ‘e’, ‘f’, ‘g’, ‘h’, ‘i’, ‘j’, ‘k’, ‘l’]

#delete items from index 1 to 5-1

del myList[1:5]

print (myList)

=> [‘a’, ‘g’, ‘h’, ‘i’, ‘j’, ‘k’, ‘l’]

#delete items from index 0 to 3-1

del myList [ :3]

print (myList)

=> [‘i’, ‘j’, ‘k’, ‘l’]

#delete items from index 2 to end del myList [2:]

print (myList)

=> [‘i’, ‘j’]

**extend( )**

Combine two lists

[Example]

myList = [‘a’, ‘b’, ‘c’, ‘d’, ‘e’]

myList2 = [1, 2, 3, 4]

myList.extend(myList2) print (myList)

=> [‘a’, ‘b’, ‘c’, ‘d’, ‘e’, 1, 2, 3, 4]

**In**

Check if an item is in a list

[Example]

myList = [‘a’, ‘b’, ‘c’, ‘d’]

‘c’ in myList

=> True

‘e’ in myList

=> False

**insert( )**

Add item to a list at a particular position

[Example]

myList = [‘a’, ‘b’, ‘c’, ‘d’, ‘e’] myList.insert(1, ‘Hi’) print (myList) => [‘a’, ‘Hi’, ‘b’, ‘c’, ‘d’, ‘e’]

**len( )**

Find the number of items in a list   
[Example]

myList = [‘a’, ‘b’, ‘c’, ‘d’] print (len(myList)) => 4

**pop( )**

Get the value of an item and remove it from the list Requires index of item as the parameter   
[Example]

myList = [‘a’, ‘b’, ‘c’, ‘d’, ‘e’]

#remove the third item member = myList.pop(2) print (member) => c

print (myList)   
=> [‘a’, ‘b’, ‘d’, ‘e’]

#remove the last item member = myList.pop( ) print (member) => e

print (myList)   
=> [‘a’, ‘b’, ‘d’]

**remove( )**

Remove an item from a list. Requires the value of the item as the

parameter.

[Example]

myList = [‘a’, ‘b’, ‘c’, ‘d’, ‘e’]

#remove the item ‘c’

myList.remove(‘c’) print (myList)

=> [‘a’, ‘b’, ‘d’, ‘e’]

**reverse()**

Reverse the items in a list

[Example]

myList = [1, 2, 3, 4]

myList.reverse()

print (myList)

=> [4, 3, 2, 1]

**sort()**

Sort a list alphabetically or numerically

[Example]

myList = [3, 0, -1, 4, 6]

myList.sort()

print(myList)

=> [-1, 0, 3, 4, 6]

**sorted()**

Return a new sorted list without sorting the original list. Requires a list as the parameter   
[Example]

myList = [3, 0, -1, 4, 6]   
myList2 = sorted(myList)   
#Original list is not sorted print (myList) => [3, 0, -1, 4, 6]

#New list is sorted print (myList2)   
=> [-1, 0, 3, 4, 6]

**Addition Operator: +**

Concatenate List

[Example]

myList = [‘a’, ‘b’, ‘c’, ‘d’]   
print (myList + [‘e’, ‘f’]) => [‘a’, ‘b’, ‘c’, ‘d’,‘e’, ‘f’]

print (myList)   
=> [‘a’, ‘b’, ‘c’, ‘d’]

**Multiplication Operator: \***

Duplicate a list and concatenate it to the end of the list [Example]

myList = [‘a’, ‘b’, ‘c’, ‘d’] print (myList\*3)

=> ['a', 'b', 'c', 'd', 'a', 'b', 'c', 'd', 'a', 'b', 'c', 'd']

print (myList)

=> [‘a’, ‘b’, ‘c’, ‘d’]

**Note:**

**The + and \* symbols do not modify the list. The list stays as [‘a’, ‘b’,**

**‘c’, ‘d’] in both cases.**

**Appendix C: Working With Tuples**

=> marks the start of the output   
**del**

Delete the entire tuple   
[Example]

myTuple = (‘a’, ‘b’, ‘c’, ‘d’) del myTuple   
print (myTuple) => NameError: name 'myTuple' is not defined   
**in**

Check if an item is in a tuple   
[Example]

myTuple = (‘a’, ‘b’, ‘c’, ‘d’) ‘c’ in myTuple => True

‘e’ in myTuple => False

**len( )**

Find the number of items in a tuple   
[Example]

myTuple = (‘a’, ‘b’, ‘c’, ‘d’) print (len(myTuple)) => 4

**Addition Operator: +**

Concatenate Tuples   
[Example]

myTuple = (‘a’, ‘b’, ‘c’, ‘d’) print (myTuple + (‘e’,‘f’)) => (‘a’, ‘b’, ‘c’, ‘d’, ‘e’, ‘f’)   
print (myTuple) => (‘a’, ‘b’, ‘c’, ‘d’)   
**Multiplication Operator: \***

Duplicate a tuple and concatenate it to the end of the tuple [Example]

myTuple = (‘a’, ‘b’, ‘c’, ‘d’) print(myTuple\*3) => ('a', 'b', 'c', 'd', 'a', 'b', 'c', 'd', 'a', 'b', 'c', 'd')   
print (myTuple) => (‘a’, ‘b’, ‘c’, ‘d’)   
**Note: The + and \* symbols do not modify the tuple. The tuple stays as [‘a’, ‘b’, ‘c’, ‘d’] in both cases.**

**Appendix D: Working With Dictionaries**

=> marks the start of the output   
**clear( )**

Removes all elements of the dictionary, returning an empty dictionary [Example]

dic1 = {1: ‘one’, 2: ‘two’}   
print (dic1)   
=> {1: 'one', 2: 'two'}

dic1.clear()   
print (dic1)   
=> { }

**del**

Delete the entire dictionary   
[Example]

dic1 = {1: ‘one’, 2: ‘two’}   
del dic1   
print (dic1)   
=> NameError: name 'dic1' is not defined **get( )**

Returns a value for the given key.

If the key is not found, it’ll return the keyword None.

Alternatively, you can state the value to return if the key is not found.

[Example]

dic1 = {1: ‘one’, 2: ‘two’}   
dic1.get(1)   
=> ‘one’

dic1.get(5)   
=> None

dic1.get(5, “Not Found”) => ‘Not Found’

**In**

Check if an item is in a dictionary   
[Example]

dic1 = {1: ‘one’, 2: ‘two’}

# based on the key 1 in dic1   
=> True

3 in dic1   
=> False

# based on the value ‘one’ in dic1.values() => True

‘three’ in dic1.values() => False

**items( )**

Returns a list of dictionary’s pairs as tuples [Example]

dic1 = {1: ‘one’, 2: ‘two’}   
dic1.items()   
=> dict\_items([(1, 'one'), (2, 'two')])   
**keys( )**

Returns list of the dictionary's keys   
[Example]

dic1 = {1: ‘one’, 2: ‘two’}   
dic1.keys()   
=> dict\_keys([1, 2])   
**len( )**

Find the number of items in a dictionary [Example]

dic1 = {1: ‘one’, 2: ‘two’}   
print (len(dic1)) => 2

**update( )**

Adds one dictionary’s key-values pairs to another. Duplicates are removed.

[Example]

dic1 = {1: ‘one’, 2: ‘two’} dic2 = {1: ‘one’, 3: ‘three’}

dic1.update(dic2) print (dic1) => {1: 'one', 2: 'two', 3: 'three'}

print (dic2) #no change => {1: ‘one’, 3: ‘three’}

**values( )**

Returns list of the dictionary's values

[Example]

dic1 = {1: ‘one’, 2: ‘two’}

dic1.values()

=> dict\_values(['one', 'two'])

**Appendix E: Project Answers**

Exercise 1

from random import randint   
from os import remove, rename

Exercise 2

def getUserScore(userName):

try:   
 input = open('userScores.txt', 'r')   
 for line in input:   
 content = line.split(',')   
 if content[0] == userName:   
 input.close()   
 return content[1]   
 input.close()   
 return "-1"   
except IOError:   
 print ("\nFile userScores.txt not found. A new file will be created.") input =   
open('userScores.txt', 'w')   
 input.close()   
 return "-1"

Exercise 3

def updateUserPoints(newUser, userName, score): if newUser:   
 input = open('userScores.txt', 'a')   
 input.write(‘\n’ + userName + ', ' + score) input.close()

else:   
 input = open('userScores.txt', 'r')   
 output = open('userScores.tmp', 'w')   
for line in input:   
 content = line.split(',')   
 if content[0] == userName:   
 content[1] = score   
 line = content[0] + ', ' + content[1] + '\n'

output.write(line)   
input.close()   
output.close()

remove('userScores.txt')   
 rename('userScores.tmp', 'userScores.txt') Exercise 4

def generateQuestion():

operandList = [0, 0, 0, 0, 0]   
operatorList = ['', '', '', '']   
operatorDict = {1:' + ', 2:' - ', 3:'*', 4:'*\*'}

for index in range(0, 5):   
 operandList[index] = randint(1, 9)

for index in range(0, 4):   
 if index > 0 and operatorList[index-1] != '\*\*': operator = operatorDict[randint(1, 4)] else: operator =   
operatorDict[randint(1, 3)]

operatorList[index] = operator questionString = str(operandList[0])

for index in range(1, 5):  
 questionString = questionString + operatorList[index-1] + str(operandList[index]) result = eval(questionString)

questionString = questionString.replace("\*\*", "^") print ('\n' + questionString)

userResult = input('Answer: ')

while True:  
 try:  
 if int(userResult) == result:   
 print ("So Smart") return 1 else: print ("Sorry, wrong answer. The correct answer is", result)   
 return 0  
 except Exception as e: print ("You did not enter a number. Please try again.")   
 userResult = input('Answer: ')   
[Explanation for Exercise 4.2]

Starting from the second item (i.e. index = 1) in operatorList, the line if index > 0 and operatorList[index-1] != '\*\*': checks if the previous item in operatorList is the ‘\*\*’ symbol..

If it is not, the statement operator = operatorDict[randint(1, 4)] will execute. Since the range given to the randint function is 1 to 4, the numbers 1, 2, 3 or 4 will be generated. Hence, the symbols ‘+’, ‘-’, ‘*’or ‘*\*’ will be assigned to the variable operator.

However, if the previous symbol is ‘\*\*’, the else statement (operator = operatorDict[randint(1, 3)]) will execute. In this case, the range given to the randint function is from 1 to 3. Hence, the ‘\*\*’ symbol, which has a key of 4 in operatorDict will NOT be assigned to the operator variable.

Exercise 5

try:

import myPythonFunctions as m

userName = input('''Please enter your user name or create a new one if this is the first time you are running the program: ''')

userScore = int(m.getUserScore(userName)) if userScore == -1:  
 newUser = True userScore = 0   
else:  
 newUser = False   
userChoice = 0

while userChoice != '-1':

userScore += m.generateQuestion() print   
("Current Score = ", userScore) userChoice =   
input("Press Enter To Continue or -1 to Exit: ")   
 m.updateUserPoints(newUser, userName,   
str(userScore))   
except Exception as e:   
 print ("An unexpected error occurred. Program will be exited.")

Challenge Yourself

You only need to change the function generateQuestion() for all the challenges. Here’s the suggested solution.

def generateQuestion():   
 operandList = [0, 0, 0, 0, 0]   
 operatorList = ['', '', '', '']   
 operatorDict = {1:' + ', 2:' - ', 3:'*', 4:'/', 5:'*\*'}

result = 500001

while result > 50000 or result < -50000: for index in range(0, 5): operandList[index] = randint(1, 9)  
 for index in range(0, 4): if index > 0 and operatorList[index-1] != '\*\*':   
 operator = operatorDict[randint(1, 4)] else: operator =   
operatorDict[randint(1, 5)]   
 operatorList[index] = operator   
 '''   
 Randomly generate the positions of ( and ) *E.g.* If openBracket = 2, the ( symbol will be placed in front of the third number If   
 closeBracket = 3, the ) symbol will be placed behind the fourth number Since the closing bracket cannot be before the opening bracket, we have to generate the position for the   
 closing bracket from openBracket + 1 onwards '''

openBracket = randint(0, 3) closeBracket = randint(openBracket+1, 4)

if openBracket == 0: questionString = '(' + str(operandList[0]) else: questionString = str(operandList[0])  
 for index in range(1, 5): if index == openBracket: questionString =   
questionString + operatorList[index-1] + '(' +   
str(operandList[index]) elif index ==   
closeBracket: questionString =   
questionString + operatorList[index-1] +   
str(operandList[index]) + ')'  
 else: questionString = questionString + operatorList[index-1] +   
str(operandList[index])  
 result = round(eval(questionString), 2) #End of While Loop   
 questionString = questionString.replace("\*\*", "^") print ('\n' + questionString)

userResult = input('Answer (correct to 2 d.p. if not an integer): ')   
 while True:  
 try:  
 if float(userResult) == result:   
 print ("So Smart") return 1 else: print ("Sorry, wrong answer. The correct answer is", result)   
 return 0  
 except Exception as e: print ("You did not enter a number. Please try again.")   
 userResult = input('Answer (correct to 2 d.p. if not an integer): ')

**One Last Thing…**

When you turn the page, Amazon will prompt you to rate this book and share your thoughts on Facebook and Twitter.

If this guide has helped you, I would be deeply appreciative if you would take a few seconds to let your friends know about it.

To me, programming is an art and a science. It is highly addictive and enjoyable. It is my hope to share this passion with as many people as possible.

In addition, I hope you do not stop learning here. If you are interested in more programming challenges, you can check out the site   
[https://projecteuler.net/](https://projecteuler.net/problems). Have fun!