Chapter 3

WRITING PROGRAMS

Topics Covered In This Chapter:

- Flow of execution
- Strings
- String concatenation
- Data types (such as strings or integers)
- Using IDLE to write source code
- Saving and running programs in IDLE
- The `print()` function
- The `input()` function
- Comments
- Capitalizing variables
- Case-sensitivity

That's enough math for now. Python is more than just a calculator. Now let's see what Python can do with text. In this chapter, you'll learn how to store text in variables, combine text together, and display text on the screen. Almost all programs display text to the user, and the user enters text into your programs through the keyboard. You'll also make your first program. This program displays the greeting, "Hello World!" and asks for your name.

Strings

In Python, text values are called **strings**. Strings values can be used just like integer or float values. You can store strings in variables. In code, string values start and end with a single quote (`'`). Try entering this code into the interactive shells:

```
>>> spam = 'hello'
```

The single quotes tell Python where the string begins and ends. They are not part of the string value. Now, if you type `spam` into the interactive shell, you will see the contents of the `spam` variable (the `'hello'` string.) Remember, Python evaluates variables to the value stored inside the variable. In this case, this is the string `'Hello'`:

```
>>> spam = 'hello'
>>> spam
'hello'
```

Strings can have any keyboard character in them. These are all examples of strings:

```
'hello'
'Hi there!'
'KITTENS'
'7 apples, 14 oranges, 3 lemons'
'Anything not pertaining to elephants is irrelephant.'
'A long time ago in a galaxy far, far away...'
'O*&#wY%*&OCfsdYO*&gfC%YO*&%3yc8r2'
```

String values can combine with operators to make expressions, just like integers and floats do.

String Concatenation

Try combining two strings with the + operator. This is **string concatenation**. Try entering `'Hello' + 'World!'` into the interactive shell:

```
>>> 'Hello' + 'World!'
'HelloWorld!'
```

The expression evaluates to a single string value, `'HelloWorld!'`. To keep the words separate, put a space at the end of the `'Hello'` string, before the single quote, like this:

```
>>> 'Hello ' + 'World!'
'Hello World!'
```

The + operator works differently on string and integer values because they are different data types. All values have a data type. The data type of the value `'Hello'` is a string. The data type of the value `5` is an integer. The data type tells Python what operators should do when evaluating expressions. The + operator will concatenate two string values but add two integer (or float) values.

Writing Programs in IDLE’s File Editor

Until now, you’ve been typing instructions into IDLE’s interactive shell one at a time. When you write programs though, you type in several instructions and have them run all at once. Let’s write your first program!

IDLE has another part called the **file editor**. Click on the **File** menu at the top of the Python Shell window. Then select **New Window**. A blank window will appear for you to type your program’s code into.

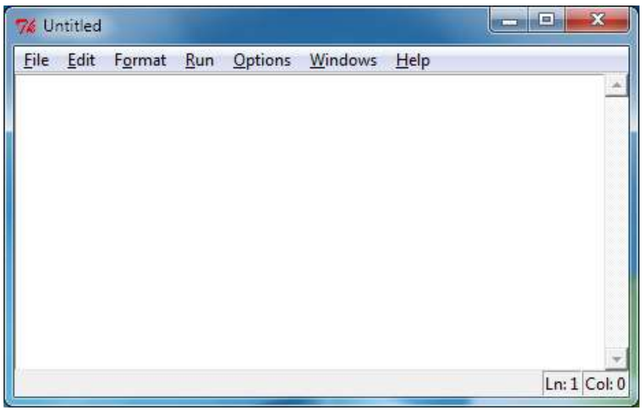


Figure 3-1: The file editor window.

The two windows look similar, but just remember this: The **interactive shell window** will have the >>> prompt. The **file editor window** will not.

Hello World!

It’s traditional for programmers to make their first program display “Hello world!” on the screen. You’ll create your own Hello World program now.

When you enter your program, don’t enter the numbers at the left side of the code. They’re there so this book can refer to code by line number. The bottom-right corner of the file editor window will tell you where the blinking cursor is. Figure 3-2 shows an example of where the cursor is according to the text in the corner.

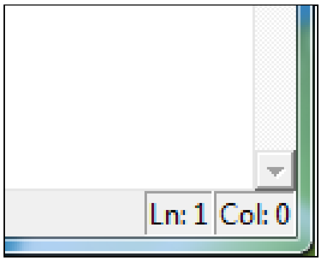


Figure 3-2: The bottom right of the file editor window tells you what line the cursor is on.

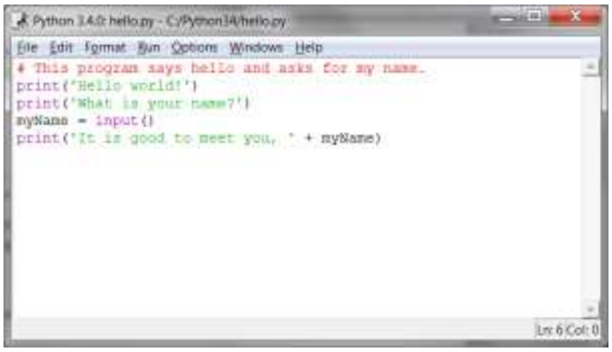
hello.py

Enter the following text into the new file editor window. This is the program’s **source code**. It contains the instructions Python will follow when the program is run. (Remember, don’t type in the line numbers!)

IMPORTANT NOTE! The programs in this book will only run on Python 3, not Python 2. When the IDLE window starts, it will say something like "Python 3.4.0" at the top. If you have Python 2 installed, you can have Python 3 installed at the same time. To download Python 3, go to https://python.org/download/.

```
# This program says hello and asks for my name.
print('Hello world!')
print('What is your name?')
myName = input()
print('It is good to meet you, ' + myName)
```

The IDLE program will write different types of instructions with different colors. After you're done typing the code, the window should look like this:

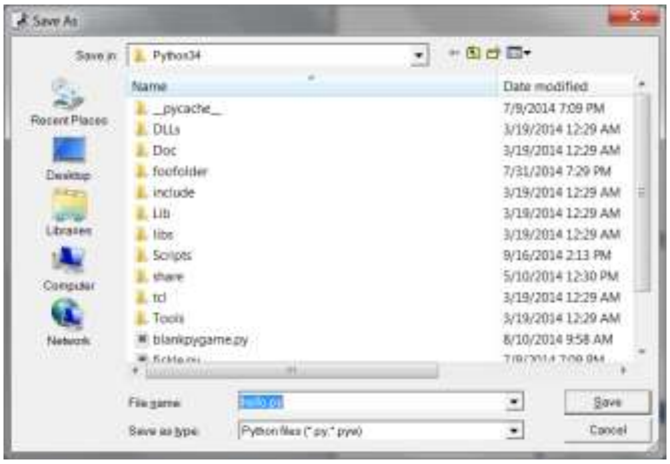


```
# This program says hello and asks for my name.
print('Hello world!')
print('What is your name?')
myName = input()
print('It is good to meet you, ' + myName)
```

Figure 3-3: The file editor window will look like this after you type in the code.

Saving Your Program

Once you've entered your source code, save it by clicking the **File** menu at the top of the File Editor window. Then click on **Save As**. Figure 3-4 shows the Save As window that will open. Enter *hello.py* in the **File name** text field then click **Save**. Or press Ctrl-S to save with a keyboard shortcut.



Name	Date modified
__pycache__	7/9/2014 7:09 PM
DLLs	3/19/2014 12:29 AM
Doc	3/19/2014 12:29 AM
foofolder	7/31/2014 7:29 PM
include	3/19/2014 12:29 AM
Lib	3/19/2014 12:29 AM
libs	3/19/2014 12:29 AM
Scripts	9/16/2014 2:13 PM
share	5/10/2014 12:30 PM
tcl	3/19/2014 12:29 AM
Tools	3/19/2014 12:29 AM
blankpygame.py	8/10/2014 9:58 AM

Figure 3-4: Saving the program.

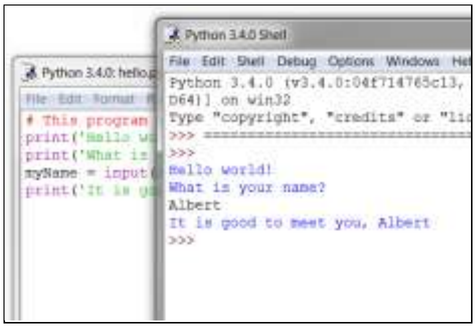
You should save your programs while you type them. That way, if the computer crashes or you accidentally exit from IDLE you won't lose much work.

Opening The Programs You've Saved

To load a saved program, click **File ► Open**. Choose *hello.py* in the window that appears and click the **Open** button. Your saved *hello.py* program will open in the File Editor window.

Now it's time to run the program. Click **File ► Run ► Run Module** or just press F5 from the file editor window. Your program will run in the interactive shell window.

Enter your name when the program asks for it. This will look like Figure 3-5:



```
# This program
print('Hello w
print('What is
myName = input(
print('It is g
```

```
Python 3.4.0 (v3.4.0:04f714765c13,
D64)] on win32
Type "copyright", "credits" or "lic
>>> ================================
>>>
Hello world!
What is your name?
Albert
It is good to meet you, Albert
>>>
```

Figure 3-5: The interactive shell after running hello.py.

When you type your name and push ENTER, the program will greet you by name. Congratulations! You've written your first program and are now a computer programmer. Press F5 again and enter another name.

If you got an error, compare your code to this book's code with the online diff tool at http://invpy.com/diff/hello.

If you get an error that looks like this:

```
Hello world!
What is your name?
Albert
Traceback (most recent call last):
  File "C:/Python26/test1.py", line 4, in <module>
    myName = input()
  File "<string>", line 1, in <module>
NameError: name 'Albert' is not defined
```

...then this means you are using Python 2, instead of Python 3. Install a version of Python 3 from http://python.org. Then, re-run the program with Python 3.

How the "Hello World" Program Works

Each line of code is an instruction interpreted by Python. These instructions make up the program. A computer program's instructions is like the steps in a cake recipe. Each instruction executes in order, beginning from the top of the program and working down the list of instructions.

What step Python is in the program's recipe is called the **flow of execution**, or just the **execution** for short. When the program starts, the execution is at the first line. Then it goes down to the next instruction.

Let's look at each line of code to see what it's doing. We'll begin with line number 1.

Comments

```
1. # This program says hello and asks for my name.
```

This line is a **comment**. Any text following a # sign (called the **pound sign**) is a comment. Comments are not for the Python, but for you, the programmer. Python ignores comments. Comments are notes about what the code does for you or any other programmer who is examining the source code. To make it easier to read the source code, this book prints comments in a light gray-colored text.

Programmers usually put a comment at the top of their code to give their program a title. The IDLE program displays comments in red text to help them stand out.

Functions

A **function** is kind of like a mini-program inside your program. It contains instructions to execute when the function is called. Python provides some built-in functions already. Two functions, `print()` and `input()`, are described next. The great thing about functions is that you only need to know what the function does, but not how it does it.

A **function call** is a piece of code that tells Python to run the code inside a function. For example, your program calls the `print()` function to display a string on the screen. The `print()` function takes the string you type in between the parentheses as input and displays the text on the screen. In order to display `Hello world!` on the screen, type the `print` function name, followed by an opening parenthesis, followed by the `'Hello world!'` string and a closing parenthesis.

The `print()` function

```
2. print('Hello world!')
3. print('What is your name?')
```

Lines 2 and 3 are calls to the `print()` function. A value between the parentheses in a function call is an **argument**. The argument on line 2's `print()` function call is `'Hello world!'`. The argument on line 3's `print()` function call is `'What is your name?'`. This is called **passing** the argument to the `print()` function.

In this book function names have parentheses at the end. This makes it clear that the book means a function named `print()`, not a variable named `print`. This is like the quotes around the number `'42'` tell Python that you are talking about the string `'42'` and not the integer `42`.

The `input()` function

```
4. myName = input()
```

This line has an assignment statement with a variable (`myName`) and a function call (`input()`). When `input()` is called, the program waits for the user to enter text. The text string that the user enters becomes the value that the function call evaluates to. Function calls can be used in expressions anywhere a value can be used.

The value that the function call evaluates to is the **return value**. (In fact, "the value a function call returns" means the same thing as "the value a function call evaluates to".) In this case, the return value of the `input()` function is the string that the user typed in-their name. If the user typed in "Albert", the `input()` function call evaluates to the string `'Albert'`. This evaluation looks like this:

```
myName = input()
            ▼
myName = 'Albert'
```

This is how the string value 'Albert' gets stored in the `myName` variable.

Using Expressions in Function Calls

```
5. print('It is good to meet you, ' + myName)
```

The last line is another `print()` function call. The expression `'It is good to meet you, ' + myName` is passed to `print()`. However, arguments are always single values. Python will first evaluate this expression and then pass the value as the argument. If `'Albert'` is stored in `myName`, the evaluation looks like this:

```
print('It is good to meet you, ' + myName)
                         ▼
print('It is good to meet you, ' + 'Albert')
                         ▼
print('It is good to meet you, Albert')
```

This is how the program greets the user by name.

Ending the Program

Once the program executes the last line, it **terminates** or **exits**. This means the program stops running. Python forgets all of the variables, including the string stored in `myName`. If you run the program again with a different name, the program will think that different string is your name.

```
Hello world!
What is your name?
Carolyn
It is good to meet you, Carolyn
```

Remember, the computer does exactly what you program it to do. Computers are dumb. The computer doesn’t care if you type in your name, someone else’s name, or just something silly. Type in anything you want. The computer will treat it the same way:

```
Hello world!
What is your name?
poop
It is good to meet you, poop
```

Variable Names

Giving variables descriptive names makes it easier to understand what a program does. Imagine if you were moving to a new house and you labeled every moving box "Stuff". That wouldn't be helpful at all!

Instead of `myName`, you could have called this variable `abrahamLincoln` or `nAmE`. Python doesn't care. It will run the program just the same.

Variable names are case-sensitive. **Case-sensitive** means the same variable name in a different case is a different variable. So `spam`, `SPAM`, `Spam`, and `sPAM` are four different variables in Python. They each contain their own separate values.

It's a bad idea to have differently cased variables in your program. If you stored your first name in the variable `name` and your last name in the variable `NAME`, it would be confusing when you read your code weeks after you first wrote it. Did `name` mean first and `NAME` mean last, or the other way around?

Variable names are usually lowercase. If there is more than one word in the variable name, capitalize each word after the first. This makes your code more readable. For example, the variable name `whatIHadForBreakfastThisMorning` is much easier to read than `whatihadforbreakfastthismorning`. This is a **convention**: an optional but standard way of doing things) in Python programming.

This book's interactive shell examples use variable names like `spam`, `eggs`, `ham`, and `bacon`. This is because the variable names in these examples don't matter. However, this book's programs all use descriptive names. Your programs should also use descriptive variable names.

Summary

Once you learn about strings and functions, you can start making programs that interact with users. This is important because text is the main way the user and the computer will communicate with each other. The user enters text through the keyboard with the `input()` function, and the computer will display text on the screen with the `print()` function.

Strings are just values of a new data type. All values have a data type, and there are many data types in Python. The `+` operator can concatenate strings together.

Variables let you remember values to use in later parts of the program. Functions are used to carry out some complicated instruction as part of your program. Python has many built-in functions that you'll learn about in this book. Variables and function calls can be used in expressions anywhere a value is used.

The instruction in your program that Python is currently following is the execution. In the next chapter, you'll learn more about making the execution move in ways other than just straight down the program. Once you learn this, you'll be ready to create games.