PYTHON CRASH COURSE

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A Hands-On, Project-Based Introduction to Programming

by Eric Matthes

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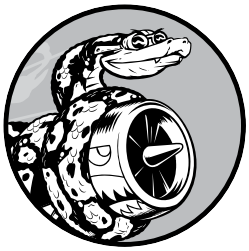
2

VARIABLES AND SIMPLE DATA TYPES



In this chapter you'll learn about the different kinds of data you can work with in your Python programs. You'll also learn how to use variables to represent data in your programs.

What Really Happens When You Run hello_world.py

Let's take a closer look at what Python does when you run *hello_world.py*. As it turns out, Python does a fair amount of work, even when it runs a simple program:

hello_world.py

```
print("Hello Python world!")
```

When you run this code, you should see the following output:

```
Hello Python world!
```

When you run the file *hello_world.py*, the ending *.py* indicates that the file is a Python program. Your editor then runs the file through the *Python interpreter*, which reads through the program and determines what each word in the program means. For example, when the interpreter sees the word `print` followed by parentheses, it prints to the screen whatever is inside the parentheses.

As you write your programs, your editor highlights different parts of your program in different ways. For example, it recognizes that `print()` is the name of a function and displays that word in one color. It recognizes that `"Hello Python world!"` is not Python code, and displays that phrase in a different color. This feature is called *syntax highlighting* and is quite useful as you start to write your own programs.

Variables

Let's try using a variable in *hello_world.py*. Add a new line at the beginning of the file, and modify the second line:

hello_world.py

```
message = "Hello Python world!"
print(message)
```

Run this program to see what happens. You should see the same output you saw previously:

```
Hello Python world!
```

We've added a *variable* named `message`. Every variable is connected to a *value*, which is the information associated with that variable. In this case the value is the `"Hello Python world!"` text.

Adding a variable makes a little more work for the Python interpreter. When it processes the first line, it associates the variable `message` with the `"Hello Python world!"` text. When it reaches the second line, it prints the value associated with `message` to the screen.

Let's expand on this program by modifying *hello_world.py* to print a second message. Add a blank line to *hello_world.py*, and then add two new lines of code:

```
message = "Hello Python world!"
print(message)

message = "Hello Python Crash Course world!"
print(message)
```

Now when you run *hello_world.py*, you should see two lines of output:

```
Hello Python world!
Hello Python Crash Course world!
```

You can change the value of a variable in your program at any time, and Python will always keep track of its current value.

Naming and Using Variables

When you're using variables in Python, you need to adhere to a few rules and guidelines. Breaking some of these rules will cause errors; other guidelines just help you write code that's easier to read and understand. Be sure to keep the following rules in mind when working with variables:

- Variable names can contain only letters, numbers, and underscores. They can start with a letter or an underscore, but not with a number. For instance, you can call a variable `message_1` but not `1_message`.
- Spaces are not allowed in variable names, but underscores can be used to separate words in variable names. For example, `greeting_message` works but `greeting message` will cause errors.
- Avoid using Python keywords and function names as variable names. For example, do not use the word `print` as a variable name; Python has reserved it for a particular programmatic purpose. (See "Python Keywords and Built-in Functions" on page 466.)
- Variable names should be short but descriptive. For example, `name` is better than `n`, `student_name` is better than `s_n`, and `name_length` is better than `length_of_persons_name`.
- Be careful when using the lowercase letter *l* and the uppercase letter *O* because they could be confused with the numbers *1* and *0*.

It can take some practice to learn how to create good variable names, especially as your programs become more interesting and complicated. As you write more programs and start to read through other people's code, you'll get better at coming up with meaningful names.

NOTE *The Python variables you're using at this point should be lowercase. You won't get errors if you use uppercase letters, but uppercase letters in variable names have special meanings that we'll discuss in later chapters.*

Avoiding Name Errors When Using Variables

Every programmer makes mistakes, and most make mistakes every day. Although good programmers might create errors, they also know how to respond to those errors efficiently. Let's look at an error you're likely to make early on and learn how to fix it.

We'll write some code that generates an error on purpose. Enter the following code, including the misspelled word `mesage`, which is shown in bold:

```
message = "Hello Python Crash Course reader!"
print(mesage)
```

When an error occurs in your program, the Python interpreter does its best to help you figure out where the problem is. The interpreter provides a traceback when a program cannot run successfully. A *traceback* is a record of where the interpreter ran into trouble when trying to execute your code.

Here's an example of the traceback that Python provides after you've accidentally misspelled a variable's name:

```
Traceback (most recent call last):
❶  File "hello_world.py", line 2, in <module>
❷    print(mesage)
           ^^^^^^
❸ NameError: name 'mesage' is not defined. Did you mean: 'message'?
```

The output reports that an error occurs in line 2 of the file *hello_world.py* ❶. The interpreter shows this line ❷ to help us spot the error quickly and tells us what kind of error it found ❸. In this case it found a *name error* and reports that the variable being printed, `mesage`, has not been defined. Python can't identify the variable name provided. A name error usually means we either forgot to set a variable's value before using it, or we made a spelling mistake when entering the variable's name. If Python finds a variable name that's similar to the one it doesn't recognize, it will ask if that's the name you meant to use.

In this example we omitted the letter *s* in the variable name `message` in the second line. The Python interpreter doesn't spellcheck your code, but it does ensure that variable names are spelled consistently. For example, watch what happens when we spell *message* incorrectly in the line that defines the variable:

```
mesage = "Hello Python Crash Course reader!"
print(mesage)
```

In this case, the program runs successfully!

```
Hello Python Crash Course reader!
```

The variable names match, so Python sees no issue. Programming languages are strict, but they disregard good and bad spelling. As a result, you don't need to consider English spelling and grammar rules when you're trying to create variable names and writing code.

Many programming errors are simple, single-character typos in one line of a program. If you find yourself spending a long time searching for one of these errors, know that you're in good company. Many experienced and talented programmers spend hours hunting down these kinds of tiny errors. Try to laugh about it and move on, knowing it will happen frequently throughout your programming life.

Variables Are Labels

Variables are often described as boxes you can store values in. This idea can be helpful the first few times you use a variable, but it isn't an accurate way to describe how variables are represented internally in Python. It's much better to think of variables as labels that you can assign to values. You can also say that a variable references a certain value.

This distinction probably won't matter much in your initial programs, but it's worth learning earlier rather than later. At some point, you'll see unexpected behavior from a variable, and an accurate understanding of how variables work will help you identify what's happening in your code.

NOTE *The best way to understand new programming concepts is to try using them in your programs. If you get stuck while working on an exercise in this book, try doing something else for a while. If you're still stuck, review the relevant part of that chapter. If you still need help, see the suggestions in Appendix C.*

TRY IT YOURSELF

Write a separate program to accomplish each of these exercises. Save each program with a filename that follows standard Python conventions, using lowercase letters and underscores, such as *simple_message.py* and *simple_messages.py*.

2-1. Simple Message: Assign a message to a variable, and then print that message.

2-2. Simple Messages: Assign a message to a variable, and print that message. Then change the value of the variable to a new message, and print the new message.

Strings

Because most programs define and gather some sort of data and then do something useful with it, it helps to classify different types of data. The first data type we'll look at is the string. Strings are quite simple at first glance, but you can use them in many different ways.

A *string* is a series of characters. Anything inside quotes is considered a string in Python, and you can use single or double quotes around your strings like this:

```
"This is a string."
'This is also a string.'
```

This flexibility allows you to use quotes and apostrophes within your strings:

```
'I told my friend, "Python is my favorite language!"'
"The language 'Python' is named after Monty Python, not the snake."
"One of Python's strengths is its diverse and supportive community."
```

Let's explore some of the ways you can use strings.

Python defaults to a float in any operation that uses a float, even if the output is a whole number.

Underscores in Numbers

When you're writing long numbers, you can group digits using underscores to make large numbers more readable:

```
>>> universe_age = 14_000_000_000
```

When you print a number that was defined using underscores, Python prints only the digits:

```
>>> print(universe_age)
14000000000
```

Python ignores the underscores when storing these kinds of values. Even if you don't group the digits in threes, the value will still be unaffected. To Python, `1000` is the same as `1_000`, which is the same as `10_00`. This feature works for both integers and floats.

Multiple Assignment

You can assign values to more than one variable using just a single line of code. This can help shorten your programs and make them easier to read; you'll use this technique most often when initializing a set of numbers.

For example, here's how you can initialize the variables `x`, `y`, and `z` to zero:

```
>>> x, y, z = 0, 0, 0
```

You need to separate the variable names with commas, and do the same with the values, and Python will assign each value to its respective variable. As long as the number of values matches the number of variables, Python will match them up correctly.

Constants

A *constant* is a variable whose value stays the same throughout the life of a program. Python doesn't have built-in constant types, but Python programmers use all capital letters to indicate a variable should be treated as a constant and never be changed:

```
MAX_CONNECTIONS = 5000
```

When you want to treat a variable as a constant in your code, write the name of the variable in all capital letters.

TRY IT YOURSELF

2-9. Number Eight: Write addition, subtraction, multiplication, and division operations that each result in the number 8. Be sure to enclose your operations in `print()` calls to see the results. You should create four lines that look like this:

```
print(5+3)
```

Your output should be four lines, with the number 8 appearing once on each line.

2-10. Favorite Number: Use a variable to represent your favorite number. Then, using that variable, create a message that reveals your favorite number. Print that message.

Comments

Comments are an extremely useful feature in most programming languages. Everything you've written in your programs so far is Python code. As your programs become longer and more complicated, you should add notes within your programs that describe your overall approach to the problem you're solving. A *comment* allows you to write notes in your spoken language, within your programs.

How Do You Write Comments?

In Python, the hash mark (#) indicates a comment. Anything following a hash mark in your code is ignored by the Python interpreter. For example:

comment.py

```
# Say hello to everyone.
print("Hello Python people!")
```

Python ignores the first line and executes the second line.

```
Hello Python people!
```

What Kinds of Comments Should You Write?

The main reason to write comments is to explain what your code is supposed to do and how you are making it work. When you're in the middle of working on a project, you understand how all of the pieces fit together. But when you return to a project after some time away, you'll likely have

forgotten some of the details. You can always study your code for a while and figure out how segments were supposed to work, but writing good comments can save you time by summarizing your overall approach clearly.

If you want to become a professional programmer or collaborate with other programmers, you should write meaningful comments. Today, most software is written collaboratively, whether by a group of employees at one company or a group of people working together on an open source project. Skilled programmers expect to see comments in code, so it's best to start adding descriptive comments to your programs now. Writing clear, concise comments in your code is one of the most beneficial habits you can form as a new programmer.

When you're deciding whether to write a comment, ask yourself if you had to consider several approaches before coming up with a reasonable way to make something work; if so, write a comment about your solution. It's much easier to delete extra comments later than to go back and write comments for a sparsely commented program. From now on, I'll use comments in examples throughout this book to help explain sections of code.

TRY IT YOURSELF

2-11. Adding Comments: Choose two of the programs you've written, and add at least one comment to each. If you don't have anything specific to write because your programs are too simple at this point, just add your name and the current date at the top of each program file. Then write one sentence describing what the program does.

The Zen of Python

Experienced Python programmers will encourage you to avoid complexity and aim for simplicity whenever possible. The Python community's philosophy is contained in "The Zen of Python" by Tim Peters. You can access this brief set of principles for writing good Python code by entering `import this` into your interpreter. I won't reproduce the entire "Zen of Python" here, but I'll share a few lines to help you understand why they should be important to you as a beginning Python programmer.

```
>>> import this
The Zen of Python, by Tim Peters
Beautiful is better than ugly.
```

Python programmers embrace the notion that code can be beautiful and elegant. In programming, people solve problems. Programmers have always respected well-designed, efficient, and even beautiful solutions to problems. As you learn more about Python and use it to write more code,

someone might look over your shoulder one day and say, "Wow, that's some beautiful code!"

```
Simple is better than complex.
```

If you have a choice between a simple and a complex solution, and both work, use the simple solution. Your code will be easier to maintain, and it will be easier for you and others to build on that code later on.

```
Complex is better than complicated.
```

Real life is messy, and sometimes a simple solution to a problem is unattainable. In that case, use the simplest solution that works.

```
Readability counts.
```

Even when your code is complex, aim to make it readable. When you're working on a project that involves complex coding, focus on writing informative comments for that code.

```
There should be one-- and preferably only one --obvious way to do it.
```

If two Python programmers are asked to solve the same problem, they should come up with fairly compatible solutions. This is not to say there's no room for creativity in programming. On the contrary, there is plenty of room for creativity! However, much of programming consists of using small, common approaches to simple situations within a larger, more creative project. The nuts and bolts of your programs should make sense to other Python programmers.

```
Now is better than never.
```

You could spend the rest of your life learning all the intricacies of Python and of programming in general, but then you'd never complete any projects. Don't try to write perfect code; write code that works, and then decide whether to improve your code for that project or move on to something new.

As you continue to the next chapter and start digging into more involved topics, try to keep this philosophy of simplicity and clarity in mind. Experienced programmers will respect your code more and will be happy to give you feedback and collaborate with you on interesting projects.

TRY IT YOURSELF

2-12. Zen of Python: Enter `import this` into a Python terminal session and skim through the additional principles.

Summary

In this chapter you learned how to work with variables. You learned to use descriptive variable names and resolve name errors and syntax errors when they arise. You learned what strings are and how to display them using lowercase, uppercase, and title case. You started using whitespace to organize output neatly, and you learned how to remove unneeded elements from a string. You started working with integers and floats, and you learned some of the ways you can work with numerical data. You also learned to write explanatory comments to make your code easier for you and others to read. Finally, you read about the philosophy of keeping your code as simple as possible, whenever possible.

In Chapter 3, you'll learn how to store collections of information in data structures called *lists*. You'll also learn how to work through a list, manipulating any information in that list.