The Elements of Programming in Python

A programming language is more than just a means for instructing a computer to perform tasks. The language also serves as a framework within which we organize our ideas about computational processes. Programs serve to communicate those ideas among the members of a programming community. Thus, programs must be written for people to read, and only incidentally for machines to execute.

When we describe a language, we should pay particular attention to the means that the language provides for combining simple ideas to form more complex ideas. Every powerful language has three such mechanisms:

- **primitive expressions and statements**, which represent the simplest building blocks that the language provides,
- **means of combination**, by which compound elements are built from simpler ones, and
- **means of abstraction**, by which compound elements can be named and manipulated as units.

In programming, we deal with two kinds of elements: functions and data. (Soon we will discover that they are really not so distinct.) Informally, data is stuff that we want to manipulate, and functions describe the rules for manipulating the data. Thus, any powerful programming language should be able to describe primitive data and primitive functions, as well as have some methods for combining and abstracting both functions and data.

Expressions

Having experimented with the full Python interpreter in the previous section, we now start anew, methodically developing the Python language element by element. Be patient if the examples seem simplistic --- more exciting material is soon to come.

We begin with primitive expressions. One kind of primitive expression is a number. More precisely, the expression that you type consists of the numerals that represent the number in base 10.

```
>>> 42
42
```

Expressions representing numbers may be combined with mathematical operators to form a compound expression, which the interpreter will evaluate:

```
>>> -1 - -1
0
>>> 1/2 + 1/4 + 1/8 + 1/16 + 1/32 + 1/64 + 1/128
0.9921875
```

These mathematical expressions use *infix* notation, where the *operator* (e.g., `+`, `-`, `*`, or `/`) appears in between the *operands*(numbers). Python includes many ways to form compound expressions. Rather than attempt to enumerate them all immediately, we will introduce new expression forms as we go, along with the language features that they support.

Strings expressions. A *string* is a sequence of characters enclosed by matching single or double quotes, such as `'Python'`and `" is cool!"`. (The Python interpreter uses single quotes to represent a string, regardless of what kind of quote you use.)

```
>>> 'Python'
'Python'
>>> " is cool!"
' is cool!'
```

The enclosing quotes are not actually part of a string; they are merely used for representation. We can see that this is the case by using the `+` operator to concatenate multiple strings into a larger string:

```
>>> 'Python' + " is cool!"
'Python is cool!'
```

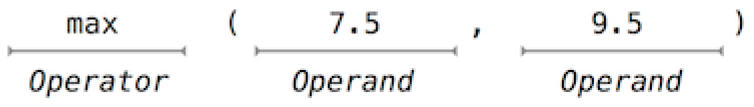
Strings are a general representation for any kind of text, such as words, phrases, URLs, error messages, and so on. Later, we will see many different ways to use and manipulate strings in Python.

Call Expressions

The most important kind of compound expression is a *call expression*, which applies a function to some arguments. Recall from algebra that the mathematical notion of a function is a mapping from some input arguments to an output value. For instance, the`max` function maps its inputs to a single output, which is the largest of the inputs. The way in which Python expresses function application is the same as in conventional mathematics.

```
>>> max(7.5, 9.5)
9.5
```

This call expression has subexpressions: the *operator* is an expression that precedes parentheses, which enclose a comma-delimited list of *operand* expressions.



The operator specifies a *function*. When this call expression is evaluated, we say that the function `max` is *called* with arguments 7.5 and 9.5, and *returns* a value of 9.5.

The order of the arguments in a call expression matters. For instance, the function `pow` raises its first argument to the power of its second argument.

```
>>> pow(100, 2)
10000
>>> pow(2, 100)
1267650600228229401496703205376
```

Function notation has three principal advantages over the mathematical convention of infix notation. First, functions may take an arbitrary number of arguments:

```
>>> max(1, -2, 3, -4)
3
```

No ambiguity can arise, because the function name always precedes its arguments.

Second, function notation extends in a straightforward way to *nested* expressions, where the elements are themselves compound expressions. In nested call expressions, unlike compound infix expressions, the structure of the nesting is entirely explicit in the parentheses.

```
>>> max(min(1, -2), min(pow(3, 5), -4))
-2
```

There is no limit (in principle) to the depth of such nesting and to the overall complexity of the expressions that the Python interpreter can evaluate. However, humans quickly get confused by multi-level nesting. An important role for you as a programmer is to structure expressions so that they remain interpretable by yourself, your programming partners, and other people who may read your expressions in the future.

Third, mathematical notation has a great variety of forms: multiplication appears between terms, exponents appear as superscripts, division as a horizontal bar, and a square root as a roof with slanted siding. Some of this notation is very hard to type! However, all of this complexity can be unified via the notation of call expressions. While Python supports common mathematical operators using infix notation (like `+` and `-`), any operator can be expressed as a function with a name.

Importing Library Functions

Python defines a very large number of functions, including the operator functions mentioned in the preceding section, but does not make all of their names available by default. Instead, it organizes the functions and other quantities that it knows about into modules, which together comprise the Python Library. To use these elements, one imports them. For example, the `math` module provides a variety of familiar mathematical functions:

```
>>> from math import sqrt
>>> sqrt(256)
16.0
```

and the `operator` module provides access to functions corresponding to infix operators:

```
>>> from operator import add, sub, mul
>>> add(14, 28)
42
>>> sub(100, mul(7, add(8, 4)))
16
```

An `import` statement designates a module name (e.g., `operator` or `math`), and then lists the named attributes of that module to import (e.g., `sqrt`). Once a function is imported, it can be called multiple times.

There is no difference between using these operator functions (e.g., `add`) and the operator symbols themselves (e.g., `+`). Conventionally, most programmers use symbols and infix notation to express simple arithmetic.

The Python 3 Library Docs list the functions defined by each module, such as the math module. However, this documentation is written for developers who know the whole language well. For now, you may find that experimenting with a function tells you more about its behavior than reading the documemtation. As you become familiar with the Python language and vocabulary, this documentation will become a valuable reference source.

Source : http://inst.eecs.berkeley.edu/~cs61A/book/chapters/functions.html#the-elements-of-programming