

Python data structures and Scratch Costumes

The next step in program for most languages is mastering variables and data structures. We will go that direction with Python, but will detour slightly in Scratch. Scratch uses sprites to create its visual appeal. One of the ways to create animation and variety with the sprites is through costumes.

Python Lists, Tuples and Dictionaries

Simple variables in Python are in fact simple. You simply assign a value to a label using an equal sign.

```
a = 25
```

To store more complex data Python has three main structures: the list, the tuple, and the dictionary. A list is a collection of values. If you are familiar with other languages it is similar to an array and a structure. By design lists are one dimensional. But that one dimension can have values of any type. For example: You can use a list to hold the information associated with a book.

```
bookinfo = ['Hacking Raspberry Pi', 'Timothy L Walker', 'Que', 370, 29.99]
```

The list is indicated by square brackets. The values are separated by commas. Accessing the elements of the list is also done via square brackets. The index values are zero based.

```
print bookinfo[0]
Hacking Raspberry Pi
```

```
print bookinfo[3]
370
```

You can change a value in the list by assigning a new value to it.

```
bookinfo[4] = 30.99
```

A tuple is like a list but its values can not be changed after the initial assignment. This is useful when pulling data from a source that is read only. (sensors, databases, etc.)

Strings are also sequences and characters can be accessed using square brackets.

```
s = 'Linux on Saturday'
print s[9]
S
```

Negative index values start at the end of the sequence and work backward. Since zero (0) is a “positive” index indicating the first character, the last character is -1.

```
print bookinfo[-1]
30.99
```

Slicing is the concept of providing a range for the index and it will return the elements indicated. NOTE: The last index listed is not included in the slice. Using the variable `s` defined above:

```
print s[6:8]
on
```

If you leave out the first index it starts at the beginning of the list or string. If you leave out the second index it goes to the end of the string.

```
print s[:5]
Linux
print s[9:]
Saturday
```

The first example is the equivalent of a Left string function, the second a Right string function. An alternative to `s[9:]` is `s[-8:]`.

A dictionary is Python’s answer to what in other languages is called an associative array. Instead of a simple numeric index a dictionary uses key:value pairs to allow you identify the data in the dictionary by names. Redoing our `bookinfo` as a dictionary looks like this:

```
book2 = {'title':'Hacking Raspberry Pi', 'author':'Timothy L Walker',
        'publisher':'Que', 'pages':370, 'price':29.99}
```

The curly braces are used to create the dictionary. Square brackets are used for retrieval or reassignment:

```
print book2['author']
Timothy L Walker

book2['price'] = 30.99
```

Sidebar: Operators

Performing calculations and comparisons in python requires the use of operators. The basic math operators are what you know from spreadsheets, `+` `-` `*` `/`. Exponents can be calculated using a double asterisk (`**`). Comparison operators are usually two characters:

`==` equal

!= not equal
>= greater than or equal
<= less than or equal
> greater than
< less than

Operators and Strings

You can use the + (concatenation) and the * (duplicate) options with strings. Examples:

```
print bookinfo[0] + bookinfo[1]
Hacking Raspberry PiTimothy L Walker
```

or

```
print bookinfo[0] + ` by ` + bookinfo[1]
Hacking Raspberry Pi by Timothy L Walker
```

An example of the duplicate operator:

```
print `very ` * 9 + `small`
very very very very very very very very small
```

Scratch Sprites and Costumes

In this example we will use two sprite files to create a single sprite with two costumes. Start by deleting **Sprite 1** the Scratch cat. To do this right click on the image in the sprite area below the white stage area. Once you have done that click on the **Choose new sprite from file** icon. It is the center of the three icons above the sprite area. From the folder options provided select **Animals**. Select **bat1-a** and click **Ok**. This will create a new **Sprite 1**. In the center section of the interface select the **Costumes** tab. Click the **Import** button and find **bat1-b**. The image of the bat on the stage will change to bat1-b. Drag the bat to the left side of the stage. Click on the **Scripts** tab to start building the script.

From the **Control** group select **When [Green Flag] Clicked** and drag into the Scripts area. Next select the **Repeat 10 times** block and drag it out so it snaps under the starter block. Change the 10 in the repeat block to **25**. Select the **Looks** group and drag the **Next Costume** block inside the loop block. Select the **Motion** group and drag the **Move 10 Steps** block and place it below the Next Costume block inside the loop. The last block we will need is back in the Control group. Drag the **Wait 1 sec** block and place it after the Move 10 Steps block. Change the 1 to **0.1** in the Wait block.

Once this is done click the green flag. Your bat should fly across the stage.

Variables in Scratch

Scratch has a group where you can create variables and lists. Once created there are code blocks for manipulating the value(s) of the variable or list. There is also a group called **Operators** that contains code blocks for working with the variables that you create.