

# KEY\_Lesson08\_Logic

December 10, 2019

## 1 Logic

Previously, we learned about Booleans. Booleans are variables that can take two values: `True` or `False`.

We can make a variable a Boolean by setting it equal to `True` or `False`, but as we discussed earlier we can also use comparison operators to generate

`<` less than

`>` greater than

`<=` less than/equal to

`>=` greater than or equal to

`==` equal to

`!=` not equal to

Let's create a basic list to get started

```
[2]: # create a list called my_list with numbers 1,2,3 inside
my_list = [1, 2, 3]
```

Let's say a list with more than 2 items is considered long. Using the `len` function, we can create a Boolean value that tells us if our list is long or short.

```
[3]: # create a boolean called long_list that is True if our list has more than 2
    ↪ items
long_list = len(my_list) > 2

# print the value of long_list
print(long_list)
```

`True`

What if we wanted to create a Boolean that had the opposite value?

Certain pairs of operators are opposites of one another.

`>` and `<=` are opposites

`<` and `>=` are opposites

`==` and `!=` are opposites

So, since we used `>` to figure out if our list was long, we can use `<=` to figure out if our list is short.

```
[4]: # create a boolean called short_list that is False if our list doesn't have
      ↪ more than 2 items
      short_list = len(my_list) <= 2

      # print the value of short_list
      print(short_list)
```

False

One cool thing about Python is that we can use words in place of some of the operators we talked about earlier. The operator `==` is used to tell if two things are equal, but we can also use `is` in its place.

**note to editor:** I'm not sure if introducing `is` is a good idea or not given it only works in place of `==` in certain circumstance. I think it's useful to know it exists but obviously explaining when to use it would be too advanced, at least for this lesson.

First, let's use the `==` operator to test if the first item of our list is equal to 1.

```
[5]: # use == to see if the first item of my_list equals 1
      my_list[0] == 1
```

[5]: True

Now, let's do the same thing using the `is` operator

```
[6]: # use is to see if the first item of my_list equals 1
      my_list[0] is 1
```

[6]: True

In most cases, it doesn't matter whether you use `is` or `==`. Using `is` might help you avoid accidentally using `=` instead of `==`, which is a common mistake.

Another useful python keyword is `not`. Putting `not` in front of a boolean will flip the value to its opposite—remember that `True` and `False` are opposites.

```
[7]: # use the "not" keyword to calculate the opposite of True
      not True
```

[7]: False

The `not` keyword can be used with logical operators. Recall that the operator `!=` determines if two things are not equal to each other. We learned above that `is` can be used to compare two objects, too. Then, we can use `is` and `not` together to see if two values are different.

```
[8]: # use != to see if the first item of my_list is not equal to 5  
my_list[0] != 5
```

[8]: True

```
[9]: # use "is not" to see if the first item of my_list is not equal to 5  
my_list[0] is not 5
```

[9]: True

Just like comparison operators such as `>` and `<=` can work on things like strings and integers (and booleans, too!), there are operators just for booleans.

First, we'll look at `or`.

`or` looks at the two booleans and returns `True` if **at least one** is `True`, and otherwise returns `False`.

```
[10]: # print the value of True or True  
print(True or True)  
  
# print the value of True or False  
print(True or False)  
  
# print the value of False or False  
print(False or False)
```

True  
True  
False

Another really useful boolean operator is `and`.

`and` works similarly to `or`, except it only returns `True` if **both** of the booleans are `True`.

```
[11]: # print the value of True and True  
print(True and True)  
  
# print the value of True and False  
print(True and False)  
  
# print the value of False and False  
print(False and False)
```

True  
False  
False

One kind of problem that `or` and `and` can be useful for solving is testing if a value is inside a certain range.

Say we wanted to see if the length of our list was greater than 5 or less than 4—so any length except 4 or 5.

```
[12]: # use "or" to see if my_list has less than 4 or more than 5 items
len(my_list) > 5 or len(my_list) < 4
```

```
[12]: True
```

Say we wanted to solve the opposite problem—we want to see if the length of our list is exactly 4 or 5.

```
[13]: # use "and" to see if my_list has 4 or 5 items
len(my_list) >=4 and len(my_list) <= 5
```

```
[13]: False
```

We see that the length of our list **is** less than or equal to 5, but it isn't greater than or equal to 4, so the value is **False**.

This is a bit of a tricky example, so it may take a minute or two for it to sink in. If it is confusing, try making a list with two columns - one representing  $\geq 4$  and one representing  $\leq 5$ . For different example values, place a check in each column if that condition is true, and an X if it is false - only values where all columns have checks will result in **True** using the **and** operator.

**Challenge:** What about when we use the **or** operator?

Great job! You just learned about logic in Python! You learned: - How to create a boolean using operators - That some operators (for example,  $>$  and  $\leq$ ) are "opposites" - That keywords like **is** and **not** can be used in place of symbol-based operators - How to use **or** and **and** to combine booleans