

# KEY\_Lesson08\_Logic

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## 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