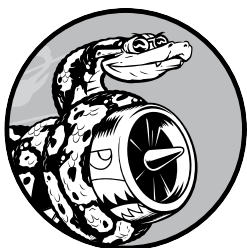


# 5

## IF STATEMENTS



Programming often involves examining a set of conditions and deciding which action to take based on those conditions.

Python's `if` statement allows you to examine the current state of a program and respond appropriately to that state.

In this chapter, you'll learn to write conditional tests, which allow you to check any condition of interest. You'll learn to write simple `if` statements, and you'll learn how to create a more complex series of `if` statements to identify when the exact conditions you want are present. You'll then apply this concept to lists, so you'll be able to write a `for` loop that handles most items in a list one way but handles certain items with specific values in a different way.

## A Simple Example

The following example shows how if tests let you respond to special situations correctly. Imagine you have a list of cars and you want to print out the name of each car. Car names are proper names, so the names of most cars should be printed in title case. However, the value 'bmw' should be printed in all uppercase. The following code loops through a list of car names and looks for the value 'bmw'. Whenever the value is 'bmw', it's printed in uppercase instead of title case:

---

```
cars.py cars = ['audi', 'bmw', 'subaru', 'toyota']

for car in cars:
    ❶ if car == 'bmw':
        print(car.upper())
    else:
        print(car.title())
```

---

The loop in this example first checks if the current value of car is 'bmw' ❶. If it is, the value is printed in uppercase. If the value of car is anything other than 'bmw', it's printed in title case:

---

```
Audi
BMW
Subaru
Toyota
```

---

This example combines a number of the concepts you'll learn about in this chapter. Let's begin by looking at the kinds of tests you can use to examine the conditions in your program.

## Conditional Tests

At the heart of every if statement is an expression that can be evaluated as True or False and is called a *conditional test*. Python uses the values True and False to decide whether the code in an if statement should be executed. If a conditional test evaluates to True, Python executes the code following the if statement. If the test evaluates to False, Python ignores the code following the if statement.

### Checking for Equality

Most conditional tests compare the current value of a variable to a specific value of interest. The simplest conditional test checks whether the value of a variable is equal to the value of interest:

---

```
>>> car = 'bmw'
>>> car == 'bmw'
True
```

---

The first line sets the value of `car` to `'bmw'` using a single equal sign, as you've seen many times already. The next line checks whether the value of `car` is `'bmw'` by using a double equal sign (`==`). This *equality operator* returns `True` if the values on the left and right side of the operator match, and `False` if they don't match. The values in this example match, so Python returns `True`.

When the value of `car` is anything other than `'bmw'`, this test returns `False`:

---

```
>>> car = 'audi'
>>> car == 'bmw'
False
```

---

A single equal sign is really a statement; you might read the first line of code here as “Set the value of `car` equal to `'audi'`.” On the other hand, a double equal sign asks a question: “Is the value of `car` equal to `'bmw'`?” Most programming languages use equal signs in this way.

### ***Ignoring Case When Checking for Equality***

Testing for equality is case sensitive in Python. For example, two values with different capitalization are not considered equal:

---

```
>>> car = 'Audi'
>>> car == 'audi'
False
```

---

If case matters, this behavior is advantageous. But if case doesn't matter and instead you just want to test the value of a variable, you can convert the variable's value to lowercase before doing the comparison:

---

```
>>> car = 'Audi'
>>> car.lower() == 'audi'
True
```

---

This test will return `True` no matter how the value `'Audi'` is formatted because the test is now case insensitive. The `lower()` method doesn't change the value that was originally stored in `car`, so you can do this kind of comparison without affecting the original variable:

---

```
>>> car = 'Audi'
>>> car.lower() == 'audi'
True
>>> car
'Audi'
```

---

We first assign the capitalized string `'Audi'` to the variable `car`. Then, we convert the value of `car` to lowercase and compare the lowercase value to the string `'audi'`. The two strings match, so Python returns `True`. We can see that the value stored in `car` has not been affected by the `lower()` method.

Websites enforce certain rules for the data that users enter in a manner similar to this. For example, a site might use a conditional test like this to

ensure that every user has a truly unique username, not just a variation on the capitalization of another person's username. When someone submits a new username, that new username is converted to lowercase and compared to the lowercase versions of all existing usernames. During this check, a username like 'John' will be rejected if any variation of 'john' is already in use.

## Checking for Inequality

When you want to determine whether two values are not equal, you can use the *inequality operator* (`!=`). Let's use another if statement to examine how to use the inequality operator. We'll store a requested pizza topping in a variable and then print a message if the person did not order anchovies:

---

```
toppings.py requested_topping = 'mushrooms'

if requested_topping != 'anchovies':
    print("Hold the anchovies!")
```

---

This code compares the value of `requested_topping` to the value `'anchovies'`. If these two values do not match, Python returns `True` and executes the code following the if statement. If the two values match, Python returns `False` and does not run the code following the if statement.

Because the value of `requested_topping` is not `'anchovies'`, the `print()` function is executed:

---

```
Hold the anchovies!
```

---

Most of the conditional expressions you write will test for equality, but sometimes you'll find it more efficient to test for inequality.

## Numerical Comparisons

Testing numerical values is pretty straightforward. For example, the following code checks whether a person is 18 years old:

---

```
>>> age = 18
>>> age == 18
True
```

---

You can also test to see if two numbers are not equal. For example, the following code prints a message if the given answer is not correct:

---

```
magic
_number.py answer = 17
if answer != 42:
    print("That is not the correct answer. Please try again!")
```

---

The conditional test passes, because the value of `answer` (17) is not equal to 42. Because the test passes, the indented code block is executed:

---

```
That is not the correct answer. Please try again!
```

---

You can include various mathematical comparisons in your conditional statements as well, such as less than, less than or equal to, greater than, and greater than or equal to:

---

```
>>> age = 19
>>> age < 21
True
>>> age <= 21
True
>>> age > 21
False
>>> age >= 21
False
```

---

Each mathematical comparison can be used as part of an if statement, which can help you detect the exact conditions of interest.

### **Checking Multiple Conditions**

You may want to check multiple conditions at the same time. For example, sometimes you might need two conditions to be True to take an action. Other times, you might be satisfied with just one condition being True. The keywords `and` and `or` can help you in these situations.

#### **Using `and` to Check Multiple Conditions**

To check whether two conditions are both True simultaneously, use the keyword `and` to combine the two conditional tests; if each test passes, the overall expression evaluates to True. If either test fails or if both tests fail, the expression evaluates to False.

For example, you can check whether two people are both over 21 by using the following test:

---

```
>>> age_0 = 22
>>> age_1 = 18
❶ >>> age_0 >= 21 and age_1 >= 21
False
❷ >>> age_1 = 22
>>> age_0 >= 21 and age_1 >= 21
True
```

---

First, we define two ages, `age_0` and `age_1`. Then we check whether both ages are 21 or older ❶. The test on the left passes, but the test on the right fails, so the overall conditional expression evaluates to False. We then change `age_1` to 22 ❷. The value of `age_1` is now greater than 21, so both individual tests pass, causing the overall conditional expression to evaluate as True.

To improve readability, you can use parentheses around the individual tests, but they are not required. If you use parentheses, your test would look like this:

---

```
(age_0 >= 21) and (age_1 >= 21)
```

---

## Using or to Check Multiple Conditions

The keyword `or` allows you to check multiple conditions as well, but it passes when either or both of the individual tests pass. An `or` expression fails only when both individual tests fail.

Let's consider two ages again, but this time we'll look for only one person to be over 21:

---

```
>>> age_0 = 22
>>> age_1 = 18
❶ >>> age_0 >= 21 or age_1 >= 21
True
❷ >>> age_0 = 18
>>> age_0 >= 21 or age_1 >= 21
False
```

---

We start with two age variables again. Because the test for `age_0` ❶ passes, the overall expression evaluates to `True`. We then lower `age_0` to 18. In the final test ❷, both tests now fail and the overall expression evaluates to `False`.

## Checking Whether a Value Is in a List

Sometimes it's important to check whether a list contains a certain value before taking an action. For example, you might want to check whether a new username already exists in a list of current usernames before completing someone's registration on a website. In a mapping project, you might want to check whether a submitted location already exists in a list of known locations.

To find out whether a particular value is already in a list, use the keyword `in`. Let's consider some code you might write for a pizzeria. We'll make a list of toppings a customer has requested for a pizza and then check whether certain toppings are in the list.

---

```
>>> requested_toppings = ['mushrooms', 'onions', 'pineapple']
>>> 'mushrooms' in requested_toppings
True
>>> 'pepperoni' in requested_toppings
False
```

---

The keyword `in` tells Python to check for the existence of `'mushrooms'` and `'pepperoni'` in the list `requested_toppings`. This technique is quite powerful because you can create a list of essential values, and then easily check whether the value you're testing matches one of the values in the list.

## Checking Whether a Value Is Not in a List

Other times, it's important to know if a value does not appear in a list. You can use the keyword `not in` in this situation. For example, consider a list of users who are banned from commenting in a forum. You can check whether a user has been banned before allowing that person to submit a comment:

---

```
banned_users.py banned_users = ['andrew', 'carolina', 'david']
user = 'marie'
```

```
if user not in banned_users:
    print(f"{user.title()}, you can post a response if you wish.")
```

---

The if statement here reads quite clearly. If the value of `user` is not in the list `banned_users`, Python returns True and executes the indented line.

The user 'marie' is not in the list `banned_users`, so she sees a message inviting her to post a response:

---

Marie, you can post a response if you wish.

---

## ***Boolean Expressions***

As you learn more about programming, you'll hear the term *Boolean expression* at some point. A Boolean expression is just another name for a conditional test. A *Boolean value* is either True or False, just like the value of a conditional expression after it has been evaluated.

Boolean values are often used to keep track of certain conditions, such as whether a game is running or whether a user can edit certain content on a website:

---

```
game_active = True
can_edit = False
```

---

Boolean values provide an efficient way to track the state of a program or a particular condition that is important in your program.

### **TRY IT YOURSELF**

**5-1. Conditional Tests:** Write a series of conditional tests. Print a statement describing each test and your prediction for the results of each test. Your code should look something like this:

---

```
car = 'subaru'
print("Is car == 'subaru'? I predict True.")
print(car == 'subaru')

print("\nIs car == 'audi'? I predict False.")
print(car == 'audi')
```

---

- Look closely at your results, and make sure you understand why each line evaluates to True or False.
- Create at least 10 tests. Have at least 5 tests evaluate to True and another 5 tests evaluate to False.

*(continued)*

**5-2. More Conditional Tests:** You don't have to limit the number of tests you create to 10. If you want to try more comparisons, write more tests and add them to `conditional_tests.py`. Have at least one True and one False result for each of the following:

- Tests for equality and inequality with strings
- Tests using the `lower()` method
- Numerical tests involving equality and inequality, greater than and less than, greater than or equal to, and less than or equal to
- Tests using the `and` keyword and the `or` keyword
- Test whether an item is in a list
- Test whether an item is not in a list

## if Statements

When you understand conditional tests, you can start writing `if` statements. Several different kinds of `if` statements exist, and your choice of which to use depends on the number of conditions you need to test. You saw several examples of `if` statements in the discussion about conditional tests, but now let's dig deeper into the topic.

### Simple if Statements

The simplest kind of `if` statement has one test and one action:

---

```
if conditional_test:  
    do something
```

---

You can put any conditional test in the first line and just about any action in the indented block following the test. If the conditional test evaluates to True, Python executes the code following the `if` statement. If the test evaluates to False, Python ignores the code following the `if` statement.

Let's say we have a variable representing a person's age, and we want to know if that person is old enough to vote. The following code tests whether the person can vote:

---

```
voting.py age = 19  
if age >= 18:  
    print("You are old enough to vote!")
```

---

Python checks to see whether the value of `age` is greater than or equal to 18. It is, so Python executes the indented `print()` call:

---

```
You are old enough to vote!
```

---



Indentation plays the same role in if statements as it did in for loops. All indented lines after an if statement will be executed if the test passes, and the entire block of indented lines will be ignored if the test does not pass.

You can have as many lines of code as you want in the block following the if statement. Let's add another line of output if the person is old enough to vote, asking if the individual has registered to vote yet:

---

```
age = 19
if age >= 18:
    print("You are old enough to vote!")
    print("Have you registered to vote yet?")
```

---

The conditional test passes, and both print() calls are indented, so both lines are printed:

---

```
You are old enough to vote!
Have you registered to vote yet?
```

---

If the value of age is less than 18, this program would produce no output.

### ***if-else Statements***

Often, you'll want to take one action when a conditional test passes and a different action in all other cases. Python's if-else syntax makes this possible. An if-else block is similar to a simple if statement, but the else statement allows you to define an action or set of actions that are executed when the conditional test fails.

We'll display the same message we had previously if the person is old enough to vote, but this time we'll add a message for anyone who is not old enough to vote:

---

```
age = 17
❶ if age >= 18:
    print("You are old enough to vote!")
    print("Have you registered to vote yet?")
❷ else:
    print("Sorry, you are too young to vote.")
    print("Please register to vote as soon as you turn 18!")
```

---

If the conditional test ❶ passes, the first block of indented print() calls is executed. If the test evaluates to False, the else block ❷ is executed. Because age is less than 18 this time, the conditional test fails and the code in the else block is executed:

---

```
Sorry, you are too young to vote.
Please register to vote as soon as you turn 18!
```

---

This code works because it has only two possible situations to evaluate: a person is either old enough to vote or not old enough to vote. The if-else

structure works well in situations in which you want Python to always execute one of two possible actions. In a simple if-else chain like this, one of the two actions will always be executed.

## The if-elif-else Chain

Often, you'll need to test more than two possible situations, and to evaluate these you can use Python's if-elif-else syntax. Python executes only one block in an if-elif-else chain. It runs each conditional test in order, until one passes. When a test passes, the code following that test is executed and Python skips the rest of the tests.

Many real-world situations involve more than two possible conditions. For example, consider an amusement park that charges different rates for different age groups:

- Admission for anyone under age 4 is free.
- Admission for anyone between the ages of 4 and 18 is \$25.
- Admission for anyone age 18 or older is \$40.

How can we use an if statement to determine a person's admission rate? The following code tests for the age group of a person and then prints an admission price message:

---

```
amusement    age = 12
_park.py     ❶ if age < 4:
              print("Your admission cost is $0.")
              ❷ elif age < 18:
                print("Your admission cost is $25.")
              ❸ else:
                print("Your admission cost is $40.")
```

---

The if test ❶ checks whether a person is under 4 years old. When the test passes, an appropriate message is printed and Python skips the rest of the tests. The elif line ❷ is really another if test, which runs only if the previous test failed. At this point in the chain, we know the person is at least 4 years old because the first test failed. If the person is under 18, an appropriate message is printed and Python skips the else block. If both the if and elif tests fail, Python runs the code in the else block ❸.

In this example the if test ❶ evaluates to False, so its code block is not executed. However, the elif test evaluates to True (12 is less than 18) so its code is executed. The output is one sentence, informing the user of the admission cost:

---

```
Your admission cost is $25.
```

---

Any age greater than 17 would cause the first two tests to fail. In these situations, the else block would be executed and the admission price would be \$40.

Rather than printing the admission price within the if-elif-else block, it would be more concise to set just the price inside the if-elif-else chain

and then have a single `print()` call that runs after the chain has been evaluated:

---

```
age = 12

if age < 4:
    price = 0
elif age < 18:
    price = 25
else:
    price = 40

print(f"Your admission cost is ${price}.")
```

---

The indented lines set the value of `price` according to the person's age, as in the previous example. After the price is set by the `if-elif-else` chain, a separate unindented `print()` call uses this value to display a message reporting the person's admission price.

This code produces the same output as the previous example, but the purpose of the `if-elif-else` chain is narrower. Instead of determining a price and displaying a message, it simply determines the admission price. In addition to being more efficient, this revised code is easier to modify than the original approach. To change the text of the output message, you would need to change only one `print()` call rather than three separate `print()` calls.

### ***Using Multiple elif Blocks***

You can use as many `elif` blocks in your code as you like. For example, if the amusement park were to implement a discount for seniors, you could add one more conditional test to the code to determine whether someone qualifies for the senior discount. Let's say that anyone 65 or older pays half the regular admission, or \$20:

---

```
age = 12

if age < 4:
    price = 0
elif age < 18:
    price = 25
elif age < 65:
    price = 40
else:
    price = 20

print(f"Your admission cost is ${price}.")
```

---

Most of this code is unchanged. The second `elif` block now checks to make sure a person is less than age 65 before assigning them the full admission rate of \$40. Notice that the value assigned in the `else` block needs to be changed to \$20, because the only ages that make it to this block are for people 65 or older.

## Omitting the else Block

Python does not require an else block at the end of an if-elif chain. Sometimes, an else block is useful. Other times, it's clearer to use an additional elif statement that catches the specific condition of interest:

---

```
age = 12

if age < 4:
    price = 0
elif age < 18:
    price = 25
elif age < 65:
    price = 40
elif age >= 65:
    price = 20

print(f"Your admission cost is ${price}.")
```

---

The final elif block assigns a price of \$20 when the person is 65 or older, which is a little clearer than the general else block. With this change, every block of code must pass a specific test in order to be executed.

The else block is a catchall statement. It matches any condition that wasn't matched by a specific if or elif test, and that can sometimes include invalid or even malicious data. If you have a specific final condition you're testing for, consider using a final elif block and omit the else block. As a result, you'll be more confident that your code will run only under the correct conditions.

## Testing Multiple Conditions

The if-elif-else chain is powerful, but it's only appropriate to use when you just need one test to pass. As soon as Python finds one test that passes, it skips the rest of the tests. This behavior is beneficial, because it's efficient and allows you to test for one specific condition.

However, sometimes it's important to check all conditions of interest. In this case, you should use a series of simple if statements with no elif or else blocks. This technique makes sense when more than one condition could be True, and you want to act on every condition that is True.

Let's reconsider the pizzeria example. If someone requests a two-topping pizza, you'll need to be sure to include both toppings on their pizza:

---

```
toppings.py requested_toppings = ['mushrooms', 'extra cheese']

if 'mushrooms' in requested_toppings:
    print("Adding mushrooms.")
❶ if 'pepperoni' in requested_toppings:
    print("Adding pepperoni.")
```

```
if 'extra cheese' in requested_toppings:
    print("Adding extra cheese.")

print("\nFinished making your pizza!")
```

---

We start with a list containing the requested toppings. The first `if` statement checks to see whether the person requested mushrooms on their pizza. If so, a message is printed confirming that topping. The test for pepperoni ❶ is another simple `if` statement, not an `elif` or `else` statement, so this test is run regardless of whether the previous test passed or not. The last `if` statement checks whether extra cheese was requested, regardless of the results from the first two tests. These three independent tests are executed every time this program is run.

Because every condition in this example is evaluated, both mushrooms and extra cheese are added to the pizza:

---

```
Adding mushrooms.
Adding extra cheese.

Finished making your pizza!
```

---

This code would not work properly if we used an `if-elif-else` block, because the code would stop running after only one test passes. Here's what that would look like:

---

```
requested_toppings = ['mushrooms', 'extra cheese']

if 'mushrooms' in requested_toppings:
    print("Adding mushrooms.")
elif 'pepperoni' in requested_toppings:
    print("Adding pepperoni.")
elif 'extra cheese' in requested_toppings:
    print("Adding extra cheese.")

print("\nFinished making your pizza!")
```

---

The test for `'mushrooms'` is the first test to pass, so mushrooms are added to the pizza. However, the values `'extra cheese'` and `'pepperoni'` are never checked, because Python doesn't run any tests beyond the first test that passes in an `if-elif-else` chain. The customer's first topping will be added, but all of their other toppings will be missed:

---

```
Adding mushrooms.

Finished making your pizza!
```

---

In summary, if you want only one block of code to run, use an `if-elif-else` chain. If more than one block of code needs to run, use a series of independent `if` statements.

## TRY IT YOURSELF

**5-3. Alien Colors #1:** Imagine an alien was just shot down in a game. Create a variable called `alien_color` and assign it a value of 'green', 'yellow', or 'red'.

- Write an `if` statement to test whether the alien's color is green. If it is, print a message that the player just earned 5 points.
- Write one version of this program that passes the `if` test and another that fails. (The version that fails will have no output.)

**5-4. Alien Colors #2:** Choose a color for an alien as you did in Exercise 5-3, and write an `if-else` chain.

- If the alien's color is green, print a statement that the player just earned 5 points for shooting the alien.
- If the alien's color isn't green, print a statement that the player just earned 10 points.
- Write one version of this program that runs the `if` block and another that runs the `else` block.

**5-5. Alien Colors #3:** Turn your `if-else` chain from Exercise 5-4 into an `if-elif-else` chain.

- If the alien is green, print a message that the player earned 5 points.
- If the alien is yellow, print a message that the player earned 10 points.
- If the alien is red, print a message that the player earned 15 points.
- Write three versions of this program, making sure each message is printed for the appropriate color alien.

**5-6. Stages of Life:** Write an `if-elif-else` chain that determines a person's stage of life. Set a value for the variable `age`, and then:

- If the person is less than 2 years old, print a message that the person is a baby.
- If the person is at least 2 years old but less than 4, print a message that the person is a toddler.
- If the person is at least 4 years old but less than 13, print a message that the person is a kid.
- If the person is at least 13 years old but less than 20, print a message that the person is a teenager.
- If the person is at least 20 years old but less than 65, print a message that the person is an adult.
- If the person is age 65 or older, print a message that the person is an elder.

**5-7. Favorite Fruit:** Make a list of your favorite fruits, and then write a series of independent `if` statements that check for certain fruits in your list.

- Make a list of your three favorite fruits and call it `favorite_fruits`.
- Write five `if` statements. Each should check whether a certain kind of fruit is in your list. If the fruit is in your list, the `if` block should print a statement, such as *You really like bananas!*

## Using `if` Statements with Lists

You can do some interesting work when you combine lists and `if` statements. You can watch for special values that need to be treated differently than other values in the list. You can efficiently manage changing conditions, such as the availability of certain items in a restaurant throughout a shift. You can also begin to prove that your code works as you expect it to in all possible situations.

### *Checking for Special Items*

This chapter began with a simple example that showed how to handle a special value like `'bmw'`, which needed to be printed in a different format than other values in the list. Now that you have a basic understanding of conditional tests and `if` statements, let's take a closer look at how you can watch for special values in a list and handle those values appropriately.

Let's continue with the pizzeria example. The pizzeria displays a message whenever a topping is added to your pizza, as it's being made. The code for this action can be written very efficiently by making a list of toppings the customer has requested and using a loop to announce each topping as it's added to the pizza:

---

```
toppings.py requested_toppings = ['mushrooms', 'green peppers', 'extra cheese']

for requested_topping in requested_toppings:
    print(f"Adding {requested_topping}.")

print("\nFinished making your pizza!")
```

---

The output is straightforward because this code is just a simple `for` loop:

---

```
Adding mushrooms.
Adding green peppers.
Adding extra cheese.

Finished making your pizza!
```

---

But what if the pizzeria runs out of green peppers? An if statement inside the for loop can handle this situation appropriately:

---

```
requested_toppings = ['mushrooms', 'green peppers', 'extra cheese']

for requested_topping in requested_toppings:
    if requested_topping == 'green peppers':
        print("Sorry, we are out of green peppers right now.")
    else:
        print(f"Adding {requested_topping}.")

print("\nFinished making your pizza!")
```

---

This time, we check each requested item before adding it to the pizza. The if statement checks to see if the person requested green peppers. If so, we display a message informing them why they can't have green peppers. The else block ensures that all other toppings will be added to the pizza.

The output shows that each requested topping is handled appropriately.

---

```
Adding mushrooms.
Sorry, we are out of green peppers right now.
Adding extra cheese.
```

```
Finished making your pizza!
```

---

## ***Checking That a List Is Not Empty***

We've made a simple assumption about every list we've worked with so far: we've assumed that each list has at least one item in it. Soon we'll let users provide the information that's stored in a list, so we won't be able to assume that a list has any items in it each time a loop is run. In this situation, it's useful to check whether a list is empty before running a for loop.

As an example, let's check whether the list of requested toppings is empty before building the pizza. If the list is empty, we'll prompt the user and make sure they want a plain pizza. If the list is not empty, we'll build the pizza just as we did in the previous examples:

---

```
requested_toppings = []

if requested_toppings:
    for requested_topping in requested_toppings:
        print(f"Adding {requested_topping}.")
    print("\nFinished making your pizza!")
else:
    print("Are you sure you want a plain pizza?")
```

---

This time we start out with an empty list of requested toppings. Instead of jumping right into a for loop, we do a quick check first. When the name of a list is used in an if statement, Python returns True if the list contains at least one item; an empty list evaluates to False. If requested\_toppings passes the conditional test, we run the same for loop we used in the previous



example. If the conditional test fails, we print a message asking the customer if they really want a plain pizza with no toppings.

The list is empty in this case, so the output asks if the user really wants a plain pizza:

---

```
Are you sure you want a plain pizza?
```

---

If the list is not empty, the output will show each requested topping being added to the pizza.

## Using Multiple Lists

People will ask for just about anything, especially when it comes to pizza toppings. What if a customer actually wants french fries on their pizza? You can use lists and if statements to make sure your input makes sense before you act on it.

Let's watch out for unusual topping requests before we build a pizza. The following example defines two lists. The first is a list of available toppings at the pizzeria, and the second is the list of toppings that the user has requested. This time, each item in `requested_toppings` is checked against the list of available toppings before it's added to the pizza:

---

```
available_toppings = ['mushrooms', 'olives', 'green peppers',
                    'pepperoni', 'pineapple', 'extra cheese']

❶ requested_toppings = ['mushrooms', 'french fries', 'extra cheese']

for requested_topping in requested_toppings:
❷   if requested_topping in available_toppings:
       print(f"Adding {requested_topping}.")
❸   else:
       print(f"Sorry, we don't have {requested_topping}.")

print("\nFinished making your pizza!")
```

---

First, we define a list of available toppings at this pizzeria. Note that this could be a tuple if the pizzeria has a stable selection of toppings. Then, we make a list of toppings that a customer has requested. There's an unusual request for a topping in this example: 'french fries' ❶. Next we loop through the list of requested toppings. Inside the loop, we check to see if each requested topping is actually in the list of available toppings ❷. If it is, we add that topping to the pizza. If the requested topping is not in the list of available toppings, the else block will run ❸. The else block prints a message telling the user which toppings are unavailable.

This code syntax produces clean, informative output:

---

```
Adding mushrooms.
Sorry, we don't have french fries.
Adding extra cheese.

Finished making your pizza!
```

---

In just a few lines of code, we've managed a real-world situation pretty effectively!

### TRY IT YOURSELF

**5-8. Hello Admin:** Make a list of five or more usernames, including the name 'admin'. Imagine you are writing code that will print a greeting to each user after they log in to a website. Loop through the list, and print a greeting to each user.

- If the username is 'admin', print a special greeting, such as *Hello admin, would you like to see a status report?*
- Otherwise, print a generic greeting, such as *Hello Jaden, thank you for logging in again.*

**5-9. No Users:** Add an `if` test to `hello_admin.py` to make sure the list of users is not empty.

- If the list is empty, print the message *We need to find some users!*
- Remove all of the usernames from your list, and make sure the correct message is printed.

**5-10. Checking Usernames:** Do the following to create a program that simulates how websites ensure that everyone has a unique username.

- Make a list of five or more usernames called `current_users`.
- Make another list of five usernames called `new_users`. Make sure one or two of the new usernames are also in the `current_users` list.
- Loop through the `new_users` list to see if each new username has already been used. If it has, print a message that the person will need to enter a new username. If a username has not been used, print a message saying that the username is available.
- Make sure your comparison is case insensitive. If 'John' has been used, 'JOHN' should not be accepted. (To do this, you'll need to make a copy of `current_users` containing the lowercase versions of all existing users.)

**5-11. Ordinal Numbers:** Ordinal numbers indicate their position in a list, such as *1st* or *2nd*. Most ordinal numbers end in *th*, except 1, 2, and 3.

- Store the numbers 1 through 9 in a list.
- Loop through the list.
- Use an `if-elif-else` chain inside the loop to print the proper ordinal ending for each number. Your output should read "1st 2nd 3rd 4th 5th 6th 7th 8th 9th", and each result should be on a separate line.

## Styling Your if Statements

In every example in this chapter, you've seen good styling habits. The only recommendation PEP 8 provides for styling conditional tests is to use a single space around comparison operators, such as `==`, `>=`, and `<=`. For example:

---

```
if age < 4:
```

---

is better than:

---

```
if age<4:
```

---

Such spacing does not affect the way Python interprets your code; it just makes your code easier for you and others to read.

### TRY IT YOURSELF

**5-12. Styling if Statements:** Review the programs you wrote in this chapter, and make sure you styled your conditional tests appropriately.

**5-13. Your Ideas:** At this point, you're a more capable programmer than you were when you started this book. Now that you have a better sense of how real-world situations are modeled in programs, you might be thinking of some problems you could solve with your own programs. Record any new ideas you have about problems you might want to solve as your programming skills continue to improve. Consider games you might want to write, datasets you might want to explore, and web applications you'd like to create.

## Summary

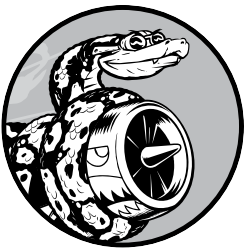
In this chapter you learned how to write conditional tests, which always evaluate to True or False. You learned to write simple `if` statements, `if-else` chains, and `if-elif-else` chains. You began using these structures to identify particular conditions you need to test and to know when those conditions have been met in your programs. You learned to handle certain items in a list differently than all other items while continuing to utilize the efficiency of a `for` loop. You also revisited Python's style recommendations to ensure that your increasingly complex programs are still relatively easy to read and understand.

In Chapter 6 you'll learn about Python's dictionaries. A dictionary is similar to a list, but it allows you to connect pieces of information. You'll learn how to build dictionaries, loop through them, and use them in combination with lists and `if` statements. Learning about dictionaries will enable you to model an even wider variety of real-world situations.



# 7

## USER INPUT AND WHILE LOOPS



Most programs are written to solve an end user's problem. To do so, you usually need to get some information from the user. For example, say someone wants to find out whether they're old enough to vote. If you write a program to answer this question, you need to know the user's age before you can provide an answer. The program will need to ask the user to enter, or *input*, their age; once the program has this input, it can compare it to the voting age to determine if the user is old enough and then report the result.

In this chapter you'll learn how to accept user input so your program can then work with it. When your program needs a name, you'll be able to prompt the user for a name. When your program needs a list of names, you'll be able to prompt the user for a series of names. To do this, you'll use the `input()` function.

You'll also learn how to keep programs running as long as users want them to, so they can enter as much information as they need to; then, your

program can work with that information. You'll use Python's `while` loop to keep programs running as long as certain conditions remain true.

With the ability to work with user input and the ability to control how long your programs run, you'll be able to write fully interactive programs.

## How the `input()` Function Works

The `input()` function pauses your program and waits for the user to enter some text. Once Python receives the user's input, it assigns that input to a variable to make it convenient for you to work with.

For example, the following program asks the user to enter some text, then displays that message back to the user:

---

```
parrot.py message = input("Tell me something, and I will repeat it back to you: ")
print(message)
```

---

The `input()` function takes one argument: the *prompt* that we want to display to the user, so they know what kind of information to enter. In this example, when Python runs the first line, the user sees the prompt `Tell me something, and I will repeat it back to you: .` The program waits while the user enters their response and continues after the user presses ENTER. The response is assigned to the variable `message`, then `print(message)` displays the input back to the user:

---

```
Tell me something, and I will repeat it back to you: Hello everyone!
Hello everyone!
```

---

### NOTE

*Some text editors won't run programs that prompt the user for input. You can use these editors to write programs that prompt for input, but you'll need to run these programs from a terminal. See "Running Python Programs from a Terminal" on page 11.*

## Writing Clear Prompts

Each time you use the `input()` function, you should include a clear, easy-to-follow prompt that tells the user exactly what kind of information you're looking for. Any statement that tells the user what to enter should work. For example:

---

```
greeter.py name = input("Please enter your name: ")
print(f"\nHello, {name}!")
```

---

Add a space at the end of your prompts (after the colon in the preceding example) to separate the prompt from the user's response and to make it clear to your user where to enter their text. For example:

---

```
Please enter your name: Eric
Hello, Eric!
```

---

Sometimes you'll want to write a prompt that's longer than one line. For example, you might want to tell the user why you're asking for certain input. You can assign your prompt to a variable and pass that variable to the `input()` function. This allows you to build your prompt over several lines, then write a clean `input()` statement.

---

```
greeter.py prompt = "If you share your name, we can personalize the messages you see."
prompt += "\nWhat is your first name? "

name = input(prompt)
print(f"\nHello, {name}!")
```

---

This example shows one way to build a multiline string. The first line assigns the first part of the message to the variable `prompt`. In the second line, the operator `+=` takes the string that was assigned to `prompt` and adds the new string onto the end.

The prompt now spans two lines, again with space after the question mark for clarity:

---

```
If you share your name, we can personalize the messages you see.
What is your first name? Eric
```

```
Hello, Eric!
```

---

## ***Using `int()` to Accept Numerical Input***

When you use the `input()` function, Python interprets everything the user enters as a string. Consider the following interpreter session, which asks for the user's age:

---

```
>>> age = input("How old are you? ")
How old are you? 21
>>> age
'21'
```

---

The user enters the number 21, but when we ask Python for the value of `age`, it returns `'21'`, the string representation of the numerical value entered. We know Python interpreted the input as a string because the number is now enclosed in quotes. If all you want to do is print the input, this works well. But if you try to use the input as a number, you'll get an error:

---

```
>>> age = input("How old are you? ")
How old are you? 21
❶ >>> age >= 18
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
❷ TypeError: '>=' not supported between instances of 'str' and 'int'
```

---

When you try to use the input to do a numerical comparison ❶, Python produces an error because it can't compare a string to an integer: the string `'21'` that's assigned to `age` can't be compared to the numerical value 18 ❷.

We can resolve this issue by using the `int()` function, which converts the input string to a numerical value. This allows the comparison to run successfully:

---

```
>>> age = input("How old are you? ")
How old are you? 21
❶ >>> age = int(age)
>>> age >= 18
True
```

---

In this example, when we enter 21 at the prompt, Python interprets the number as a string, but the value is then converted to a numerical representation by `int()` ❶. Now Python can run the conditional test: it compares `age` (which now represents the numerical value 21) and 18 to see if `age` is greater than or equal to 18. This test evaluates to `True`.

How do you use the `int()` function in an actual program? Consider a program that determines whether people are tall enough to ride a roller coaster:

---

```
rollercoaster.py height = input("How tall are you, in inches? ")
height = int(height)

if height >= 48:
    print("\nYou're tall enough to ride!")
else:
    print("\nYou'll be able to ride when you're a little older.")
```

---

The program can compare `height` to 48 because `height = int(height)` converts the input value to a numerical representation before the comparison is made. If the number entered is greater than or equal to 48, we tell the user that they're tall enough:

---

```
How tall are you, in inches? 71

You're tall enough to ride!
```

---

When you use numerical input to do calculations and comparisons, be sure to convert the input value to a numerical representation first.

## ***The Modulo Operator***

A useful tool for working with numerical information is the *modulo operator* (`%`), which divides one number by another number and returns the remainder:

---

```
>>> 4 % 3
1
>>> 5 % 3
2
>>> 6 % 3
0
>>> 7 % 3
1
```

---



The modulo operator doesn't tell you how many times one number fits into another; it only tells you what the remainder is.

When one number is divisible by another number, the remainder is 0, so the modulo operator always returns 0. You can use this fact to determine if a number is even or odd:

---

```
even_or_odd.py number = input("Enter a number, and I'll tell you if it's even or odd: ")
number = int(number)

if number % 2 == 0:
    print(f"\nThe number {number} is even.")
else:
    print(f"\nThe number {number} is odd.")
```

---

Even numbers are always divisible by two, so if the modulo of a number and two is zero (here, if `number % 2 == 0`) the number is even. Otherwise, it's odd.

---

Enter a number, and I'll tell you if it's even or odd: **42**

The number 42 is even.

---

### TRY IT YOURSELF

**7-1. Rental Car:** Write a program that asks the user what kind of rental car they would like. Print a message about that car, such as "Let me see if I can find you a Subaru."

**7-2. Restaurant Seating:** Write a program that asks the user how many people are in their dinner group. If the answer is more than eight, print a message saying they'll have to wait for a table. Otherwise, report that their table is ready.

**7-3. Multiples of Ten:** Ask the user for a number, and then report whether the number is a multiple of 10 or not.

## Introducing while Loops

The for loop takes a collection of items and executes a block of code once for each item in the collection. In contrast, the while loop runs as long as, or *while*, a certain condition is true.

### *The while Loop in Action*

You can use a while loop to count up through a series of numbers. For example, the following while loop counts from 1 to 5:

---

```
counting.py current_number = 1
while current_number <= 5:
```

```
print(current_number)
current_number += 1
```

---

In the first line, we start counting from 1 by assigning `current_number` the value 1. The `while` loop is then set to keep running as long as the value of `current_number` is less than or equal to 5. The code inside the loop prints the value of `current_number` and then adds 1 to that value with `current_number += 1`. (The `+=` operator is shorthand for `current_number = current_number + 1`.)

Python repeats the loop as long as the condition `current_number <= 5` is true. Because 1 is less than 5, Python prints 1 and then adds 1, making the current number 2. Because 2 is less than 5, Python prints 2 and adds 1 again, making the current number 3, and so on. Once the value of `current_number` is greater than 5, the loop stops running and the program ends:

---

```
1
2
3
4
5
```

---

The programs you use every day most likely contain `while` loops. For example, a game needs a `while` loop to keep running as long as you want to keep playing, and so it can stop running as soon as you ask it to quit. Programs wouldn't be fun to use if they stopped running before we told them to or kept running even after we wanted to quit, so `while` loops are quite useful.

### ***Letting the User Choose When to Quit***

We can make the `parrot.py` program run as long as the user wants by putting most of the program inside a `while` loop. We'll define a *quit value* and then keep the program running as long as the user has not entered the quit value:

---

```
parrot.py prompt = "\nTell me something, and I will repeat it back to you:"
prompt += "\nEnter 'quit' to end the program. "

message = ""
while message != 'quit':
    message = input(prompt)
    print(message)
```

---

We first define a prompt that tells the user their two options: entering a message or entering the quit value (in this case, 'quit'). Then we set up a variable `message` to keep track of whatever value the user enters. We define `message` as an empty string, "", so Python has something to check the first time it reaches the `while` line. The first time the program runs and Python reaches the `while` statement, it needs to compare the value of `message` to 'quit', but no user input has been entered yet. If Python has nothing to compare, it won't be able to continue running the program. To solve this

problem, we make sure to give `message` an initial value. Although it's just an empty string, it will make sense to Python and allow it to perform the comparison that makes the `while` loop work. This `while` loop runs as long as the value of `message` is not `'quit'`.

The first time through the loop, `message` is just an empty string, so Python enters the loop. At `message = input(prompt)`, Python displays the prompt and waits for the user to enter their input. Whatever they enter is assigned to `message` and printed; then, Python reevaluates the condition in the `while` statement. As long as the user has not entered the word `'quit'`, the prompt is displayed again and Python waits for more input. When the user finally enters `'quit'`, Python stops executing the `while` loop and the program ends:

---

```
Tell me something, and I will repeat it back to you:
Enter 'quit' to end the program. Hello everyone!
Hello everyone!
```

```
Tell me something, and I will repeat it back to you:
Enter 'quit' to end the program. Hello again.
Hello again.
```

```
Tell me something, and I will repeat it back to you:
Enter 'quit' to end the program. quit
quit
```

---

This program works well, except that it prints the word `'quit'` as if it were an actual message. A simple `if` test fixes this:

---

```
prompt = "\nTell me something, and I will repeat it back to you:"
prompt += "\nEnter 'quit' to end the program. "
```

```
message = ""
while message != 'quit':
    message = input(prompt)

    if message != 'quit':
        print(message)
```

---

Now the program makes a quick check before displaying the message and only prints the message if it does not match the `quit` value:

---

```
Tell me something, and I will repeat it back to you:
Enter 'quit' to end the program. Hello everyone!
Hello everyone!
```

```
Tell me something, and I will repeat it back to you:
Enter 'quit' to end the program. Hello again.
Hello again.
```

```
Tell me something, and I will repeat it back to you:
Enter 'quit' to end the program. quit
```

---

## Using a Flag

In the previous example, we had the program perform certain tasks while a given condition was true. But what about more complicated programs in which many different events could cause the program to stop running?

For example, in a game, several different events can end the game. When the player runs out of ships, their time runs out, or the cities they were supposed to protect are all destroyed, the game should end. It needs to end if any one of these events happens. If many possible events might occur to stop the program, trying to test all these conditions in one `while` statement becomes complicated and difficult.

For a program that should run only as long as many conditions are true, you can define one variable that determines whether or not the entire program is active. This variable, called a *flag*, acts as a signal to the program. We can write our programs so they run while the flag is set to `True` and stop running when any of several events sets the value of the flag to `False`. As a result, our overall `while` statement needs to check only one condition: whether the flag is currently `True`. Then, all our other tests (to see if an event has occurred that should set the flag to `False`) can be neatly organized in the rest of the program.

Let's add a flag to `parrot.py` from the previous section. This flag, which we'll call `active` (though you can call it anything), will monitor whether or not the program should continue running:

---

```
prompt = "\nTell me something, and I will repeat it back to you:"
prompt += "\nEnter 'quit' to end the program. "
```

```
active = True
❶ while active:
    message = input(prompt)

    if message == 'quit':
        active = False
    else:
        print(message)
```

---

We set the variable `active` to `True` so the program starts in an active state. Doing so makes the `while` statement simpler because no comparison is made in the `while` statement itself; the logic is taken care of in other parts of the program. As long as the `active` variable remains `True`, the loop will continue running ❶.

In the `if` statement inside the `while` loop, we check the value of `message` once the user enters their input. If the user enters `'quit'`, we set `active` to `False`, and the `while` loop stops. If the user enters anything other than `'quit'`, we print their input as a message.

This program has the same output as the previous example where we placed the conditional test directly in the `while` statement. But now that we

have a flag to indicate whether the overall program is in an active state, it would be easy to add more tests (such as `elif` statements) for events that should cause active to become `False`. This is useful in complicated programs like games, in which there may be many events that should each make the program stop running. When any of these events causes the active flag to become `False`, the main game loop will exit, a *Game Over* message can be displayed, and the player can be given the option to play again.

## Using `break` to Exit a Loop

To exit a `while` loop immediately without running any remaining code in the loop, regardless of the results of any conditional test, use the `break` statement. The `break` statement directs the flow of your program; you can use it to control which lines of code are executed and which aren't, so the program only executes code that you want it to, when you want it to.

For example, consider a program that asks the user about places they've visited. We can stop the `while` loop in this program by calling `break` as soon as the user enters the 'quit' value:

---

```
cities.py prompt = "\nPlease enter the name of a city you have visited:"  
prompt += "\n(Enter 'quit' when you are finished.) "
```

```
❶ while True:  
    city = input(prompt)  
  
    if city == 'quit':  
        break  
    else:  
        print(f"I'd love to go to {city.title()}!")
```

---

A loop that starts with `while True` ❶ will run forever unless it reaches a `break` statement. The loop in this program continues asking the user to enter the names of cities they've been to until they enter 'quit'. When they enter 'quit', the `break` statement runs, causing Python to exit the loop:

---

```
Please enter the name of a city you have visited:  
(Enter 'quit' when you are finished.) New York  
I'd love to go to New York!
```

```
Please enter the name of a city you have visited:  
(Enter 'quit' when you are finished.) San Francisco  
I'd love to go to San Francisco!
```

```
Please enter the name of a city you have visited:  
(Enter 'quit' when you are finished.) quit
```

---

### NOTE

*You can use the `break` statement in any of Python's loops. For example, you could use `break` to quit a `for` loop that's working through a list or a dictionary.*

## Using *continue* in a Loop

Rather than breaking out of a loop entirely without executing the rest of its code, you can use the `continue` statement to return to the beginning of the loop, based on the result of a conditional test. For example, consider a loop that counts from 1 to 10 but prints only the odd numbers in that range:

---

```
counting.py current_number = 0
while current_number < 10:
    ❶ current_number += 1
      if current_number % 2 == 0:
          continue

      print(current_number)
```

---

First, we set `current_number` to 0. Because it's less than 10, Python enters the `while` loop. Once inside the loop, we increment the count by 1 ❶, so `current_number` is 1. The `if` statement then checks the modulo of `current_number` and 2. If the modulo is 0 (which means `current_number` is divisible by 2), the `continue` statement tells Python to ignore the rest of the loop and return to the beginning. If the current number is not divisible by 2, the rest of the loop is executed and Python prints the current number:

---

```
1
3
5
7
9
```

---

## Avoiding Infinite Loops

Every `while` loop needs a way to stop running so it won't continue to run forever. For example, this counting loop should count from 1 to 5:

---

```
counting.py x = 1
while x <= 5:
    print(x)
    x += 1
```

---

However, if you accidentally omit the line `x += 1`, the loop will run forever:

---

```
# This loop runs forever!
x = 1
while x <= 5:
    print(x)
```

---

Now the value of `x` will start at 1 but never change. As a result, the conditional test `x <= 5` will always evaluate to `True` and the `while` loop will run forever, printing a series of 1s, like this:

---

```
1
1
1
1
1
--snip--
```

---

Every programmer accidentally writes an infinite `while` loop from time to time, especially when a program's loops have subtle exit conditions. If your program gets stuck in an infinite loop, press `CTRL-C` or just close the terminal window displaying your program's output.

To avoid writing infinite loops, test every `while` loop and make sure the loop stops when you expect it to. If you want your program to end when the user enters a certain input value, run the program and enter that value. If the program doesn't end, scrutinize the way your program handles the value that should cause the loop to exit. Make sure at least one part of the program can make the loop's condition `False` or cause it to reach a `break` statement.

**NOTE**

*VS Code, like many editors, displays output in an embedded terminal window. To cancel an infinite loop, make sure you click in the output area of the editor before pressing `CTRL-C`.*

**TRY IT YOURSELF**

**7-4. Pizza Toppings:** Write a loop that prompts the user to enter a series of pizza toppings until they enter a 'quit' value. As they enter each topping, print a message saying you'll add that topping to their pizza.

**7-5. Movie Tickets:** A movie theater charges different ticket prices depending on a person's age. If a person is under the age of 3, the ticket is free; if they are between 3 and 12, the ticket is \$10; and if they are over age 12, the ticket is \$15. Write a loop in which you ask users their age, and then tell them the cost of their movie ticket.

**7-6. Three Exits:** Write different versions of either Exercise 7-4 or 7-5 that do each of the following at least once:

- Use a conditional test in the `while` statement to stop the loop.
- Use an active variable to control how long the loop runs.
- Use a `break` statement to exit the loop when the user enters a 'quit' value.

**7-7. Infinity:** Write a loop that never ends, and run it. (To end the loop, press `CTRL-C` or close the window displaying the output.)

## Using a while Loop with Lists and Dictionaries

So far, we've worked with only one piece of user information at a time. We received the user's input and then printed the input or a response to it. The next time through the `while` loop, we'd receive another input value and respond to that. But to keep track of many users and pieces of information, we'll need to use lists and dictionaries with our `while` loops.

A `for` loop is effective for looping through a list, but you shouldn't modify a list inside a `for` loop because Python will have trouble keeping track of the items in the list. To modify a list as you work through it, use a `while` loop. Using `while` loops with lists and dictionaries allows you to collect, store, and organize lots of input to examine and report on later.

### *Moving Items from One List to Another*

Consider a list of newly registered but unverified users of a website. After we verify these users, how can we move them to a separate list of confirmed users? One way would be to use a `while` loop to pull users from the list of unconfirmed users as we verify them and then add them to a separate list of confirmed users. Here's what that code might look like:

---

```
confirmed # Start with users that need to be verified,
_users.py # and an empty list to hold confirmed users.
❶ unconfirmed_users = ['alice', 'brian', 'candace']
   confirmed_users = []

   # Verify each user until there are no more unconfirmed users.
   # Move each verified user into the list of confirmed users.
❷ while unconfirmed_users:
❸     current_user = unconfirmed_users.pop()

       print(f"Verifying user: {current_user.title()}")
❹     confirmed_users.append(current_user)

   # Display all confirmed users.
   print("\nThe following users have been confirmed:")
   for confirmed_user in confirmed_users:
       print(confirmed_user.title())
```

---

We begin with a list of unconfirmed users ❶ (Alice, Brian, and Candace) and an empty list to hold confirmed users. The `while` loop runs as long as the list `unconfirmed_users` is not empty ❷. Within this loop, the `pop()` method removes unverified users one at a time from the end of `unconfirmed_users` ❸. Because Candace is last in the `unconfirmed_users` list, her name will be the first to be removed, assigned to `current_user`, and added to the `confirmed_users` list ❹. Next is Brian, then Alice.

We simulate confirming each user by printing a verification message and then adding them to the list of confirmed users. As the list of unconfirmed users shrinks, the list of confirmed users grows. When the list of



unconfirmed users is empty, the loop stops and the list of confirmed users is printed:

---

```
Verifying user: Candace
Verifying user: Brian
Verifying user: Alice
```

```
The following users have been confirmed:
Candace
Brian
Alice
```

---

## ***Removing All Instances of Specific Values from a List***

In Chapter 3, we used `remove()` to remove a specific value from a list. The `remove()` function worked because the value we were interested in appeared only once in the list. But what if you want to remove all instances of a value from a list?

Say you have a list of pets with the value 'cat' repeated several times. To remove all instances of that value, you can run a `while` loop until 'cat' is no longer in the list, as shown here:

---

```
pets.py pets = ['dog', 'cat', 'dog', 'goldfish', 'cat', 'rabbit', 'cat']
print(pets)

while 'cat' in pets:
    pets.remove('cat')

print(pets)
```

---

We start with a list containing multiple instances of 'cat'. After printing the list, Python enters the `while` loop because it finds the value 'cat' in the list at least once. Once inside the loop, Python removes the first instance of 'cat', returns to the `while` line, and then reenters the loop when it finds that 'cat' is still in the list. It removes each instance of 'cat' until the value is no longer in the list, at which point Python exits the loop and prints the list again:

---

```
['dog', 'dog', 'goldfish', 'rabbit', 'cat']
['dog', 'dog', 'goldfish', 'rabbit']
```

---

## ***Filling a Dictionary with User Input***

You can prompt for as much input as you need in each pass through a `while` loop. Let's make a polling program in which each pass through the loop prompts for the participant's name and response. We'll store the data we gather in a dictionary, because we want to connect each response with a particular user:

---

```
mountain_poll.py responses = {}
# Set a flag to indicate that polling is active.
polling_active = True
```

```

while polling_active:
    # Prompt for the person's name and response.
    ❶ name = input("\nWhat is your name? ")
    response = input("Which mountain would you like to climb someday? ")

    # Store the response in the dictionary.
    ❷ responses[name] = response

    # Find out if anyone else is going to take the poll.
    ❸ repeat = input("Would you like to let another person respond? (yes/ no) ")
    if repeat == 'no':
        polling_active = False

# Polling is complete. Show the results.
print("\n--- Poll Results ---")
    ❹ for name, response in responses.items():
        print(f"{name} would like to climb {response}.").

```

---

The program first defines an empty dictionary (`responses`) and sets a flag (`polling_active`) to indicate that polling is active. As long as `polling_active` is True, Python will run the code in the while loop.

Within the loop, the user is prompted to enter their name and a mountain they'd like to climb ❶. That information is stored in the `responses` dictionary ❷, and the user is asked whether or not to keep the poll running ❸. If they enter yes, the program enters the while loop again. If they enter no, the `polling_active` flag is set to False, the while loop stops running, and the final code block ❹ displays the results of the poll.

If you run this program and enter sample responses, you should see output like this:

---

```

What is your name? Eric
Which mountain would you like to climb someday? Denali
Would you like to let another person respond? (yes/ no) yes

What is your name? Lynn
Which mountain would you like to climb someday? Devil's Thumb
Would you like to let another person respond? (yes/ no) no

--- Poll Results ---
Eric would like to climb Denali.
Lynn would like to climb Devil's Thumb.

```

---

## TRY IT YOURSELF

**7-8. Deli:** Make a list called `sandwich_orders` and fill it with the names of various sandwiches. Then make an empty list called `finished_sandwiches`. Loop through the list of sandwich orders and print a message for each order, such as I made your tuna sandwich. As each sandwich is made, move it to the list of finished sandwiches. After all the sandwiches have been made, print a message listing each sandwich that was made.

**7-9. No Pastrami:** Using the list `sandwich_orders` from Exercise 7-8, make sure the sandwich 'pastrami' appears in the list at least three times. Add code near the beginning of your program to print a message saying the deli has run out of pastrami, and then use a `while` loop to remove all occurrences of 'pastrami' from `sandwich_orders`. Make sure no pastrami sandwiches end up in `finished_sandwiches`.

**7-10. Dream Vacation:** Write a program that polls users about their dream vacation. Write a prompt similar to *If you could visit one place in the world, where would you go?* Include a block of code that prints the results of the poll.

## Summary

In this chapter, you learned how to use `input()` to allow users to provide their own information in your programs. You learned to work with both text and numerical input and how to use `while` loops to make your programs run as long as your users want them to. You saw several ways to control the flow of a `while` loop by setting an active flag, using the `break` statement, and using the `continue` statement. You learned how to use a `while` loop to move items from one list to another and how to remove all instances of a value from a list. You also learned how `while` loops can be used with dictionaries.

In Chapter 8 you'll learn about functions. *Functions* allow you to break your programs into small parts, each of which does one specific job. You can call a function as many times as you want, and you can store your functions in separate files. By using functions, you'll be able to write more efficient code that's easier to troubleshoot and maintain and that can be reused in many different programs.

