

Method	Description
<code>startswith()</code>	If the string starts with the specified value, return True
<code>strip()</code>	Return a trimmed version of the string

1.3.3 Iterable Objects and Dictionaries

In Python, an **iterable object** is one that contains a collection of **elements** and defines, for each element, which element is next. In the following sections, we will consider some built-in iterable classes (types).

Box 1.1 Further Reading

- Python Community (2024a; § The Python Tutorial: 9 Classes), on classes, objects, and methods
- Python Community (2024a; § Python Standard Library: Built-in Types), on the basic built-in types

1.4 Lists



The **list** class defines an ordered set of elements. These elements can be of any class, and do not need to match within a list. Lists can be nested to create a list of lists. The basic syntax for creating a list of elements *ex* is `[e1, e2, ..., en]`. Consider the following list assignments:

```
int_list = [3, 9, 3, -4, 0]           # Duplication allowed
str_list = ["foo", "bar", "baz"]
com_list = [int_list, str_list]      # List of lists
mix_list = [8.41, "foo", [7]]       # Mixing element types
```

1.4.1 Accessing List Elements

Because the elements of a list have an order, they can be referred to via an **index**, a mapping of integers to elements. In Python, the first element in the list has index 0 and subsequent elements have indices of increasing values, 1, 2, 3, and so on. The syntax for accessing the element with index *i* of a list *l* is `l[i]`. For instance, elements from the previously defined lists can be accessed as follows:

```
int_list[0]           # => 3
int_list[3]           # => -4
str_list[2]           # => "baz"
mix_list[2]           # => [7]
```

Negative indices are used to access elements from the end of a list. For instance, for `int_list` above,

```
int_list[-1]          # => 0
int_list[-2]          # => -4
```

This is particularly useful when we want to access the last element of a list, which we see has index `-1`.

A selection of elements from a list can be accessed via **slicing**, which has the syntax `l[start:stop]` or `l[start:stop:step]`. For instance,

```
l = [0, 1, 2, 3, 4]
l[0:3]          # => [0, 1, 2]
l[2:4]          # => [2, 3]
l[0:-1]         # => [0, 1, 2, 3] (no last item!)
l[0:]           # => [0, 1, 2, 3, 4]
l[0::2]         # => [0, 2, 4] (every two elements)
```

It is important to note that the slice does not include the `stop` index; rather, the slice's last value is from index `stop-1`. As we see in the third slice example, this means the normal syntax for slicing through the final element (i.e., the element with index `-1`) does not include that element. To include the final element, leave off an index for `stop`, as shown in the fourth and fifth examples.

1.4.2 Mutability

Lists are **mutable**; that is, they can be mutated (changed). This is unlike most built-in types, which are **immutable** and cannot be changed. The mutability for frequently used built-in types is shown in table 1.5.

Table 1.5. Mutability of commonly used built-in types.

Data Type	Built-in Class	Mutability
Numbers	<code>int</code> , <code>float</code> , <code>complex</code>	Immutable
Strings	<code>str</code>	Immutable
Tuples	<code>tuple</code>	Immutable
Booleans	<code>bool</code>	Immutable
Lists	<code>list</code>	Mutable
Dictionaries	<code>dict</code>	Mutable
Sets	<code>set</code>	Mutable

The mutability of lists allows us to change their elements. The syntax for assigning a new value `v` to an element with index `i` of a list `l` is `l[i] = v`. For instance,

```
l = ["Hello", "World", "!"]
l[1] = "Stranger"
print(l)
```

returns

```
['Hello', 'Stranger', '!']
```

Note that although strings are immutable, a list of strings is mutable. This means "Stranger" is not at the same location in memory as was "World".

1.4.3 Methods

Lists have several methods for mutating themselves, which are given in table 1.6.

Table 1.6. Commonly used list methods for a list l.

Method	Description
<code>l.append(item)</code>	Append <code>item</code> to the end of <code>l</code>
<code>l.clear()</code>	Remove all items from <code>l</code>
<code>l.extend(iterable)</code>	Concatenate <code>l</code> with the contents of <code>iterable</code>
<code>l.index(x[, start[, end]])</code>	Return the index of the first instance of <code>x</code> in <code>l[start:end]</code>
<code>l.insert(index, item)</code>	Insert <code>item</code> into <code>l</code> at <code>index</code>
<code>l.pop(index)</code>	Return and remove the item at <code>index</code>
<code>l.pop()</code>	Return and remove the last item
<code>l.remove(item)</code>	Remove <code>item</code> 's first occurrence
<code>l.reverse()</code>	Reverse the items of <code>l</code>
<code>l.sort(key=None, reverse=False)</code>	Sort the items of <code>l</code>

For example, an element can be inserted into a list as follows:

```
| l = ["zero", "one", "three"]
| l.insert(2, "two")
| print(l)
```

which returns

```
| ['zero', 'one', 'two', 'three']
```

When using most list methods, we often do not assign the returned value from the expression. This is because most of these expressions return a value of `None`. For instance, from the previous example,

```
| print(l.insert(2, "two"))
```

returns

```
| None
```

Such methods are simply operating on the original list object and do not return that object. This is a common idiom in Python programming, and many mutable classes behave similarly.

Example 1.3

Write a program that removes the second occurrence of the element 3 from the following list:

```
| l = [1, 2, 3, 0, 3, 4, 3]
```

The `remove()` method might seem promising, but it only removes the first occurrence of the element. Instead, let's identify the index of the second occurrence. The `index(x[, start[, end]])` method allows us to identify the index of the first occurrence or the first occurrence between `start` and `end`. So our strategy is to find the index `i_first` of the first occurrence with `index()`, then narrow our search to the rest of the list after `i_first` to the end of the list, identifying the second index `i_second`. Finally, we can remove the element at `i_second` with the `pop` method.

The following program implements this strategy.

```
l = [1, 2, 3, 0, 3, 4, 3]
x = 3                                # element we are removing
i_first = l.index(x)                 # first occurrence index
i_second = l.index(x, i_first+1)     # second occurrence index
l.pop(i_second)                      # removes second occurrence
print(f"l without second {x}: {l}")
```

This prints

```
| l without second 3: [1, 2, 3, 0, 4, 3]
```

1.5 Tuples and Ranges



Python has a built-in **tuple** class. `tuple` is very similar to a `list` in that it is an ordered collection of elements. The term “tuple” is a generalization of the terms “single,” “double,” “triple,” “quadruple,” and so on. The primary difference between a tuple and a list is that a tuple is immutable, so its elements can't be changed. The syntax for a tuple literal of elements `ex` is `(e1, e2, ..., en)`. The elements can each be of any type, including tuples. For example, the following statements return tuples:

```
(0, 1, 2, 4, 5)
("foo", "bar", "baz")
([0, 1], [2, 3])
((0, 1), (2, 3))
(0, "foo", [1, 2], (3, 4))
```

Elements of a tuple can be accessed via the same syntax as is used for lists, including slicing. For instance,

```
| t = (0, 1, 2)
| t[1]          # => 1
| t[0:2]        # => (0, 1)
| t[1:]         # => (1, 2)
```