

Because tuples are immutable, there are only two built-in tuple methods, `count()` and `index()`. The `count()` method returns the number of times its argument occurs in the tuple. For instance,

```
| t = (-7, 0, 7, -7, 0, 0)
| t.count(-7)      # => 2
```

The `index()` method returns the index of the first occurrence of its argument. For instance,

```
| t = ("foo", "bar", "baz", "foo", "bar", "baz", "baz")
| t.index("baz")  # => 2
```

The **range** built-in type is a compact way of representing sequences of integers. A **range** can be constructed with the `range(start, stop, step)` constructor function, as in the following examples:

```
| list(range(0, 3, 1))    # => [0, 1, 2]
| list(range(2, 6, 1))  # => [2, 3, 4, 5]
| list(range(0, 3))     # => [0, 1, 2] (step=1 by default)
| list(range(3))        # => [0, 1, 2] (start=0 by default)
```

Note that we have wrapped the ranges in `list()` functions, which converted each range to a list. This was only so we can see the values it represents; alone, an expression like `range(0, 3)` returns itself. This is why a range is such a compact data point—all that needs to be stored in memory are the `start`, `stop`, and `step` arguments because the intermediate values are implicit.

1.6 Dictionaries



The built-in Python **dictionary** class `dict` is an unordered collection of elements, each of which has a unique **key** and a **value**. A key can be any immutable object, but a string is most common. A value can be any object. The basic syntax to create a `dict` object with keys `kx` and values `vx` is `{k1: v1, k2: v2, ...}`. For instance, we can define a `dict` as follows:

```
| d = {"foo": 5, "bar": 1, "baz": -3}
```

Accessing a value requires its key. To access a value in dictionary `d` with key `k`, use the syntax `d[k]`. For example,

```
d = { # It is often useful to break lines at each key-value pair
    "name": "Spiff",
    "age": 33,
    "occupation": "spaceman",
    "enemies": ["Zorgs", "Zargs", "Zogs"]
}
print(f"{d['name']} is a {d['age']} year old"
      f"{d['occupation']} who fights {d['enemies'][0]}".)
```

This returns

```
| Spiff is a 33 year old spaceman who fights Zorgs.
```

A value *v* with key *k* can be added to an existing dictionary *d* with the syntax `d[k] = v`. For instance, (Filik et al. 2019)

```
d = {} # Empty dictionary
d["irony"] = "The use of a word to mean its opposite."
d["sarcasm"] = "Irony intended to criticize."
```

Dictionaries are mutable; therefore, we can change their contents, as in the following example:

```
d = {}
d["age"] = 33 # d is {"age": 33}
d["age"] = 31 # d is {"age": 31}
```

Dictionaries have several handy methods; these are listed in table 1.7.

Table 1.7. Dictionary instance methods for dictionary instance *d* and class method for class `dict`.

Methods	Descriptions
<code>d.clear()</code>	Clears all items from <i>d</i>
<code>d.copy()</code>	Returns a shallow copy of <i>d</i>
<code>dict.fromkeys(s[, v])</code>	Returns a new <code>dict</code> with keys from sequence <i>s</i> , each with optional value <i>v</i>
<code>d.get(k)</code>	Returns the value for key <i>k</i> in <i>d</i>
<code>d.items()</code>	Returns a view object of key-value pairs in <i>d</i>
<code>d.keys()</code>	Returns a view object of keys in <i>d</i>
<code>d.pop(k)</code>	Removes and returns the value for key <i>k</i> in <i>d</i>
<code>d.popitem()</code>	Removes and returns the last-inserted key-value pair from <i>d</i>
<code>d.setdefault(k, v)</code>	Returns the value for the key <i>k</i> in <i>d</i> ; inserts <i>v</i> if absent
<code>d.update(d_)</code>	Updates <i>d</i> with key-value pairs from another dictionary <i>d_</i>
<code>d.values()</code>	Returns a view object of values in <i>d</i>

Note that most of these methods apply to dictionary instance *d*, either mutating *d* or returning something from *d*. However, the `fromkeys()` method is called from the class `dict` because it has nothing to do with an instance. Such methods are

called **class methods**; the other methods we've considered thus far are **instance methods**.

Dictionary **view objects**—returned by `items()`, `keys()`, and `values()`—are dynamically updating objects that change with their dictionary. For instance,

```
d = {"a": 1, "b": 2}
d_keys = d.keys()
print(f"View object before: {d_keys}")
d["c"] = 3
print(f"View object after: {d_keys}")
```

This returns

```
View object before: dict_keys(['a', 'b'])
View object after: dict_keys(['a', 'b', 'c'])
```

View objects can be converted to lists with the `list()` function, as in `list(d_keys)`.

Example 1.4

Write a program that meets the following requirements:

1. It defines a list of strings `names = ["Mo", "Jo", "Flo"]`
2. It constructs a `dict` instance `data` with keys from the list `names`
3. It creates and populates a sub-`dict` with the follow properties for each name:
 - a. Mo—year: sophomore, major: Mechanical Engineering, GPA: 3.44
 - b. Jo—year: junior, major: Computer Science, GPA: 3.96
 - c. Flo—year: sophomore, major: Philosophy, GPA: 3.12
4. It prints each of the students' name and year
5. It replaces Jo's GPA with 3.98 and prints this new value
6. It removes the entry for Mo and prints a list of remaining keys in `data`

The following program meets the given requirements:

```
names = ["Mo", "Jo", "Flo"]
data = dict.fromkeys(names) # => {"Mo": None, "Jo": None, "Flo": None}

#%% Populate Data
data["Mo"] = {}
data["Mo"]["year"] = "sophomore"
data["Mo"]["major"] = "Mechanical Engineering"
data["Mo"]["GPA"] = 3.44
data["Jo"] = {}
data["Jo"]["year"] = "junior"
data["Jo"]["major"] = "Computer Science"
data["Jo"]["GPA"] = 3.96
data["Flo"] = {}
data["Flo"]["year"] = "sophomore"
data["Flo"]["major"] = "Philosophy"
data["Flo"]["GPA"] = 3.12

#%% Data Operations and Printing
print(f"Mo is a {data['Mo']['year']}. "
      f"Jo is a {data['Jo']['year']}. "
      f"Flo is a {data['Flo']['year']}.")
data["Jo"]["GPA"] = 3.98
print(f"Jo's new GPA is {data['Jo']['GPA']}")
data.pop("Mo")
print(f"Names sans Mo: {list(data.keys())}")
```

This prints the following in the console:

```
Mo is a sophomore. Jo is a junior. Flo is a sophomore.
Jo's new GPA is 3.98
Names sans Mo: ['Jo', 'Flo']
```

1.7 Functions



In Python, **functions** are reusable blocks of code that accept input arguments and return one or more values. As we have seen, a method is a special type of function that is contained within an object. We typically do not refer to methods as “functions,” instead reserving the term for functions that are not methods. A function that computes the square root of the sum of the squares of two arguments can be defined as:

```
def root_sum_squared(arg1, arg2):
    sum_squared = arg1**2 + arg2**2
    return sum_squared**(1/2)
```

The syntax requires the block of code following the **def** line to be indented. A block ends where the indent ends. The indent should, by convention, be 4 space characters. The function ends with a **return statement**, which begins with the keyword **return** followed by an expression, the value of which is returned to the caller code. The variable `sum_squared` is created inside the function, so it is local to the function and cannot be accessed from outside. **Calling** (using) this function could look like

```
| root_sum_squared(3, 4)
```

This call returns the value 5.0.

The arguments `arg1` and `arg2` in the previous example are called **positional arguments** because they are identified in the function call by their position; that is, 3 is identified as `arg1` and 4 is identified as `arg2` based on their positions in the argument list. There is another type of argument, called a **keyword argument** (sometimes called a “named” argument), that can follow positional arguments and have the syntax `<key>=<value>`. For instance, we could augment the previous function as follows:

```
def root_sum_squared(arg1, arg2, pre="RSS ="):
    sum_squared = arg1**2 + arg2**2
    rss = sum_squared**(1/2)
    print(pre, rss)
    return rss
```

The pre positional argument is given a default value of `"RSS ="`, and the function now prints the root sum square with `pre` prepended. Calling this function with

```
| sum_squared(4, 6)
```

prints the following to the console:

```
| RSS = 7.211102550927978
```

Alternatively, we could pass a value to `pre` with the call