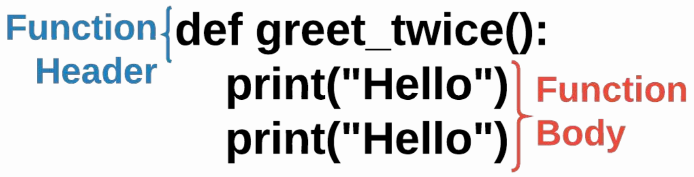
Learning Objective - Function Basics

- **Demonstrate how to define a function**
- **Differentiate between the function header and the function body**
- **Identify the proper order of declaring and calling functions**
- **Explain the importance of whitespace in functions**
- **Identify the purpose of a docstring**

Function Definition

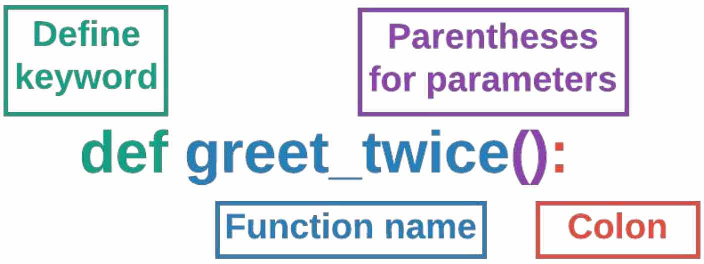
Function Syntax

You have seen and used built-in functions like the length function (`len(my_list)`). This unit deals with user-defined function. Functions are composed of two parts, the header and the body.



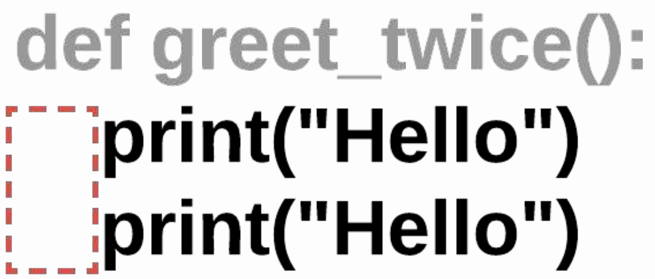
Fuction Header & Body

The function header contains the `def` keyword which signals the definition of a function. Next is the name of the function. Function names follow the same rules as variable names; letters, numbers, and underscores. Function names cannot start with a number. Parentheses are required, and any parameters go between them. Finally, the header ends with a colon.



Function Header

The function body is the list of actions the function performs. All of the code for the function body must be indented (four spaces is the Python standard) from the function header. The function ends when the code is no longer indented.



```
def greet_twice():
    print("Hello")
    print("Hello")
```

Function Body

Calling a Function

Enter the code below into the editor and click the `TRY IT` button. Nothing is printed. Defining a function does not cause Python to run it.

```
def greet_twice():
    print("Hello")
    print("Hello")
```

You have to explicitly call the function if you want it to run. Add `greet_twice()` after the function definition. Remember **do not** indent the function call. Run the code again.

```
def greet_twice():
    print("Hello")
    print("Hello")

greet_twice()
```

challenge

What happens if you:

- Add another line code that says `greet_twice()`?
- Indent `greet_twice` four spaces?
- Add a `1` between the parentheses of the function call `greet_twice(1)`?

Functions and Whitespace

Whitespace

Whitespace refers to indentations and blank lines in your program. Indentations matter greatly for Python; your program can change greatly when indentation is not properly done. Notice that there is no function call in the code below. What do you think will happen when you run this program?

```
def greet_twice():
    print("Hello")
print("Hello")
```

So the first print statement does not run because there is no function call. However, the second print statement is not a part of the function definition because it is not indented. So it will run when the program is executed.

challenge

What happens if you:

- Change the code to look like this:

```
def greet_twice():
  print("Hello")
    print("Hello")
greet_twice()
```

- Change the code to look like this:

```
def greet_twice():

  print("Hello")

  print("Hello")

greet_twice()
```

- Change the code to look like this:

```
def greet_twice():
    print("Hello")
    print("Hello")
    greet_twice()
```

Order Matters

The order of function definitions and function calls is important in Python. In the code below, the function call appears before the function definition. What do you think will happen when you run the code?

```
greet_twice()

def greet_twice():
    print("Hello")
    print("Hello")
```

Python says that `greet_twice` is not defined. But two lines later the function is clearly defined. Python requires that functions be defined before they are called.

Docstring

Function Documentation

Python has a built-in function called `help` that explains how other functions work. This is a handy way of learning how to use a function without having to look it up in the official documentation.

```
help(len)
```

challenge

What happens if you:

- Replace `len` with `max`?
- Change the code to look like this:

```
def greet_twice():
    print("Hello")
    print("Hello")

help(greet_twice)
```

Docstring

The `help` function does not provide any information for user-defined functions. Adding a docstring to a user-defined function will provide output for the `help` function. A docstring goes between the function header and the function body. Use triple-quotes to create a string which explains what the function does and how to use it. Remember, triple-quotes respect all of the whitespace in the string. You can indent or add a new line to increase readability.

```
def greet_twice():
    """ Print the string 'Hello' two times"""
    print("Hello")
    print("Hello")
```

Docstring

```python
def greet_twice():
    """Print the string 'Hello' two times"""
    print("Hello")
    print("Hello")

help(greet_twice)
```

challenge

What happens if you:

- Remove the indentation for the docstring?
- Indent the docstring and then change it to:

```
"""Print the string
'Hello' two times"""
```

- Change the docstring to `"Print the string 'Hello' two times"`?
- Change the docstring to:

```
"Print the string
'Hello' two times"
```

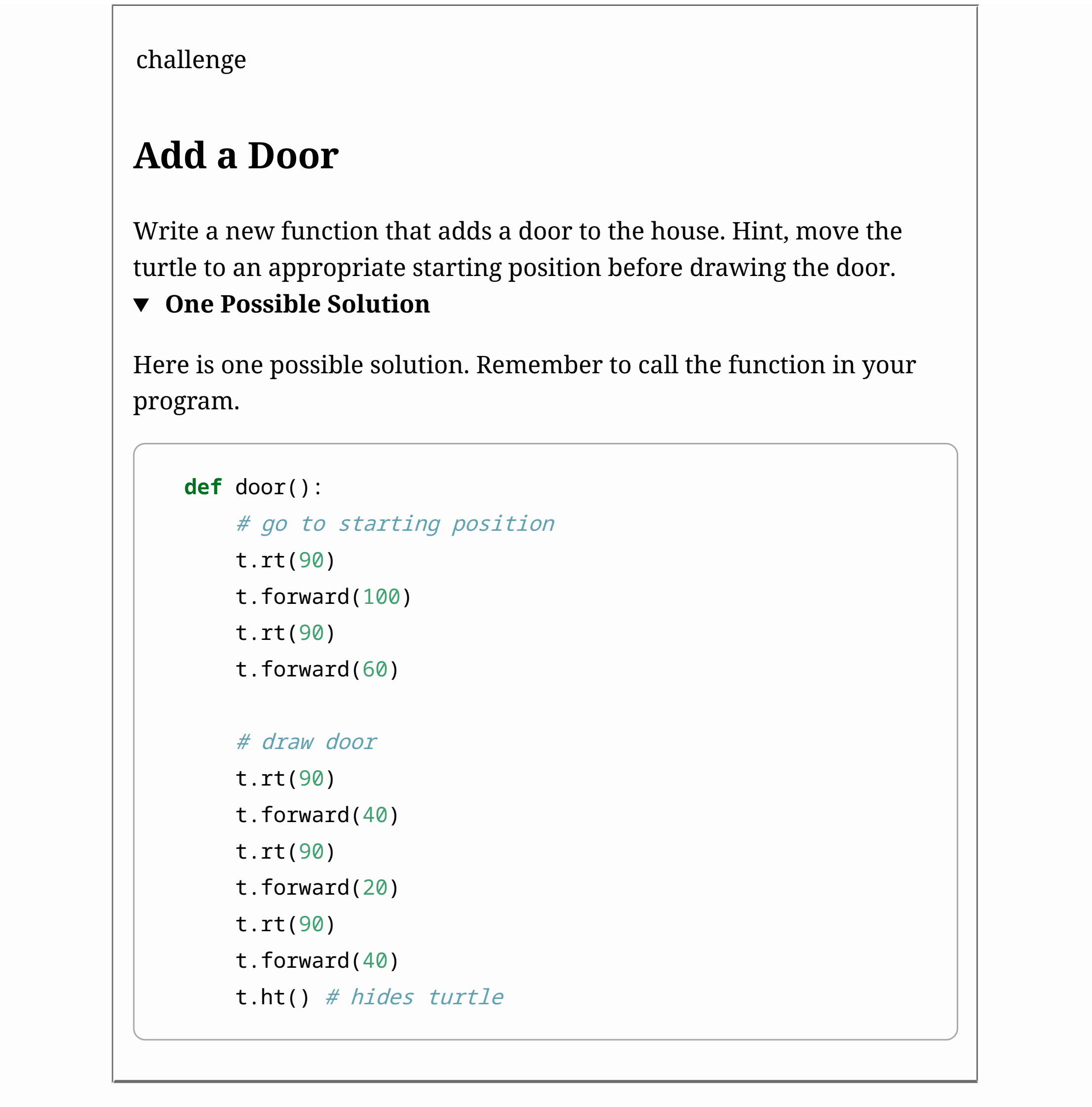
When to Use a Function

Divide and Conquer

If you had to explain how to draw a house, you would make a list of shapes to draw. Draw a triangle for the roof, draw a square for the house, draw a rectangle for the door, etc. Combine all of these shapes, and you have a house. This approach to problem solving makes complex problems easier to understand, easier to solve, and easier to fix.

Functions allow for the same divide and conquer approach to problem solving but for programming. Each of the tasks above become a function. Combine all of the functions together, and you should have a house.

```python
import turtle

t = turtle.Turtle()

def roof():
    """Draw a triangle to represent a roof"""
    for i in range(3):
        t.lt(120)
        t.forward(100)

def house():
    """Draw a rectangle to represent a house"""
    for i in range(4):
        t.rt(90)
        t.forward(100)

roof()
house()

turtle.mainloop()
```



challenge

Add a Door

Write a new function that adds a door to the house. Hint, move the turtle to an appropriate starting position before drawing the door.

▼ **One Possible Solution**

Here is one possible solution. Remember to call the function in your program.

```python
def door():
    # go to starting position
    t.rt(90)
    t.forward(100)
    t.rt(90)
    t.forward(60)

    # draw door
    t.rt(90)
    t.forward(40)
    t.rt(90)
    t.forward(20)
    t.rt(90)
    t.forward(40)
    t.ht() # hides turtle
```

Formative Assessment 1

Formative Assessment 2