CSCI 141

Scott Wehrwein

"""Docstrings, Preconditions, and Postconditions"""

Goals

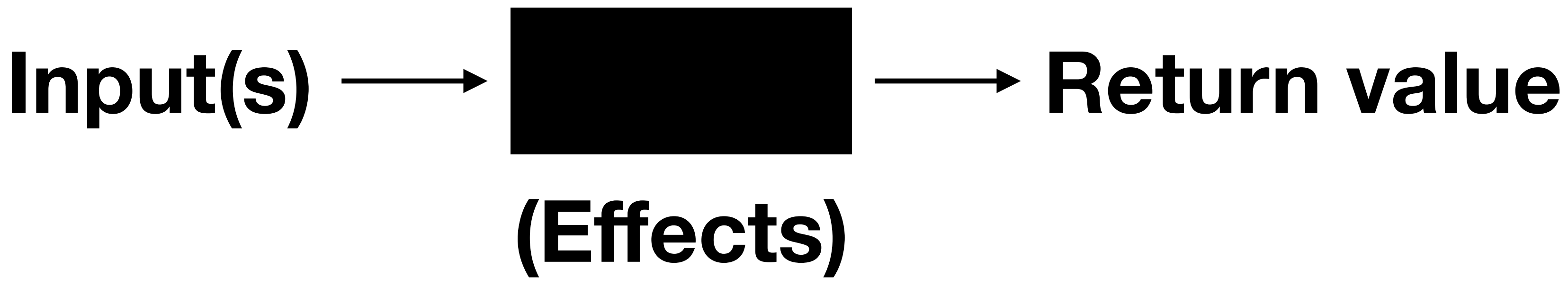
- Know the syntax for triple-quoted strings
- Know the convention for writing docstrings that describe a function's specification
- Know what does and does not belong in a function specification
- Know the definition and purpose of preconditions and postconditions

Functions, Revisited

What **is** a function, anyway?

- As a user, you can treat a function as a **“black box”:** all you need to know is:
  - the **inputs**, **effects**, and **return value**.

- Functions are named chunks of code.



A bunch of (complicated)
stuff is wrapped up in a nice,
easy-to-use package.

Function Syntax: Summary

`def` keyword

function name

```
def name(parameters):
    statements
```

inputs

comma-separated list of parameters: variable names that will get assigned to the arguments

An indented code block that does any computation, executes any effects, and (optionally) returns a value

effects; return value

Why are functions great?

- **Concise** - wrap something complicated in an easy-to-use package
- **Customizable** - make the easy-to-use package do different things
- **Composable** - use the result of one computation as input to (or as one step in) another

Demo: Function to draw a square using a turtle

Demo: Function to draw a square using a turtle

- Concise: turtle_square call tells the turtle to do a bunch of things

- Customizable: turtle_rectangle(t, w, h) function draws a w-by-h rectangle

- add docstrings at the end!

`turtle_rectangle`

```
def turtle_rectangle(t, w, h):
    """ Draw a w-by-h rectangle using turtle t
    """
    for i in range(2):
        t.forward(w)
        t.left(90)
        t.forward(h)
        t.left(90)
```

What's `""" this """` about? Two things in one:

- **Multiline strings**: An alternate way to write strings that include newlines.
- A **docstring**: The conventional way to write comments that describe the purpose and behavior of a function.

Multiline Strings and Docstrings: Demo

Multiline Strings and Docstrings: Demo

- Multiline strings: printing, assigning, etc.
- A string on a line by itself has no effect on the program.
- Docstrings in functions are like comments (but aren’t, technically)

Docstrings

Docstrings are **not** required by the language.

Docstrings **are** required by me from now on.

- A docstring tells you **what** the function does, but not **how** it does it.
- In other terms, it tells you what you need to know to **use** the function, but not what the function's author needed to know to **write** it.

Docstrings: Example

The (actual) source code for turtle.forward:

Docstring:

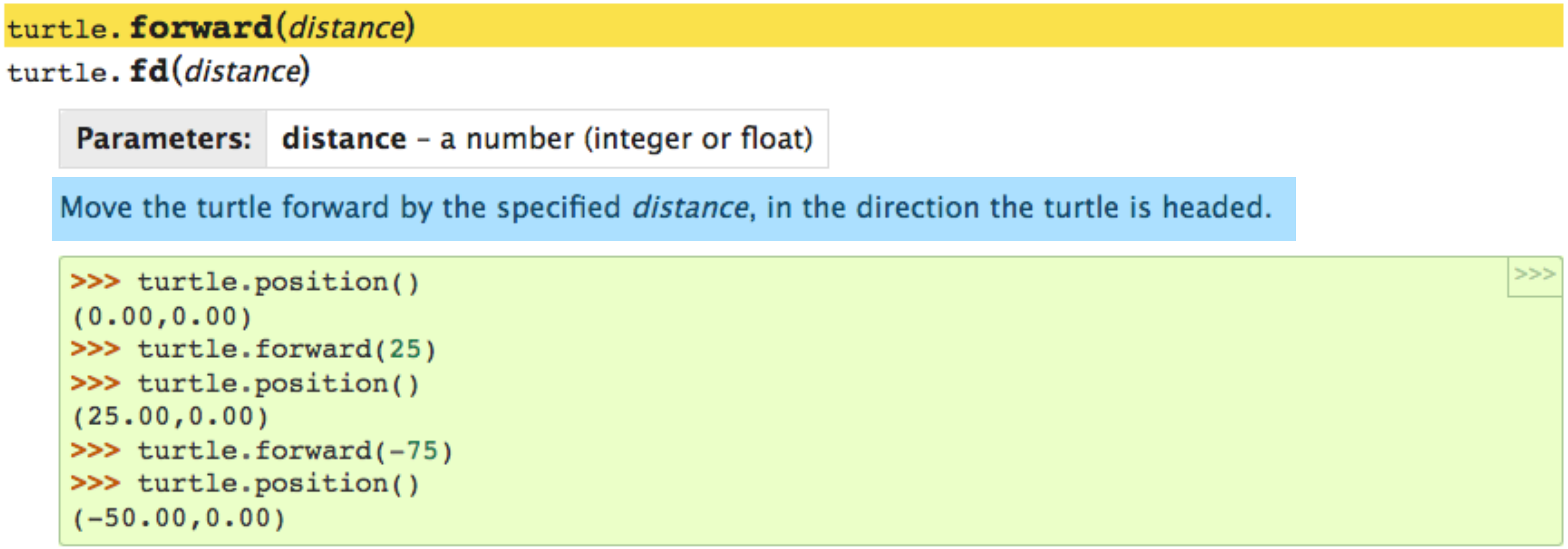
```
def forward(self, distance):
    """Move the turtle forward by the specified distance.

    Aliases: forward | fd

    Argument:
    distance -- a number (integer or float)

    Move the turtle forward by the specified distance, in the direction
    the turtle is headed.

    Example (for a Turtle instance named turtle):
    >>> turtle.position()
    (0.00, 0.00)
    >>> turtle.forward(25)
    >>> turtle.position()
    (25.00,0.00)
    >>> turtle.forward(-75)
    >>> turtle.position()
    (-50.00,0.00)
    """
```

Implementation:

```
    self._go(distance)
```

Docstrings: Example

Python documentation is generated from the docstrings in the code!



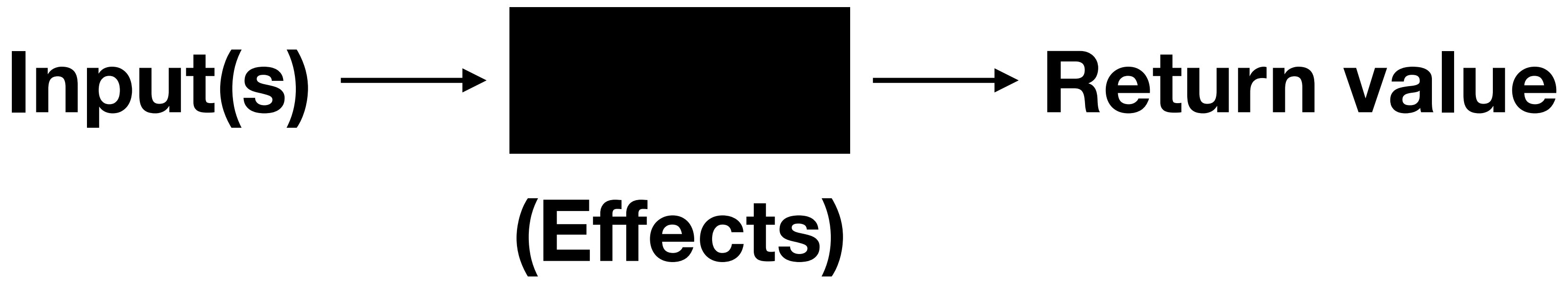
turtle.**forward**(*distance*)
turtle.**fd**(*distance*)

Parameters:	**distance** – a number (integer or float)

Move the turtle forward by the specified *distance*, in the direction the turtle is headed.

```
>>> turtle.position()
(0.00,0.00)
>>> turtle.forward(25)
>>> turtle.position()
(25.00,0.00)
>>> turtle.forward(-75)
>>> turtle.position()
(-50.00,0.00)
```

What belongs in a docstring?



- As a user, you can treat a function as a **“black box”:** all you need to know is:
  - the **inputs**, **effects**, and **return value**.

- Docstrings give a *user* of your function everything they need to know to call it.

- A docstring should explain **what the function does**, but not **how the function works**

What belongs in a docstring?

$$\begin{tikzcd}
\textbf{Input(s)} \arrow[r] & \boxed{\texttt{f}} \arrow[r] & \textbf{Return value} \\
 & \textbf{(Effects)} &
\end{tikzcd}$$

preconditions:
Things the **caller** is responsible for
ensuring before the function is called.

like comments, these are human constructs, not part of Python

postconditions:
Things the **function** is responsible for
ensuring by the time the function returns.

Preconditions: why?

- Demo: abs.py
- Absolute value only makes sense on numbers, so specify a **precondition** that the input must be a number.

Postconditions: why?

- Demo: turtle_rectangle.py
- It's important to know where a Turtle function leaves the turtle so you know how to continue with your drawing.
- Specify a **postcondition** that the turtle ends up in the same position and direction as it started.

Preconditions and Postconditions: Assigning Blame

Example. Suppose you wrote this function:

```
def split_bill(bill_amt, tip_pct, num_diners):
    """ Return the total owed by each diner for a
        restaurant bill of bill_amt, assuming a tip
        percent of tip_pct and splitting the bill
        evenly among num_diners people.

    """
    total = bill_amt + (bill_amt * tip_pct/100)
    return total / num_diners
```

```
>>> split_bill(34.78, 18.0, 0)
ZeroDivisionError: float division by zero
```

Bad news: This is your fault.

Preconditions and Postconditions: Assigning Blame

Example. Suppose you wrote this function:

```
def split_bill(bill_amt, tip_pct, num_diners):
    """ Return the total owed by each diner for a
        restaurant bill of bill_amt, assuming a tip
        percent of tip_pct and splitting the bill
        evenly among num_diners people.
        Precondition: num_diners > 0
    """
    total = bill_amt + (bill_amt * tip_pct/100)
    return total / num_diners
```

```
>>> split_bill(34.78, 18.0, 0)
ZeroDivisionError: float division by zero
```

Good news: This is my fault.