Python Functions

Thomas Schwarz, SJ
Marquette University

Software Engineering

- Programming is difficult
  - To make it easier:
    - Modularize: break task into simpler task
    - Functions and procedures are a universal programming paradigm
      - Example: First routine calculated the sine of a number
    - Functions can then be used in many places

Software Engineering

- Function:
  - Solve a repetitive task
  - Usually take arguments
  - Usually return a result

Python Functions

- Python almost completely uses the abstraction of a function
- A function is called from the caller, given none or a number of *arguments* (aka parameters)
- The function returns to the caller
  - Giving a return value (a *fruitful* function)
  - Or just returning (a *fruitless* function)

Python Function

- Calling fruitless functions
  - We already have used a fruitless function, namely `print`
    - `print` is special, it can have any number of arguments
- Example: `print("The value is", 3.145)`
  - Two arguments
    - String `"The value is"`
    - Floating point `3.145`

Python Functions

- We can use built-in fruitful functions
  - `abs` returns the absolute value

```
>>> abs(-4)
4
```

  - We can import the module math in order to have access to many mathematical functions
    - A complete list is in the Python Docs.
      - Here we just print out the values of some functions.

mathmodule.py - /Users/thomasschwarz/Documents/My website/Classes/Module...

```
import math
x = 2.56
print(x, math.sin(x), math.exp(x), math.log(x, 2), math.log(x, 10), math.log(x))
```

Python Functions

- Creating functions

```
def function_name ( parameter_list ) :
    ⟷ Statement Block
      Indent
```

- Uses key word def
- Followed by the name of the function (usually lower-letter)
- In parentheses, a list of arguments (aka parameters) separated by comma
- Followed by colon

Python Functions

- Example for a fruitless function
  - Function that prints out *n* asterisks, then a blank line, then *n* asterisks

```
def asterisks(n):
    print(n*"*")
    print()
    print(n*"*")
```

- There is a single argument, *n*
  - Note that *n* does not have a specified type.
  - Since in the body of the function we multiply with *n*, it better be an integer.

Python Functions

- Example for a fruitless function
  - Function that prints out *n* asterisks, then a blank line, then *n* asterisks

```
def asterisks(n):
    print(n*"*")
    print()
    print(n*"*")
```

  - Three statements follow in the function block.
  - The function execution finishes, when we fall out of the block
  - If we want to be explicit, we can add a final line to the function block with the single statement `return`

Python Function

- Example for a fruitful function
  - A function that given x and y, calculates the expression

$$\frac{|x-y|}{x^2+y^2}$$

  - The function needs two arguments and needs to return a value

Python Functions

$$x, y \rightarrow \frac{|x-y|}{x^2+y^2}$$

```
def fun(x, y):
    enumerator = abs(x-y)
    denominator = x*x+y*y
    return enumerator/denominator
```

- There are now two arguments, separated by a comma
- The *body* of the function calculates the result
- The result is returned with the return-statement.
- An exception will be thrown if we call the function with values 0 and 0 since we then divide by zero in the calculation of the function.

Python Functions

- We can have more than one return statement
  - An implementation of the maximum of two numbers function

```
def my_max(x,y):
    if x<y:
        return y
    return x
```

- I do not need to put the last line in an else, since if x<y, then I already jumped out of the execution of the function body.

Activities

- Write a script that imports the math module
  - `import math`
- Then a function f1 of a single argument `x` that calculates and returns
  - $\sin(x)^2 + \cos(x)^2$
- Print out the values of this function at $\frac{i}{\pi}$ as a table:
  - `for i in range(51):`
  - `    print(i, '\t', f1(i/math.pi))`

Activities

- Implement a function $f(x, y) = \dfrac{x \cdot y}{1 + x^2 + y^2}$