



Functions

Chapter 4



Python for Informatics: Exploring Information
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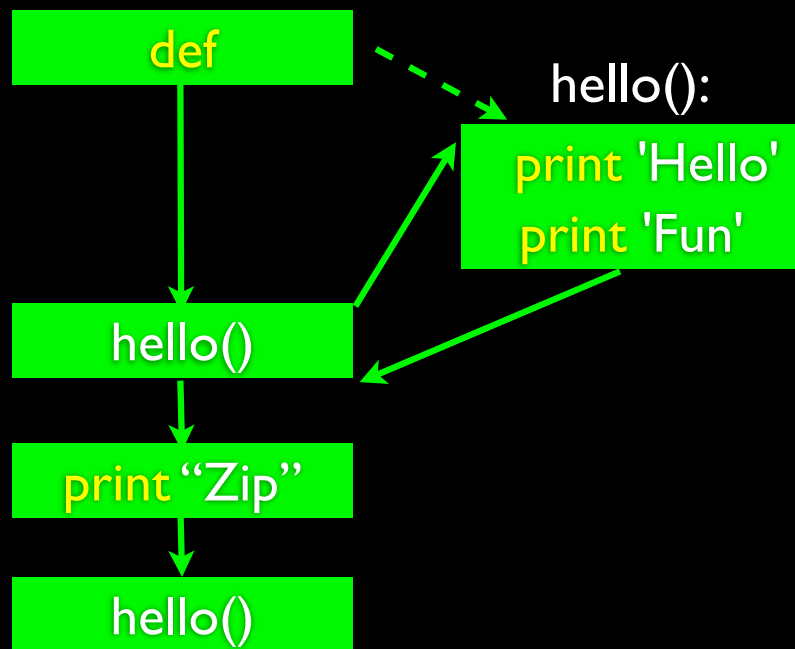
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Stored (and reused) Steps



Program:

```
def hello():  
    print 'Hello'  
    print 'Fun'
```

```
hello()  
print 'Zip'  
hello()
```

Output:

```
Hello  
Fun  
Zip  
Hello  
Fun
```

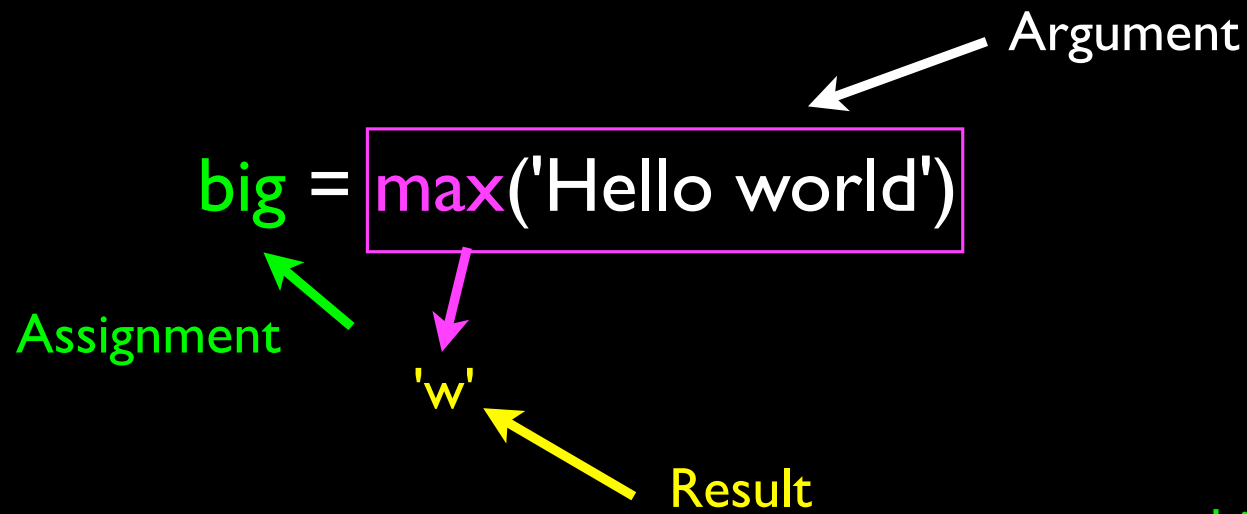
We call these reusable pieces of code “functions”.

Python Functions

- There are two kinds of **functions** in Python.
 - **Built-in functions** that are provided as part of Python - `raw_input()`, `type()`, `float()`, `int()` ...
 - **Functions** that we **define ourselves** and then use
- We treat the of the built-in **function** names as "new" **reserved words** (i.e. we avoid them as variable names)

Function Definition

- In Python a **function** is some reusable code that takes **arguments(s)** as input does some computation and then returns a result or results
- We define a **function** using the **def** reserved word
- We call/invoke the **function** by using the function name, parenthesis and **arguments** in an expression



```
>>> big = max('Hello world')
>>> print big
w
>>> tiny = min('Hello world')
>>> print tiny

>>>
```

Max Function

```
>>> big = max('Hello world')
>>> print big
'w'
```

A function is some stored code that we use. A function takes some input and produces an output.



Guido wrote this code

Max Function

```
>>> big = max('Hello world')
>>> print big
'w'
```

A function is some stored code that we use. A function takes some input and produces an output.

“Hello world”
(a string)



```
def max(inp):
    blah
    blah
    for x in y:
        blah
        blah
```



'w'
(a string)

Guido wrote this code

Type Conversions

- When you put an integer and floating point in an expression the integer is **implicitly** converted to a float
- You can control this with the built in functions `int()` and `float()`

```
>>> print float(99) / 100
0.99
>>> i = 42
>>> type(i)
<type 'int'>
>>> f = float(i)
>>> print f
42.0
>>> type(f)
<type 'float'>
>>> print 1 + 2 * float(3) / 4 - 5
-2.5
>>>
```

String Conversions

- You can also use `int()` and `float()` to convert between strings and integers
- You will get an **error** if the string does not contain numeric characters

```
>>> sval = '123'
>>> type(sval)
<type 'str'>
>>> print sval + 1
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: cannot concatenate 'str' and 'int'
>>> ival = int(sval)
>>> type(ival)
<type 'int'>
>>> print ival + 1
124
>>> nsv = 'hello bob'
>>> niv = int(nsv)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
ValueError: invalid literal for int()
```

Building our Own Functions

- We create a new **function** using the **def** keyword followed by optional parameters in parenthesis.
- We indent the body of the function
- This **defines** the function but **does not** execute the body of the function

```
def print_lyrics():  
    print "I'm a lumberjack, and I'm okay."  
    print 'I sleep all night and I work all day.'
```

```
x = 5  
print 'Hello'
```

```
def print_lyrics():  
    print "I'm a lumberjack, and I'm okay."  
    print 'I sleep all night and I work all day.'
```

```
print 'Yo'  
x = x + 2  
print x
```

```
print_lyrics():
```

```
print "I'm a lumberjack, and I'm okay."  
print 'I sleep all night and I work all day.'
```

```
Hello  
Yo  
7
```

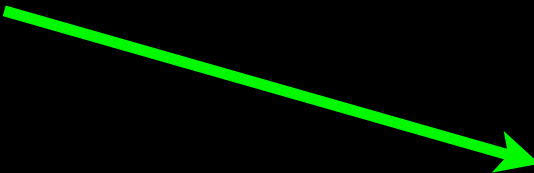
Definitions and Uses

- Once we have **defined** a function, we can **call** (or **invoke**) it as many times as we like
- This is the **store** and **reuse** pattern

```
x = 5  
print 'Hello'
```

```
def print_lyrics():  
    print "I'm a lumberjack, and I'm okay."  
    print 'I sleep all night and I work all day.'
```

```
print 'Yo'  
print_lyrics()  
x = x + 2  
print x
```



```
Hello  
Yo  
I'm a lumberjack, and I'm okay.  
I sleep all night and I work all day.  
7
```

Arguments

- An **argument** is a value we pass into the **function** as its **input** when we call the function
- We use **arguments** so we can direct the **function** to do different kinds of work when we call it at **different** times
- We put the **arguments** in parenthesis after the **name** of the function

```
big = max('Hello world')
```

← Argument

Parameters

- A **parameter** is a variable which we use **in** the function **definition** that is a “handle” that allows the code in the **function** to access the **arguments** for a particular **function** invocation.

```
>>> def greet(lang):
...     if lang == 'es':
...         print 'Hola'
...     elif lang == 'fr':
...         print 'Bonjour'
...     else:
...         print 'Hello'
...
>>> greet('en')
Hello
>>> greet('es')
Hola
>>> greet('fr')
Bonjour
>>>
```


Return Values

- Often a function will take its arguments, do some computation and **return** a value to be used as the value of the function call in the **calling expression**. The **return** keyword is used for this.

```
def greet():  
    return "Hello"  
  
print greet(), "Glenn"  
print greet(), "Sally"
```

Hello Glenn
Hello Sally

Return Value

- A “fruitful” **function** is one that produces a **result** (or **return value**)
- The **return** statement ends the **function** execution and “sends back” the **result** of the **function**

```
>>> def greet(lang):
...     if lang == 'es':
...         return 'Hola'
...     elif lang == 'fr':
...         return 'Bonjour'
...     else:
...         return 'Hello'
...
>>> print greet('en'),'Glenn'
Hello Glenn
>>> print greet('es'),'Sally'
Hola Sally
>>> print greet('fr'),'Michael'
Bonjour Michael
>>>
```

Arguments, Parameters, and Results

```
>>> big = max('Hello world')  
>>> print big  
'w'
```

Argument
→

“Hello world”



```
def max(inp):  
    blah  
    blah  
    for x in y:  
        blah  
        blah  
    return 'w'
```

Parameter
↙



'w'

↑
Result

Multiple Parameters / Arguments

- We can define more than one **parameter** in the **function definition**
- We simply add more **arguments** when we call the **function**
- We match the number and order of arguments and parameters

```
def addtwo(a, b):  
    added = a + b  
    return added
```

```
x = addtwo(3, 5)  
print x
```

Void (non-fruitful) Functions

- When a function does not return a value, we call it a "void" function
- Functions that return values are "fruitful" functions
- Void functions are "not fruitful"

To function or not to function...

- Organize your code into “paragraphs” - capture a complete thought and “name it”
- Don’t repeat yourself - make it work once and then reuse it
- If something gets too long or complex, break up logical chunks and put those chunks in functions
- Make a library of common stuff that you do over and over - perhaps share this with your friends...

Summary

- Functions
- Built-In Functions
 - Type conversion (int, float)
 - Math functions (sin, sqrt)
- Try / except (again)
- Arguments
- Parameters
- Results (Fruitful functions)
- Void (non-fruitful) functions
- Why use functions?

Exercise

Rewrite your pay computation with time-and-a-half for overtime and create a function called `compute_pay` which takes two parameters (hours and rate).

Enter Hours: 45

Enter Rate: 10

Pay: 475.0

$$475 = 40 * 10 + 5 * 15$$