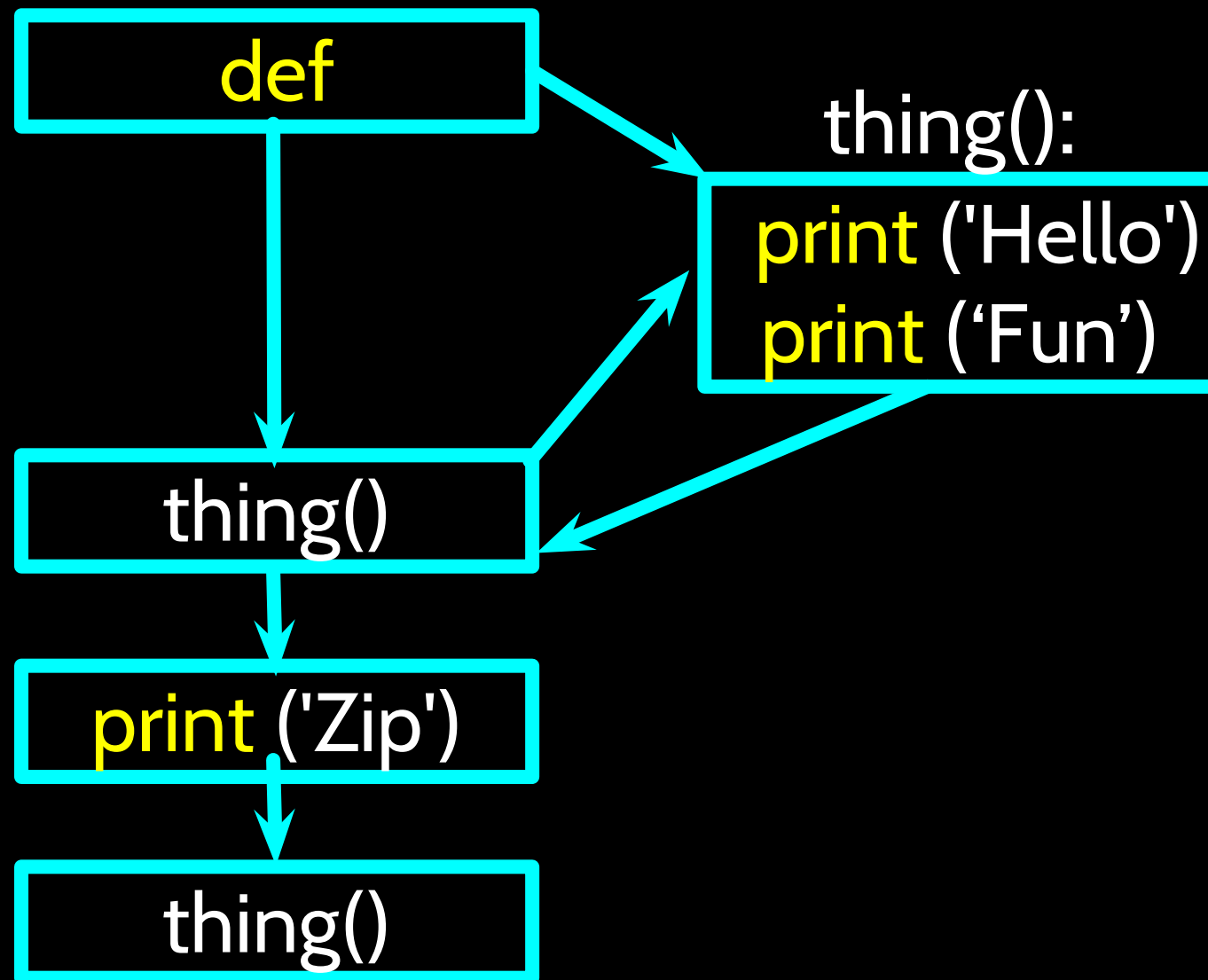


# Functions

## Chapter 4

Python for Informatics: Exploring Information  
[www.pythonlearn.com](http://www.pythonlearn.com)

# Stored (and reused) Steps



Program:

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

```
thing()  
print ('Zip')  
thing()
```

Output:

```
Hello  
Fun  
Zip  
Hello  
Fun
```

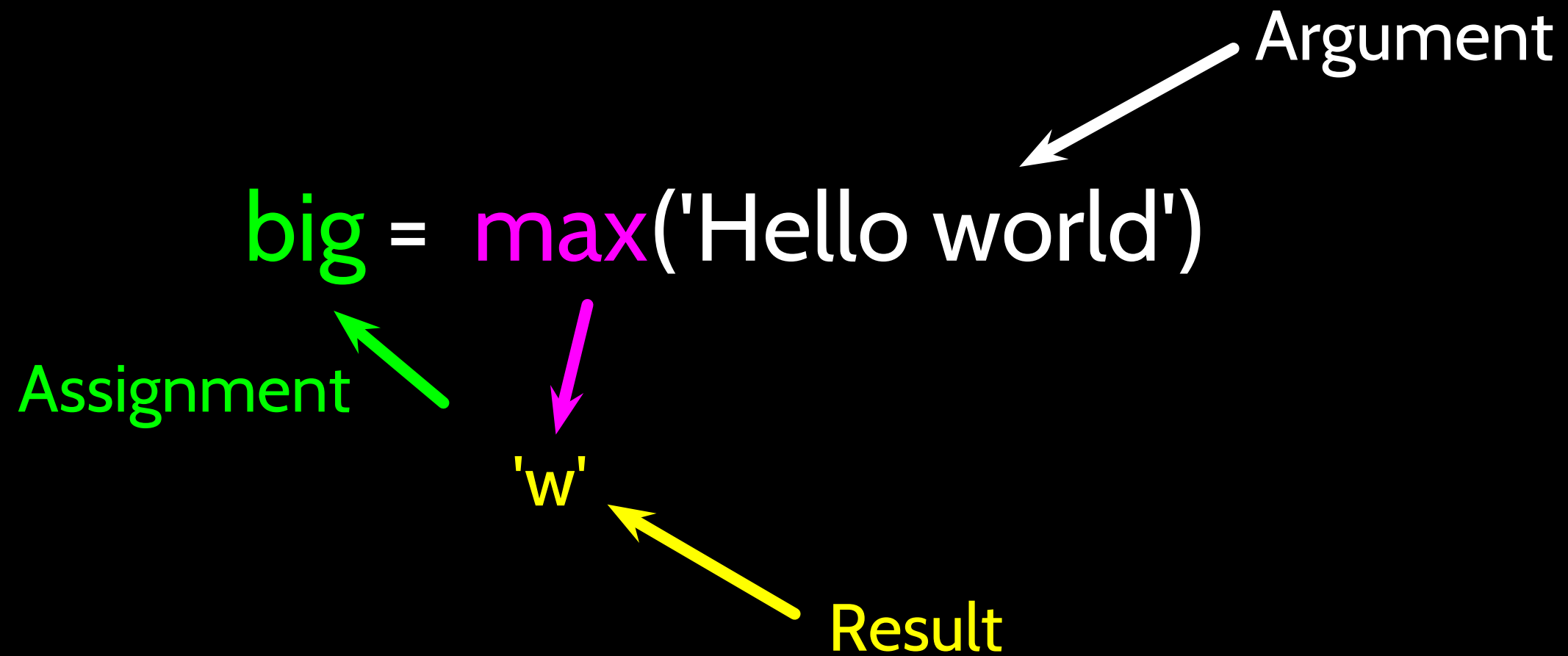
We call these reusable pieces of code “functions”

# Python Functions

- There are two kinds of functions in Python.
  - > **Built-in functions** that are provided as part of Python - input(), type(), float(), int() ...
  - > **Functions that we define ourselves** and then use
- We treat 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, parentheses, and **arguments** in an expression



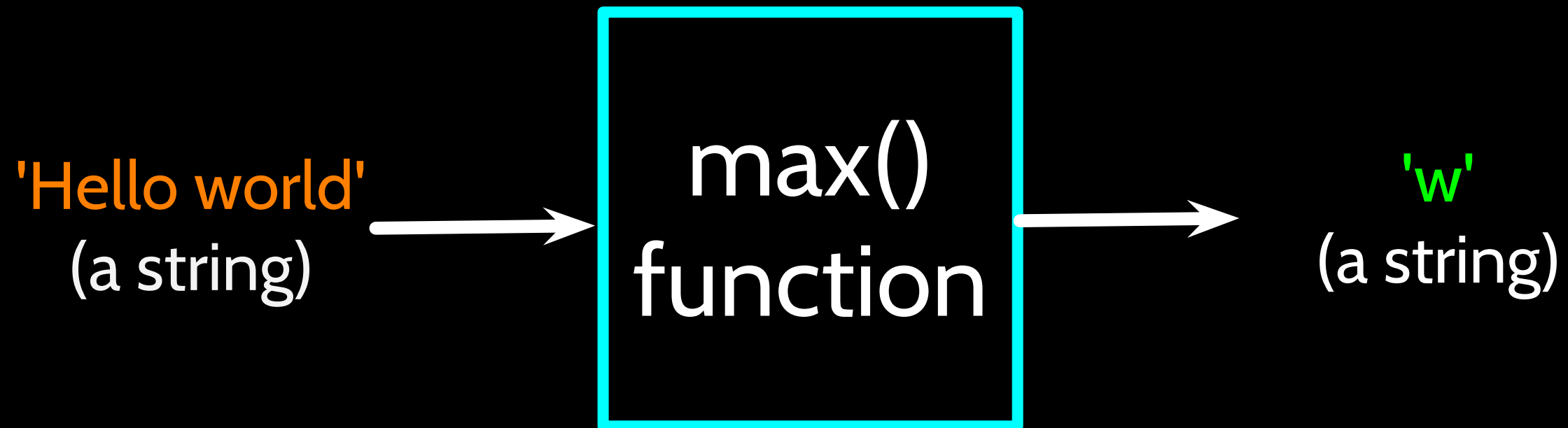
```
>>> big = max('Hello world')
>>> print (big)
w
>>> tiny = min('Hello world')
>>> print (tiny)

>>>
```

# 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

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

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

'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 parentheses
- 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.')
```

`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)
```

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 parentheses after the **name** of the function

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

Argument



# Parameters

A **parameter** is a variable which we use **in** the function **definition**. It 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'

Parameter →

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

→ '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)  
8
```

# 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 it up into 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...

## 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

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

# Summary

- Functions
- Built-In Functions
  - > Type conversion (int, float)
  - > String conversions
- Parameters
- Arguments
- Results (fruitful functions)
- Void (non-fruitful) functions
- Why use functions?



# Acknowledgements / Contributions



These slides are Copyright 2010- Charles R. Severance ([www.dr-chuck.com](http://www.dr-chuck.com)) of the University of Michigan School of Information and [open.umich.edu](http://open.umich.edu) and made available under a Creative Commons Attribution 4.0 License. Please maintain this last slide in all copies of the document to comply with the attribution requirements of the license. If you make a change, feel free to add your name and organization to the list of contributors on this page as you republish the materials.

Initial Development: Charles Severance, University of Michigan School of Information

... Insert new Contributors and Translators here