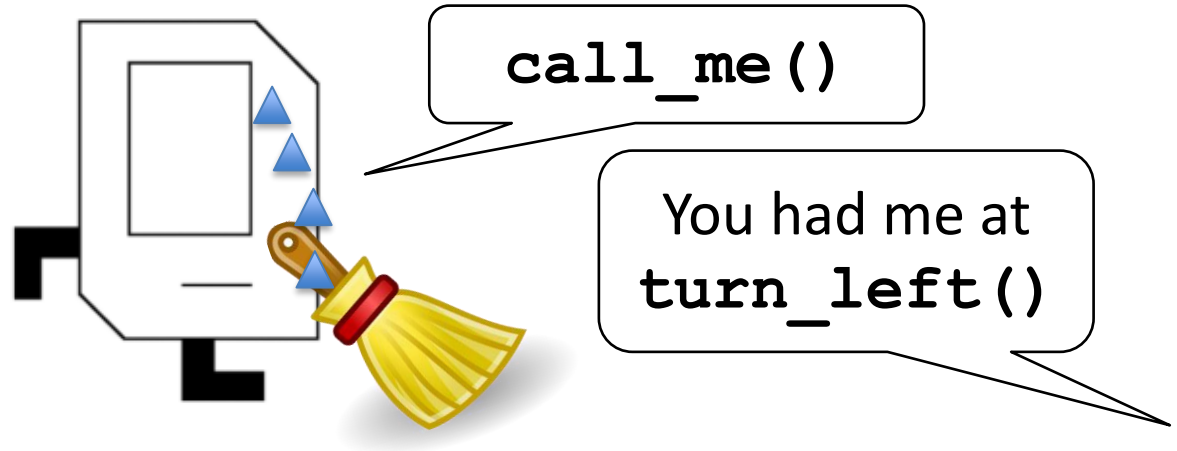




Introduction to Python

Chris Piech and Mehran Sahami
CS106A, Stanford University

Housekeeping



- Class website: <http://cs106a.stanford.edu>
- Sections
 - Start this week
 - If you missed sign-ups, email: cs198@cs.stanford.edu
- LaIR is now open. See class webpage for details
- Bye bye, Karel!

More on Programming Style

```
"""
File: SteepleChaseKarel.py
-----
Karel runs a steeple chase that is 9 avenues long.
Hurdles are of arbitrary height and placement.
"""
```

Comments for program
and *every* function

```
"""
To run a race that is 9 avenues long, we need to move
forward or jump hurdles 8 times.
"""
```

```
def main():
    for i in range(8):
        if front_is_clear():
            move()
        else:
            jump_hurdle()
```

Consistent
indentation

Decomposition principle:
Each function should solve
one step of problem

```
"""
Pre-condition: Facing East at bottom of hurdle
Post-condition: Facing East at bottom in next avenue after hurdle
"""
```

```
def jump_hurdle():
    ascend_hurdle()
    move()
    descend_hurdle()
```

Short functions
(usually 1-15 lines)

Descriptive *names*
(snake_case)

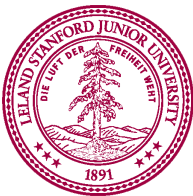


What's Mozart Doing Now?



```
if mehran_teaching() :  
    not_funny()
```

```
while mehran_teaching() :  
    not_funny()
```



Welcome to Python

Guido van Rossum
(Creator of Python)

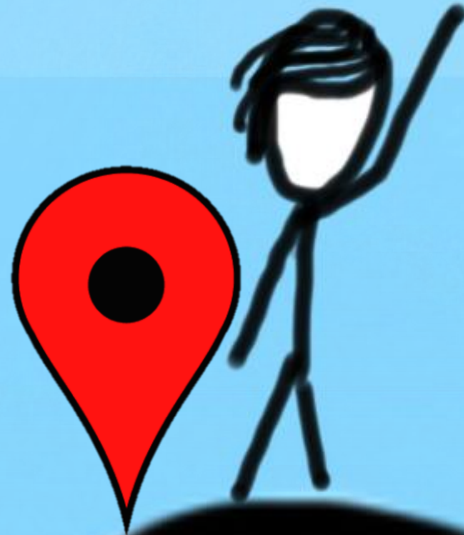


Monty Python's Flying Circus 👍



Today's Goal

1. Introduction to Python
2. Understanding variables



Our First Python Program

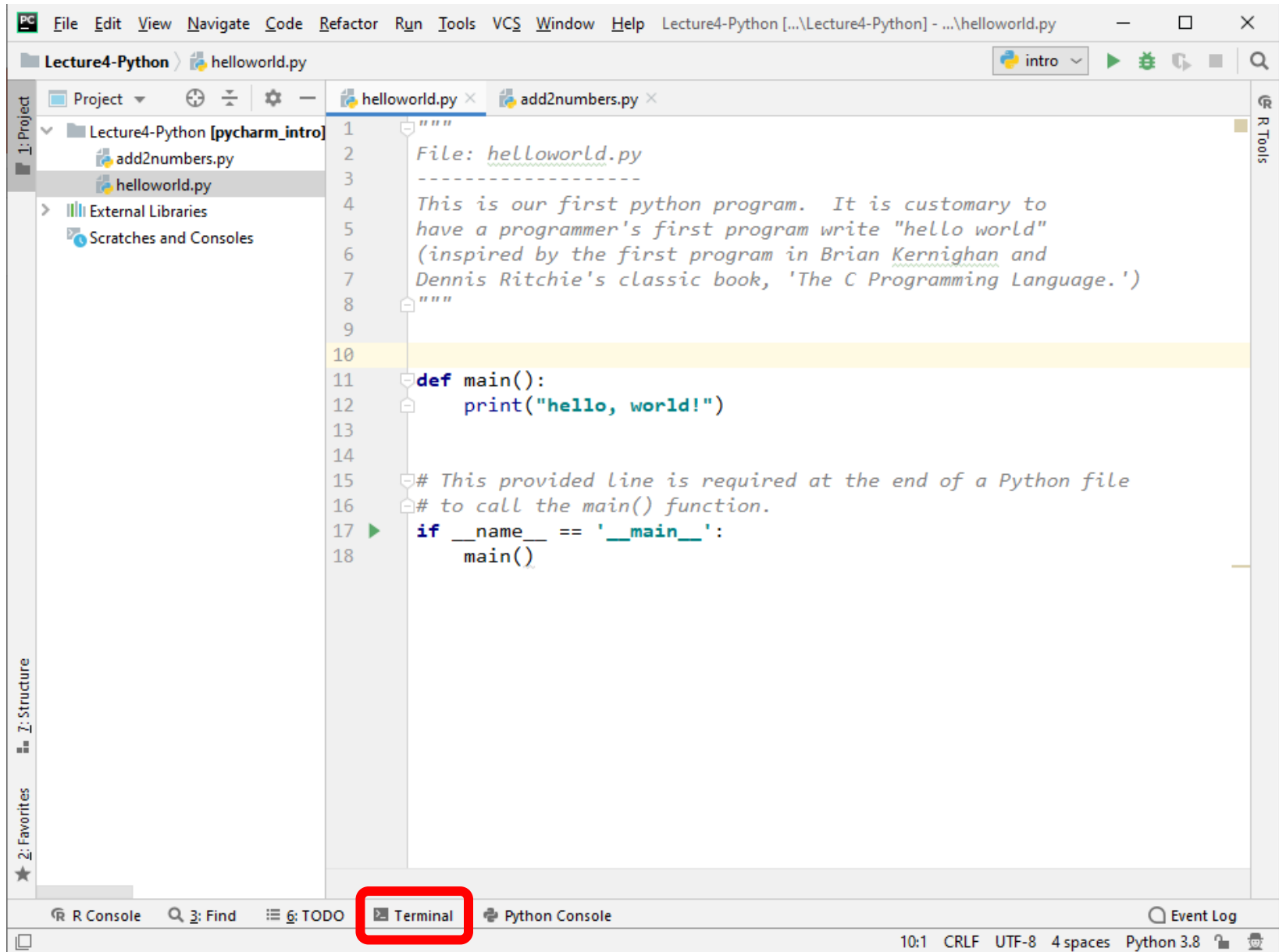
```
"""
File: helloworld.py
-----
This is our first python program.  It is customary to
have a programmer's first program write "hello world"
(inspired by the first program in Brian Kernighan and
Dennis Ritchie's classic book, 'The C Programming Language.')
"""
```

```
def main():  
    print("hello, world!")
```

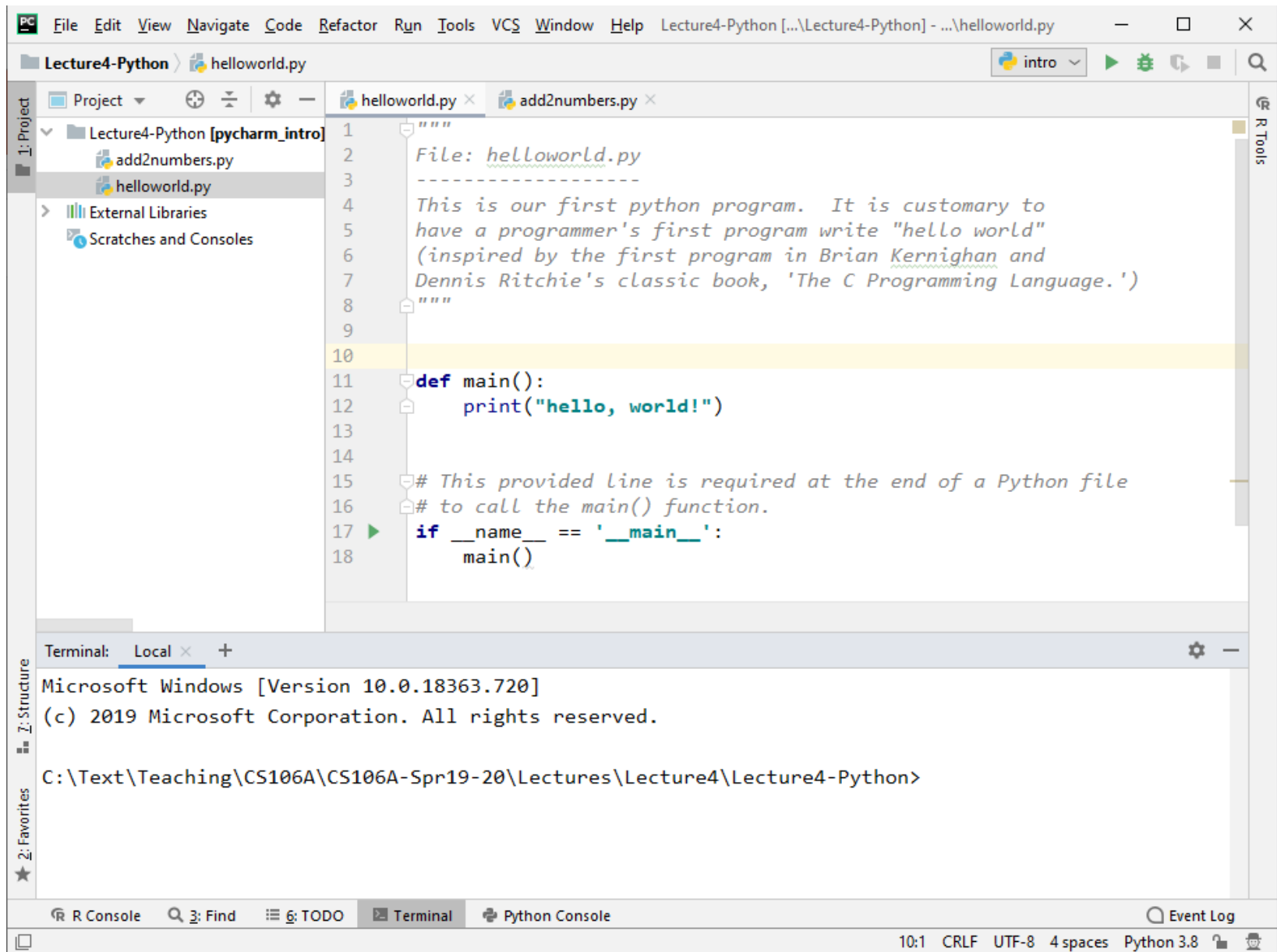
```
# This provided line is required at the end of a Python
# file to call the main() function.
```

```
if __name__ == '__main__':  
    main() # little bit different than in Karel
```

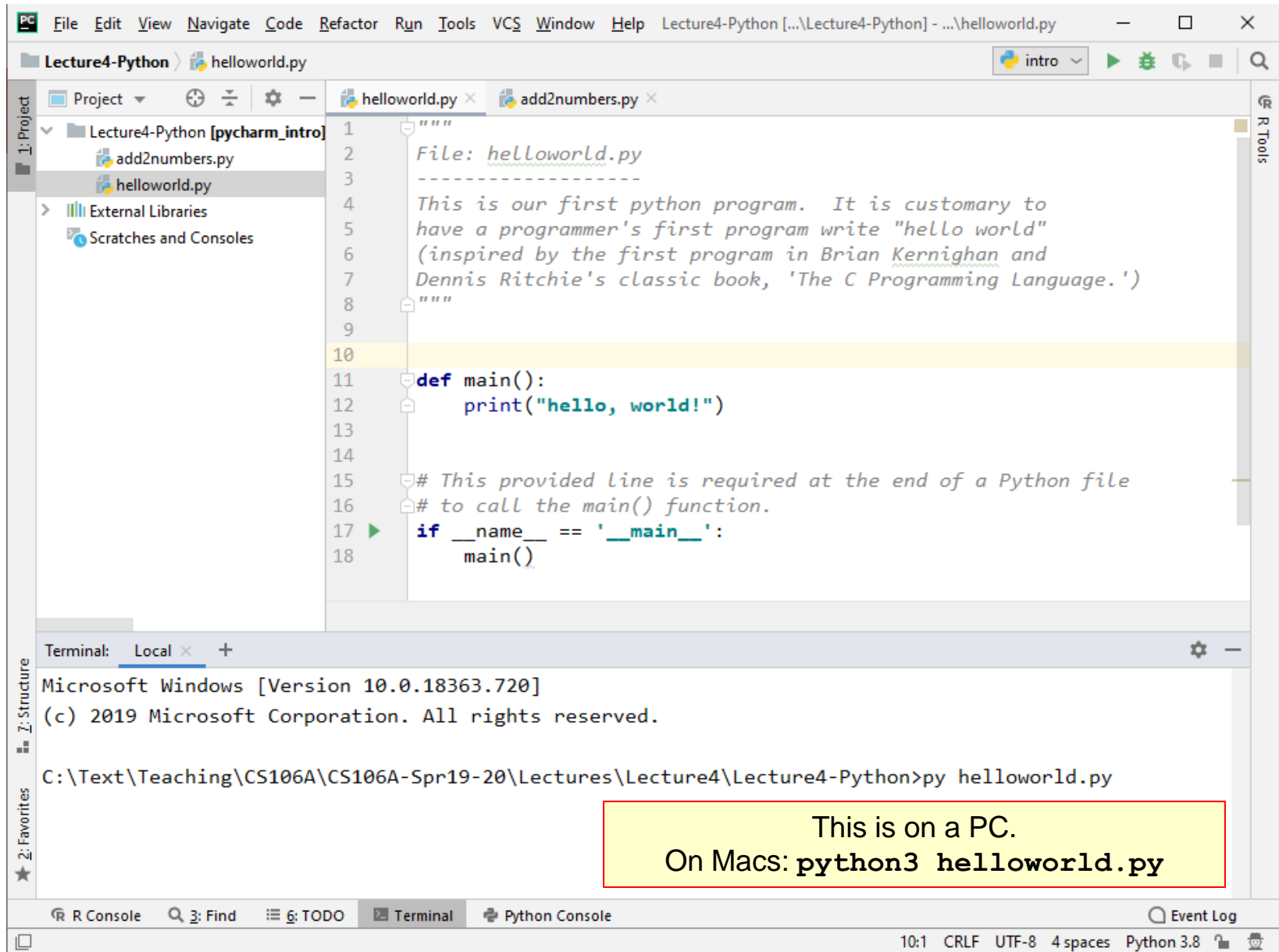
Our First Python Program



Our First Python Program



Our First Python Program



The screenshot shows the PyCharm IDE interface. The main editor window displays the file `helloworld.py` with the following Python code:

```
1 """
2     File: helloworld.py
3     -----
4     This is our first python program. It is customary to
5     have a programmer's first program write "hello world"
6     (inspired by the first program in Brian Kernighan and
7     Dennis Ritchie's classic book, 'The C Programming Language.')
8 """
9
10
11 def main():
12     print("hello, world!")
13
14
15 # This provided line is required at the end of a Python file
16 # to call the main() function.
17 if __name__ == '__main__':
18     main()
```

The left sidebar shows the project structure for `Lecture4-Python`, including `add2numbers.py` and `helloworld.py`. The bottom terminal window shows the command prompt output:

```
Microsoft Windows [Version 10.0.18363.720]
(c) 2019 Microsoft Corporation. All rights reserved.

C:\Text\Teaching\CS106A\CS106A-Spr19-20\Lectures\Lecture4\Lecture4-Python>py helloworld.py
```

A yellow box with a red border is overlaid on the terminal output, containing the text:

This is on a PC.
On Macs: `python3 helloworld.py`

The status bar at the bottom indicates the current file is `helloworld.py`, the encoding is UTF-8, and the Python version is 3.8.

Our First Python Program

The screenshot shows the PyCharm IDE interface. The main editor window displays the file `helloworld.py` with the following Python code:

```
1 """
2     File: helloworld.py
3     -----
4     This is our first python program. It is customary to
5     have a programmer's first program write "hello world"
6     (inspired by the first program in Brian Kernighan and
7     Dennis Ritchie's classic book, 'The C Programming Language.')
```

```
8 """
9
10
11 def main():
12     print("hello, world!")
13
14
15 # This provided line is required at the end of a Python file
16 # to call the main() function.
17 if __name__ == '__main__':
18     main()
```

The left sidebar shows the project structure for `Lecture4-Python`, including `add2numbers.py` and `helloworld.py`. The bottom panel shows the `Terminal` window with the following output:

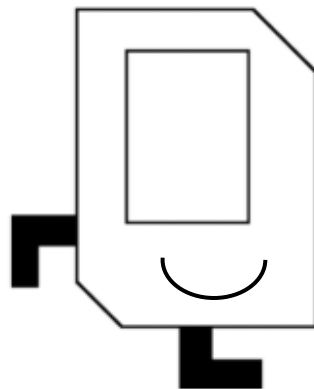
```
Microsoft Windows [Version 10.0.18363.720]
(c) 2019 Microsoft Corporation. All rights reserved.

C:\Text\Teaching\CS106A\CS106A-Spr19-20\Lectures\Lecture4\Lecture4-Python>py helloworld.py
hello, world!

C:\Text\Teaching\CS106A\CS106A-Spr19-20\Lectures\Lecture4\Lecture4-Python>
```

The status bar at the bottom indicates the current settings: `10:1 CRLF UTF-8 4 spaces Python 3.8`.

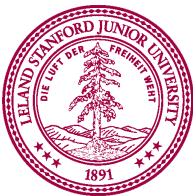
You're now all Python programmers!



`hey_that_looks_
like_what_I_
taught_them()`

Another Program

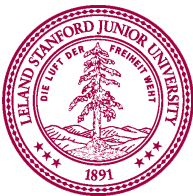
```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```



Another Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

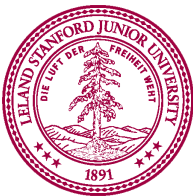
This program adds two numbers.



Another Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

```
This program adds two numbers.  
Enter first number:
```



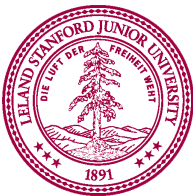
Another Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

num1

"9"

```
This program adds two numbers.  
Enter first number: 9
```



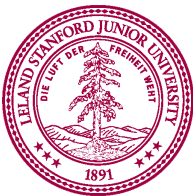
Another Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

num1

9

This program adds two numbers.
Enter first number: 9



Another Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

num1

9

```
This program adds two numbers.  
Enter first number: 9  
Enter second number:
```



Another Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

num1

9

num2

"17"

```
This program adds two numbers.  
Enter first number: 9  
Enter second number: 17
```



Another Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

num1

9

num2

17

```
This program adds two numbers.  
Enter first number: 9  
Enter second number: 17
```



Another Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

num1

9

num2

17

total

26

```
This program adds two numbers.  
Enter first number: 9  
Enter second number: 17
```



Another Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

num1

9

num2

17

total

26

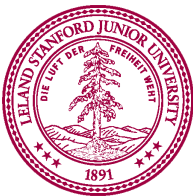
```
This program adds two numbers.  
Enter first number: 9  
Enter second number: 17  
The total is 26.
```



print function

```
print("This program adds two numbers.")
```

- **print** command prints text to the terminal
- Text printed is between double quotes ("text")
 - Can also be between single quotes ('text')
 - Choice of quotes depends on text you are printing
 - Double quotes when text contains single quotes
`print("no, you didn't")` → no, you didn't
 - Single quotes when text contains double quotes
`print('say "hi" Karel')` → say "hi" Karel



input function

```
num1 = input("Enter first number: ")
```

- **input** command gets text input from the user
- Prints text specified in double/single quotes
 - Then waits for user input
 - Here, user input from **input** is put in a variable (**num1**)
 - The user input is considered text, even if user entered a number
- We'll talk more about **input** function later

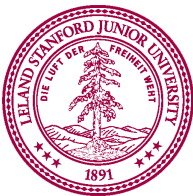


What is a Variable?

x 10

- A **variable** is a place to store information in a program
- It associates a **name** with a **value**
- You can create a new variable by assigning a value:

x = 10



What is a Variable?

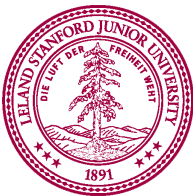
x 5

- A **variable** is a place to store information in a program
- It associates a **name** with a **value**
- You can create a new variable by assigning a value:

x = 10

- The value can change with a new assignment

x = 5



What is a Variable?

x 12

- A **variable** is a place to store information in a program
- It associates a **name** with a **value**
- You can create a new variable by assigning a value:

x = 10

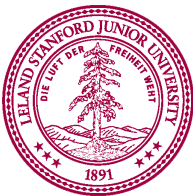
- The value can change with a new assignment

x = 5

- You can set the value using mathematical expressions

x = 5 + 7

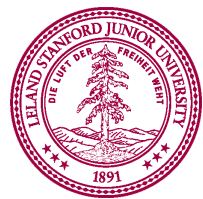
- More about expressions next class



Variable Assignment

- You use the equal sign (=) to assign to a variable
 - The first time you assign a value to a variable, you create it
 - Subsequent assignments give the variable a new value
- Assignment is not the same as "equals" in math
 - Assignment: first evaluate right-hand side, then assign to the variable on the left-hand side
 - Consider the following code:

```
total = 5  
total = total + 1
```
- Variables are only visible inside the function in which they are created (called "scope" of variable)
 - If you create a variable in `main()`, its only visible in `main()`
 - More on that next class



Variable Names

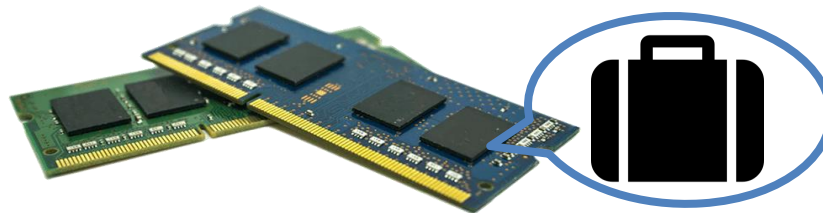
- Variable names must:
 - Start with a letter or an underscore (`_`)
 - Contain only letters, digits, or underscores
 - Cannot be a "built in" command in Python (e.g., **for**)
- Variable names are case sensitive
 - **Hello** is not the name as **hello**
- Variable names should:
 - Be descriptive of the value they refer to
 - E.g., **x** is only a good name if it's a coordinate
 - Be in snake case (e.g., **num_students**)



Suitcase Analogy

x 12

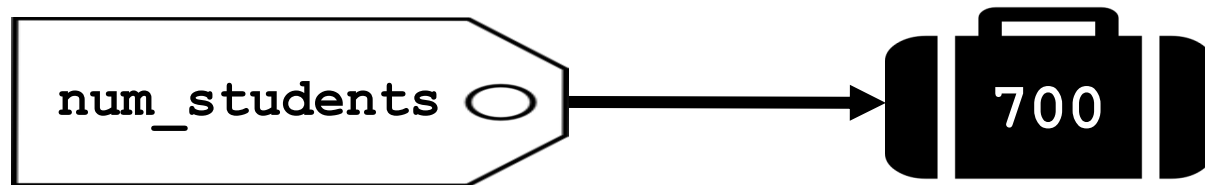
- When you store information in a variable, it becomes a Python *object*
 - Objects come in different sizes and types
- Think about a Python object as a suitcase stored in your computer's memory
 - Object take up different amounts of RAM depending on what you're storing.



You have space for millions on suitcases!

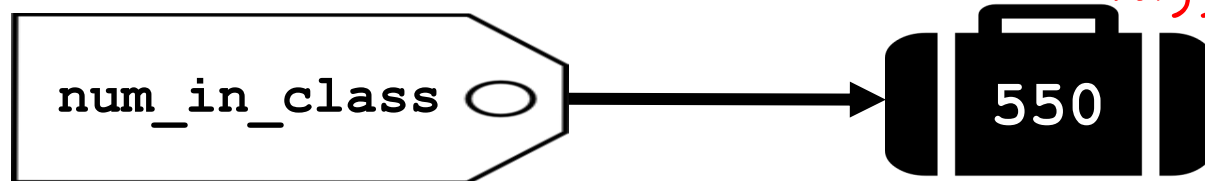
Suitcase Analogy

- Variable is a luggage tag that gives a *name* to suitcase
 - `num_students = 700`
 - Value* is what is stored in the suitcase
 - Create the tag/suitcase the first time you assign to variable

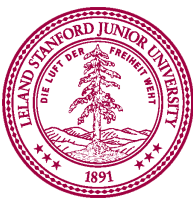
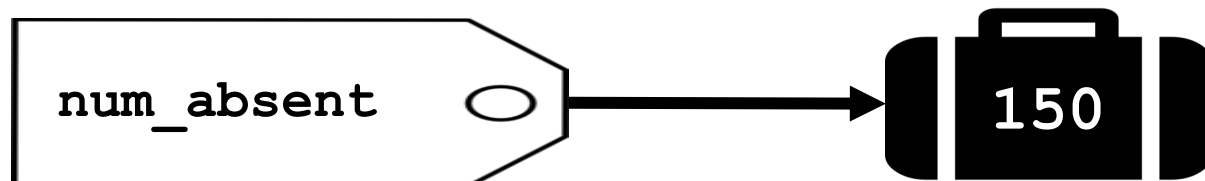


`num_in_class = 550`

Python handles the
baggage for you!



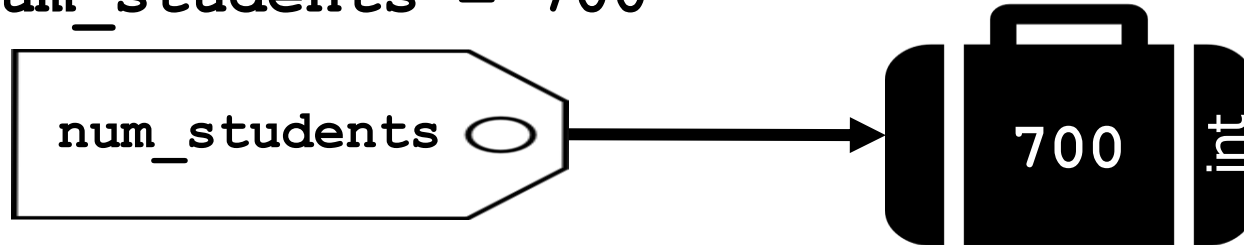
`num_absent = num_students - num_in_class`



Types

- Each suitcase knows what **type** of information it carries

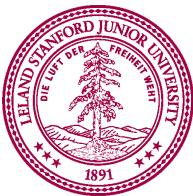
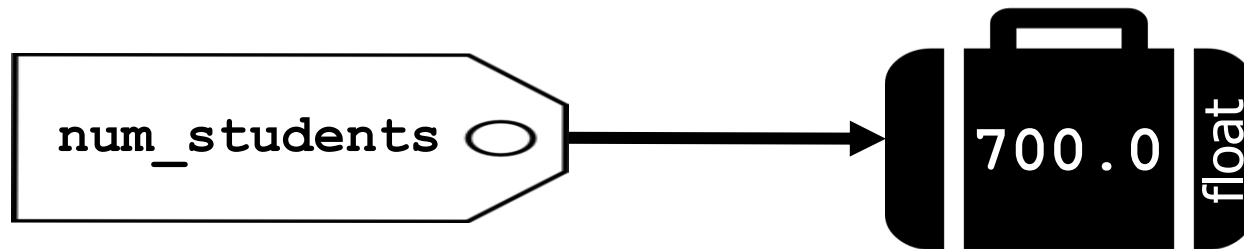
```
num_students = 700
```



- Value stored in suitcase is an integer (called an `int` in Python)
- Suitcase keeps track of **type** of data that is stored there

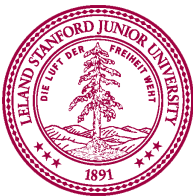
```
num_students = 700.0    # note decimal point
```

- Now, value stored is a real number (called a `float` in Python)



Some Types in Python

- **int:** integer value (no decimal point)
`x = 10` `y = -2`
- **float:** real number value (has decimal point)
`x = 5.0` `y = -3.7`
- **string:** text characters (between single/double quotes)
`x = "hello"` `y = '10'`
 - Note: the string "5" is ***not*** the same as the integer 5
- **bool:** Boolean logical values (**True/False**)
`x = True` `y = False`
- More on strings and bools in a few days



Why Do We Have int and float?

- How much do I weigh?
 - Answer can be a real valued number
 - There is no "next" number
 - This would be a float

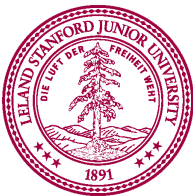


- How many children do I have?
 - Answer is an integer
 - There is a well-defined "next" number
 - This would be an int



Recall, Our Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

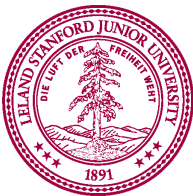


Recall, Our Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

```
This program adds two numbers.
```

- **print** command is displaying a **string**



Recall, Our Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

num1

"9"

```
This program adds two numbers.  
Enter first number: 9
```

- **input** command gives you back a **string**
 - Even if the user types in a number



Recall, Our Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

num1

9

```
This program adds two numbers.  
Enter first number: 9
```

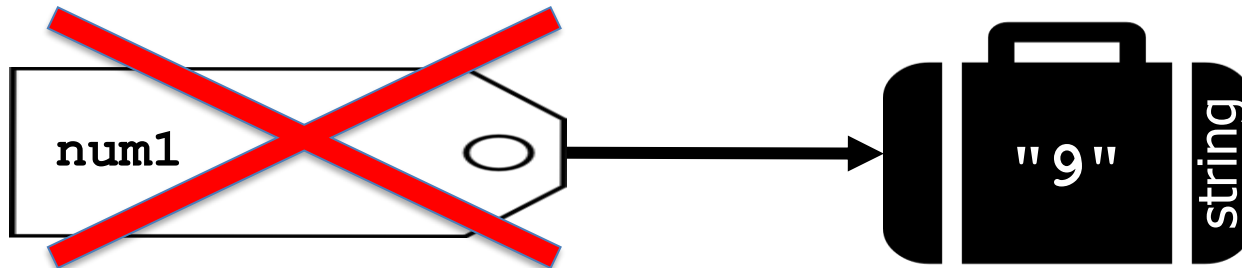
- Create **int** version of **string** and assign it back to **num1**



Show Me The Luggage!

- **input** command gives you back a **string**

```
num1 = input("Enter first number: ")
```

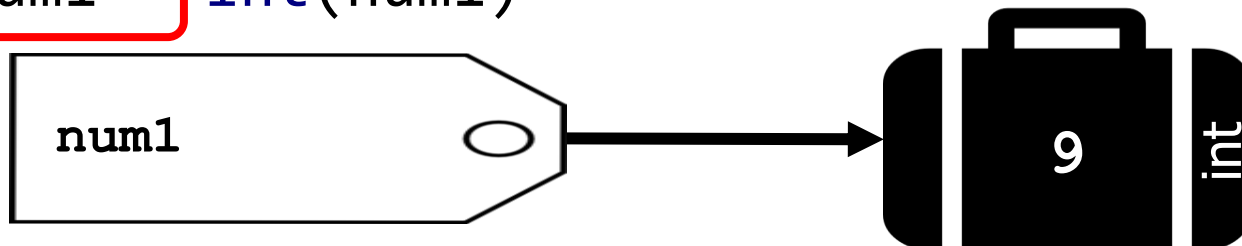


- We create an integer version of **num1**

```
num1 = int(num1)
```

- Create a new suitcase that has **int** version of **num1**
- Then assign the tag **num1** to that piece of luggage

```
num1 = int(num1)
```



Recall, Our Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

num1

9

```
This program adds two numbers.  
Enter first number: 9
```

- Create **int** version of **string** and assign it back to **num1**



Recall, Our Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

num1

9

```
This program adds two numbers.  
Enter first number: 9  
Enter second number:
```



Recall, Our Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

num1

9

num2

"17"

```
This program adds two numbers.  
Enter first number: 9  
Enter second number: 17
```



Recall, Our Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

num1

9

num2

17

```
This program adds two numbers.  
Enter first number: 9  
Enter second number: 17
```



Recall, Our Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

num1

9

num2

17

total

26

```
This program adds two numbers.  
Enter first number: 9  
Enter second number: 17
```



Recall, Our Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

num1

9

num2

17

total

26

```
This program adds two numbers.  
Enter first number: 9  
Enter second number: 17  
The total is 26.
```



What's Going on With `print`

- Adding strings in `print` command?!

```
print("The total is " + str(total) + ".")
```

- The `+` operator concatenates strings together

```
str1 = "hi"
```

```
str2 = " "
```

```
str3 = "there"
```

```
str4 = str1 + str2 + str3
```

- `total` is integer, so we need to create a string version

```
str(total)
```

- String version of `total` is a new value that is concatenated to produce final string that is printed
- Original variable `total` is still an `int`



Recall, Our Program

```
def main():  
    print("This program adds two numbers.")  
    num1 = input("Enter first number: ")  
    num1 = int(num1)  
    num2 = input("Enter second number: ")  
    num2 = int(num2)  
    total = num1 + num2  
    print("The total is " + str(total) + ".")
```

num1

9

num2

17

total

26

```
This program adds two numbers.  
Enter first number: 9  
Enter second number: 17  
The total is 26.
```



Side note about print

- You can **print** numbers by themselves directly
 - Only need to create string version of numbers when printing other text (strings) with them

```
def main():  
    x = 10  
    y = 3.5  
    print(x)  
    print(y)  
    print("x = " + str(x))
```

```
10  
3.5  
x = 10
```



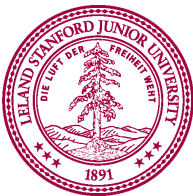
Multiple values in print

- You can also **print** multiple items separating them with commas
 - By default, a space is printed between each item

```
def main():  
    x = 4  
    y = 0.2  
    print(x, y)  
    print("x =", x, "and y =", y)
```

```
4 0.2
```

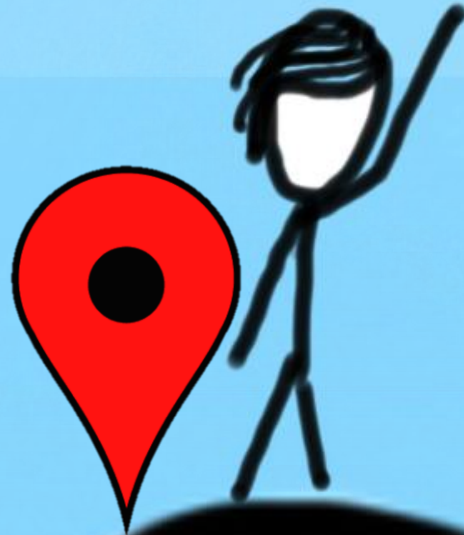
```
x = 4 and y = 0.2
```



You just wrote your first
Python program and learned
about variables!

Today's Goal

1. Introduction to Python
2. Understanding variables



`add2numbers.py`