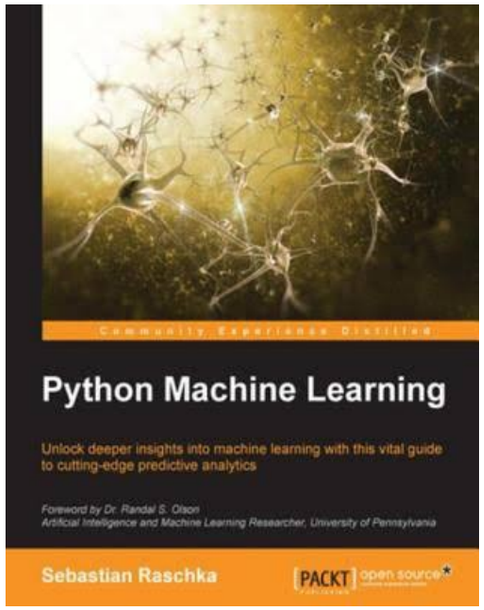
INTRODUCTION TO PYTHON

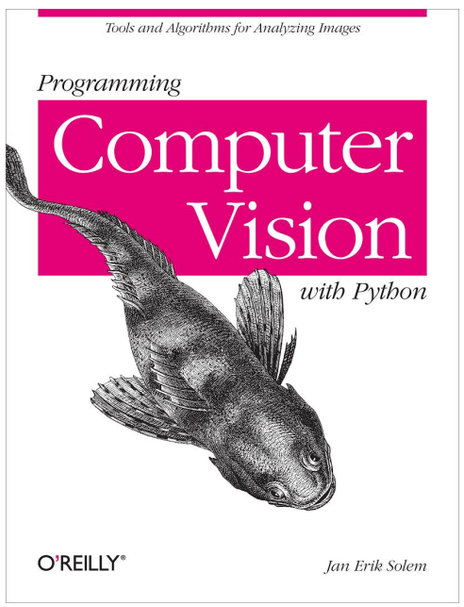
WHY PYTHON

- One of the most popular programming language for data science
  - Many useful add-ons and libraries
- Well supported
  - Large community. Many tutorials on the web
  - Current version is V-3.4 (we will use V-2.7 -more stable-)
  - Multi plateform
- Easy to use and understand the code (interpreted language)
  - Can do many things with few lines of code (pythonic!)
  - Extensions build upon lower layers (Fortran/C) allow fast and vectorized operation

REFERENCES

- Fluent Python
- Data Science from Scratch
- Python Machine learning
- Programming Computer Vision with Python
- https://www.python.org





INSTALLING PYTHON AND PACKAGES

- Python is available for Windows / Mac OS X / Linux
- We will use Python 2.7.
  - If you want to use Python 3.4 ->https://wiki.python.org/moin/Python2orPython3
- Install Anaconda -> https://docs.continuum.io/anaconda/install
  - For Python 2.7 version

comes with many libraries

  - Or you can install Python only -> https://www.python.org
    - To install libraries use *pip* installer program
      - **pip install SomePackage (--upgrade)**

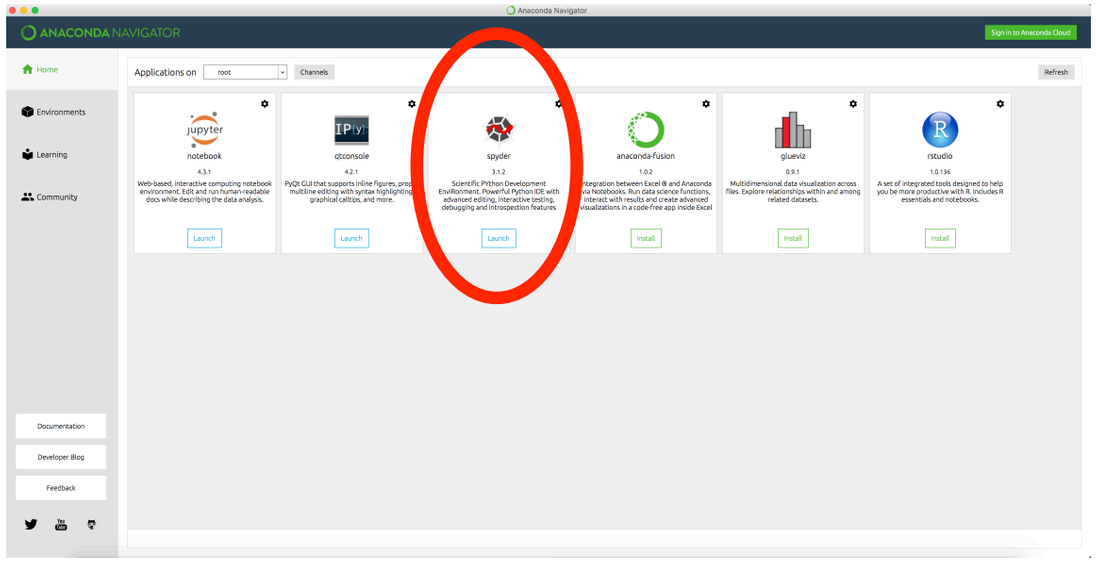
need to install libraries

LIBRARIES OVERVIEW

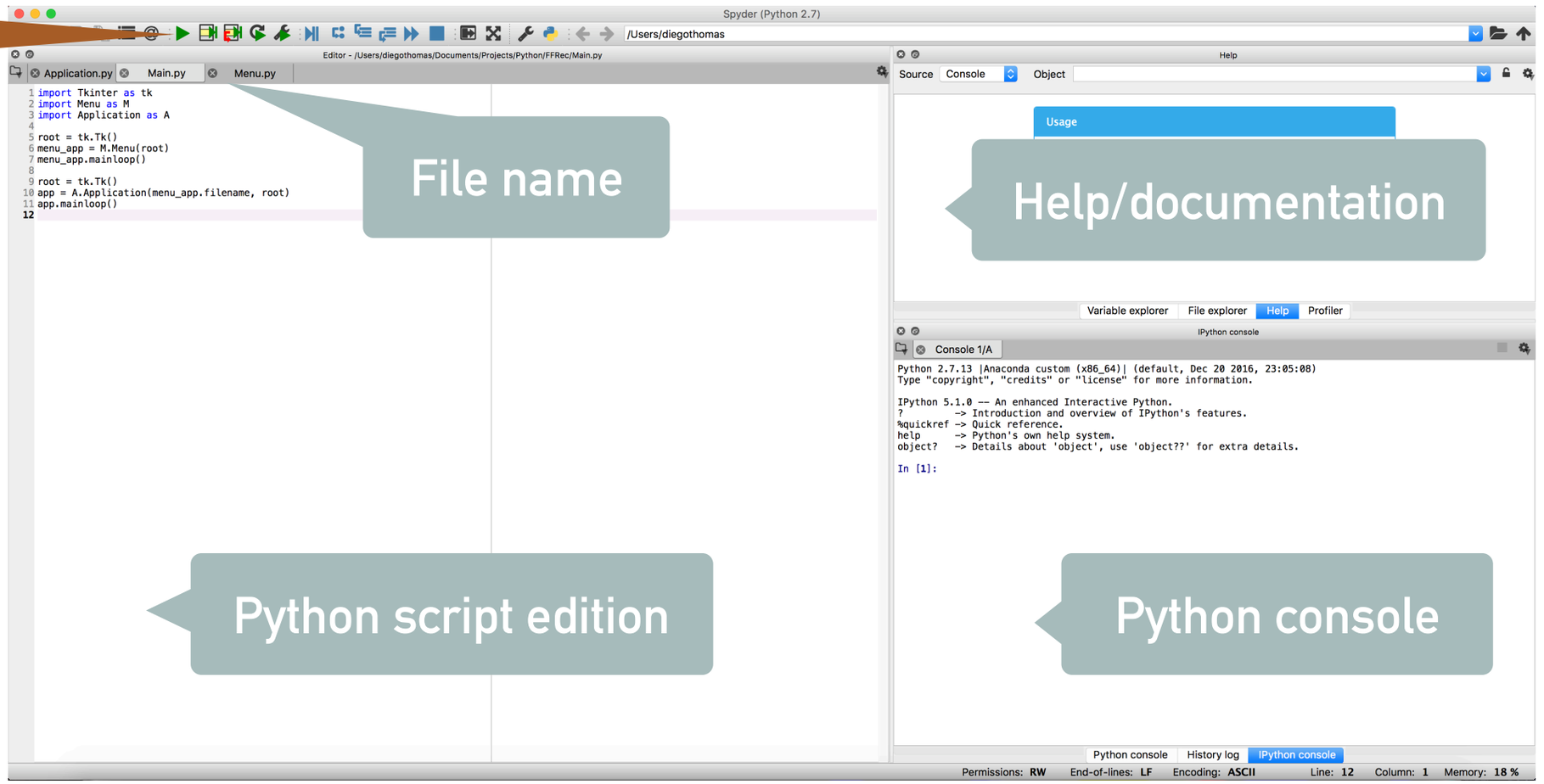
- NumPy
  - Package used for scientific computing with Python.
- Matplotlib
  - Produces high quality figures (plot graph, points, lines, curves, ...).
- Panda
- PIL
  - Python Imaging Library: general image handling and lots of useful basic image operations.
- SciPy
  - Package for mathematics that provides many useful operations.
- OpenCv

CRASH COURSE IN PYTHON (THE BASICS)

- Python is an interpreted language
  - Easy readability
  - Fewer lines of codes
- Open Anaconda Navigator



- Open Spider

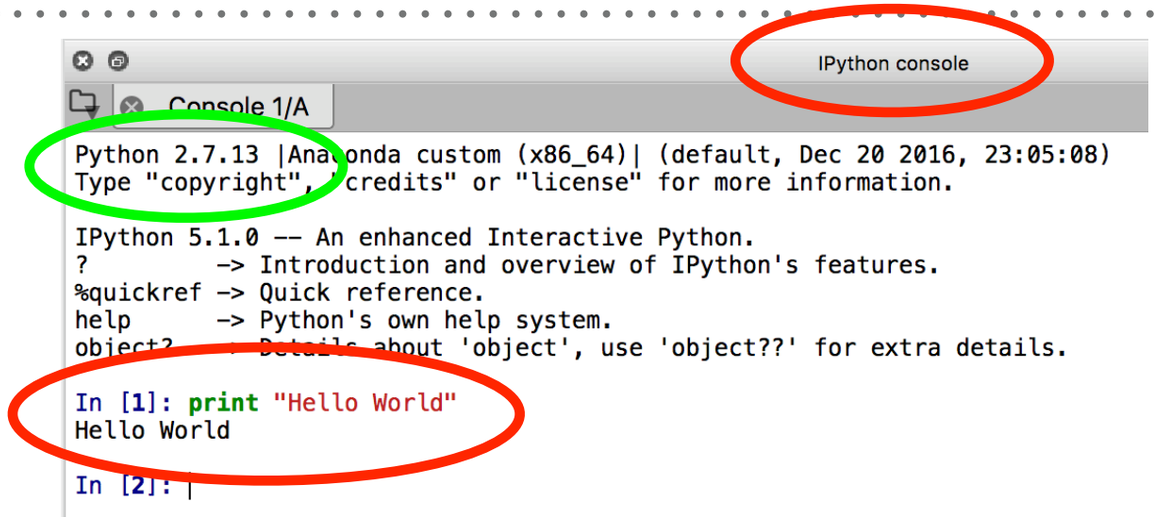


HELLO WORLD

- In Python console type

print “Hello World”

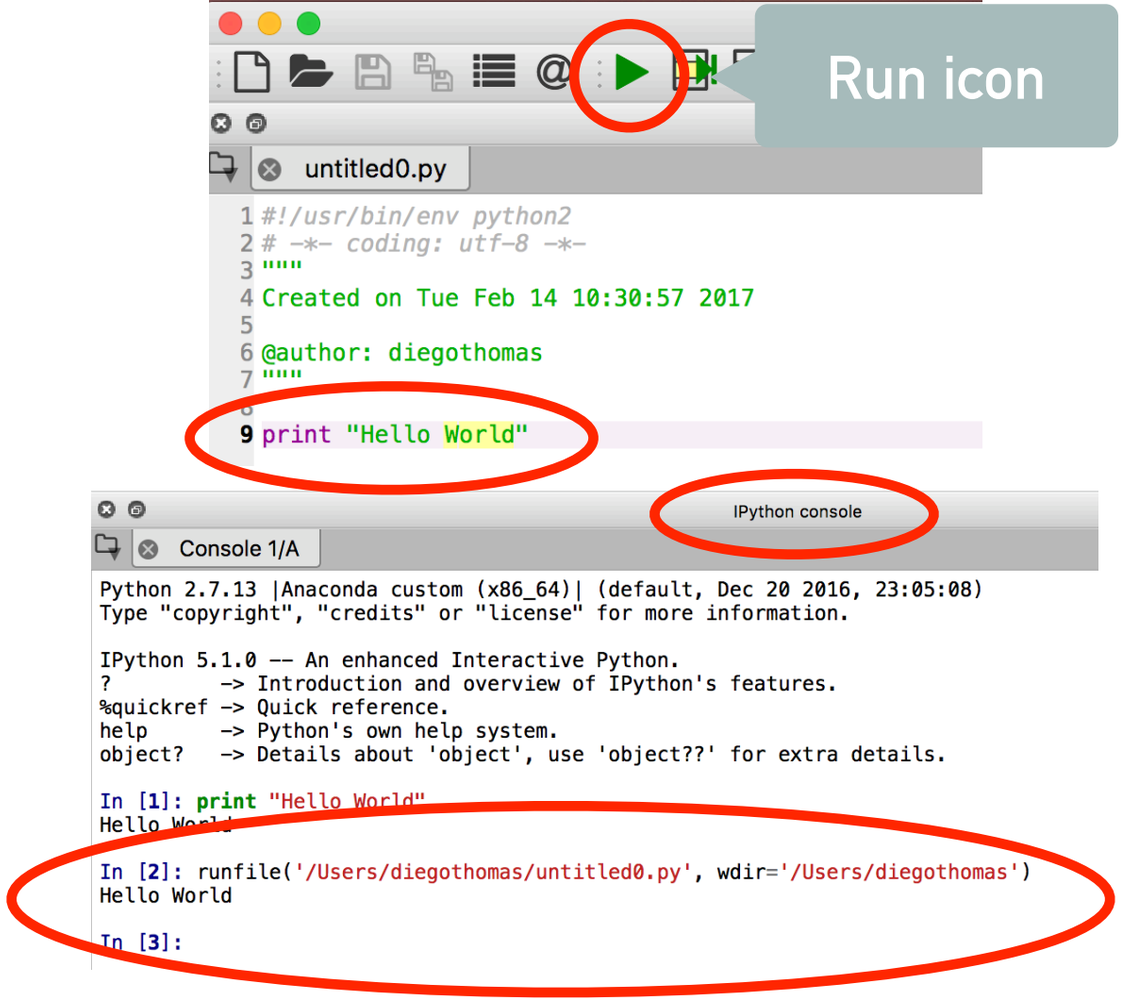
- Press ‘return’ on keyboard



- In the file manager type

print “Hello World”

- Click the ‘Run’ icon (save file)



WHITESPACE FORMATTING

➤ Python uses indentation to delimit blocks of code:

Whitespace is ignored inside parentheses and brackets

```
for i in [1, 2, 3, 4, 5]:
    print i                          #first line in “for i” block
    for j in [1, 2, 3, 4, 5]:
        print j                      #first line in “for j” block
        print i+j                    #last line in “for j” block
    print i                          #last line in “for i” block
print “done looping”
```

➤ Dangerous to copy paste code in the shell !!

```
for i in [1, 2, 3, 4, 5]:

    #notice the blank line
    print i
```

Interpreter thinks that the blank line signals the end of the for loop’s block

This would produce the error: **IdentationError: expected an indented block**

MODULES

- Some features of Python are not loaded by default
  - Need to **import** the modules that contain them

```
import matplotlib.pyplot as plt
plt.plot([1,2,3,4])
plt.ylabel('some numbers')
plt.show()
```

- After the **import**, access the functions from the module by prefixing there with **plt.**.

ARITHMETIC

- Addition

```
a = 1+2
```

- Subtraction

```
a = 2-1
```

- Multiplication

```
a = 2*3
```

- Division
  - Python uses integer division by default:
    - 5/2 equals 2

```
from __future__ import division
```

  - Now 5/2 equals 2.5. For integer division, use 5 // 2 (equals 2)

FUNCTIONS

- A function is a rule for taking zero or more inputs and returning a corresponding output
- Definition:

Name of the function

Magic word that says we are going to create a function

```
def double(x):
```

Input

```
    # Put your comments here (what the function does etc...)
    # For example: this function multiplies its input by 2
    return x*2
```

Magic word that says this is the output

STRINGS

- Array of characters (represent common words)
- Delimited by quotes (have to match)

```
single_quoted_string = ‘data science’
double_quoted_string = “data science”
```

- Backslash for special characters

```
tab_string = “\t” # the tab character
len(tab_string)    # is 1
```

- Use r”” for raw strings (useful for directories)

```
raw_string = r”\t” # represents ‘\’ and ’t’
len(raw_string)     # is 2
```

- For multiline strings, use double or triple quotes

```
multi_line_string = “”” This is the first line.
This is the second line
This is the third line “””
```

LISTS

- Ordered collection. Important data structure!!

```
integer_list = [1, 2, 3]

heterogeneous_list = [“string”, 0.1, true]

list_of_lists = [integer_list, heterogeneous_list, []]

list_length = len(integer_list) # equals 3

list_sum = sum(integer_list)  # equals 6
```

- Access the nth element with brackets

```
X = range (10) # is the list [0, 1, …, 9]

Zero = X[0]     # equals 0

Nine = X[-1]    # the last element

X[0] = -1       # now X equals [-1, 1, 2, …, 9]

one_to_four = X[1:5] # [1, 2, 3, 4]
```

- Check for membership with in

```
1 in [1, 2, 3] # is true

0 in [1, 2, 3] # is false
```

- Other common operations

```
x = [1, 2, 3]

x.extend([4, 5, 6])  # x is [1,2,3,4,5,6]

y = x + [7, 8, 9]      # y is [1,2,3,4,5,6,7,8,9]

x.append(0)          # x is [1,2,3,4,5,6,0]

x, y = [1, 2]         # x is 1 and y is 2

_, y = [1, 2]         # y is 2, don’t care
                      # about the first element
```

TUPLES

- Uses parentheses (or nothing) instead of brackets

```
my_tuple = (1, 2)
other_tuple = 1, 2
```

- Cannot modify a tuple

```
my_tuple[0] = 0 # ERROR!!
```

- Convenient way to return multiple values from functions

```
def sum_and_product(x, y)
  return (x+y), (x*y)
```

DICTIONARIES

- Associate *values* with *keys*. Quickly retrieves *value* corresponding to a given *key*

```
Empty_dict = {}
empty_dic2 = dict()
Grades = {“Joel”: 80, “Tim”: 95}
```

- Lookup for the value for a key using brackets (safer version with **get**)

```
joel_grade = Grades[“Joel”] #equal 80
```

- check for existence using in

```
Joel_has_grade = “Joel” in Grades # True
Kate_has_grade = “Kate” in Grade # False
```

- Assign value with brackets

```
Grades[“Joel”] = 70  # Joel now has a grade of 70
Grades[“Kate”] = 85 # adds a new entry for Kate
```

- Simple way to represent structured data

```
Tweet = {“user”: “Kentaro”,
    “text”: “Data science is Awesome”,
    “retweet count”: 100,
    “hashtag”: [‘#data’, ‘#science’, ‘#datascience’, ‘#Awesome’, ‘#blabla’]
    }
```

- Other functions

```
tweet_keys = Tweet.keys() # list of keys
tweet_values = Tweet.values() # list of values
tweet_items = Tweet.items() # list of (key, value) tuples
```

SETS

- Collection of *distinct* elements

```
s = set()
s.add(1)    # s is now {1}
s.add(2)    # s is now {1, 2}
s.add(2)    # s is still {1, 2}
x = len(s)  # equals 2
```

- **in** is very fast on sets
- Easy to find *distinct* elements in a collection

```
item_list = [1, 2, 3, 1, 2, 3]
num_items = len(item_list)                # equals 6
item_set = set(item_list)                 # equals {1, 2, 3}
num_distinct_items = len(item_set)    # equals 3
distinct_item_list = list(item_set)       # equals [1, 2, 3]
```

CONTROL FLOW

➤ Conditional action using **if**

```
if 1 > 2
   Message = “if only 1 were greater than 2 …”
elif 1 > 3
   Message = “elif stands for else if”
else
   Message = “when all else fails use else”
parity = “even” if  x % 2 == 0 else “odd”
# write on 1 line
```

➤ The **while** loop

```
x = 0
while x < 10:
   print x, “is less than 10”
   x += 1
```

➤ The **for** and **in** loop

```
for x in range(10):
   print x, “is less than 10”
```

➤ The **continue** and **break** command

```
for x in range(10):
   if x == 3
      continue  # go immediately to the next iteration
   if x == 5
      break       # quit the loop entirely
   print x
# this will print 0, 1,  2,  4
```

TRUTHINESS

- Booleans are used to express truthiness

```
one_is_less_than_true = 1 < 2          # equals True

true_equals_false = True == False      # equals False
```

- A non-existent value is identified with None

EXERCISES

- 1. Implement a function that computes the sum of :
  (1 + 2 + 3 + ... + n)
  - Verify for some numbers that:

    Result equals n(n-1) / 2

Hint:
(1) Use the range() function
(2) Use the sum() function

- 2. Implement a function that computes the sum of the n first numbers of the Fibonacci sequence:
  - f(0) = f(1) = 1;
  - f(t+2) = f(t) + f(t+1)