Data Journalism

Jupyter and Python Basics

Angelica Lo Duca
angelica.loduca@iit.cnr.it

Jupyter Basics

extracted from: https://www.dataquest.io/blog/jupyter-notebook-tutorial/

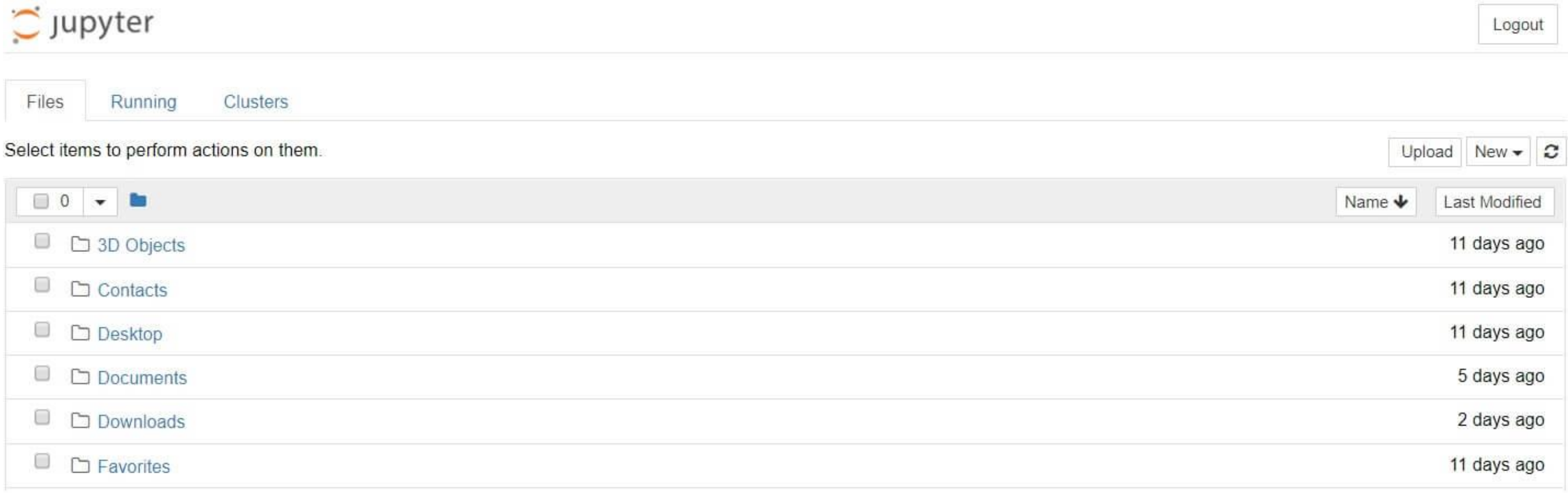
Jupyter Notebook

Notebook documents (or “notebooks”, all lower case) are documents produced by the Jupyter Notebook App, which contain both computer code (e.g. python) and rich text elements (paragraph, equations, figures, links, etc…).

From Jupyter Notebook Beginner Guide

Build the first Notebook

- Run Jupyter by typing on the console: jupyter-notebook or jupyter notebook
- Jupyter Notebook opens in the browser, with the URL like http://localhost:8888/tree
- A dashboard opens



Select items to perform actions on them.

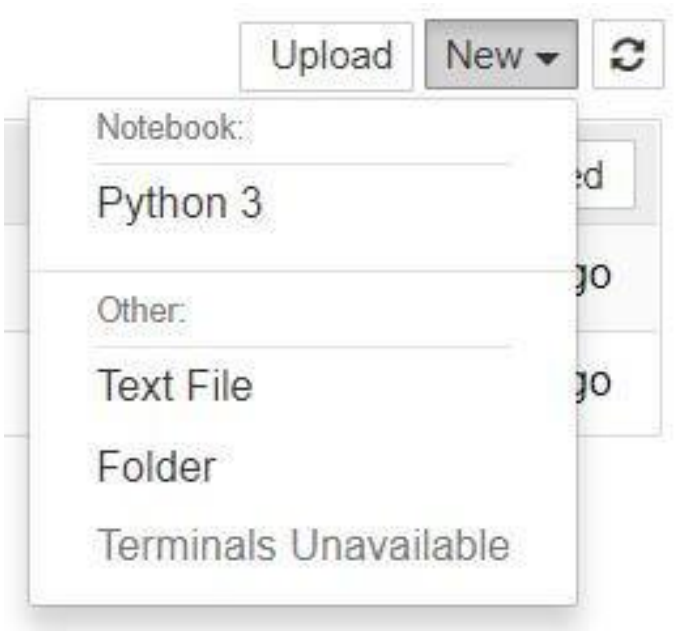
Name	Last Modified
3D Objects	11 days ago
Contacts	11 days ago
Desktop	11 days ago
Documents	5 days ago
Downloads	2 days ago
Favorites	11 days ago

Build the first Notebook

Create the first notebook, click the “New” button in the top-right and select “Python 3”

The notebook opens

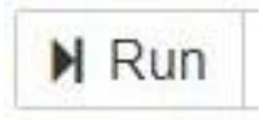
Its name is `Untitled.ipynb`



The Notebook Interface

- A **kernel** is a “computational engine” that executes the code contained in a notebook document.
- A **cell** is a container for text to be displayed in the notebook or code to be executed by the notebook’s kernel.
  - A code cell contains code to be executed in the kernel. When the code is run, the notebook displays the output below the code cell that generated it.
  - A Markdown cell contains text formatted using Markdown and displays its output in-place when the Markdown cell is run.

To run a cell: Ctrl + Enter / Shift + Enter



Commands

- Toggle between edit and command mode with Esc and Enter, respectively.
- Once in command mode:
    - Scroll up and down your cells with your Up and Down keys.
    - Press A or B to insert a new cell above or below the active cell.
    - M will transform the active cell to a Markdown cell.
    - Y will set the active cell to a code cell.
    - D + D (D twice) will delete the active cell.
    - Z will undo cell deletion.
    - Hold Shift and press Up or Down to select multiple cells at once. With multiple cells selected, Shift + M will merge your selection.

Python Basics

extracted from: https://www.csee.umbc.edu/courses/671/fall09/notes/python1.ppt
and https://www.csee.umbc.edu/courses/671/fall09/notes/python2.ppt

Basic Datatypes

- **Integers (default for numbers)**

```
z = 5 / 2  # Answer 2, integer division
```

- **Floats**

```
x = 3.456
```

- **Strings**

```
name = “Angelica”
```

- **Booleans**

```
option = True
option = False
```

Whitespace

- Whitespace is meaningful in Python: especially indentation and placement of newlines
- Use a newline to end a line of code
- Use \ when must go to next line prematurely
- No braces {} to mark blocks of code, use *consistent* indentation instead
    - First line with *less* indentation is outside of the block
    - First line with *more* indentation starts a nested block

Comments

- Start comments with #, rest of line is ignored
- Can include a “documentation string” as the first line of a new function or class you define

```
# this is a comment
```

Assignment

- Basic assignment

```
x = 2
```

- You can assign to multiple names at the same time

```
x, y = 2, 3
```

Accessing Non-Existent Name

Accessing a name before it's been properly created (by placing it on the left side of an assignment), raises an error

```
y

Traceback (most recent call last):
  File "<pyshell#16>", line 1, in -toplevel-
    y
NameError: name ‘y' is not defined
y = 3
y
```

Sequence Types

Sequence Types

1. **Tuple: (‘john’, 32, [CMSC])**
   - A simple *immutable* ordered sequence of items
   - Items can be of mixed types, including collection types
2. **Strings: “John Smith”**
   - *Immutable*
   - Conceptually very much like a tuple
4. **List: [1, 2, ‘john’, (‘up’, ‘down’)]**
   - *Mutable* ordered sequence of items of mixed types

Sequence Types 1

- Define tuples using parentheses and commas

```
tu = (23, ‘abc’, 4.56, (2,3), ‘def’)
```

- Define lists are using square brackets and commas

```
li = [“abc”, 34, 4.34, 23]
```

- Define strings using quotes (“, ‘, or “““).

```
st = “Hello World”
st = ‘Hello World’
st = “““This is a multi-line
string that uses triple quotes.”””
```

Sequence Types 2

- Access individual members of a tuple, list, or string using square bracket "array" notation

```
tu = (23, 'abc', 4.56, (2,3), 'def')
tu[1]     # Second item in the tuple.
   'abc'

li = ["abc", 34, 4.34, 23]
li[1]      # Second item in the list.
   34

st = "Hello World"
st[1]   # Second character in string.
   'e'
```

Positive and negative indices

```
t = (23, 'abc', 4.56, (2,3), 'def')
```

Positive index: count from the left, starting with 0

```
t[1]
    'abc'
```

Negative index: count from right, starting with –1

```
t[-3]
    4.56
```

Slicing: return copy of a subset

```
t = (23, ‘abc’, 4.56, (2,3), ‘def’)
```

Return a copy of the container with a subset of the original members. Start copying at the first index, and stop copying *before* second.

```
t[1:4]
    (‘abc’, 4.56, (2,3))
```

Negative indices count from end

```
t[1:-1]
    (‘abc’, 4.56, (2,3))
```

Slicing: return copy of a =subset

```
t = (23, ‘abc’, 4.56, (2,3), ‘def’)
```

Omit first index to make copy starting from beginning of the container

```
t[:2]
    (23, ‘abc’)
```

Omit second index to make copy starting at first index and going to end

```
t[2:]
    (4.56, (2,3), ‘def’)
```

Copying the Whole Sequence

- [:] makes a *copy* of an entire sequence

```
t[:]
    (23, 'abc', 4.56, (2,3), 'def')
```

The ‘in’ Operator

- Boolean test whether a value is inside a container:

```
t = [1, 2, 4, 5]
3 in t
       False
4 in t
       True
4 not in t
       False
```

- For strings, tests for substrings

```
a = 'abcde'
'c' in a
       True
'cd' in a
       True
'ac' in a
       False
```

The + Operator

The + operator produces a *new* tuple, list, or string whose value is the concatenation of its arguments.

```
(1, 2, 3) + (4, 5, 6)
    (1, 2, 3, 4, 5, 6)

[1, 2, 3] + [4, 5, 6]
    [1, 2, 3, 4, 5, 6]

“Hello” + “ ” + “World”
 ‘Hello World’
```

The * Operator

- The * operator produces a *new* tuple, list, or string that “repeats” the original content.

```
(1, 2, 3) * 3
    (1, 2, 3, 1, 2, 3, 1, 2, 3)

[1, 2, 3] * 3
    [1, 2, 3, 1, 2, 3, 1, 2, 3]

“Hello” * 3
    ‘HelloHelloHello’
```

Operations on Lists Only

```
li = [1, 11, 3, 4, 5]

li.append(‘a’)   # Note the method syntax
li
   [1, 11, 3, 4, 5, ‘a’]

li.insert(2, ‘i’)
li
   [1, 11, ‘i’, 3, 4, 5, ‘a’]
```

Operations on Lists Only

Lists have many methods, including index, count, remove, reverse, sort

```
li = [‘a’, ‘b’, ‘c’, ‘b’]
li.index(‘b’)  # index of 1st occurrence
   1
li.count(‘b’)  # number of occurrences
   2
li.remove(‘b’) # remove 1st occurrence
li
  [‘a’, ‘c’, ‘b’]
```

Operations on Lists Only

```
li = [5, 2, 6, 8]

li.reverse()    # reverse the list *in place*
li
  [8, 6, 2, 5]

li.sort()       # sort the list *in place*
li
  [2, 5, 6, 8]
```

Dictionaries

Dictionaries: A Mapping type

- Dictionaries store a *mapping* between a set of keys and a set of values
  - Keys can be any *immutable* type.
  - Values can be any type
  - A single dictionary can store values of different types
- You can define, modify, view, lookup or delete the key-value pairs in the dictionary
- Python’s dictionaries are also known as *hash tables* and *associative arrays*

Creating & accessing dictionaries

```
d = {'user':'bozo', 'pswd':1234}
d['user']
   'bozo'
d['pswd']
   123
d['bozo']
Traceback (innermost last):
  File '<interactive input>' line 1, in ?
KeyError: bozo
```

Updating Dictionaries

- Assigning to an existing key replaces its value

```
d = {'user':'bozo', 'pswd':1234}
d['user'] = 'clown'
d
    {'user':'clown', 'pswd':1234}
```

- A new key-value pair can be added to the dictionary

```
d['id'] = 45
d
{'user':'clown', 'id':45, 'pswd':1234}
```

- Dictionaries are unordered
  - New entries can appear anywhere in output

Removing dictionary entries

```
d = {‘user’:‘bozo’, ‘p’:1234, ‘i’:34}
del d[‘user’]  # Remove one.
d
    {‘p’:1234, ‘i’:34}
d.clear()        # Remove all.
d
    {}
a=[1,2]
del a[1]         # del works on lists, too
a
    [1]
```

Useful Accessor Methods

```
d = {‘user’:‘bozo’, ‘p’:1234, ‘i’:34}

d.keys()   # List of keys, VERY useful
    [‘user’, ‘p’, ‘i’]

d.values() # List of values
    [‘bozo’, 1234, 34]

d.items()   # List of item tuples
    [(‘user’,‘bozo’), (‘p’,1234), (‘i’,34)]
```

Functions

Defining Functions

Function definition begins with “def.”

Function name and its arguments.

```
def get_final_answer(filename):
    line1
    line2
    return total_counter
```

Colon.

The indentation matters… First line with less indentation is considered to be outside of the function definition.

The keyword ‘return’ indicates the value to be sent back to the caller.

Calling a Function

- The syntax for a function call is:

```
def myfun(x, y):
    return x * y

myfun(3, 4)
     12
```

Default Values for Arguments

- You can provide default values for a function’s arguments
- These arguments are optional when the function is called

```
def myfun(b, c=3, d=“hello”):
            return b + c
myfun(5,3,”hello”)
myfun(5,3)
myfun(5)
```

All of the above function calls return 8

Keyword Arguments

- You can call a function with some or all of its arguments out of order as long as you specify their names
- You can also just use keywords for a final subset of the arguments.

```
def myfun(a, b, c):
    return a-b

myfun(2, 1, 43)
  1
myfun(c=43, b=1, a=2)
  1
myfun(2, c=43, b=1)
  1
```

Lambda Notation

- Python uses a lambda notation to create anonymous functions

```
applier(lambda z: z * 4, 7)
  28
```

- Python supports functional programming idioms, including closures and continuations

Control of Flow

if Statements

```
if x == 3:
    print “X equals 3.”
elif x == 2:
    print “X equals 2.”
else:
    print “X equals something else.”
print “This is outside the ‘if’.”
```

Be careful! The keyword *if* is also used in the syntax of filtered *list comprehensions*. Note:

- Use of indentation for blocks
- Colon (*:*) after boolean expression

while Loops

```
x = 3
while x < 5:
    print x, "still in the loop"
    x = x + 1
```

```
3 still in the loop
4 still in the loop
```

```
x = 6
while x < 5:
    print x, "still in the loop"
```

break and continue

- You can use the keyword *break* inside a loop to leave the *while* loop entirely.

- You can use the keyword *continue* inside a loop to stop processing the current iteration of the loop and to immediately go on to the next one.

assert

- An *assert* statement will check to make sure that something is true during the course of a program.
  - If the condition if false, the program stops
    — (more accurately: the program throws an exception)

```
assert(number_of_players < 5)
```

For Loops 1

- A for-loop steps through each of the items in a collection type, or any other type of object which is “iterable”

```
for <item> in <collection>:
  <statements>
```

- If <collection> is a list or a tuple, then the loop steps through each element of the sequence
- If <collection> is a string, then the loop steps through each character of the string

```
for someChar in “Hello World”:
   print someChar
```

For Loops 2

```
for <item> in <collection>:
  <statements>
```

- <item> can be more than a single variable name
- When the <collection> elements are themselves sequences, then <item> can match the structure of the elements.
- This multiple assignment can make it easier to access the individual parts of each element

```
for (x,y) in [(a,1),(b,2),(c,3),(d,4)]:
  print x
```

For loops & the range() function

- Since a variable often ranges over some sequence of numbers, the *range()* function returns a list of numbers from 0 up to but not including the number we pass to it.
- range(5) returns [0,1,2,3,4]
- So we could say:

```
for x in range(5):
    print x
```

- (There are more complex forms of *range()* that provide richer functionality…)

For Loops and Dictionaries

```
ages = { "Sam" : 4, "Mary" : 3, "Bill" : 2 }
ages
```

```
{'Bill': 2, 'Mary': 3, 'Sam': 4}
```

```
for name in ages.keys():
    print name, ages[name]
```

```
Bill 2
Mary 3
Sam 4
```