LABORATORY OF DATA SCIENCE

Python recap

Python

Python is a

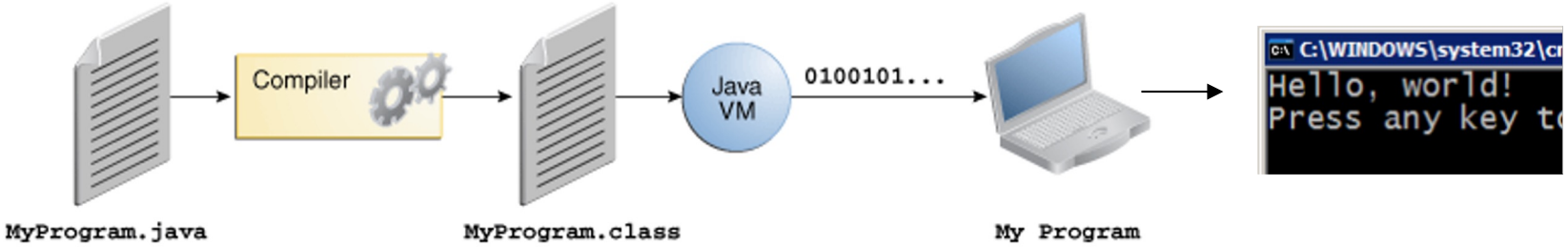
- High-level
- Interpreted (Interpreters for many OS)
- Dynamically Typed
  - Verification of the type safety of a program at runtime
- Object oriented
- Cross-Platform
- Multi-purpose (WEB, GUI, Scripting)

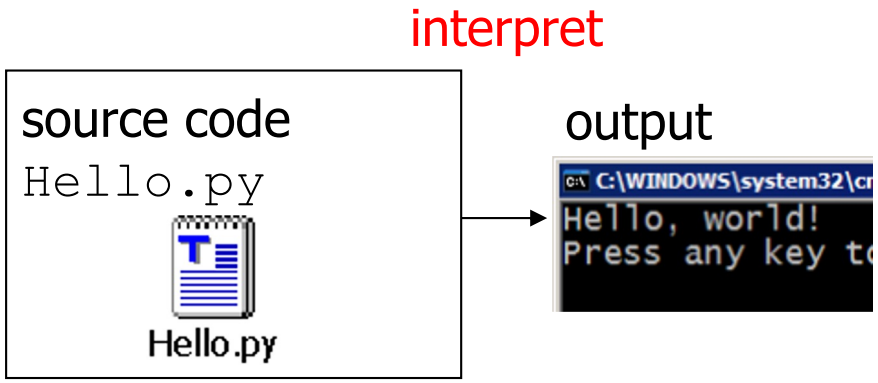
computer programming language

https://www.python.org/

Compiling and interpreting

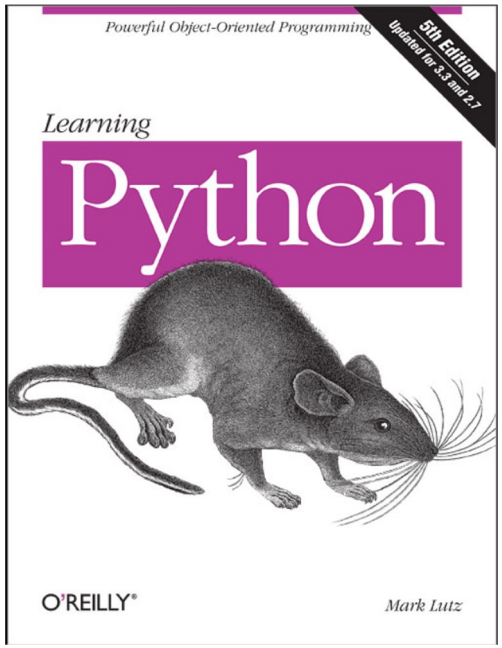
Many languages require you to *compile* (translate) your program into a form that the machine understands.



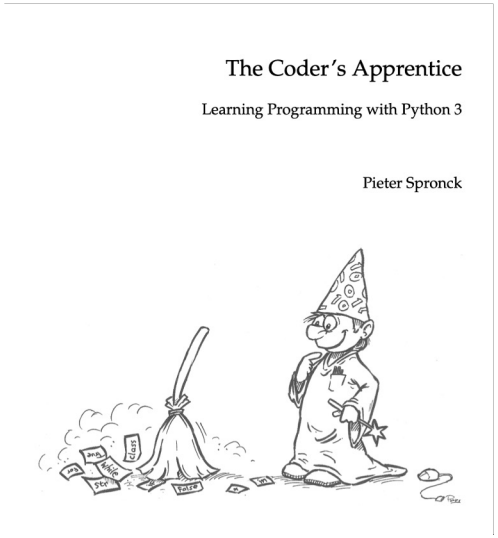


Python is instead directly *interpreted* into machine instructions.

Python language: books



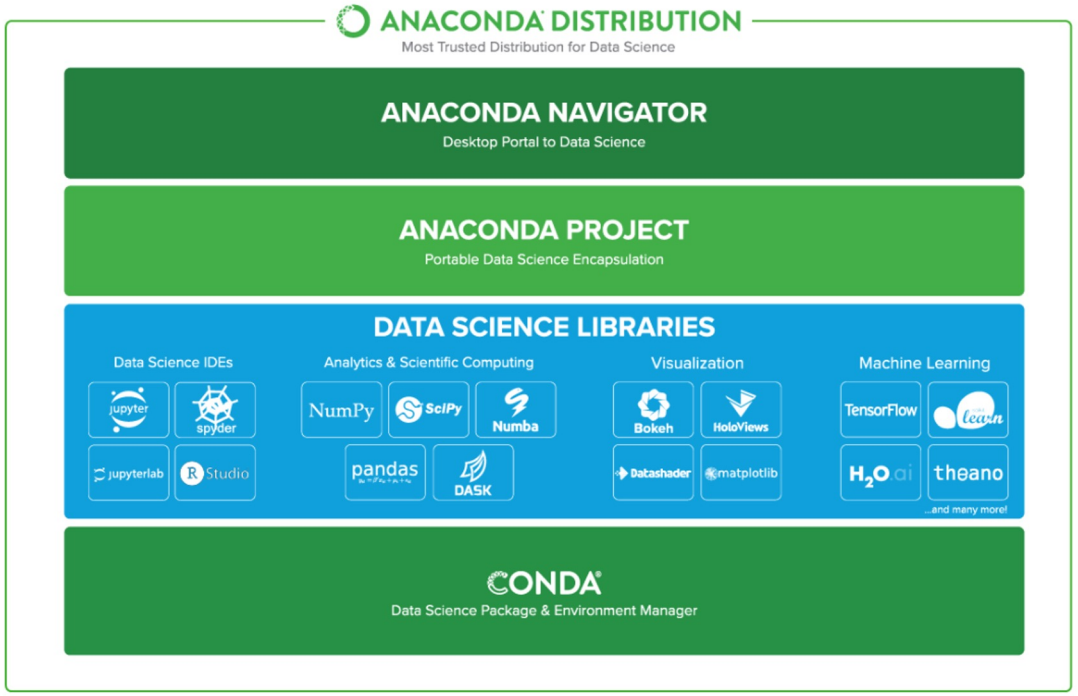
http://www.spronck.net/pythonbook/



Anaconda - www.anaconda.com

Manage your DS packages, **dependencies,** and environments

Develop DS projects using Jupyter, JupyterLab, Spyder…



Automatically manages all packages, including cross-language **dependencies**

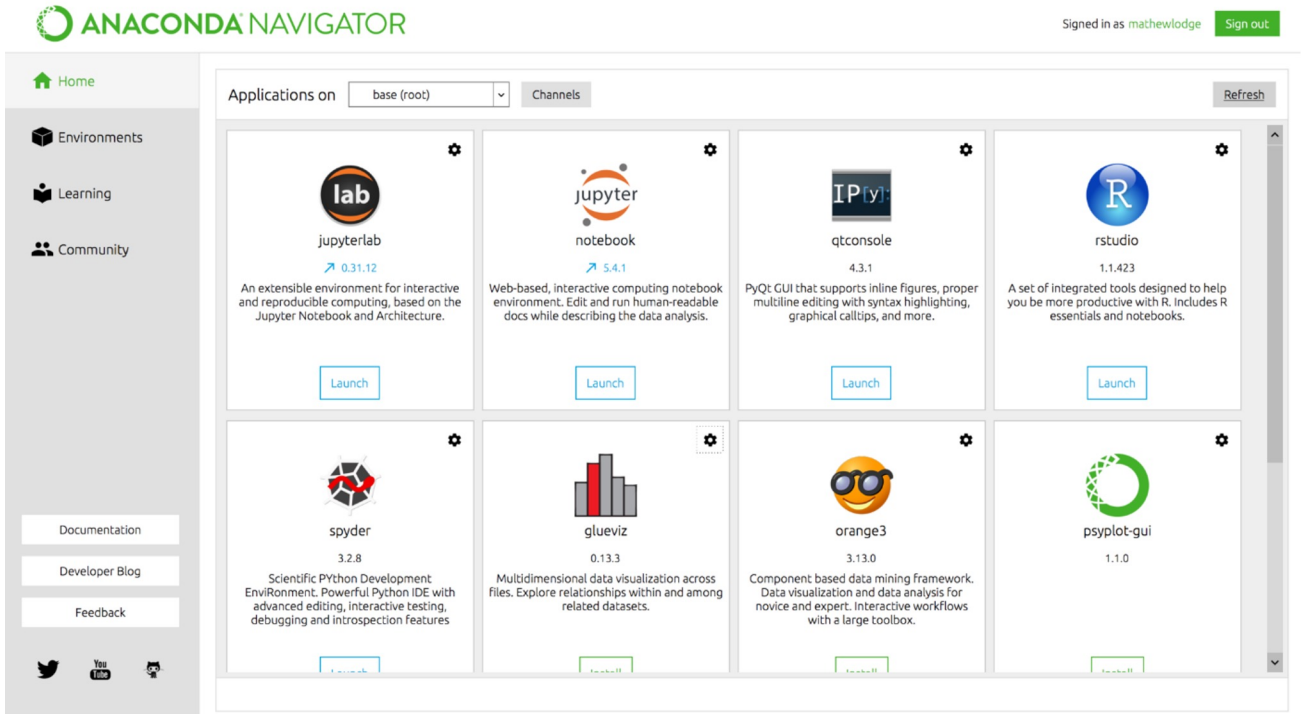
Works across all platforms: Linux, macOS, Windows

Anaconda Navigator

Desktop Portal to Data Science

Install and launch applications and editors including Jupyter, RStudio, Visual Studio Code, Spyder…

Manage your local environments and data science projects from a graphical interface



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Python Recap

Indentation


```
/* Bogus C code */
if (foo) {
    if (bar) {
        baz(foo, bar);
}
else {
    qux();
}}
```

```
# Python code
if foo:
    if bar:
        baz(foo, bar)
    else:
        qux()
```

Numbers


```
# Integers Numbers
year = 2010
year = int("2010")

# Floating Point Numbers
pi = 3.14159265
pi = float("3.14159265")

# Fixed Point Numbers
from decimal import Decimal
price = Decimal("0.02")
```

Arithmetic


```
a = 10          # 10
a += 1          # 11
a -= 1          # 10

b = a + 1       # 11
c = a - 1       # 9

d = a * 2       # 20
e = a / 2       # 5
f = a % 3       # 1
g = a ** 2      # 100
```

Strings


```
#This is a string
name = 'Anna Monreale (that\'s not me)'

#This is also a string
city = "Pisa"

#This is a multi-line string
office = """My office is at the department
of Computer Science, University of Pisa"""

#This is also a multi-line string
other = '''My office hours is on Tuesday in the
afternoon, however, it is always better to take
an appointment'''
```

String manipulation


```
animals = "Cats, " + "Dogs, "
animals += "Rabbits"
# Cats, Dogs, Rabbits

fruits = ', '.join(['Apples', 'Bananas', 'Oranges'])
# Apples, Bananas, Oranges

end_of_the_world = "%s %d %d" % ('Dec', 21, 2012)
# Dec 21 2012

#This is also  a multi-line string
other = f"On {end_of_the_world} I ate {fruits}"
# On Dec 21 2012 I ate some apples, bananas, oranges
```

Lists


```
# Lists can be heterogeneous
favorites = []

# Appending
favorites.append(42)

# Extending
favorites.extend(["Python", True])

# Equivalent to
favorites = [42, "Python", True]
```

Lists


```
numbers = [1, 2, 3, 4, 5]

len(numbers)
# 5

numbers[0]
# 1

numbers[0:2]
# [1, 2]

numbers[2:]
# [3, 4, 5]
```

Dictionary


```
person = {}

# Set by key / Get by key
person['name'] = 'Nowell Strite'

# Update
person.update({
    'favorites': [42, 'food'],
    'gender': 'male',
    })

# Any immutable object can be a dictionary key
person[42] = 'favorite number'
person[(44.47, -73.21)] = 'coordinates'
```

Dictionary


```
person = {'name': 'Nowell', 'gender': 'Male'}

person['name']
person.get('name', 'Anonymous')
# 'Nowell Strite'

person.keys()
# ['name', 'gender']

person.values()
# ['Nowell', 'Male']

person.items()
# [['name', 'Nowell'], ['gender', 'Male']]
```

Set


```
set_a = {1, 2, 3, 4}
set_b = {3, 4, 5}

set_a.union(set_b) # set_a | set_b
# {1, 2, 3, 4, 5}

set_a.intersection(set_b) # set_a & set_b
# {2, 4}

set_a.difference(set_b) # set_a - set_b
# {1, 2}

set_a.pop()
# 1
set_a
# {2, 3, 4}
```

Additional built-in Functions


```
a = {4, 3, 2, 1, 0}

sorted(a)
# [0, 1, 2, 3, 4]

min(a) # max
# 0

len(a)
# 5

sum(a)
# 10


# And more...
```

If-then-else


```
grade = 82
if grade >= 90:
    if grade == 100:
        print 'A+'
    else:
        print "A"
elif grade >= 80:
    print "B"
elif grade >= 70:
    print "C"
else:
    print "F"

# B
```

For Loop


```
for x in range(10): #0-9
    print( x )
```

```
fruits = ['Apple', 'Orange']

for fruit in fruits:
    print( fruit)
```

```
states = {
    'VT': 'Vermont',
    'ME': 'Maine',
    }

for key, value in states.items():
    print('%s: %s' % (key, value))
```

Function Definition


```
def my_function():
    """Function Documentation"""
    print("Hello World")
```

```
# Positional
def add(x, y):
    return x + y

# Keyword
def shout(phrase='Yipee!'):
    print( phrase)

# Positional + Keyword
def echo(text, prefix=''):
    print ('%s%s' % (prefix, text)
           )
```

Exercise: maximal subsequence

Given an array of integers, e.g.

- a = [-2, 1, -3, 4, -1, 2, 1, -5, 4]

And a function S to compute the sum from h to k,

$$S(a, h, k) = \sum_{i=h}^{k} a[i]$$

Find the values of h and k such that S maximizes ($S(3, 6) = 6$)

Variant:

- Use `a = generate_large_array()` (import the function from the provided `supplementary_code.py`) and make the code run in less then 1s

Exercise: lists and dictionaries

Given the list: l = [12, 3, -4, 6, -5, 9]

Given the dictionary:

d = {'apple': 3, 'orange': 4, 'tomato': -5, 'meat': 6, 'potato': 15, 'strawberry': 9}

If a value in the dictionary is found in the list, add the corresponding key to a string named 'to_buy' and print it at the end.

If a value in the dictionary is not found in the list, chose a random value from the list, that is not present in the dictionary, and assign it to the corresponding key. Print the updated dictionary at the end.

Exercise: lists

Given 2 lists:

a = [12, 3, 4, 6, 5, 9]

b = [10, 3, 2, 6, 3, 7]

Compute the Pearson's correlation.

Exercise: for loops

Import and run `generate_order` and `get_menu` from `sushi_rest.py`

`Generate_order` return the list of all the plates in a order

`Get_menu` return a dictionaty with `<plate_name, price>`

Answer the following questions:

How many plates are in the order?

How many unique plates are in the order?

For each plate in the menu, find if it is in the order

Create a dictionary that counts how often each plate from the menu appears in the order.

Add to the previous dictionary all menu plates, even if they don't appear in the order.

Exercise: for loops (with constraints)

Import and run `generate_order` and `get_menu` from `sushi_rest.py`

`Generate_order` return the list of all the plates in a order

`Get_menu` return a dictionaty with `<plate_name, price>`

Answer the following questions:

How many plates are in the order? Max 1 instruction

How many unique plates are in the order? Max 2 instruction

For each plate in the menu, find if it is in the order

Less then len(menu)*len(order) iterations

Create a dictionary that counts how often each plate from the menu appears in the order. len(order) iterations

Add to the previous dictionary all menu plates, even if they don't appear in the order. Use the for loop to add elements to the dictionary ONLY. Max 1 for loop

Import packages


```
# Renaming imports
from datetime import date
from my_module import date as my_date

# This is usually considered a big No-No
from datetime import *
```

Kinds of Imports


```
└── project
    ├── package1
    │   ├── module1.py
    │   └── module2.py
    └── package2
        ├── __init__.py
        ├── module3.py
        ├── module4.py
        └── subpackage1
            └── module5.py
```

Absolute

```python
from package1 import module1
from package1.module2 import function1
from package2 import class1
from package2.subpackage1.module5 import function2
```

Relative

```python
# package1/module1.py
from .module2 import function1

# package2/module3.py
from . import class1
from .subpackage1.module5 import function2
```

Error Handling


```
import datetime
import random

day = random.choice(['Eleventh', 11])
try:
    date = 'September ' + day
except TypeError:
    date = datetime.date(2010, 9, day)
else:
    date += ' 2010'
finally:
    print( date)
```

Reference Semantics

Assignment manipulates references

- x = y **does not make a copy** of y
- x = y makes x **reference** the object y references

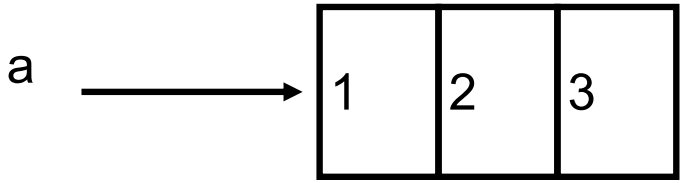
Very useful; but beware!

Example:

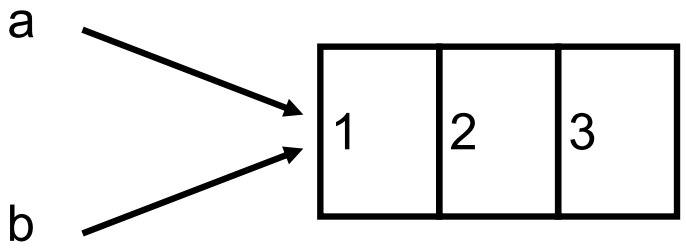
```
>>> a = [1, 2, 3]
>>> b = a
>>> a.append(4)
>>> print b
[1, 2, 3, 4]
```

Changing a Shared List

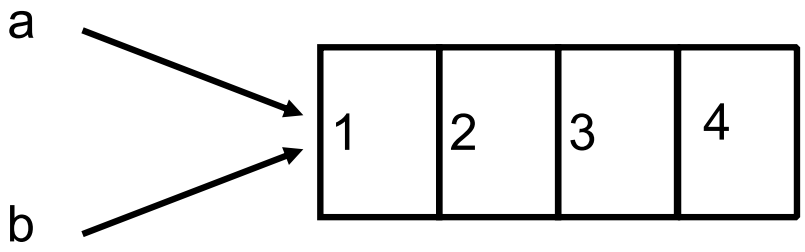
a = [1, 2, 3]



b = a



a.append(4)



Changing an Integer

a = 1

b = a

a = a+1