

Data Science tools in Python

Inteligencia Artificial en los Sistemas de Control Autónomo
Máster Universitario en Ingeniería Industrial

Departamento de Automática

Objectives

1. Introduce Data Science
2. Setup a Data Science development environment
3. iPython basic commands

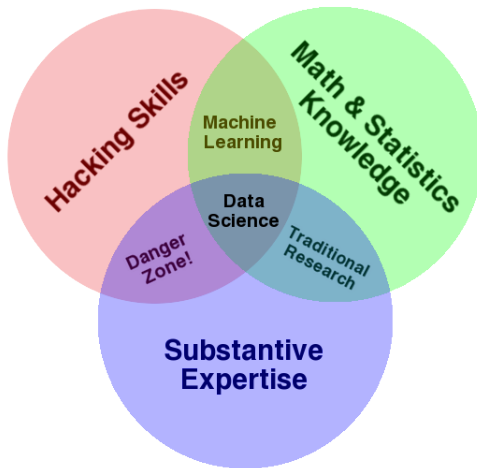
Bibliography

Jake VanderPlas. Python Data Science Handbook. Chapter 1. O'Reilly. [\(Link\)](#).

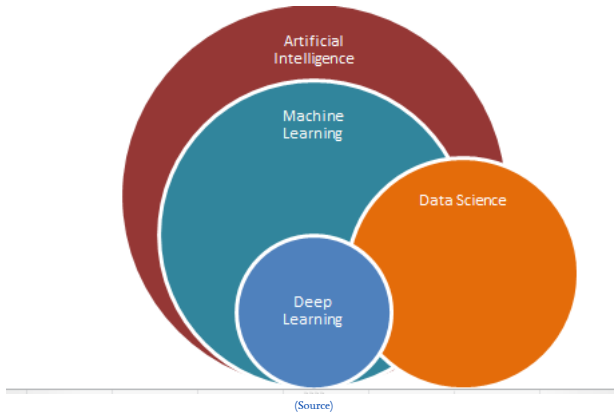
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Overview (I)



Overview (II)



The data scientist toolkit

Motivation

Data science is about manipulating data

- Need of specialized tools
- Two main languages: R and Python

Python is a general purpose programming language

- Easy integration
- Huge ecosystem of packages and tools

Need of data-oriented tools

- Features provided by third-party tools

The data scientist toolkit

Overview

Tool	Type	Description
conda	Software	Python environments and package management
iPython	Software	Advanced Python interpreter
Jupyter	Software	Python notebooks (Python interpreter)
Numpy	Package	Efficient array operations
Pandas	Package	Dataframe support
Matplotlib	Package	Data visualization
Seaborn	Package	Data visualization with dataframes
Scikit-learn	Package	AI/ML package for Python

The data scientist toolkit

Anaconda

Most of those tools are packaged in *Anaconda*

- Python distribution for Data Science
- Environment management for Python
- Package management system

Anaconda provides *conda*

- Packages management tool
- Environment management for Python

In addition, Anaconda provides *Spyder*

- Python IDE designed for Data Science



The data scientist toolkit

Conda crush introduction

Conda environment for Data Science

1. `conda create --name ml seaborn=0.9.0`
2. `source activate ml`
3. `conda install ipython`
4. `conda install nb_conda`

List environments:

```
conda info --envs
```

Activate environment:

```
source activate <env>
```

Install package:

```
conda install <package>
```

List packages:

```
conda list
```

Exit environment (Linux):

```
deactivate
```

The data scientist toolkit

Python IDEs for Data Science (I)

iPython

iPython = Interactive Python

- Extended functionality
- Enhanced UI
- External editor

Running iPython:
\$ ipython

Jupyter

Python notebooks

- Web-based IDE
- Documentation
- Integration with GitHub
- Uses iPython

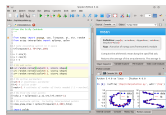
Running Jupyter:
\$ jupyter notebook



Spyder

Matlab-like IDE

- Default IDE in Anaconda
- Uses iPython



Rodeo

Python version of RStudio

- Good for R developers
- Not included in Anaconda
- Uses iPython



The data scientist toolkit

Python IDEs for Data Science (II)

Exercises

Write a Python script that shows the multiplication table of the number 5. Write the script using each one of the following environments:

1. iPython + text editor of your choice.
2. Jupyter.
 - Bonus track: Publish the notebook in GitHub.
3. Spyder.
4. Rodeo (optional).

iPython

Basics (I)

In regular Python ...

- most objects come with a docstring attribute
- docstring accesible thorough `help()`

iPython provides ``?'`, a shortcut to `help()`

- `len?`, `list?`, `list.append?`
- Try to type just ``?'`

Easy access to source code with ``??'`

- Does not work with most builtin functions!

iPython

Basics (II)

Press <tab> to complete almost everything

- Object contents

```
In [21]: a = [1,2,1]
In [22]: a.
a.append  a.count  a.insert  a.reverse
a.clear   a.extend  a.pop     a.sort
a.copy    a.index   a.remove
```

- Packages

```
In [26]: import num
numba      numpy
numbers    numpydoc
numexpr
```

- Wildcards

```
In [29]: *Warning?
%%!
ArithmeticError      BaseException
AssertionError        BlockingIOError
AttributeError         BrokenPipeError
BufferError
```

iPython

Keyboard shortcuts

Navigation

KEYSTROKE	ACTION
Ctrl-a	Move cursor to the beginning of the line
Ctrl-e	Move cursor to the end of the line
Ctrl-b	Move cursor back one character
Ctrl-f	Move cursor forward one character

History

KEYSTROKE	ACTION
Ctrl-p (↑)	Previous command
Ctrl-n (↓)	Next command
Ctrl-r	Reverse-search

Text entry

KEYSTROKE	ACTION
Ctrl-d	Delete next character in line
Ctrl-k	Cut text from cursor to end of line
Ctrl-u	Cut text from beginning of line to cursor
Ctrl-y	Yank (paste) previously cut text

iPython

Magic commands

Magic commands: iPython extension of Python syntax

- Not valid in regular Python
- Provides handy features
- Widely used in DS and ML

Two flavours

- % prefix: Line magics - single line
- %% prefix: Cell magics - several lines

Help available

- %magic: Magic commands
- %lsmagic: List of magic commands

iPython

Pasting code blocks: %paste and %cpaste

Pasting code in Python is troublesome

- %paste: Paste one time
- %%cpaste: Paste several times

%paste

```
In [20]: %paste
def donothing(x):
    return x

## -- End pasted text --
```

```
def donothing(x):
    return x
```

%cpaste

```
In [25]: %cpaste
Pasting code; enter '--' alone on the line
to stop or use Ctrl-D.
:         def donothing(x):
           return x:
:--
```


iPython

Running external code: %run and %timeit

%run: Execute script

- Many optional arguments
- Checkout %run?

```
In [40]: %run donothing.py
```

```
In [41]: donothing(10)
```

```
Out[41]: 10
```

%timeit: Computes execution time

- Executes a single line
- Automatic adjustment of runs
- Shows basic statistics

```
In [33]: %timeit [n ** 2 for n in range(200)]  
71.6 µs ± 1.84 µs per loop  
(mean ± std. dev. of 7 runs, 10000 loops each)
```

```
In [34]: %timeit [n ** 2 for n in range(2000)]  
753 µs ± 16.2 µs per loop  
(mean ± std. dev. of 7 runs, 1000 loops each)
```

%%timeit: Several lines

iPython

Input and output history (I)

iPython stores its history as objects

- **In:** Input commands
 - List storing commands
- **Out:** Commands output
 - Dictionary storing outputs
 - Not all commands have outputs

```
In [1]: import math
In [2]: math.sin(2)
Out[2]: 0.9092974268256817
In [3]: math.cos(2)
Out[3]: -0.4161468365471424
In [4]: Out[2]** 2 + Out[3]** 2
Out[4]: 1.0
```

iPython

Input and output history (II)

Fast access to history: Underscore (`_`)

- Variable containing the last output
- Example: `print(_)`

Double and triple underscores

- Example: `print(__)`
- Example: `print(___)`

Trick: Shortcut to access (`_n`)

- `Out[n] = _n`, with `n=number`
- Example: `print(_2)`

Magic command to show history

- `%history`

Supressing command output (`;`)

- Example: `4 * 2;`

iPython

iPython shell commands

iPython provides easy interaction with the shell

- Execution of shell commands from iPython
- Use prefix `!`
- Example: `!ls`, `!pwd`

Save shell output in Python variables

- Example: `files = !ls`

Use Python variables in shell

- Example: `!echo {files}`

iPython

Automagic

Problems with some shell
commands

```
In [23]: !pwd
/repositorios/pythonCourse
In [24]: !cd ..
In [25]: !pwd
/repositorios/pythonCourse
```

Some magic commands here to
help

- %cd, %ls, %mkdir, %pwd,
...

Those magics are regularly used ...

- ... so common that % is no longer required (automagic)
- Working with iPython is almost like working with a Unix-like shell

Automagic commands

cat, cp, env, ls, man, mkdir, more,
mb, pwd, rm and rmdir