Python: powerful interpreted language

- “All is object”
  modules/functions/types are objects
- Automatic memory management

- Running ~ on Linux, Windows, Mac
- Free GPL licence
- ~IDL & Matlab
- Better than IDL for IDL tasks and much
  easier than compiled language.
- Optimal learning curve: fast to start without
  compromise on advanced functionalities.
- Based on C codes for vector operations (~as fast as C): if well written
  a program is almost as fast as its equivalent in C
- Very easy C, C++, Fortran extension or inline acceleration
  for time-consuming loops
- Rely on robusts and famous C libraries
  for CPU consuming routines:
  FFTW, Lapack & BLAS (ATLAS), etc.
- Straightforward to install and configure on .deb
  linux distributions (debian, ubuntu, etc.)

Scientifical data analysis

- iPython
- Scipy/numpy
- pylab/matplotlib
- pyfits

Powerful interpreter

shell command, history,
log, help function,
command completion, etc.

N-dimension array & Scientifical functions

fast array operation (matrix, vector, 3D arrays),
resizing, reshaping, minimum, maximum, etc. &
many modules for scientifical calculation: FFT,
linear algebra, statistics, integration, derivation,
interpolation, fitting, etc.

FITS I/O

fast and easy (but complete) reading and
writing to fits format

Quality plotting module

plotting curves, surfaces, histograms, etc.
Color, transparency, easy labeling, insertion of LATEX
mathematical formulas, many output: PS, X, etc.

Other useful libraries

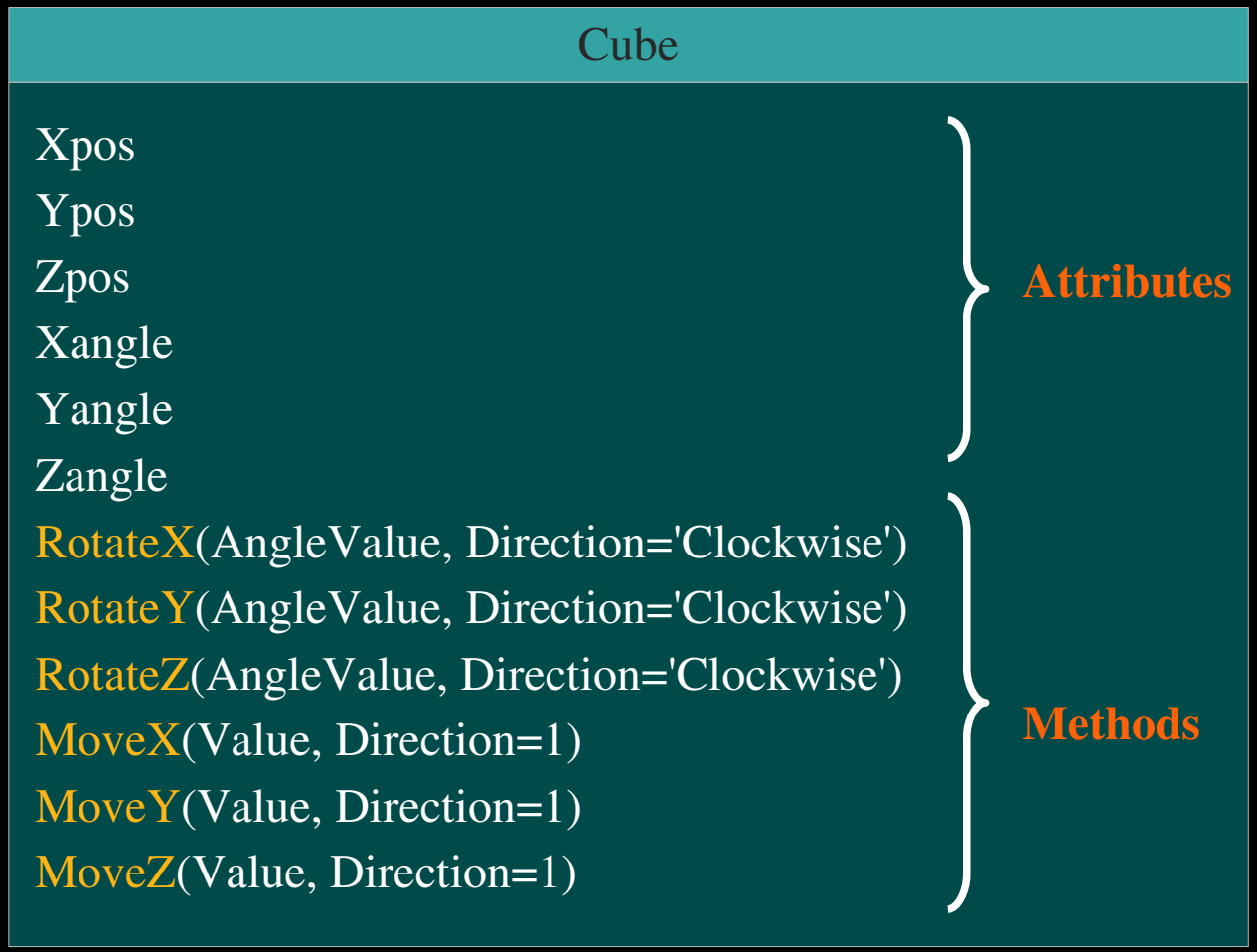
- scipy (numpy): scientifical analysis
- matplotlib (pylab): complete quality ploting tools
- pyfits: FITS io

- mayavi: very powerful 3d ploting (VTK)
- pytable: HDF5 i/o
- pyraf: IRAF binding
- mdp: signal & image processing (ICA, PCA, etc.)
- fann, bpnn: neural networks
- PIL: image manipulation
- PyWavelets: 1d and 2d wavelets transform

... many (many) other dedicated libraries available on the net

In practice 0: very basics

- Object programming




```
# Loading the module object3d.py
# where the class Cube is defined
import object3d
# Creating a copy of the object
C = object3d.Cube()
# Modifying an attribute
C.Xpos=2.0
# Accessing attributes
print C.Xpos
:: 2.0
# Calling a method
C.MoveX(5.0, Direction=-1)
print C.Xpos
:: -3.0
```

- Starting python interpreter
- loading modules

In practice 1: python/ipython basics

- ipython completion and help system
- Calculator

  float/int distinction, ipython useful command
- Strings
- Lists/tuple

  creating, iterating, etc.
- Dictionary
- ASCII i/o

  input, output
- Pickle
- date/time
- iPython magic functions

Biblio:

http://ipython.scipy.org/

In practice 2: Numpy ndim-arrays

- Creating an array
  1D, 2D, 3D
- Access by index
- Slicing
- Some methods
- I/O to ascii format
  using scipy.io, using matplotlib
- I/O to fits format

Biblio:

http://www.scipy.org/
/Documentation
/Cookbook

In practice 3: Plotting with pylab/matplotlib

- Curves: 1D
- Maps: 2D
- Contours

...much more: 3D scatter, 3D volumes, chart, etc.

Biblio:

http://matplotlib.sourceforge.net/

http://www.scipy.org/

/Documentation

/Cookbook

In practice 4: some Scipy tools

- Interpolation 1D, 2D
- FFT
- Fitting
- Integration
- Linear algebra
- Minimization/root finding “optimization”
- Signal processing (convolution, filtering, etc.)
- Weave module for C code inline integration

...a lot more

Biblio:

http://www.scipy.org/
/Documentation
/Cookbook

In practice 5: MySQL database queries

- Using MySQLdb

```
# Importing the module
import MySQLdb
# Creating a connection with the MySQL database
connection = MySQLdb.connect(host='172.17.2.1', user='toto', passwd='123', db='mycollection')
# Getting a pointer to the connection
c = connection.cursor()
# What we want
author = " 'Shakespeare' "
# Executing the query
c.execute(" " " SELECT title, description FROM books WHERE author = %s  " " " %(author, ) )
# Getting the result
result = c.fetchall()
```

Biblio:

http://wikipython.flibuste.net/moin.py/CodesBDD

In practice 6: Software development

- Main file

A .py file with inside:

```
# import modules
import blablabla
# The main function
if __name__ == '__main__':
    # The main program from which to call functions/objects from the modules etc.
```

The .py file created is then callable from the shell using 'python blabla.py'

- Functions

```
# Function definition
def MyFunction(Param1, Param2='toto'):
    print ' The parameter 1 is: ', Param1
    print ' The parameter 2 is: ', Param2
```

- Class = object

```
# Class definition
class MyClass():
    # Default constructor
    __init__(self):
        self.Attribute1=0.0
        self.Attribute2=2.0
    # One method
    def MyMethod(self, Param1, Param2='toto')
        print self.Attribute1=Param1
```

Personal work to practice all that

1- SDSS galaxies analysis – N. Nagar

SQL request on SDSS public database

Analysis of spectrums with IRAF/PyIRAF

Fitting with Python to extract photometric redshift from spectrums

2- SDSS cluster extraction – N. Nagar & JB Juin

SQL request on SDSS public database

Finding clusters in south hemisphere, in redshift space and direction

Caracterization of these clusters

3- ACT galaxy cluster photometry – JB Juin

ACT official simulated maps (N-body simulation)

Cluster/point-sources separation

Cluster photometry: beta-profile fitting

Where to find help ?

- in ipython shell: help(FunctionOrModuleOrObject)
- in ipython shell: object?
- in ipython shell, the auto-completion tool: object.<tab key>

- in my work site: **www.astro-udec.cl/juin/Python.zip //Help**
- www.scipy.org /Documentation & /Cookbook
- jbjuin@astro-udec.cl

... y tambien: “Siempre **Google** sera tu amigo”

How to install that ?

Depend a lot of your system !

- Compile/install external libraries:
  LAPACK, BLAS, 'ATLAS', FFTW
- Install Python 2.5

} easy for .deb linux (ubuntu/debian)

- Install Numpy
- Install Scipy
- Install Matplotlib
- Install Pyfits

} easy: python installation tools

All these are in: **www.astro-udec.cl/juin/Python.zip //Install**

We will install that on Radio1 (segundo piso biblioteca PC) and ALMA

If personal computer:

- for Mac ask help to Roger ;)
- for PC with linux ask me
- for PC with windows install linux and then ask me