

Python tutorial @ BIG (EPFL)

A *short* introduction to Python for Image Analysis and Deep Learning

By Lilian Besson besson@crans.org

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ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE



université
PARIS-SACLAY

Introduction

This short tutorial will get you started with Python 3.

| We will try to discover together what Daniel asked me yesterday.

1. Install Python 3 🐍

Try to do this on your laptop , during the tutorial

1. Download [Anaconda \(Python 3.5\)](https://continuum.io/downloads) from continuum.io/downloads (~ 346 Mo)
2. Install it: double-click the downloaded `.pkg` file (on Mac) or `.exe` file (on Windows),, and follow the instructions
3. Check that Python (`python3`) has been installed:

```
$ python3  
[it should work]
```

2. Basic introduction to Python

- ⚠ **Not covered today**
- Start with introtopython.org
- More in-depth tutorial: scipy-lectures.org (very good quality)
- Example: [Hello World!](#) :

```
>>> print("Hello Python world!")  
Hello Python world!
```

3. Using the Spyder IDE

- The Spyder IDE [is shipped](#) with Anaconda
- Gives a nice MATLAB-like interface: advanced editing, interactive testing, debugging and introspection features
- A numerical computing environment thanks to the support of: `IPython` (enhanced interactive Python interpreter) and core Python libraries: `NumPy` (linear algebra), `SciPy` (signal and image processing) or `matplotlib` (interactive 2D/3D plotting)
- Easy to debug: add breakpoint, previous/next buttons etc
- → It's *Demo time!*
- Other good IDE : the [Jupyter notebook](#) (in your browser)

4. Importing the main libraries

- They are all shipped with Anaconda!

- NumPy:

```
import numpy as np
```

- Scipy:

```
import scipy
```

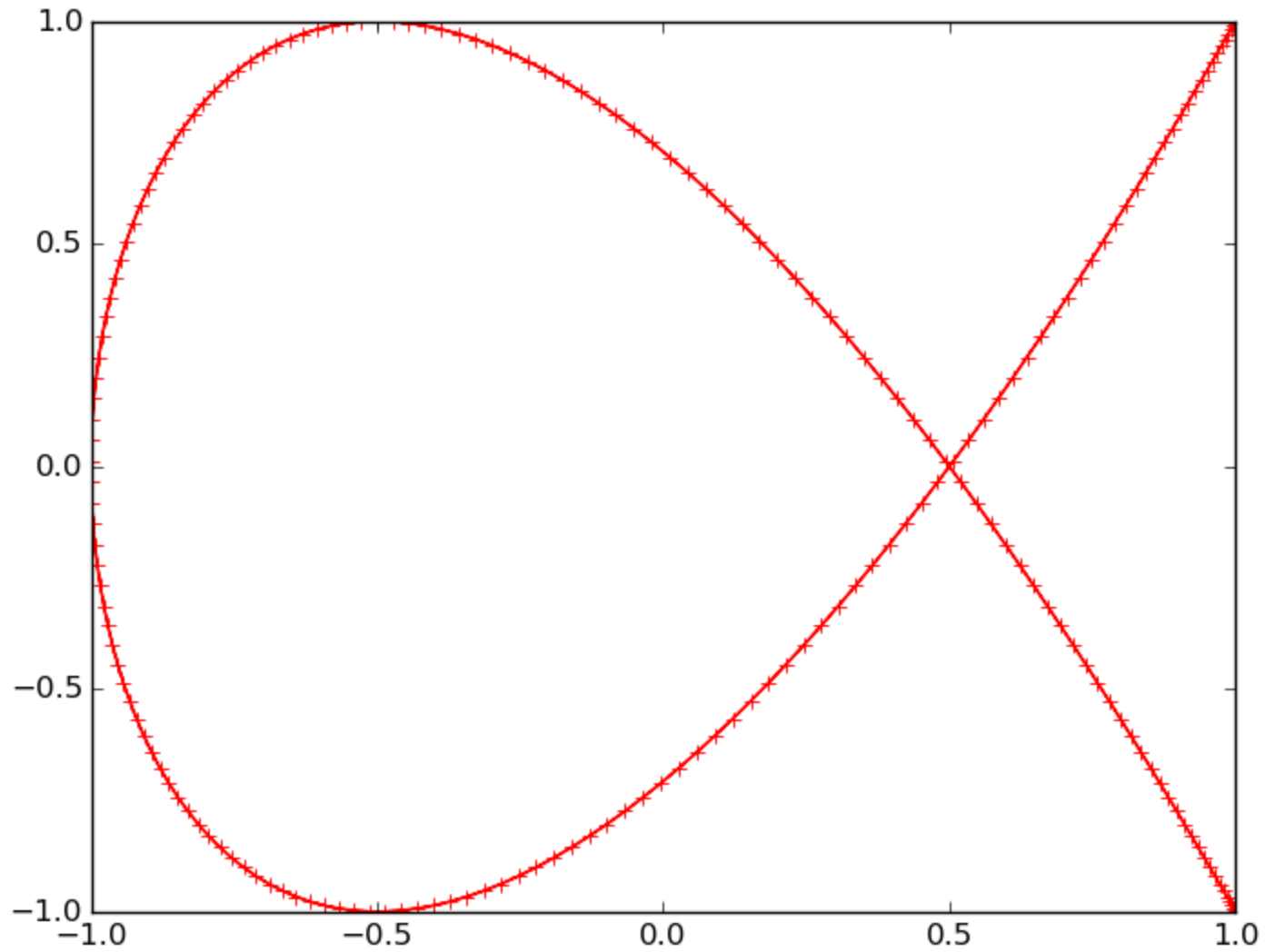
- Matplotlib:

```
import matplotlib.pyplot as plt
```

4.1. First example:

```
t = np.linspace(0, 2 * np.pi, 400)
x = np.cos(2*t)
y = np.cos(3*t)           # Vectorized functions!
plt.figure()
plt.plot(x, y, 'r+-')    # Shortcut à-la MATLAB
plt.show()
```

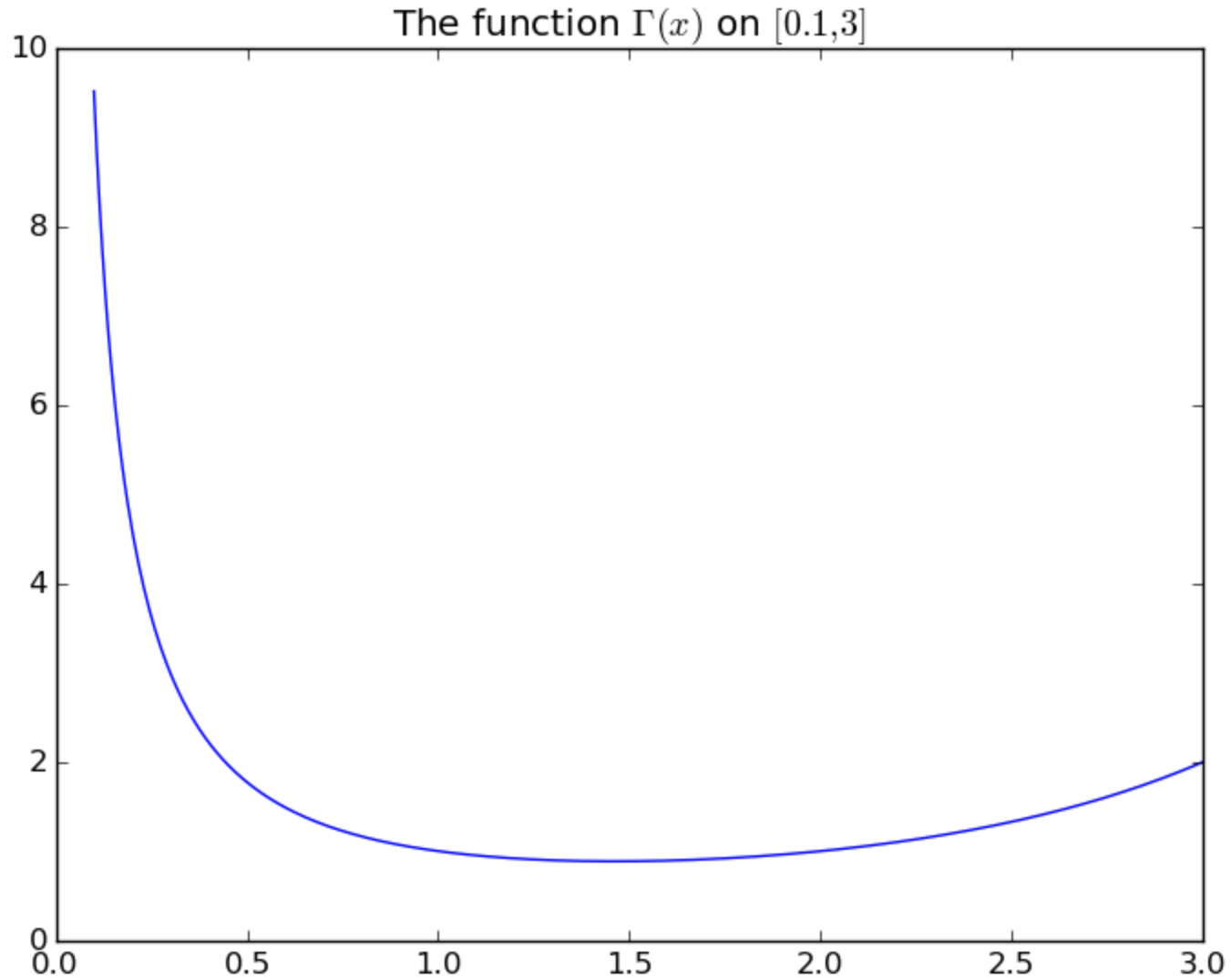
4.1. First example:



4.1. Second example:

```
from scipy.special import gamma
x = np.linspace(0.1, 3, 400)
y = gamma(x) # Vectorized function!
plt.figure() # (Optional)
plt.plot(x, y)
plt.title("The function  $\Gamma(x)$  on  $[0.1, 3]$ ")
# And LaTeX is supported! ↑
plt.show() # (Optional)
```

4.1. Second example:



5. Reading data, images etc, with `scipy` or `scikit-image`

- They are all shipped with Anaconda!
- `scipy.ndimage` implements a lot of image processing functions, mostly for n-dimensional images.
→ Cf. www.scipy-lectures.org/advanced/image_processing
- And `scikit-image` (scikit-image.org) adds functions specific to 2D/3D images, and more.
→ Cf. www.scipy-lectures.org/packages/scikit-image
- For 3D plotting, use [Mayavi](#) (more complex)

5.1. Example: reading an image

```
from scipy import ndimage          # module for n-d images
import matplotlib.pyplot as plt  # module for plotting

from scipy import misc # some toy data are there
face = misc.face(gray=True)
# Or...
face = plt.imread('face.png')
# Or...
from skimage.io import imread  # import a function
face = imread('face.jpg')

print(face[0, 0]) # Example, first pixel: 114
# Display the image
plt.imshow(face, cmap='gray')
plt.show()
```

5.1. Example: reading an image

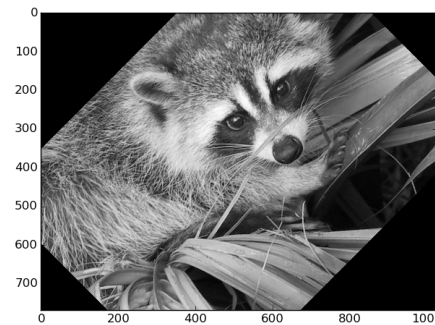
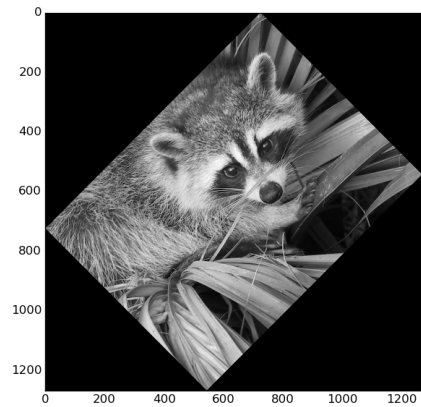
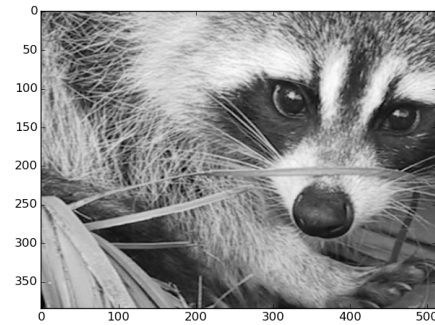


5.2. Example: more on images...

```
lx, ly = face.shape
# Cropping, by slicing the ndarray (matrix)
crop_face = face[lx / 4: - lx / 4, ly / 4: - ly / 4]
# Up <-> down flip
flip_ud_face = np.flipud(face)
# Rotation
rotate_face = ndimage.rotate(face, 45)
rotate_face_noreshape = ndimage.rotate(face, 45,
                                       reshape=False)

plt.figure()
plt.subplot(2, 3, 1) # Subplot like in MATLAB
plt.imshow(face, cmap='gray')
plt.subplot(2, 3, 2)
plt.imshow(crop_face, cmap='gray')
# etc...
```

5.2. Example: more on images...



6. Machine Learning in Python with `scikit-learn`

- Shipped with Anaconda!
- Importing `scikit-learn`:

```
import sklearn as sk, or from sklearn import XXX
```

- Documentation on scikit-learn.org
- Lots of "not-deep" machine learning algorithm, easy to use
- Lots of examples!

7. Deep Learning in Python, with `caffe`, `lasagne` or `tensorflow` ...

- I don't do deep learning myself!
So I don't know which library is the best... 🙄
- ⚠️ *Warning: NOT shipped with Anaconda !*
- Every framework require a specific installation, usually not easy...
- → Try to ask to someone who already installed it!

7. Deep Learning in Python, with `caffe` , `lasagne` or `tensorflow` ...

- `caffe` : Python interface to a C++ engine, by Berkeley's Vision lab, caffe.berkeleyvision.org, see this [example](#)
- `lasagne` : C and Python, built on top of `theano` , by Yoshua Bengio's lab (Montreal), lasagne.readthedocs.org, see this [example](#)

7. Deep Learning in Python, with `caffe`, `lasagne` or `tensorflow` ...

- `tensorflow` : Python interface to a C++ engine, by Google, tensorflow.org, see this [example](#).
- See also: tflearn.org for a nicer interface?
- Also interesting: keras.io, using either Theano or TensorFlow, pure Python, lots of [examples](#)

Questions ?

| Please ask if any!

References for Python 3 and basic tools

- Python 3 documentation: docs.python.org/3
- introtopython.org for a small introduction to Python syntax and concepts
- Spyder documentation: pythonhosted.org/spyder
- IPython tutorial: ipython.readthedocs.io

References for libraries (1/3)

- NumPy documentation: docs.scipy.org/doc/numpy/reference
- SciPy documentation: docs.scipy.org/doc/scipy/reference
- SciPy for image manipulation: www.scipy-lectures.org/advanced/image_processing
- Matplotlib documentation: matplotlib.org/contents.html
- Matplotlib tutorial: www.labri.fr/perso/nrougier/teaching/matplotlib

References for libraries (2/3)

- `scikit-learn` tutorial: scikit-learn.org/stable/tutorial/index.html
- `scikit-image` tutorial: scikit-image.org/docs/stable/overview.html
- Also on scipy-lectures.org: www.scipy-lectures.org/packages/scikit-image

References for libraries (3/3)

- `theano` documentation: deeplearning.net/software/theano
- `lasagne` documentation: lasagne.readthedocs.org
- `tensorflow` documentation:
www.tensorflow.org/versions/r0.9/get_started/index.html
- `tflearn` tutorial: tflearn.org/#quick-overview
- `keras` tutorial: keras.io/#getting-started-30-seconds-to-keras

Questions ?

| Please ask if any!

End