

# Intro to SciPy & Numpy through Image Processing

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# Outline

- 1 Introduction
- 2 Getting Started
- 3 Looking at Lena
- 4 Histogram Equalization
- 5 Edge detection
- 6 Looking Ahead

# Audience?

- Basic Knowledge of Python
  - data types
  - variables, data-structures
  - looping constructs
- Anybody doing "Scientific" Computation
  - Engineering Students, Researchers
  - People using Fortran/C, Matlab/IDL

## A Quote

*In 1998, ... I came across Python and its numerical extension (Numeric) while I was looking for ways to analyze large data sets ... using a high-level language. I quickly fell in love with Python programming which is a remarkable statement to make about a programming language. If I had not seen others with the same view, I might have seriously doubted my sanity.*  
-Travis Oliphant, Numpy Book

# Checklist

## Installed?

- python-numpy
- python-scipy
- python-matplotlib
- ipython
- python-imaging or pil

## Files

- smoothing.gif
- unequalized.jpg
- lena.png
- image.png

# Getting Started

```
$ ipython -pylab
```

- Opening an image
- Showing it

```
a = imread('image.png') imshow(a)
```

# Some attributes

- `shape`
- `min, max, sum`
- `dtype`

`ipython?`

- `array.<Tab>`
- `plot?`

# Basic Operations

- $+$   $-$   $*$   $/$   $**$   $//$
- Element-wise operations



# Simple Arrays

- Straight forward - single dim, multi dim.
- `ones`, `zeros` et. al
- `arange`, `linspace` with `shape`

# Accessing (& Changing) Elements

- Accessing (& Changing) individual elements
- Accessing (& Changing) Rows
- Accessing (& Changing) Columns
- Accessing in Steps - Striding

# Chop and Cut Lena!

- `a = scipy.lena()`
- Select regions
  - Top Left Quarter
  - Face Only
- Resize by dropping pixels
  - Alternate pixels
  - 2 in every 3
- RGB channels in colour images
  - `imread`
  - `imshow`

# Smoothing Lena

- A mean filter
  - Neighborhoods
  - for loops
  - Array slicing
  - %run -t (timing it)
- A median filter
  - for loops - should be easy?
  - Array slicing
- `ndimage.median_filter`

# Copies & Views

- Slicing and Striding just reference the same memory
- They produce views of the data, not copies

# Obtain Image, Histogram

- `imread`
- `imshow`
  - normalizes images by default
- `ndimage.histogram`
- `hist`
- `cumsum`

# Useful Plot Commands

- `plot`
- `figure`
- `xlim, ylim`
- `savefig`

# Obtain Normalized Image, Histogram

- Linear

- $$A = (A - A.min()) \frac{255}{A.max() - A.min()}$$



# Distance

- A crude algorithm
  - A point is farther than K
  - distance from lower and right neighbor

# Sobel, Prewitt

- First order algorithms
- $a = [-1, 0, 1]$ ,  $b = [1, 2, 1]$ ; Sobel
- $a = [-1, 0, 1]$ ,  $b = [1, 1, 1]$ ; Prewitt

# Getting involved

- Documentation
  - ReStructured Text
  - “docstrings”
  - modify docstrings without access to source code
- Bug-fixes <http://www.scipy.org/BugReport>
- Testing
- Code contributions
  - Scikits <http://scikits.appspot.com>
- Web design
- Community Participation
  - Active on Mailing list
  - Code sprints/Documentation/Bug-fix Days

# References

- Python Tutorial
- Tentative Numpy Tutorial
- Numpy Reference Guide
- Scipy Reference Guide
- Wikipedia