Intro to SciPy & Numpy through Image Processing

Shantanu & Puneeth

29 December 2010

Outline

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