Introductory Scientific Computing with Python

IPython notebooks

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Introduction

- Have used the IPython console so far
  - Terminal: **`ipython`**
  - GUI: **`qtconsole`**
- Powerful and convenient
- Must be installed as a package

IPython notebook

- Create and share documents containing
  - live code
  - equations
  - visualizations
  - interactive widgets
  - explanatory text
- A web application

jupyter spectrogram (autosaved)

File Edit View Insert Cell Kernel Help Python 3

Markdown CellToolbar

Simple spectral analysis

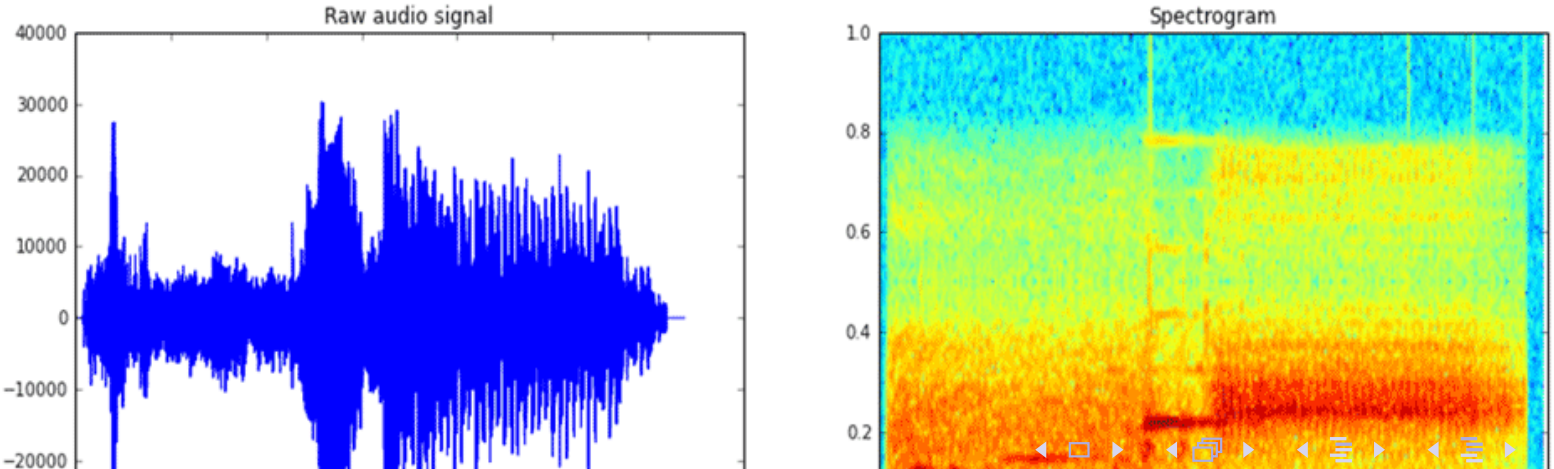
An illustration of the Discrete Fourier Transform

$$X_k = \sum_{n=0}^{N-1} x_n exp^{\frac{-2\pi i}{N} kn} \quad k = 0, \ldots, N-1$$

In [2]:
```
from scipy.io import wavfile
rate, x = wavfile.read('test_mono.wav')
```

And we can easily view it's spectral structure using matplotlib's builtin specgram routine:

In [5]:
```
fig, (ax1, ax2) = plt.subplots(1,2,figsize(16,5))
ax1.plot(x); ax1.set_title('Raw audio signal')
ax2.specgram(x); ax2.set_title('Spectrogram');
```



Jupyter

- Open source, interactive data science and computing
- Brings IPython-like features to other languages
- Console
- Notebooks
- Other tools: jupyterhub, nbviewer, etc.


jupyter

IPython and Jupyter

- IPython provides Python specific functionality
- Python **kernel**

Getting started: IPython

Console

```
$ ipython
```

The notebook:

```
$ ipython notebook
```

Getting started: Jupyter

```
$ jupyter console
```

The notebook:

```
$ jupyter notebook
```

IPython notebooks and Canopy

- Can directly open `*.ipynb` files from Canopy
- Or create a new notebook using the File menu

Pylab mode

```
In []: %pylab
```

Or:

```
In []: %matplotlib
```

Using matplotlib

```
In []: %matplotlib
In []: from matplotlib import pyplot as plt
In []: from numpy import linspace, sin
In []: x = linspace(0, 2*pi)
In []: plt.plot(x, sin(x))
```

What is the difference?

- **`%pylab`**: imports pylab
- **`%matplotlib`**: just sets up the plotting, no imports
- Using explicit imports is cleaner
- **`pyplot`** provides the useful functionality
- Could also just import **`pylab`**

Using the IPython notebook

- Start the notebook
- Try: **`jupyter notebook`**
- If that doesn't work use **`ipython notebook`**
- Create a new Python 2 or Python 3 notebook

Basic Notebook Demo

Open the **`sample.ipynb`** file provided

Exercise

- Start the notebook
- Create a new notebook
- Try the interface tour (Help->Interface tour)
- Add some markdown text, an image, and a simple equation
- Write some simple code in multiple cells
- Add code from **`four_plot.py`** and run it

More resources

- Markdown syntax
- IPython website
- IPython documentation
- Jupyter website
- Jupyter documentation
- Jupyter notebook tips and tricks
- Example notebooks
- Python textbook companions