Python Intro — Part 2

Loops, Spectrograms

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KnitR

Intro

Scripts

Loops

Making a spectrogram

First, a small aside...

- This entire presentation is a KnitR demonstration, as well as a presentation on Python
- Check out the .Rnw file to see the mixture of LaTeX code and R code that is combined by KnitR to generate the output
- I'm using the LaTeX beamer package to create this slideshow
- KnitR makes for very elegant presentations of R code and easy inclusion of graphics

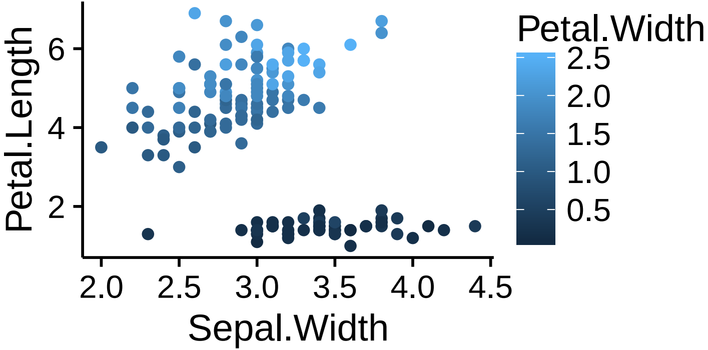
First, a small aside...

```
d <- select(iris, Sepal.Width, Petal.Length, Petal.Width)
head(d)

##   Sepal.Width Petal.Length Petal.Width
## 1         3.5          1.4         0.2
## 2         3.0          1.4         0.2
## 3         3.2          1.3         0.2
## 4         3.1          1.5         0.2
## 5         3.6          1.4         0.2
## 6         3.9          1.7         0.4
```

First, a small aside...

```
ggplot(d,aes(x=Sepal.Width, y=Petal.Length, color=Petal.Wid
```



First, a small aside...

- Of course, the question arises — Why is KnitR and LaTeX in *this* presentation?
- KnitR is also ready to handle other languages
- If you ever need to present code in Python, C, R, Scala, Perl, Fortran, etc...
- For example...

```
x = [1,2,3,4,5]
x.append(4)
print(2+2)
print(x)
```

```
## 4
## [1, 2, 3, 4, 5, 4]
```

Plan

- We're going to focus on two things today
  1. Theoretical — control statements and loops
  2. Practical — applying numpy and scipy to analyze sound
- What we'll need
  1. Python 3 (through IPython)
  2. numpy, scipy, matplotlib, sounddevice
  3. Sound files (in folder "samples")
- Overview
  1. Set up scripting tools
  2. A brief intro to loops
  3. Make one spectrogram
  4. Make a bunch of spectrograms

Bare bones scripting

- Today, we'll set up a bare bones environment for scripts
- You'll soon probably want something more fully fledged...
  1. Spyder
  2. Eclipse
- Now, let's open up Notepad++

Our first loop

- Loops in Python have a very easy and powerful syntax

```
for i in range(5):
 print(i)
```

```
## 0
## 1
## 2
## 3
## 4
```

Loop syntax

- Unlike MATLAB and R which employ brackets, Python uses tabs to indicate nesting
- If we don't indent at least one line for a loop we'll have problems
- I personally like this, I think it promotes more readable code!

```
for i in range(5):
print(i)

##   File "<string>", line 2
##     print(i)
##         ^
## IndentationError: expected an indented block
```

Looping over other things

- We can loop over a variety of objects
- The range() function is for when we want integer sequences, but many things in Python can be used to create a loop (technically, these things are called iterables in Python-lingo)
- Lists are iterables...

```
x = [1,4,9,16,25]
for i in x:
 print(str(i) + str(x))

## 1[1, 4, 9, 16, 25]
## 4[1, 4, 9, 16, 25]
## 9[1, 4, 9, 16, 25]
## 16[1, 4, 9, 16, 25]
## 25[1, 4, 9, 16, 25]
```

Looping over other things

- Strings are also iterables...

```
for i in "Hello":
 print(i)

## H
## e
## l
## l
## o
```

Nested loops

- Just like in other languages, we can nest for loops to do more powerful things

```
bases = [1, 2, 3]
for base in bases:
 for expo in range(3):
  print(str(base) + "^" + str(expo) + "=" + str(base**expo))
```

```
## 1^0=1
## 1^1=1
## 1^2=1
## 2^0=1
## 2^1=2
## 2^2=4
## 3^0=1
## 3^1=3
## 3^2=9
```

Setting up the environment

- First, we need to import the necessary modules

```
import numpy
from scipy.io import wavfile
import matplotlib.pyplot as plt
import sounddevice as sd
```

- Numpy — provides key matrix and DSP operations
- wavfile — provides read/write to wavfile
- pyplot — user-friendly functions and objects for plotting

Game Plan

1. Import one signal
2. Collect measurements of amplitude in each time frequency bin
3. Plot it
4. Save the plot to file
5. Loop the above four steps as necessary
6. Put everything in a script

Importing a sound file

- The following pertains specifically to certain types of .wav files
- For other file types or unusual .wavs, you may need to do some research!

```
location =
"/home/daniel/Desktop/samples/m03ae.wav"
[fs, y] = wavfile.read(location)
```

- This will place the sampled waveform contained in m03ae.wav with sample rate fs into the numpy vector y
- We can see what this waveform looks like with ...

```
plt.plot(y)
```

- And what it sounds like with...

```
sd.play(y,fs)

## Segmentation fault
```

Importing some files

```
2+2
```