Python for Science and Engg: Plotting experimental data

FOSSEE

Department of Aerospace Engineering
IIT Bombay

7 November, 2009
Day 1, Session 2

Outline

Outline

Why would I plot f(x)?

Do we plot analytical functions or experimental data?

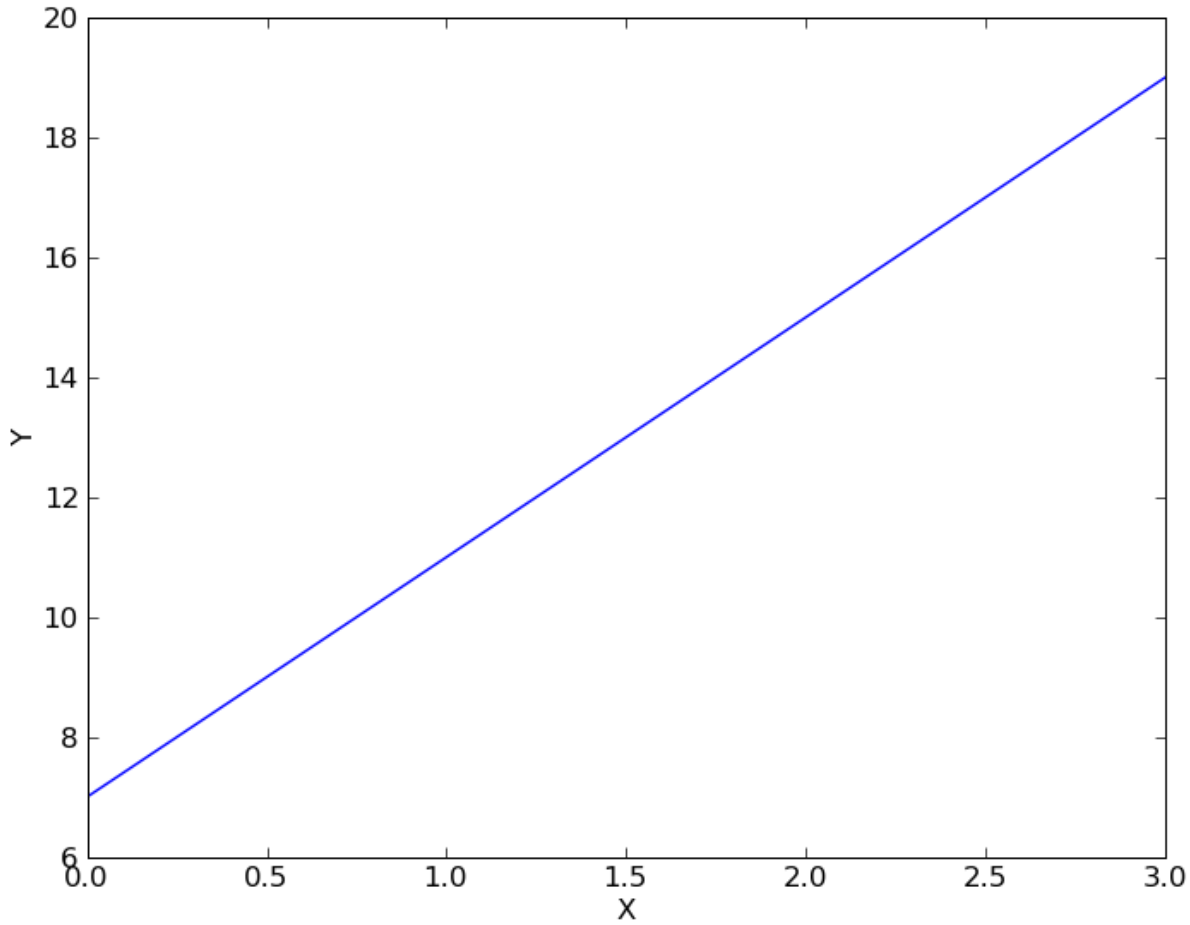
```
In [ ]: x = [0, 1, 2, 3]

In [ ]: y = [7, 11, 15, 19]

In [ ]: plot(x, y)
Out[ ]: [<matplotlib.lines.Line2D object at 0xa73a

In [ ]: xlabel('X')
Out[ ]: <matplotlib.text.Text object at 0x986e9ac>

In [ ]: ylabel('Y')
Out[ ]: <matplotlib.text.Text object at 0x98746ec>
```



Is this what you have?

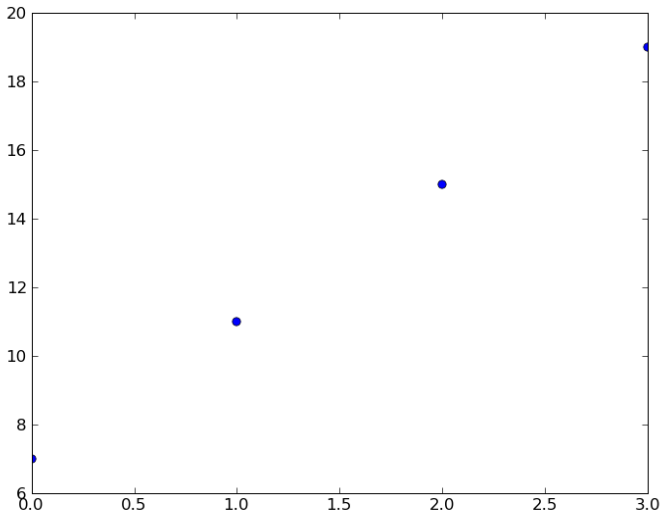
Plotting points

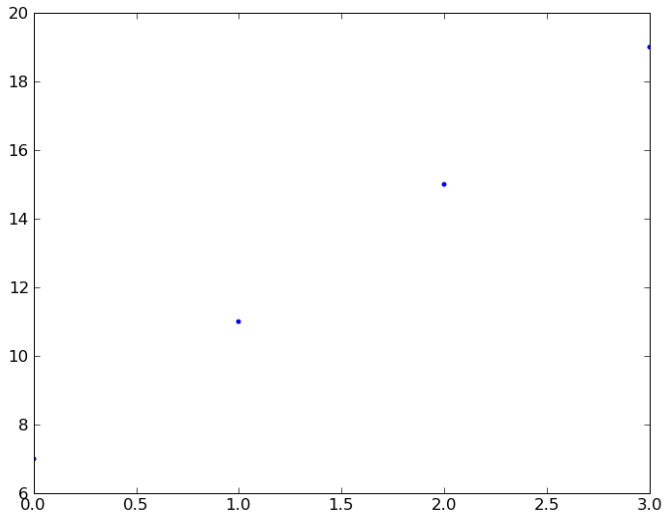
- What if we want to plot the points!

```
In [ ]: clf()

In [ ]: plot(x, y, 'o')
Out[ ]: [<matplotlib.lines.Line2D object

In [ ]: clf()
In [ ]: plot(x, y, '.')
Out[ ]: [<matplotlib.lines.Line2D object
```


20
18
16
14
12
10
8
6
0.0
0.5
1.0
1.5
2.0
2.5
3.0


20
18
16
14
12
10
8
6
0.0
0.5
1.0
1.5
2.0
2.5
3.0

Additional Plotting Attributes

- `'o'` - Filled circles
- `'.'` - Small Dots
- `'-'` - Lines
- `'- -'` - Dashed lines

Outline

Lists: Introduction

```
In []: x = [0, 1, 2, 3]

In []: y = [7, 11, 15, 19]
```

What are **x** and **y**?

lists!!

Lists: Initializing & accessing elements

```
In []: mtlist = []
```

Empty List

```
In []: a = [ 1, 2, 3, 4, 5]

In []: a[0]+a[1]+a[-1]
Out[]: 8
```

List: Slicing

Remember...

```
In []:  a = [ 1, 2, 3, 4, 5]
```

```
In []: a[1:3]
Out[]: [2, 3]

In []: a[1:-1]
Out[]: [2, 3, 4]
```

```
list[initial:final]
```

List operations

```
In [ ]: b = [ 6, 7, 8, 9]
In [ ]: c = a + b

In [ ]: c
Out[ ]: [1, 2, 3, 4, 5, 6, 7, 8, 9]

In [ ]: a.append(6)
In [ ]: a
Out[ ]: [ 1, 2, 3, 4, 5, 6]
```

Outline

Simple Pendulum - L and T

Let us look at the Simple Pendulum experiment.

L	T	T^2
0.1	0.6900	
0.2	0.8989	
0.3	1.1867	
0.4	1.2991	
0.5	1.4656	
0.6	1.5843	
0.7	1.7706	
0.8	1.8296	
0.9	1.9440	

$L \alpha T^2$

Lets use lists

```
In []: l = [0.1, 0.2, 0.3, 0.4, 0.5,
            0.6, 0.7, 0.8, 0.9]

In []: t = [0.69, 0.8989, 1.1867,
            1.2991, 1.4656, 1.5843,
            1.7706, 1.8296, 1.9440]
```

Plotting L vs T^2

- We must square each of the values in `t`
- How to do it?
- We use a `for` loop to iterate over `t`

Plotting L vs T^2

```
In [ ]: tsq = []

In [ ]: for time in t:
 ....:      tsq.append(time*time)

In [ ]: plot(l, tsq)
Out[ ]: [<matplotlib.lines.Line2D object a
```

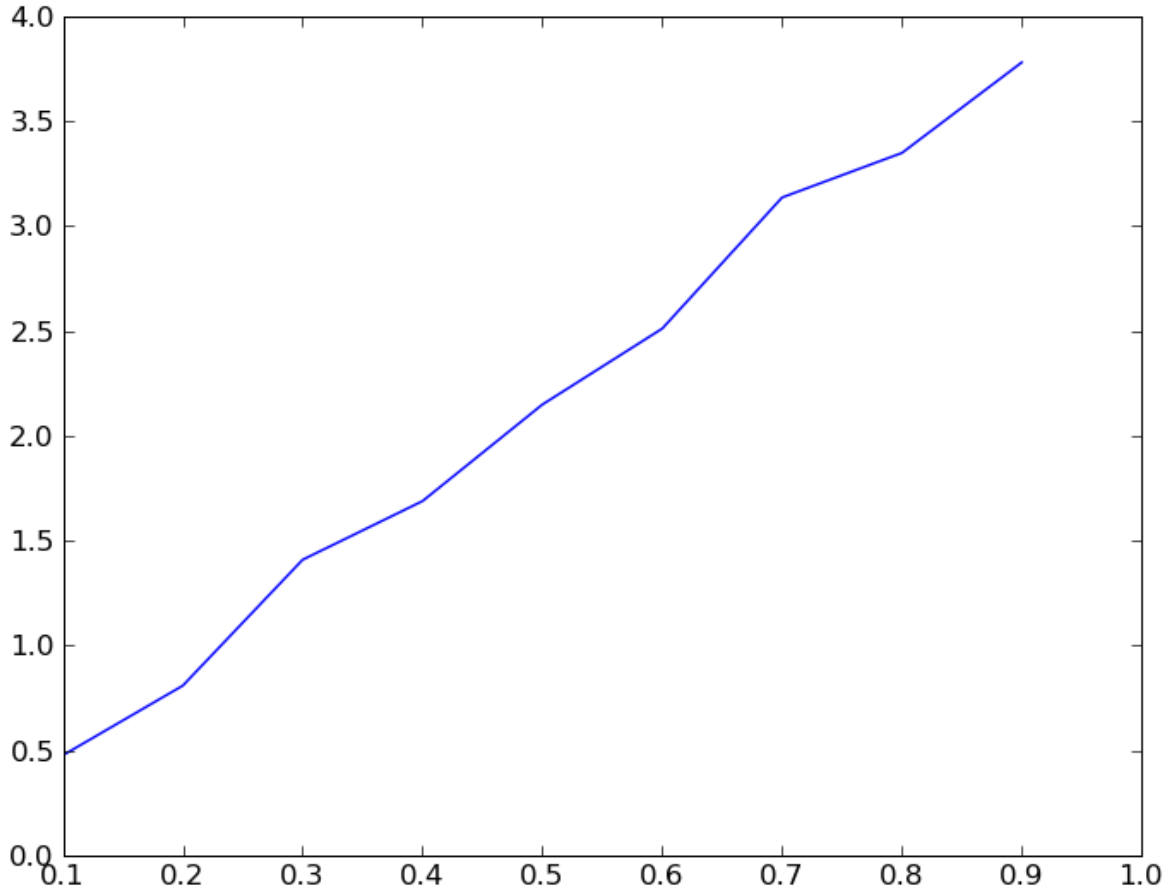
This gives `tsq` which is the list of squares of `t` values.

How to come out of the `for` loop?

Hit the “ENTER” key twice to come to the previous indentation level

```
In [ ]: for time in t:
  ....:     tsq.append(time*time)
  ....:
  ....:

In [ ]: print tsq
```


4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

What about larger data sets?

Data is usually present in a file!

Lets look at the **pendulum.txt** file.

```
$ cat pendulum.txt
1.0000e-01 6.9004e-01
1.1000e-01 6.9497e-01
1.2000e-01 7.4252e-01
1.3000e-01 7.5360e-01
1.4000e-01 8.3568e-01
1.5000e-01 8.6789e-01

...
```

Windows users:

C:>type pendulum.txt

Reading `pendulum.txt`

- Let us generate a plot from the data file
- File contains L vs. T values
- L - Column1; T - Column2

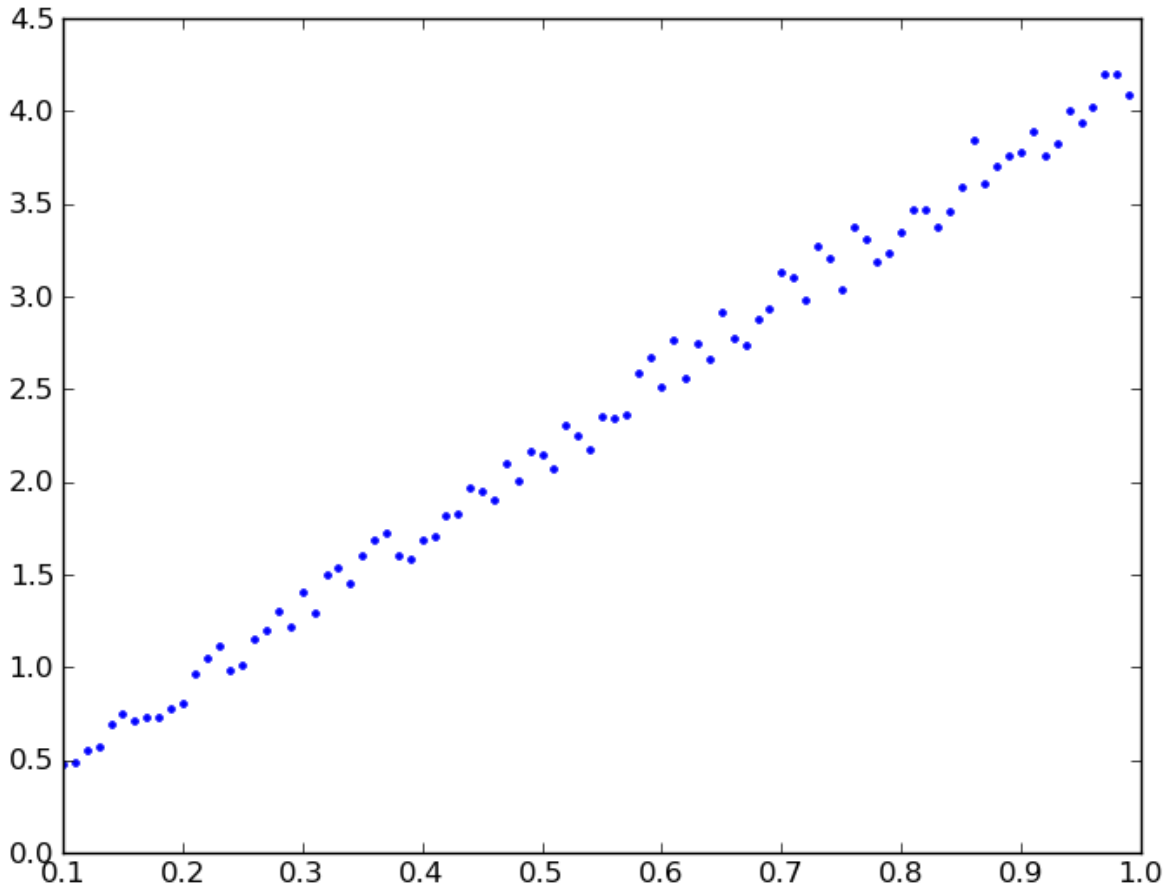
Plotting from `pendulum.txt`

Open a new script and type the following:

```
l = []
t = []
for line in open('pendulum.txt'):
    point = line.split()
    l.append(float(point[0]))
    t.append(float(point[1]))
tsq = []
for time in t:
    tsq.append(time*time)
plot(l, tsq, '.')
```

Save and run

- Save as pendulum_plot.py.
- Run using `%run -i pendulum_plot.py`


4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

Reading files . . .

```
for line in open('pendulum.txt'):
```

- opening file '**pendulum.txt**'
- reading the file line by line
- **line** is a **string**

Outline

Strings

Anything within “quotes” is a string!

```
' This is a string '
" This too! "
""" This one too! """
''' And one more! '''
```

Strings and `split()`

```
In [ ]: greet = 'hello world'

In [ ]: greet.split()
Out[ ]: ['hello', 'world']
```

This is what happens with **`line`**

```
In [ ]: line = '1.2000e-01 7.4252e-01'

In [ ]: point = line.split()

In [ ]: point
Out[ ]: ['1.2000e-01', '7.4252e-01']
```

Getting floats from strings

```
In [ ]: type(point[0])
Out[ ]: <type 'str'>
```

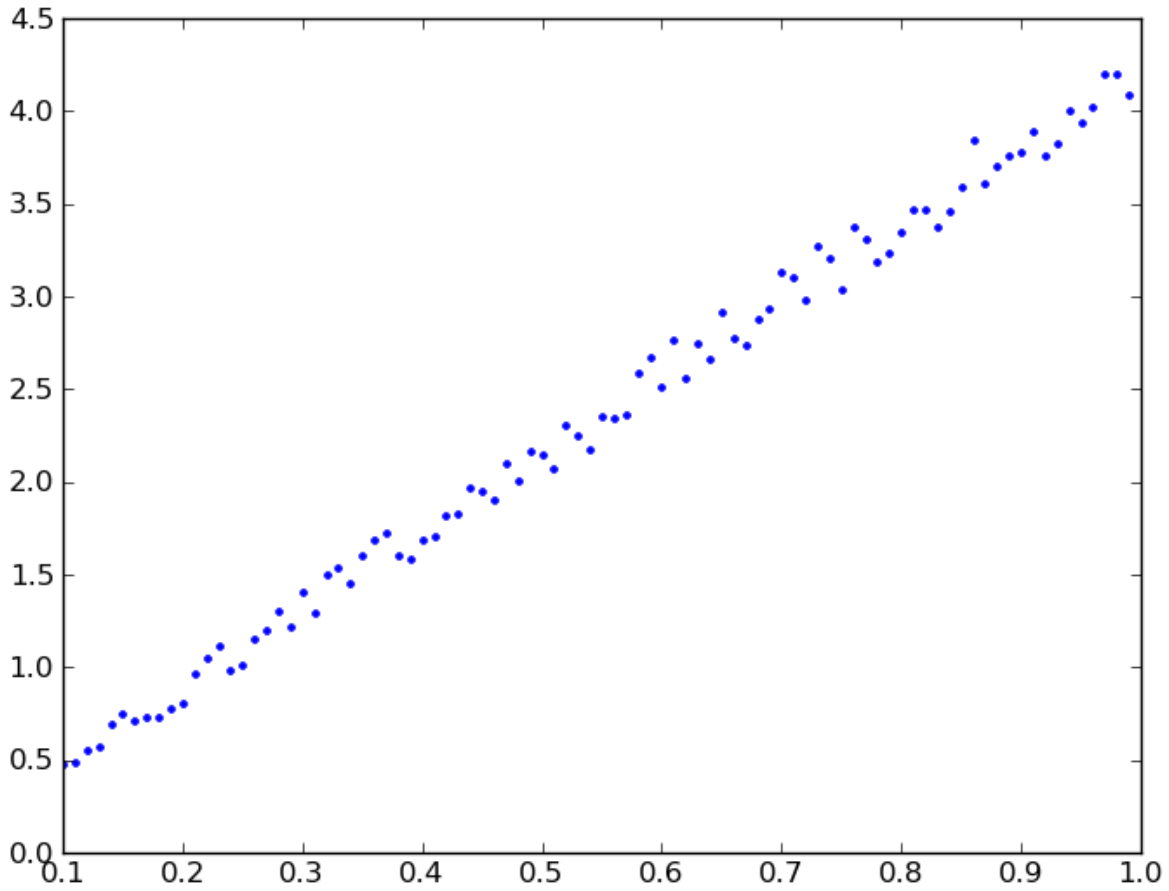
But, we need floating point numbers

```
In [ ]: t = float(point[0])

In [ ]: type(t)
Out[ ]: <type 'float'>
```

Let's review the code

```
l = []
t = []
for line in open('pendulum.txt'):
    point = line.split()
    l.append(float(point[0]))
    t.append(float(point[1]))
tsq = []
for time in t:
    tsq.append(time*time)
plot(l, tsq, '.')
```


4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

Outline

What did we learn?

- Plotting points
- Plot attributes
- Lists
- `for`
- Reading files
- Tokenizing
- Strings