Introduction to Computer Programming Lecture 8.2:

Matplotlib:
Saving plots and importing data

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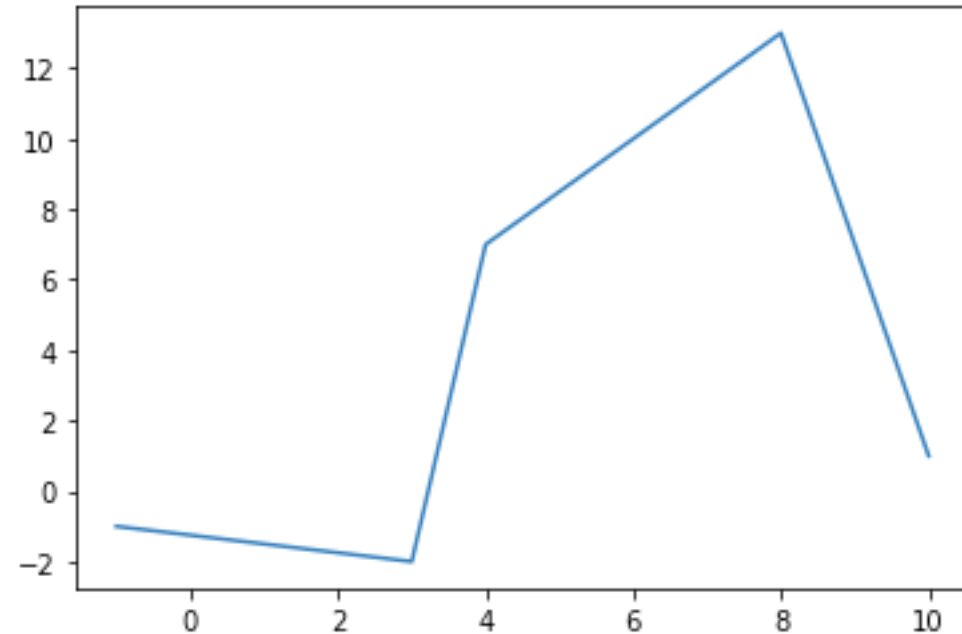Department of Engineering Mathematics

Saving a Plot

```
 1 import matplotlib.pyplot as
 2
 3 x = [-1, 3, 4, 8 , 10]
 4 f = [-1, -2, 7, 13 , 1]
 5
 6 plt.plot(x, f)
 7
 8 plt.savefig("my-plot.pdf")
 9 plt.savefig("my-plot.png")
10
11 plt.show()
12
13
14
15
16
17
```

Save figure in the current directory

If called before saving, saved figure will be blank

Importing data

	A	B	C	D	E	F	G	H	I	J	K	L
1	0	0.19	0.381	0.571	0.762	0.952	1.142	1.333	1.523	1.714	1.904	2.09
2	4.401	7.323	6.319	5.96	5.193	6.06	6.807	4.506	3.917	2.218	1.674	0.4
3												
4												

signal_data.csv

```
0.000,0.190,0.381,0.571,0.762,0.952,1.142,1.333,1.523,1.714,1.904,2.094,2.285,2.475,2.666,2.856,3.046,3.237,3.427,3.6
18,3.808,3.998,4.189,4.379,4.570,4.760,4.950,5.141,5.331,5.522,5.712,5.902,6.093,6.283,6.474,6.664,6.854,7.045,7.235,
7.426,7.616,7.806,7.997,8.187,8.378,8.568,8.758,8.949,9.139,9.330,9.520,9.710,9.901,10.091,10.282,10.472,10.662,10.85
3,11.043,11.234,11.424,11.614,11.805,11.995,12.186,12.376,12.566,12.757,12.947,13.138,13.328,13.518,13.709,13.899,14.
090,14.280,14.470,14.661,14.851,15.042,15.232,15.422,15.613,15.803,15.994,16.184,16.374,16.565,16.755,16.946,17.136,1
7.326,17.517,17.707,17.898,18.088,18.278,18.469,18.659,18.850
4.401,7.323,6.319,5.960,5.193,6.060,6.807,4.506,3.917,2.218,1.674,0.480,-0.570,0.142,-2.336,-3.390,-2.278,-4.094,-4.7
97,-2.316,-2.018,-4.518,-2.534,-1.862,-0.106,-0.564,-0.981,0.584,2.004,2.116,3.333,3.693,5.952,5.939,7.264,7.717,6.44
9,6.122,5.129,6.681,4.489,3.474,3.075,1.303,1.607,0.989,0.498,-2.272,-3.130,-2.539,-3.712,-3.295,-4.378,-4.168,-1.915
,-1.618,-1.228,-1.983,-1.436,0.718,-0.412,2.566,4.379,4.894,5.430,4.539,6.171,5.370,5.215,7.644,7.738,7.397,6.938,3.4
67,3.175,4.830,1.771,2.902,-0.909,-0.576,-1.188,-2.773,-2.411,-2.485,-2.608,-3.430,-4.350,-3.451,-3.857,-2.419,-0.703
,-1.570,1.403,0.429,0.664,3.588,3.451,4.389,4.552,5.074
```

Importing data

File in current directory

Open as read only

Specify delimiter

Convert imported data to numpy array

2 rows, 100 columns

```python
1  import csv
2  import numpy as np
3  import matplotlib.pyplot as plt
4
5  data_path = 'signal_data.csv'
6
7
8  with open(data_path, 'r') as f:
9      reader = csv.reader(f, delimiter=',')
10     data = np.array(list(reader)).astype(float)
11     print(data)
```

```
[[ 0.     0.19    0.381  0.571  0.762  0.952  1.142  1.333  1.523  1.714
   1.904  2.094  2.285  2.475  2.666  2.856  3.046  3.237  3.427  3.618
   3.808  3.998  4.189  4.379  4.57   4.76   4.95   5.141  5.331  5.522
   5.712  5.902  6.093  6.283  6.474  6.664  6.854  7.045  7.235  7.426
   7.616  7.806  7.997  8.187  8.378  8.568  8.758  8.949  9.139  9.33
   9.52   9.71   9.901 10.091 10.282 10.472 10.662 10.853 11.043 11.234
  11.424 11.614 11.805 11.995 12.186 12.376 12.566 12.757 12.947 13.138
  13.328 13.518 13.709 13.899 14.09  14.28  14.47  14.661 14.851 15.042
  15.232 15.422 15.613 15.803 15.994 16.184 16.374 16.565 16.755 16.946
  17.136 17.326 17.517 17.707 17.898 18.088 18.278 18.469 18.659 18.85 ]
 [ 4.401  7.323  6.319  5.96   5.193  6.06   6.807  4.506  3.917  2.218
   1.674  0.48  -0.57   0.142 -2.336 -3.39  -2.278 -4.094 -4.797 -2.316
  -2.018 -4.518 -2.534 -1.862 -0.106 -0.564 -0.981  0.584  2.004  2.116
   3.333  3.693  5.952  5.939  7.264  7.717  6.449  6.122  5.129  6.681
   4.489  3.474  3.075  1.303  1.607  0.989  0.498 -2.272 -3.13  -2.539
  -3.712 -3.295 -4.378 -4.168 -1.915 -1.618 -1.228 -1.983 -1.436  0.718
  -0.412  2.566  4.379  4.894  5.43   4.539  6.171  5.37   5.215  7.644
   7.738  7.397  6.938  3.467  3.175  4.83   1.771  2.902 -0.909 -0.576
  -1.188 -2.773 -2.411 -2.485 -2.608 -3.43  -4.35  -3.451 -3.857 -2.419
  -0.703 -1.57   1.403  0.429  0.664  3.588  3.451  4.389  4.552  5.074]]
```

Importing data

```
1  import csv
2  import numpy as np
3  import matplotlib.pyplot as plt
4
5  data_path = 'signal_data.csv'
6  with open(data_path, 'r') as f:
7      reader = csv.reader(f, delimiter=',')
8      data = np.array(list(reader)).astype(float)
9
10 # Plot the data
11 plt.plot(data[0, :], data[1, :])
```
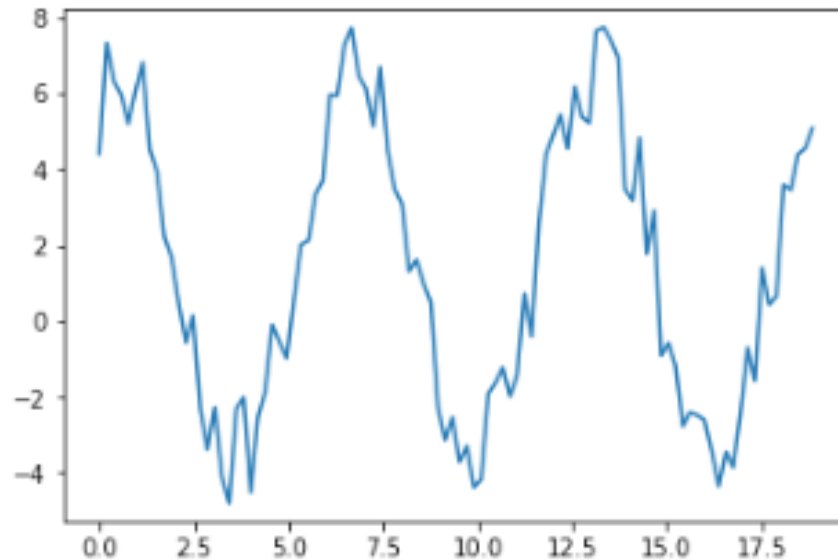
Importing data

temperature_data.csv

	A	B	C	D	E	F	G	H
1		Jan	Mar	May	Jul	Sep	Nov	Dec
2	London	3.1	6.2	13.1	17.9	14.5	6.7	3.7
3	Philadelphia	-1	4	16	24	19	7	2
4	Hong_Kong	-3.5	7	20.5	27	20.5	4.5	-1

```
1  data_path = 'temperature_data.csv'
2  with open(data_path, 'r') as f:
3      reader = csv.reader(f, delimiter=',')
4      data = list(reader)
5      print(data)
```

Operations on reader must be completed before file closed

```
[['', 'Jan', 'Mar', 'May', 'Jul', 'Sep', 'Nov', 'Dec'], ['London', '3.1', '6.2', '13.1', '17.9', '14.5', '6.7', '3.7'], ['Philadelphia', '-1', '4', '16', '24', '19', '7', '2'], ['Hong_Kong', '-3.5', '7', '20.5', '27', '20.5', '4.5', '-1']]
```

Importing data

	A	B	C	D	E	F	G	H
1		Jan	Mar	May	Jul	Sep	Nov	Dec
2	London	3.1	6.2	13.1	17.9	14.5	6.7	3.7
3	Philadelphia	-1	4	16	24	19	7	2
4	Hong_Kong	-3.5	7	20.5	27	20.5	4.5	-1

```python
with open('temperature_data.csv', 'r') as f:
    reader = csv.reader(f, delimiter=',')
    data = list(reader)

cities = [d[0] for d in data][1:]

data = [d[1:] for d in data]

headers = data[0]

data = np.array(data[1:]).astype(float)
```

First item of each row of data

Remove first item of each list

First list

Data to numpy array

Importing data

```python
# Array with the position of each bar
x_pos = np.arange(data.shape[1])


# Width of each bar
W = 0.2


# # 2. Bar plot
for i in range(3):
    plt.bar(x_pos, data[i, :], label=cities[i], width=W);
    x_pos = x_pos + W


# # 3. Replace x ticks with text
# # Rotate labels 30 degrees
plt.xticks(x_pos-W, headers, rotation=30);


# # 4. Add axis labels
plt.xlabel('2007');
plt.ylabel('ave temp deg C');
plt.legend();
```
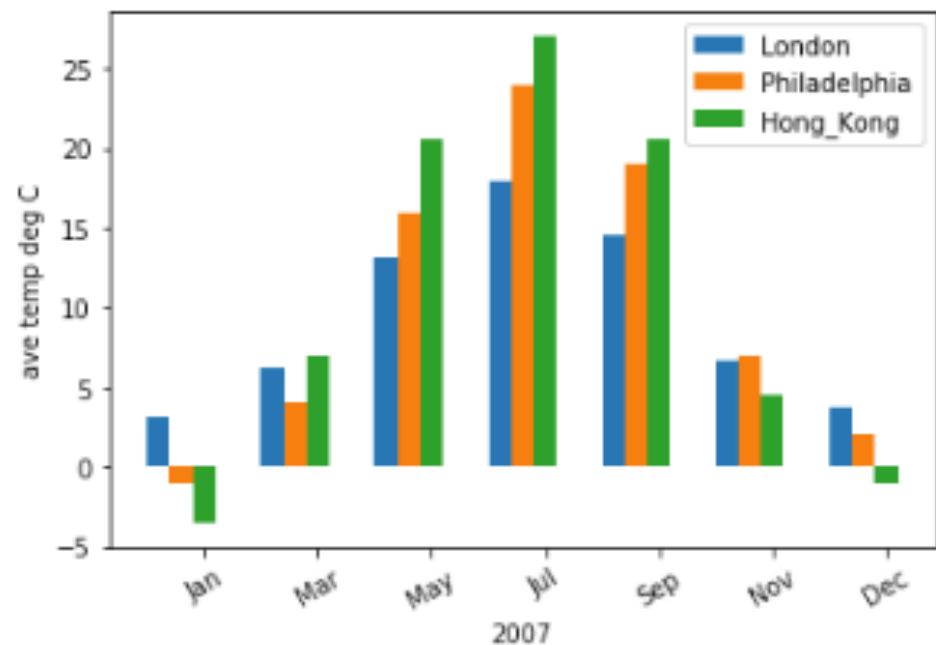
Load CSV with Numpy

```python
data = np.loadtxt('temperature_data.csv', delimiter=',', skiprows=1, usecols=range(1,7))

for i in range(data.shape[0]):
    plt.plot(data[i, :])
```
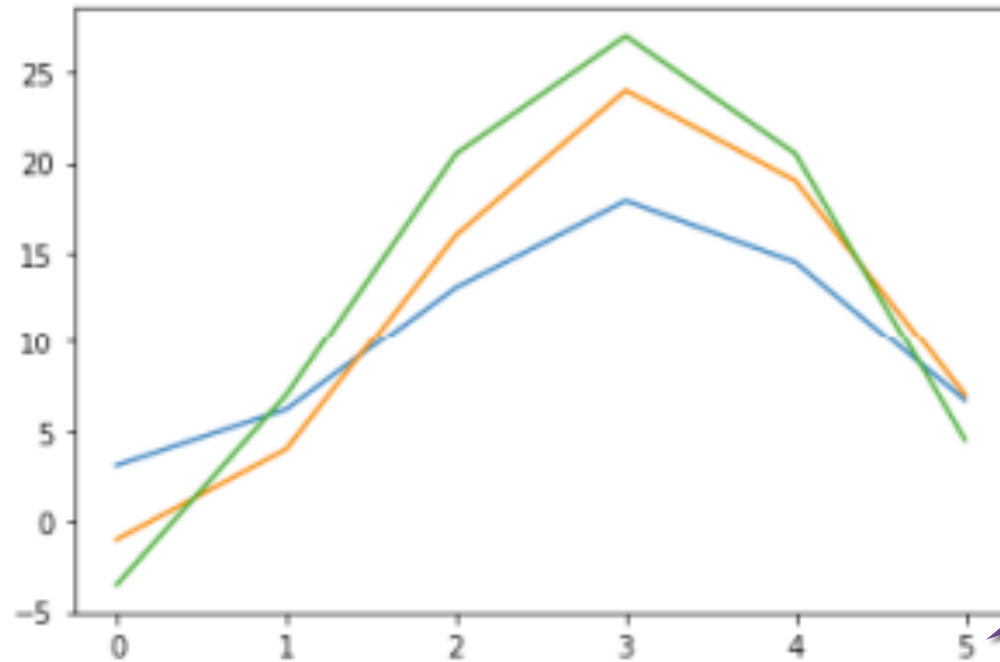

Only numerical values can be extracted

Load CSV with Numpy

> Headers can be used to address columns of data

```
1  data = np.genfromtxt('temperature_data.csv', delimiter=',' , usecols=range(1,7), names=True)
2  print(data['May'])
```

[6.2 4. 7.]