Machine Learning Computing Tutorial 1

Programming Preliminaries / Linear Mappings

1. Start Jupyter by visiting the following url: https://jupyter.org/try. Once the page has loaded, click "Try Jupyter with Python". Then go to: 'File' → 'New Notebook' → 'Python 3'.

2. First you may want to import these libraries:

```
from pylab import *
from scipy import *
```

   or

```
import pylab as pl
import scipy as sp
```

   Note that you can execute cells by pressing 'shift' + 'enter'.

3. Linear Mappings
   a) Generate $N = 100$ data points from a 2-d gaussian Distribution with mean $[1, 2]^\top$.
   b) Plot the data as a point cloud using `plot(x(1,:),(2,:),'.')` for MATLAB or `plot(X[0,:],X[1,:],'.')` for Python.
   c) Create a linear mapping **A** such that **AX** scales the first row of **X** by 1/2
   d) Plot the data again
   e) Create a linear mapping **B** such that **BAX** mirrors the data at the y-axis
   f) Plot the data again
   g) Create a linear mapping **C** such that **CBAX** permutes the y-axis and x-axis
   h) Plot the data again
   i) Create a linear mapping **D** such that **DCBAX** rotates the data by 45°
   j) Plot the data again
   k) Compute $\mathbf{E} = \mathbf{DCBA}$ and then compute **EX**
   l) Plot the data again
   m) Compute $\mathbf{F} = \mathbf{ABCD}$ and then compute **FX**
   n) Plot the data again

4. Loading numeric data in ASCII format

   Download an example text file from the moodle. The file is called: `handpositions.txt`
   Each row of this file contains tab-separated 2d-coordinates.
   Write a function that

   a) loads the data into a d-by-N array (N is the number of data points/rows of the file)

   b) plots the 2d-coordinates as in assignment 3b.

5. Some basic operations on time series (Z-Scoring)

   a) Take the same data matrix as in assignment 4.

   b) Transform each row $A[i,:]$ of that matrix such that its mean

   $$\mu = 1/N \sum_{n=1}^{N} (A[i,:]) = 0 \tag{1}$$

   is zero and its standard deviation σ is 1

   $$\sigma = \sqrt{1/N \sum_{n=1}^{N} (A[i,:] - \mu)^2} = 1. \tag{2}$$

   c) Plot the data again as in assignment 4.

It is good programming practice to *include some comments inside your code*. If you haven't done it, please take the time to do it now. It will help you understand what is happening within your code, anytime you have another look at it.