Homework:

(1) Try a simple session to start with Matlab using
http://www.math.utah.edu/lab/ms/matlab/matlab.html

(2) Let $\mathbf{w} = [w_1, w_2, w_3]^T$. Represent the following functions in the form of $\mathbf{w}^T\mathbf{A}\mathbf{w}$.
(i) $g(\mathbf{w}) = 5w_1^2 + w_2^2 + 5w_3^2 + 4w_1w_2 - 8w_1w_3 - 4w_2w_3$
(ii) $g(\mathbf{w}) = 3w_1^2 + w_2^2 + 5w_3^2 + 4w_1w_2 - 6w_1w_3 - 4w_2w_3$

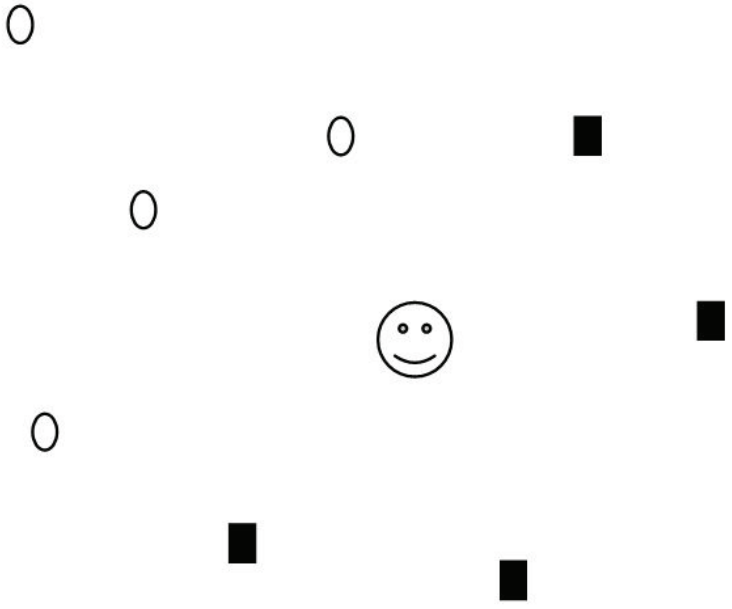
(3) Find the Hessian of $g(\mathbf{w})$ in (2).

(4) Let $\mathbf{w} = [w_1, w_2]^T$. $J(\mathbf{w}) = 8w_1^2 + 7w_2^2 + 2w_1w_2$. Use Lagrange method to find the minimum of $J(\mathbf{w})$, subject to $h(\mathbf{w}) = 2w_1 + w_2 - 2 = 0$.

(5) Let $\mathbf{w} = [w_1, w_2]^T$. Using the method of projection and Matlab to find the solutions for $\min J(\mathbf{w})$ subject to $\|\mathbf{w}\| = 1$, where
(i) $J(\mathbf{w}) = \mathbf{w}^T\mathbf{A}\mathbf{w} + \mathbf{b}^T\mathbf{w}$, with $\mathbf{A} = \begin{pmatrix} 7 & -3 \\ -3 & 8 \end{pmatrix}$, and $\mathbf{b} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$.
(ii) $J(\mathbf{w}) = \mathbf{w}^T\mathbf{A}\mathbf{w} + \mathbf{b}^T\mathbf{w} + c(\mathbf{w}^T\mathbf{w})^2$, with $\mathbf{A} = \begin{pmatrix} 7 & -3 \\ -3 & 8 \end{pmatrix}$, and $\mathbf{b} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$

(6) Change line 2 as c = [1 2 3 4 5] in par.m. Discuss the shape of the figure produced in relation to the values in c. Then repeat the above for c = [-1 -1 0 0 1] and c = [-1 0.5 -1 0 0.5].

(7) In the Figure below, data samples from two classes are denoted by 'black squares' and 'white circles'. (i) Use a ruler to measure the distance from the 'face' to each of data samples; (ii) Find the class type of the 'face' based on the nearest neighbour rule and 3-nn rule respectively.



(8) In Figure below, three data points are shown as circles and a single centre is shown as black dot and initialized. Consider applying the on-line k-means clustering algorithm with learning rate is 0.25. Plot the trajectory of the centre for two training epochs, assuming that the data samples are presented in the order of x_1, x_2 and x_3 and so on.