



Sheet#2

Orthogonal Projection

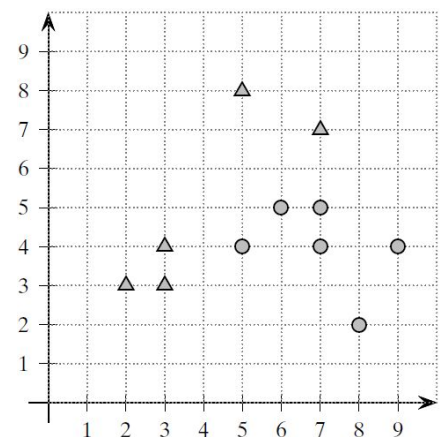
- 1) For the given vectors \mathbf{u}_1 and \mathbf{u}_2
 - a) Verify \mathbf{u}_1 and \mathbf{u}_2 are orthogonal
 - b) Find the projection of the point $\mathbf{y}=[6,3,-2]^T$ on \mathbf{u}_1 and \mathbf{u}_2

$$\mathbf{u}_1 = \begin{bmatrix} 3 \\ 4 \\ 0 \end{bmatrix}, \text{ and } \mathbf{u}_2 = \begin{bmatrix} -4 \\ 3 \\ 0 \end{bmatrix}$$

LDA

- 2) For the data on two class problem
 - a) Compute μ_{+1} and μ_{-1} , and \mathbf{B} , the between-class scatter matrix.
 - b) Find the best direction \mathbf{w} that discriminates between classes and sketch it.

$$\text{Given } \mathbf{S}^{-1} = \begin{pmatrix} 0.056 & -0.029 \\ -0.029 & 0.052 \end{pmatrix}$$



3) Midterm Question Fall 2017

For the data on two class problem

- a) Compute μ_{+1} and μ_{-1} , and \mathbf{B} , the between-class scatter matrix.
- b) Compute \mathbf{S}_{+1} and \mathbf{S}_{-1} , and \mathbf{S} , the within-class scatter matrix.
- c) Visually sketch the best direction that splits the data into the two classes.

i	x	y _i
X1	(1,1)	1
X2	(2,1)	1
X3	(1,2)	1
X4	(2,2)	-1
X5	(3,2)	-1

K Means Clustering

1. Use the k-means algorithm and Euclidean distance to cluster the following 8 examples into 3 clusters: $A1=(2,10)$, $A2=(2,5)$, $A3=(8,4)$, $A4=(5,8)$, $A5=(7,5)$, $A6=(6,4)$, $A7=(1,2)$, $A8=(4,9)$. The distance matrix based on the Euclidean distance is given below:

	A1	A2	A3	A4	A5	A6	A7	A8
A1	0	$\sqrt{25}$	$\sqrt{36}$	$\sqrt{13}$	$\sqrt{50}$	$\sqrt{52}$	$\sqrt{65}$	$\sqrt{5}$
A2		0	$\sqrt{37}$	$\sqrt{18}$	$\sqrt{25}$	$\sqrt{17}$	$\sqrt{10}$	$\sqrt{20}$
A3			0	$\sqrt{25}$	$\sqrt{2}$	$\sqrt{2}$	$\sqrt{53}$	$\sqrt{41}$
A4				0	$\sqrt{13}$	$\sqrt{17}$	$\sqrt{52}$	$\sqrt{2}$
A5					0	$\sqrt{2}$	$\sqrt{45}$	$\sqrt{25}$
A6						0	$\sqrt{29}$	$\sqrt{29}$
A7							0	$\sqrt{58}$
A8								0

Suppose that the initial seeds (centers of each cluster) are A1, A4 and A7. Run the k-means algorithm for 1 epoch only. At the end of this epoch show:

- a. The new clusters
- b. The centers of the new clusters
- c. Draw a plot with all the 8 points and show the clusters after the first epoch and the new centroids.
- d. How many more iterations are needed to converge? Draw the result for each epoch.