Lab -10
Principale Component Analysis (PCA)

→ Reduce the dimension from 2 to 1 using the principal Component Analysis (PCA). Compute the first principal Component.

Feature	Ex 1	Ex 2	Ex 3	Ex 4
X_1	4	8	13	7
X_2	11	4	5	14

Eigen values : $\lambda_1 = 30.3849$, $\lambda_2 = 6.6151$

Eigen vectors:

$$e_1 = \begin{bmatrix} 0.5574 \\ -0.8303 \end{bmatrix} \qquad e_2 = \begin{bmatrix} 0.8303 \\ 0.5574 \end{bmatrix}$$

Step 2

Mean of X_1 $= \dfrac{4+8+13+7}{4} = 8$

Mean of X_2 $= \dfrac{11+4+5+14}{4} = 8.5$

$$X_{centered} = \begin{bmatrix} 4-8 & 8-8 & 13-8 & 7-8 \\ 11-8.5 & 4-8.5 & 5-8.5 & 14-8.5 \end{bmatrix} = \begin{bmatrix} -4 & 0 & 5 & -1 \\ 2.5 & -4.5 & -3.5 & 5.5 \end{bmatrix}$$

Step 3 :

Largest Eigen value $= \lambda_1$

corresponding eigen vector $= e_1$ $= \begin{bmatrix} 0.5574 \\ -0.8303 \end{bmatrix}$

Step 4 :

$$Z = e_1^T \cdot X_{centered}$$

$$Z = [0.5574 \quad -0.8303] \begin{bmatrix} -4 & 0 & 5 & -1 \\ 2.5 & -4.5 & -3.5 & 5.5 \end{bmatrix}$$

$$Z_1 = (0.5574)(-4) + (-0.8303)(2.5) = 1.5385$$

$z_1 = 0.15385$

$z_2 = 3.73635$

$z_3 = 0.11905$

$z_4 = -4.00925$