PCALab5:

-for the following data, carry out the steps of PCA (principal component Analysis) neural network classification.

- **Covariance matrix for this you need the variance of x1 and x2.**
- **Calculate the eigen values and then calculate the eigen vectors.**
- **Use the eigen vectors to find the new transformed data.**

X1	X2	$X_1 - \overline{X_1}$	$X_2 - \overline{X_2}$	$(X_1 - \overline{X_1}) * (X_2 - \overline{X_2})$
1.4	1.65	1.85	2.2175	4.1024
1.6	1.975	2.05	2.5425	5.2121
-1.4	-1.775	-0.95	-1.2075	1.1471
-2	-2.525	-1.55	-1.9575	3.0341
-3	-3.95	-2.55	-3.3825	8.6254
2.4	3.075	2.85	3.6425	10.3811
1.5	2.025	1.95	2.5925	5.0554
2.3	2.75	1.75	3.3175	9.1231
-3.2	-4.05	-2.75	-3.4825	9.5769
-4.1	-4.85	-3.65	-4.2825	15.6311
MEAN ($\overline{X}$)	-0.45	-0.5675		
VAR	6.4228	9.9528		
coveriance	7.9876			

- Cov_Matrix

$$\begin{vmatrix} var1 & cov1,2 \\ cov1,2 & var2 \end{vmatrix}$$

$$Var = \frac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n}$$

$$COv(1,2) = \frac{\sum_{i=1}^{n}(x_{i,1} - \overline{x}_1)\ \ (x_{i,2} - \overline{x}_2)}{n-1}$$

$$\begin{vmatrix} 6.4228 & 7.9876 \\ 7.9876 & 9.9528 \end{vmatrix}$$

- To find Eigen values

$|A - \lambda I| = 0$

$\lambda^2 - 16.3756\lambda + 0.122214 = 0$

$by\ using\ aX^2 + bX + c = 0$

$X = -b \pm \sqrt{b^2 - 4ac}$

$\lambda = 16.36809984$

$\lambda = 0.007462657$

- To find Eigen Vectors

$|A - \lambda I||x| = 0$

For $\lambda = 16.36809984$

$$\begin{vmatrix} 6.4228 & 7.9876 \\ 7.9876 & 9.9528 \end{vmatrix} - \begin{vmatrix} 16.36809984 & 0 \\ 0 & 16.36809984 \end{vmatrix} |x| = 0$$

$$\begin{vmatrix} -9.9453 & 7.9876 \\ 7.9876 & -6.4153 \end{vmatrix} \begin{vmatrix} a \\ b \end{vmatrix} = 0$$

Where $a^2 + b^2 = 1$

a=0.6262

b=0.7797

For $\lambda = 0.007462657$

a=0.7797

b=- 0.6262

eigen Vector Matrix= $\begin{vmatrix} 0.6262 & 0.7797 \\ 0.7797 & -0.6262 \end{vmatrix}$

1.85	2.2175
2.05	2.5425
-0.95	-1.2075
-1.55	-1.9575
-2.55	-3.3825
2.85	3.6425
1.95	2.5925
1.75	3.3175
-2.75	-3.4825
-3.65	-4.2825

$$* \begin{vmatrix} 0.6262 & 0.7797 \\ 0.7797 & -0.6262 \end{vmatrix} =$$

Transformed Matrix

1st prenciple	2nd prenciple
2.88737	0.0538
3.266	0.00622
-1.53633	0.01545
-2.4968	0.01729
4.39133	0.12995
4.62459	0.05886
3.24237	0.10306
4.30858	0.06669
-4.43722	0.03664
-5.62453	0.16311