$$\begin{bmatrix} .69 & 0.49 \\ -1.31 & -1.21 \\ 0.39 & 0.99 \\ 0.09 & 0.29 \\ 1.29 & 1.09 \\ 0.49 & 0.79 \\ 0.19 & -0.31 \\ -0.81 & -0.81 \\ -0.31 & -0.31 \\ -0.71 & -1.01 \end{bmatrix} \times \begin{bmatrix} -.677873 & .735179 \\ .735179 & -.677873 \end{bmatrix}$$

$$Z_1 = \begin{bmatrix} .82797 & 0.175116 \\ -1.77758 & -0.142858 \\ 0.99220 & -0.384374 \\ 0.27421 & -0.130417 \\ 1.67580 & 0.209499 \\ 0.91295 & -0.175282 \\ -0.09911 & 0.349825 \\ -1.14457 & -0.046418 \\ -0.43805 & -0.017765 \\ -1.22382 & 0.162675 \end{bmatrix}$$

Case 2 :.. $W_2 = \begin{bmatrix} .677873 \\ .735179 \end{bmatrix}$

Final Data $= XW_2$
(Z_2)

$$Z_2 = \begin{bmatrix} .69 & 0.49 \\ -1.31 & -1.21 \\ 0.39 & 0.99 \\ 0.09 & 0.29 \\ 1.29 & 1.09 \\ 0.49 & 0.79 \\ 0.19 & -0.31 \\ -0.81 & -0.81 \\ -0.31 & -0.31 \\ -0.71 & -1.01 \end{bmatrix} \times \begin{bmatrix} .677873 \\ .735179 \end{bmatrix}$$

$$Z_2 = \begin{bmatrix} .82797 \\ -1.77758 \\ 0.99220 \\ 0.27421 \\ 1.67580 \\ 0.91295 \\ -0.99911 \\ -1.14457 \\ -0.43805 \\ -1.22382 \end{bmatrix}$$

(7) Reconstruction of Data :-

Case 1 :

$$W_1 = \begin{bmatrix} .677873 & 0.735179 \\ .735179 & -0.677873 \end{bmatrix}$$

$$X = Z_1 W_1^T$$

$$= \begin{bmatrix} .82797 & 0.175116 \\ -1.77758 & -0.142858 \\ \vdots & -0.384374 \\ \vdots & \vdots \\ \vdots & \vdots \\ -0.43805 & 0.017765 \\ -1.22382 & 0.162675 \end{bmatrix} \times \begin{bmatrix} .677873 & .735179 \\ .735179 & -.677873 \end{bmatrix}$$

$$X = \begin{bmatrix} 0.69 & 0.49 \\ -1.31 & -1.21 \\ 0.30 & 0.99 \\ 0.09 & \vdots \\ \vdots & \vdots \\ -0.31 & -0.31 \\ -0.71 & -1.01 \end{bmatrix}$$

(Row Zero Mean Data)

Row Original Data = Row Zero Mean Data + Original Mean

$$= X + \begin{bmatrix} 1.81 & 1.91 \end{bmatrix}$$

$$= \begin{bmatrix} 2.5 & 2.4 \\ 0.5 & 0.7 \\ 2.2 & 2.9 \\ 1.9 & 2.2 \\ 3.1 & 1 \\ \vdots & \vdots \\ 1.5 & 1.6 \\ 1.1 & 0.9 \end{bmatrix}$$

<u>Case 2 :</u> $X_1 = Z_2 \cdot W_2^T$

$$X_1 = \begin{bmatrix} .82797 \\ -1.77758 \\ \vdots \\ -0.43805 \\ -1.22382 \end{bmatrix} \times \begin{bmatrix} .677873 & 0.735179 \end{bmatrix}$$

$$X_1 = \begin{bmatrix} 0.56126 & 0.60870 \\ -1.201497 & -1.30684 \\ 0.67258 & 0.72994 \\ \vdots & \vdots \\ -0.29694 & -0.32204 \\ -0.82959 & -0.899731 \end{bmatrix}$$

Row original Data = Row zero Mean Data + Original Mean

$$= X_1 + [1.81 \quad 1.91]$$

$$= \begin{bmatrix} 2.37126 & 2.51870 \\ 0.60503 & 0.66346 \\ 2.48258 & 2.63994 \\ 1.99558 & \vdots \\ \vdots & \vdots \\ 1.51306 & 1.58796 \\ 0.98041 & 1.01027 \end{bmatrix}$$

It is seen that if only the first eigenvector is considered, then the data can be reconstructed similar to the original dataset.

Assignment: Use PCA to arrive at the transformed matrix for given matrix A.

$$A^T = \begin{bmatrix} 2 & 1 & 0 & -1 \\ 4 & 3 & 1 & 0.5 \end{bmatrix}$$

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