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Q3) $A = \begin{bmatrix} 0 & -1 \\ 2 & 3 \end{bmatrix}$

finding Eigean value :-

$A - \lambda I = 0$

$$\left| \begin{bmatrix} 0 & -1 \\ 2 & 3 \end{bmatrix} - \lambda \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \right| = 0$$

$$\left| \begin{bmatrix} 0 & -1 \\ 2 & 3 \end{bmatrix} - \begin{bmatrix} \lambda & 0 \\ 0 & \lambda \end{bmatrix} \right| = 0$$

$$\left| \begin{bmatrix} -\lambda & -1 \\ 2 & 3-\lambda \end{bmatrix} \right| = 0$$

$-3\lambda + \lambda^2 + 2 = 0$

$\lambda^2 - 3\lambda + 2 = 0$

$\therefore \lambda = 2, 1$

$\boxed{\text{Eigean values} = 2, 1}$

finding eigean vector.

$$(A - \lambda I)\vec{v} = 0$$

$$\left(\begin{bmatrix} 0 & -1 \\ 2 & 3 \end{bmatrix} - \begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix} \right) v = 0$$

$$\left(\begin{bmatrix} -2 & -1 \\ 2 & 1 \end{bmatrix} \right) \begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = 0$$

$$-2v_1 - v_2 = 0$$

$$2v_1 + v_2 = 0$$

$$\boxed{v_1 = v_2/2} \text{ —— } 1$$

$$\left(\begin{bmatrix} 0 & -1 \\ 2 & 3 \end{bmatrix} - \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \right) v = 0$$

$$\begin{bmatrix} 1 & -1 \\ 2 & 2 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = 0$$

$$v_1 - v_2 = 0$$

$$2v_1 + 2v_2 = 0$$

$$\boxed{v_1 = -v_2} \text{ —— } 2$$

Ques 2) Let $\{v_1, v_2 ---- v_n\}$ be an orthonormal basis for a subspace of R^n

For each element in this subspace, the weights in the linear combination is

$$\vec{V} = c_1\vec{V_1} + c_2\vec{V_2} ---- c_n\vec{V_n}$$

This can be given as.

$$c_i = \frac{V \cdot v_i}{(V_i)^2} \quad \text{where } i = 1, --- n$$

As orthonormal set is a set of orthogonal set of unit vectors. This formula holds true for constants in terms of S.