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Q1

$$[A-\lambda I][X] = 0$$

$$A = \begin{bmatrix} 6 & -6 & 5 \\ 14 & -13 & 10 \\ 7 & -6 & 4 \end{bmatrix}$$

$$\lambda = -1$$

$$\left[\begin{bmatrix} 6 & -6 & 5 \\ 14 & -13 & 10 \\ 7 & -6 & 4 \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}\right] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = 0$$

$$\begin{bmatrix} 7 & -6 & 5 \\ 14 & -12 & 10 \\ 7 & -6 & 5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

$$7x_1 - 6x_2 + 5x_3 = 0$$
$$14x_1 - 12x_2 + 5x_3 = 0$$

$$\Rightarrow 7x_1 - 6x_2 + 5x_3 = 0$$

Here $x_1 = 0$, $x_3 = 1$

$$x_2 = -\frac{5}{6}$$

$$X_1 = \begin{bmatrix} 0 \\ -5/6 \\ 1 \end{bmatrix} \Rightarrow X_1 = \begin{bmatrix} 0 \\ -5 \\ 6 \end{bmatrix}$$

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Q2

The characteristic equation. $A = \begin{bmatrix} 1 & 2 \\ 4 & 3 \end{bmatrix}$

$\lambda^2 - S_1\lambda + S_2 = 0$.

S_1 = trace of A = 4

S_2 = $|A|$ = -5

$\lambda^2 - 4\lambda - 5 = 0$

Replace λ by s

$A^2 - 4A - 5I = 0$.

~~Divide by~~ A^{-1} Multiply by A^{-1}

$A - 4I - 5A^{-1} = 0$

$A - 4I = 5A^{-1}$

$\begin{bmatrix} 1 & 2 \\ 4 & 3 \end{bmatrix} - 4\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = 5A^{-1}$

$\frac{1}{5}\begin{bmatrix} -3 & 2 \\ 4 & -1 \end{bmatrix} = A^{-1}$

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Q3

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

$D_1 = |a_{11}| = 1$

$$D_2 = \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} = \begin{vmatrix} 1 & 1 \\ 1 & 2 \end{vmatrix} = 2 - 1$$

$$D_3 = \begin{vmatrix} 1 & 1 & -1 \\ 1 & 2 & 1 \\ 1 & 1 & 3 \end{vmatrix} = 1(6-1) - 1(3-1) - 1(1-2)$$
$$= 5 - 2 + 1$$
$$= 4$$

Since $D_1 > 0$, $D_2 > 0$, $D_3 > 0$; A is positive definite matrix