$$|A - \lambda I| = (1-\lambda)(2-\lambda)^5 = 0$$

$$\lambda_1 = 1 \qquad \lambda_2 = 2$$

First, we calulete the eigenvectors

For $\lambda_1 = 1$

$$Ax = x$$

So

$$x_1 + x_2 + x_6 = x_1$$
$$2x_1 + x_4 + 2x_5 + 3x_6 = x_2$$
$$2x_3 + x_5 - x_6 = x_3$$
$$2x_4 + x_5 + 2x_6 = x_4$$
$$2x_5 = x_5$$
$$2x_6 = x_6$$

So $\cancel{W}_1 = \begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$ is a eigenvector

For $\lambda_2 = 2$

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

with reduced row form

$$\begin{bmatrix} -1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 2 & 3 \\ 0 & 0 & 0 & 0 & 1 & -1 \\ 0 & 0 & 0 & 0 & 0 & 3 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

So

$$N(A-2I) = \text{Span}\left\{ \begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} \begin{bmatrix} 1 \\ 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{bmatrix} \right\}$$

Denote $v_1 = \begin{pmatrix} 1 \\ 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$ $v_2 = \begin{pmatrix} 1 \\ 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{pmatrix}$

We slove

$(A-2I)x = v_1$

$$\left.\begin{aligned} x_5 + 2x_6 &= 0 \\ x_5 - x_6 &= 0 \\ x_4 + 2x_5 + 3x_6 &= 1 \\ -x_1 + x_2 + x_3 + x_4 + x_5 + x_6 &= 1 \end{aligned}\right. \Rightarrow \begin{cases} x_4 = 1 \\ -x_1 + x_2 + x_3 = 0 \end{cases}$$

So $v_3 = \begin{pmatrix} 1 \\ 1 \\ 0 \\ 1 \\ 0 \\ 0 \end{pmatrix}$

$(A-2I)X = v_3$

$$\begin{aligned} x_5 + 2x_6 &= 1 \\ x_5 - x_6 &= 0 \\ x_4 + 2x_5 + 3x_6 &= 1 \\ -x_1 + x_2 + x_3 + x_4 + x_5 + x_6 &= 1 \end{aligned}$$

$v_4 = \begin{pmatrix} 1 \\ 1 \\ 0 \\ -\frac{2}{3} \\ \frac{1}{3} \\ \frac{1}{3} \end{pmatrix}$

$$(A - 2I)x = v_2$$

$$x_5 + 2x_6 = 0$$

$$x_5 - x_6 = 1$$

$$x_4 + 2x_5 + 3x_6 = 0$$

$$-x_1 + 2x_2 + x_3 + x_4 + x_5 + x_6 = 1$$

$$v_5 = \begin{pmatrix} 1 \\ 0 \\ 0 \\ \frac{1}{3} \\ \frac{2}{3} \\ -\frac{1}{3} \end{pmatrix}$$

Take

$$P = (w_1, v_1, v_3, v_4, v_2, v_5)$$

$$J = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 2 & 1 & 0 & 0 & 0 \\ 0 & 0 & 2 & 1 & 0 & 0 \\ 0 & 0 & 0 & 2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 2 & 1 \\ 0 & 0 & 0 & 0 & 0 & 2 \end{pmatrix}$$