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5a. $A = PDP^{-1}$

$$P = \begin{bmatrix} 1 & a & a \\ 0 & b & b \\ -1 & c & c \end{bmatrix} \qquad D = \begin{bmatrix} 3 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$$

$$A = \begin{bmatrix} d & g & h \\ g & e & i \\ h & i & f \end{bmatrix} \qquad \cancel{g(g(f-3) - hi) + h(gi - h(e-3))}$$

Standard polynomial of A:

$$(\lambda - 3)(\lambda + 1)^2 = 0 \qquad \text{when } \lambda = 3,\ \vec{x} = \begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix}$$

$$A\vec{x} = \lambda x$$

$$\begin{bmatrix} d & g & h \\ g & e & i \\ h & i & f \end{bmatrix} \begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix} = \begin{bmatrix} 3 \\ 0 \\ -3 \end{bmatrix}$$

$$\begin{aligned} d - h &= 3 & h &= d - 3 \\ g - i &= 0 & g &= i \\ h - f &= -3 & f &= h + 3 = d - 3 + 3 = d \end{aligned}$$

$$A = \begin{bmatrix} d & i & d-3 \\ i & e & i \\ d-3 & i & d \end{bmatrix}$$

$$(d-\lambda)((e-\lambda)(d-\lambda)) - i(\cancel{i(d-\lambda) - i(d-\lambda)}) + (d-\lambda)(i^2 - e(d-\lambda))$$

$$(d-\lambda)^2(e-\lambda) + (d-\lambda)(i^2 - e(d-\lambda))$$

b. ~~Assume A =~~ ~~A was known (I couldn't figure it out)~~

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56. $A^{99} = \cancel{P^{99}} D^{99} \cancel{P^{-99}} = D^{99} = \begin{bmatrix} 3 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}^{99}$

$$\begin{bmatrix} 3 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} 3 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 9 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

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

$$\begin{bmatrix} 3 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}^{99} = \begin{bmatrix} 3^{99} & 0 & 0 \\ 0 & (-1)^{99} & 0 \\ 0 & 0 & 1^{99} \end{bmatrix} = \begin{bmatrix} 3^{99} & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 3^{99} & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} 1 \\ 3 \\ 1 \end{bmatrix} = \begin{bmatrix} 3^{99} \\ -3 \\ 1 \end{bmatrix}$$

$$A^{99}\vec{\omega} = \begin{bmatrix} 3^{99} \\ -3 \\ 1 \end{bmatrix}$$