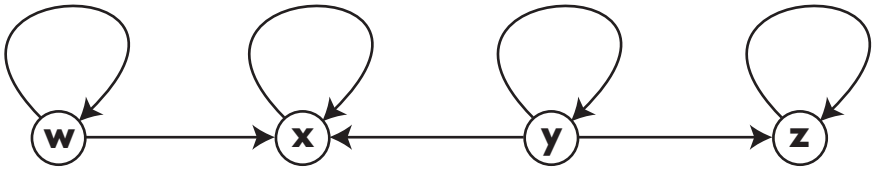
[1] Using matrix multiplication, count the number of paths of length ten from y to z.



[2] Find the 3×3 matrix that projects orthogonally onto the plane

$$x - z = 0$$

[3] Find $f(n)$, where $f(n)$ is the determinant of the $n \times n$ matrix in the sequence

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

Your final answer should be in the form $f(n) = a\,r^n + b\,s^n$

[4] Find e^{At} where A is the matrix

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

[5] Find e^{At} where A is the matrix

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

[6] Solve the differential equation $y' = Ay$ where

$$A = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 2 & 1 \\ 1 & 0 & 1 \end{bmatrix}, \qquad y(0) = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$$

[7] Solve the differential equation $y' = Ay$ where

$$A = \begin{bmatrix} -2 & 2 & -1 \\ -1 & 1 & -2 \\ -1 & 1 & 1 \end{bmatrix}, \qquad y(0) = \begin{bmatrix} 2 \\ 0 \\ 1 \end{bmatrix}$$

[8] Express the quadratic form

$$3x^2 + 2xy + 2y^2 + 2yz + 3z^2$$

as a sum of squares of othogonal linear forms.