Step-1

Fibonacci rule is given by: $F_{k+2} = F_{k+1} + F_k$.

Let the Fibonacci matrix be as follows:

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

Step-2

Lucas numbers starts with L_0, L_1 is given as follows:

 $L_0 = 2$ $L_1 = 1$

Lucas rule is the same as Fibonacci rule.

$$L_{k+2} = L_{k+1} + L_k \\$$

Step-3

Evaluate Lucas numbers L_{10} and λ_1^{10} .

Step-4

First ten Lucas number is as follows:

 $L_{2} = L_{1} + L_{0}$ = 1 + 2 = 3 $L_{3} = L_{2} + L_{1}$

 $L_3 = L_2 + L_3$ = 3 + 1= 4

Similarly, other calculated Lucas numbers are as follows:

2, 1, 3, 4, 7, 11, 18, 29, 47, 76, 123.

Step-5

Therefore, $L_{10} = 123$

Step-6

Eigen value of Lucas number will be:

$$\lambda_1 = \frac{1}{2} \Big(1 + \sqrt{5} \, \Big)$$

$$\lambda_2 = \frac{1}{2} \left(1 - \sqrt{5} \right)$$

So,

$$\lambda_1^{10} = \left(\frac{1}{2}(1+\sqrt{5})\right)^{10} = 122.99 \\ \approx 123$$

Step-7

Therefore, $\lambda_1^{10} = 123$