

A powerful Matrix

answers were double checked using the matrix multiplication calculator provided by nich

$$Q = \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}$$

$$Q^2 = (Q \times Q)$$

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

$$Q^3 = Q \times Q \times Q \quad (Q^2 \times Q \text{ or } Q \times Q^2)$$

$$Q^2 \times Q = \begin{pmatrix} 2 & 1 \\ 1 & 1 \end{pmatrix} \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix} = \begin{pmatrix} 3 & 2 \\ 2 & 1 \end{pmatrix}$$

$$Q \times Q^2 = \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 2 & 1 \\ 1 & 1 \end{pmatrix} = \begin{pmatrix} 3 & 2 \\ 2 & 1 \end{pmatrix}$$

$$Q^4 = Q \times Q \times Q \times Q$$

($Q^3 \times Q$, $Q \times Q^3$ or $Q^2 \times Q^2$)

$$\begin{pmatrix} 5 & 3 \\ 3 & 2 \end{pmatrix} = \begin{pmatrix} 5 & 3 \\ 3 & 2 \end{pmatrix}$$

$$Q^2 \times Q^2 = \begin{pmatrix} 2 & 1 \\ 1 & 1 \end{pmatrix} \begin{pmatrix} 2 & 1 \\ 1 & 1 \end{pmatrix} = \begin{pmatrix} 5 & 3 \\ 3 & 2 \end{pmatrix}$$

$$Q^5 = Q \times Q \times Q \times Q \times Q$$

($Q^4 \times Q$, $Q^3 \times Q^2$ or $Q^2 \times Q^3$)

$$Q^4 \times Q = \begin{pmatrix} 5 & 3 \\ 3 & 2 \end{pmatrix} \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix} = \begin{pmatrix} 8 & 5 \\ 5 & 3 \end{pmatrix}$$

same $Q^5 \times Q^4$, $Q^3 \times Q^2$

$$Q^1 = \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}$$

$$Q^2 = \begin{pmatrix} 2 & 1 \\ 1 & 1 \end{pmatrix}$$

$$Q^3 = \begin{pmatrix} 3 & 2 \\ 2 & 1 \end{pmatrix}$$

$$Q^4 = \begin{pmatrix} 5 & 3 \\ 3 & 2 \end{pmatrix}$$

$$Q^5 = \begin{pmatrix} 8 & 5 \\ 5 & 3 \end{pmatrix}$$

$$Q^3 \times Q = \begin{pmatrix} 3 & 2 \\ 2 & 1 \end{pmatrix} \times \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix} = \begin{pmatrix} 5 & 3 \\ 3 & 2 \end{pmatrix}$$

1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987, 1597, 2584, 4181, 6765, 10647, 16977, 26777, 42730, 66947, 104183, 161813, 251188, 390731, 600046, 919603, 1418729, 2191148, 3413141, 5212381, 8019752, 12226757, 18711487, 28637781, 43956804, 67260157, 102976745, 157132969, 239914640, 365435297, 557487337, 850648177, 1291235475, 1970053762, 2980102949, 4501550624, 6841372114, 10399084501, 15801471317, 23990743701, 36140821009, 54670957344, 82857183121, 125868640625, 190909272135, 288008414360, 435307450435, 661314163700, 1000047343645, 1511348649460, 2271486354705, 3453144004165, 5234630653870, 7907274969075, 11916089733645, 17905170726815, 27125598784490, 40930768518135, 61490367282630, 92216059714725, 139403647002465, 210194146717185, 318680806451910, 483978384669495, 727905146612150, 1100087212670745, 1664985601508845, 2511888419767460, 3771478746179245, 5648464348688000, 8506481771865505, 12790517072681505, 19290019549591010, 28901615556846465, 43530768518136470, 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