

# Challenging Problem1

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Download all latex-tikz codes from

<https://github.com/spdanda/AI1103/blob/main/Challenging%20Problem1/main.tex>

## Question :

Let  $X$  be a random variable such that  $E(X) = E(X^2) = 1$ . Then  $E(X^{100}) = ?$

1. 0
2. 1
3.  $2^{100}$
4.  $2^{100} + 1$

## Solution:

Given  $E(X) = E(X^2) = 1$ , hence variance of  $X$  is

$$Var(X) = E(X^2) - (E(X))^2 \quad (0.0.1)$$

$$= 1 - (1)^2 \quad (0.0.2)$$

$$= 0 \quad (0.0.3)$$

Also,

$$Var(X) = E[(X - E(X))^2] \quad (0.0.4)$$

$$\Rightarrow E[(X - E(X))^2] = 0$$

$$\Rightarrow (X - E(X))^2 = 0 \quad \forall X$$

$$\Rightarrow X = E(X) = 1 \quad \forall X$$

$\therefore$  The random variable  $X$  is a constant and equals to 1.

Hence,

$$E(X^{100}) = 1 \quad (0.0.5)$$

Option 2 is the correct answer.