

# Discrete Assignment

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February 17, 2024

## Problem Statement

Find the value of  $n$  so that  $\frac{a^{n+1}+b^{n+1}}{a^n+b^n}$  may be the geometric mean between  $a$  and  $b$ .

## 1 Solution

Parameter	Value	Description
$x(0)$	$a$	First term
$x(2)$	$b$	Third term
$x(1)$	$\sqrt{ab} = \frac{a^{n+1}+b^{n+1}}{a^n+b^n}$	Second term
$r$	$\sqrt{\frac{b}{a}}$	Common ratio
$n$	-	Given variable
$x(k)$	$ar^k u(k)$	General term

Table 1: Input parameters table

Consider a GP as in Table 1,

$$\therefore \frac{a^{n+1} + b^{n+1}}{a^n + b^n} = x(1) \quad (1)$$

$$\implies a^{n+1} + b^{n+1} = a^{n+\frac{1}{2}}b^{\frac{1}{2}} + a^{\frac{1}{2}}b^{n+\frac{1}{2}} \quad (2)$$

$$\implies a^{n+\frac{1}{2}}(a^{\frac{1}{2}} - b^{\frac{1}{2}}) = b^{n+\frac{1}{2}}(a^{\frac{1}{2}} - b^{\frac{1}{2}}) \quad (3)$$

$$\implies \left(\frac{a}{b}\right)^{n+\frac{1}{2}} = \left(\frac{a}{b}\right)^0 \quad (4)$$

$$\implies n = -\frac{1}{2} \quad (5)$$

From Table 1,

$$X(z) = \sum_{k=-\infty}^{\infty} (ar^k)u(k)z^{-k} \quad (6)$$

$$= \sum_{k=-\infty}^{\infty} a(rz^{-1})^n \quad (7)$$

$$= \frac{a}{1 - \left(\sqrt{\frac{b}{a}}\right)z^{-1}} \quad |z| > \left|\sqrt{\frac{b}{a}}\right| \quad (8)$$