

# Assignment

EE23BTECH11008 - Meenakshi

Q:The difference between any two cosecutive interior angles of a polygon is  $5^\circ$ .If the smallest angle is  $120^\circ$ ,find the number of sides of polygon.

**Solution:** The interior angles of a polygon are in AP with  $x(0) = 120$ ,  $d = 5$

| Variable | Description             | Value |
|----------|-------------------------|-------|
| $x(0)$   | first term of AP        | 120   |
| $d$      | common difference of AP | 5     |
| $x(n)$   | general term of AP      | none  |

Sum of interior angles of a polygon with  $n+1$  sides is given by

$$S = (n - 1)180 \quad (1)$$

Sum of  $n$  terms of AP is given by

$$y(n) = \sum_{k=0}^n x(k) \quad (2)$$

$$= x(n) * u(n) \quad (3)$$

$$x(n) * u(n) = (n - 1)180 \quad (4)$$

now taking Z-transform on both sides

$$X(z)U(z) = \sum_{n=-\infty}^{\infty} (180n - 180)z^{-n}u(n) \quad (5)$$

$$\left( \frac{x(0)}{1 - z^{-1}} + \frac{dz^{-1}}{(1 - z^{-1})^2} \right) \cdot \frac{1}{1 - z^{-1}} \quad |z| > 1 = \sum_{n=0}^{\infty} (180n - 180)z^{-n} \quad (6)$$

$$\frac{120}{(1 - z^{-1})^2} + \frac{5z^{-1}}{(1 - z^{-1})^3} = \frac{180}{1 - z^{-1}} - \frac{180z^{-1}}{(1 - z^{-1})^2} \quad |z| > 1 \quad (7)$$

$$120 \left[ \frac{1}{1 - z^{-1}} + \frac{z^{-1}}{(1 - z^{-1})^2} \right] + \frac{5}{2} \left[ -\frac{d}{dz} \left( \frac{1}{1 - z^{-1}} + \frac{z^{-1}}{(1 - z^{-1})^2} \right) \right] - \frac{180}{1 - z^{-1}} + \frac{180z^{-1}}{(1 - z^{-1})^2} = 0 \quad (8)$$

Taking inverse Z- transform on both sides

$$120(n + 1)u[n - 1] + \frac{5}{2}n(n + 1)u[n - 1] - 180nu[n] + 180u[n + 1] = 0 \quad (9)$$

$$\frac{n + 1}{2} (240 + 5n) u[n] - 180nu[n] + 180u[n + 1] = 0 \quad (10)$$

$$(n + 1)(240 + 5n) - 360n + 360 = 0 \quad \forall n \geq 1 \quad (11)$$

$$(12)$$

now replace  $n$  by  $n-1$ :

$$n(235 + 5n) - 360(n - 1) + 360 = 0 \quad (13)$$

$$5n^2 - 125n + 720 = 0 \quad (14)$$

solving the above equation we get

$$n = 16, 9 \quad (15)$$

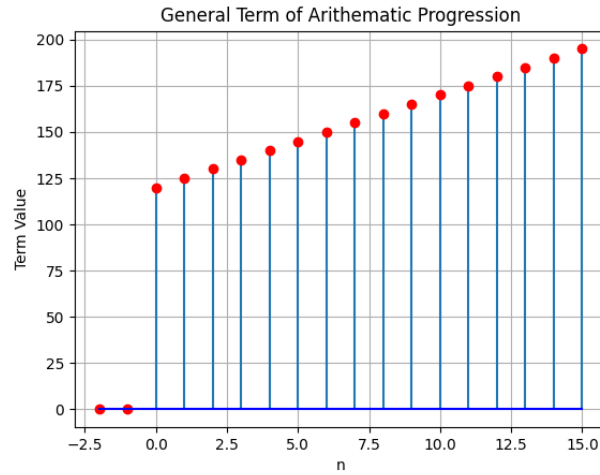


Fig. 0: Plot of the general term taken from Python