Discrete Mathematics

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1 Arithmetic Progression Problem

Which term of the arithmetic progression (AP): $3, 8, 13, 18, \ldots$, is 78?

$$\text{Let } \mathrm{x}(n) = [\mathrm{x}(0) + (n-1)\mathrm{d}] \times \mathrm{u}(n) \quad \text{(Arithmetic Progression formu}$$
$$\text{Given: } \mathrm{x}(0) = 3, \quad \mathrm{d} = 5, \quad \mathrm{x}(k) = 78$$

Substitute values into the formula:

$$\begin{aligned} 78 &= 3 + (k-1) \times 5 \\ 75 &= 5(k-1) \\ 15 &= k - 1 \\ k &= 16 \end{aligned}$$

Therefore, the term number (k) when $\mathrm{x}(k) = 78$ in the given arithmetic progression is 16.

Now, let the Z-transform of $x(n)$ be $X(z)$. Let $U(z)$ be the Z-transform of $u(n)$.

$$\begin{aligned} X(z) &= x(0)U(z) + dZ\{nu(n)\} \\ &= \frac{x(0)}{1 - z^{-1}} + \frac{d}{(1 - z^{-1})^2} \quad \forall \quad |z| > 1 \end{aligned}$$

Using the values from the arithmetic progression problem:

$$X(z) = \frac{3}{1 - z^{-1}} + \frac{5}{(1 - z^{-1})^2} \quad \forall \quad |z| > 1$$