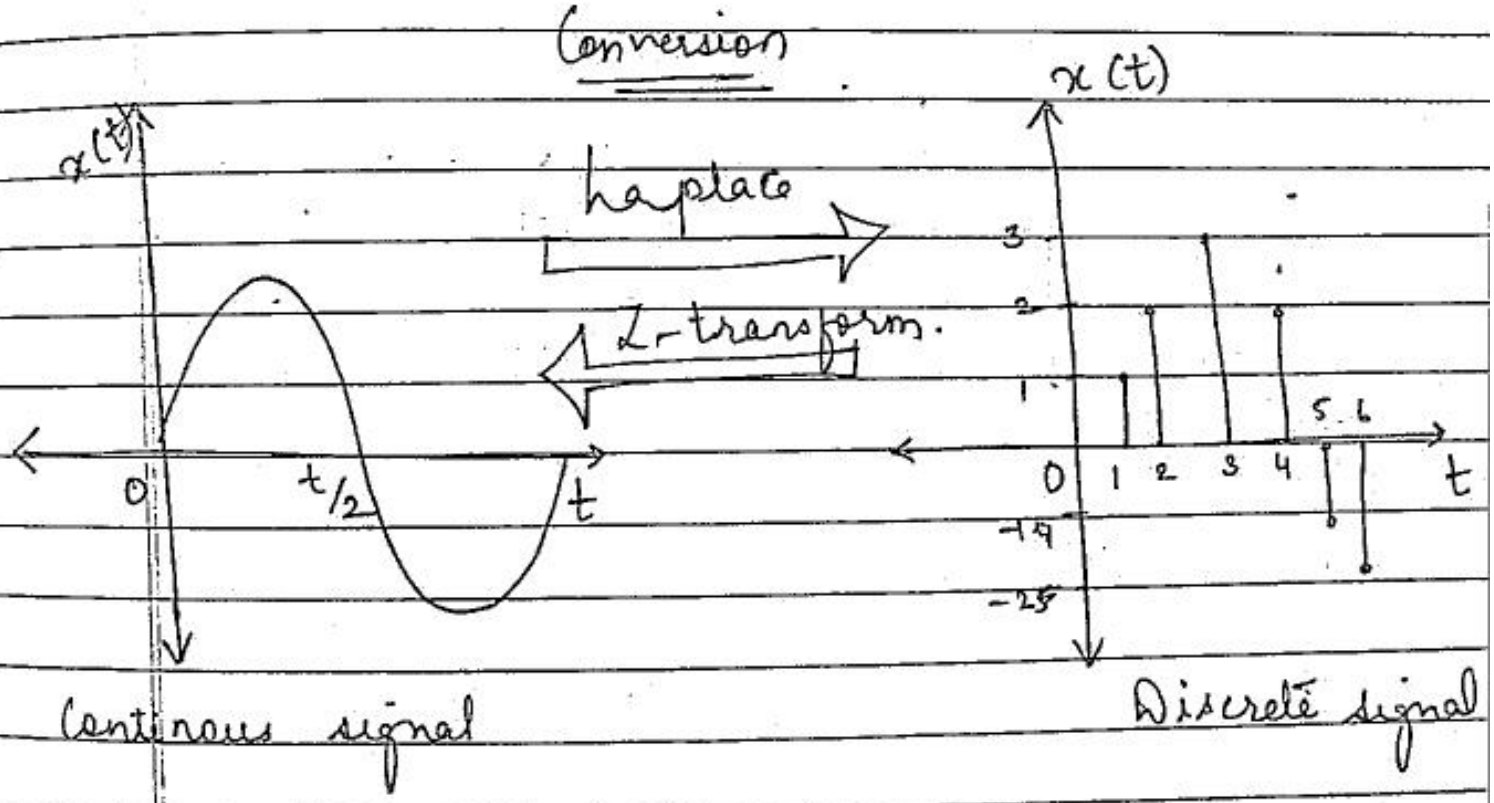
Z transforms.

→ Convert discrete signal to Continous signal.
→ Denoted by -

$$X(z) = \sum_{n=-\infty}^{\infty} x(n) \cdot z^{-n}$$

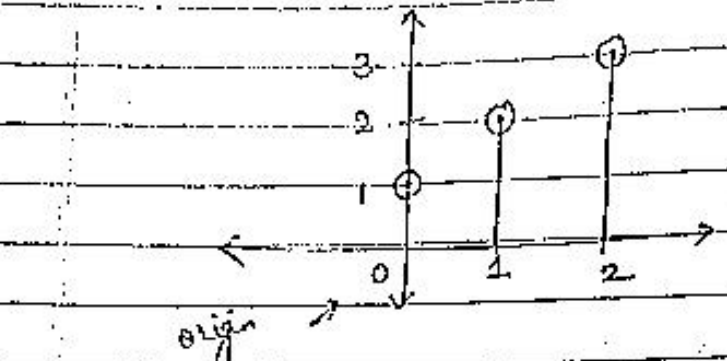
where $X(z)$ → Z transformed signal (o/p)
$x(n)$ → discrete signal (i/p)
z^{-n} → complex variable.
all of above continues for $n = -\infty$ to ∞.



→ Types of Z transform.

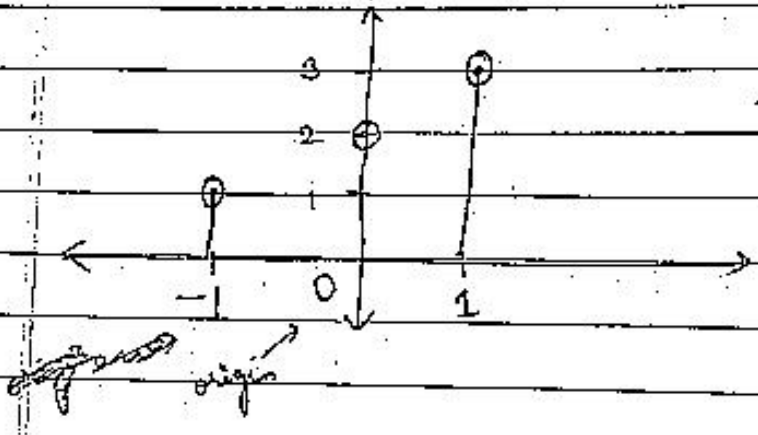
Eg: $x(n) = \{1, \underset{\uparrow}{2}, 3\}$

origin



∴ Since signal is only in 1 quadrant it is a 'Unilateral signal'.

Similarly if $x(n) = \{1, \underset{\uparrow}{2}, 3\}$



∴ Since signal is in both 2 quadrants, it is a 'Bilateral signal'.

★ Formula for Unilateral :-

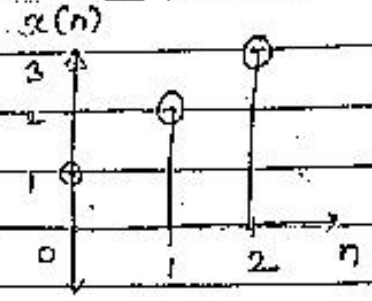
$$X(z) = \sum_{n=0}^{\infty} x(n) \cdot z^{-n}$$

★ Formula for Bilateral :-

$$X(z) = \sum_{n=-\infty}^{\infty} x(n) \cdot z^{-n}$$

Ex: If $x(n) = \{1, 2, 3\}$

$n = 0 \quad 1 \quad 2$



formula for Z-transform -

Unilateral Z-transform

$$X(z) = \sum_{n=0}^{\infty} x(n) \cdot z^{-n}$$

Here n ranges from 0 to 2.

$$\therefore X(z) = \sum_{n=0}^{2} x(n) \cdot z^{-n}$$

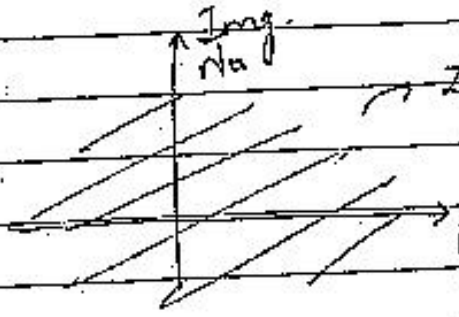
$$X(z) = x(0) \cdot z^0 + x(1) \cdot z^{-1} + x(2) \cdot z^{-2}$$

$$= 1 \cdot 1 + 2 \cdot z^{-1} + 3 \cdot z^{-2}$$

$$\therefore \boxed{X(z) = 1 + \frac{2}{z} + \frac{3}{z^2}}$$

→ Now, Region of convergence (ROC).

z → Complex variable.



Region of convergence lies here where the value of n becomes finite.

→ Lets find the ROC of above eqn –

$$X(z) = 1 + \frac{2}{z} + \frac{3}{z^2}$$

Lets substitute $z = 0$ & check. –

$$\therefore X(z) = 1 + \frac{2}{0} + \frac{3}{0}$$

Anything devided by 0 becomes ∞.

$$\therefore X(z) = 1 + \infty + \infty$$

$\therefore X(z) = \infty$ for $z = 0$ is ∞

$\therefore$ Not ROC.

Next substitute $z = 1$ & check –

$$X(z) = 1 + \frac{2}{1} + \frac{3}{1^2}$$

$$= 1 + 2 + 3$$

$\therefore \boxed{X(z) = 6}$ which is finite

$\therefore \boxed{z = 1 \text{ is in ROC}}$

Now lets substitute $z = \infty$ & check –

$$X(z) = 1 + \frac{2}{\infty} + \frac{3}{\infty}$$

(when anything divided by large no., it nearly equals to zero.

ex: $\frac{1}{10} = 0.1$

$\frac{1}{100} = 0.01$

$$\therefore X(z) = 1 + 0 + 0$$

i.e $\boxed{X(z) = 1}$

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Thus the ROC for $X(z) = 1 + \frac{2}{z} + \frac{3}{z^2}$

is anything but not Zero.

→ Lets plot —.