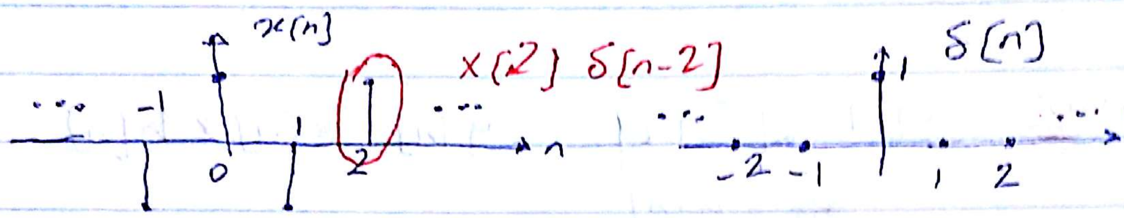
$z = r e^{j\hat{\omega}}$

$\hat{\omega}$: discrete-time frequency in rad/sample



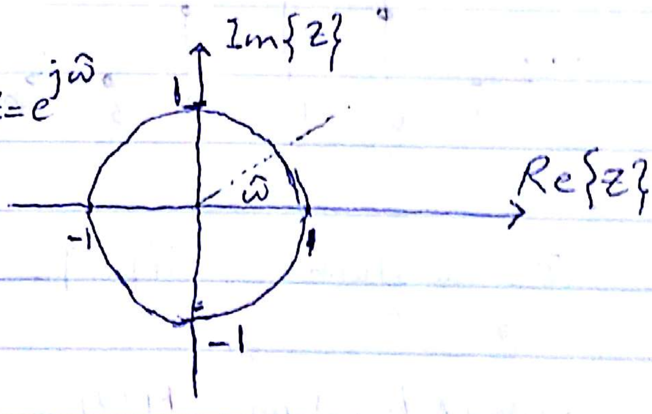
$$X_{freq}(\hat{\omega}) = \sum_{k=-\infty}^{\infty} x[k]\, e^{-j\hat{\omega}k}$$

$$X(z) = \sum_{k=-\infty}^{\infty} x[k]\, z^{-k}$$

when $z = e^{j\hat{\omega}}$ is a valid substitution

$$X_{freq}(\hat{\omega}) = X(z)\Big|_{z=e^{j\hat{\omega}}}$$

$\hat{\omega}$	$e^{j\hat{\omega}}$
0	1
$\frac{\pi}{2}$	j
$-\pi$ or π	-1
$-\frac{\pi}{2}$	$-j$



$$X(z) = x[0] + x[1]\, z^{-1} + \dots + x[N]\, z^{-N}$$

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$e^{j\hat{\omega}n} \longrightarrow \boxed{\text{LTI}} \longrightarrow H_{freq}(\hat{\omega})\, e^{j\hat{\omega}n}$

z^{+n} $\qquad$ $H(z)\, z^{+n}$

Simulation/Analysis $\Longrightarrow$ $x[n] \longrightarrow \boxed{\text{LTI}} \longrightarrow y[n] = x[n] * h[n]$

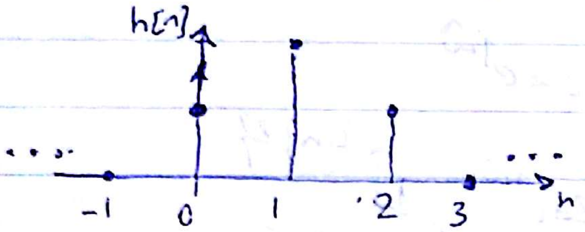
$h[n]$

Analysis $\Longrightarrow$ $X_{freq}(\hat{\omega})$ $\quad H_{freq}(\hat{\omega})$ $\quad Y_{freq}(\hat{\omega}) = H_{freq}(\hat{\omega})\, X_{freq}(\hat{\omega})$

Design $\Longrightarrow$ $X(z)$ $\quad H(z)$ $\quad Y(z) = H(z)\, X(z)$

$H(z) = 1 + 2z^{-1} + z^{-2}$

$h[n] = \delta[n] + 2\delta[n-1] + \delta[n-2]$



z-transform $\quad h[n] \longrightarrow \boxed{\mathcal{Z}\{\}} \longrightarrow H(z) = \sum_{k=-\infty}^{\infty} h[k]\, z^{-k}$

inverse z-transform $\quad H(z) \longrightarrow \boxed{\mathcal{Z}^{-1}\{\}} \longrightarrow h[n]$