2. (20pts) An LTI system is described by the input-output relation

$$y[n] = x[n] + 2x\lfloor n-1 \rfloor + x\lfloor n-2 \rfloor.$$

(a) Determine $h[n]$.

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

(b) Is this a stable system?

(c) Determine $H(e^{j\omega})$ and simplify it using trigonometric identities.

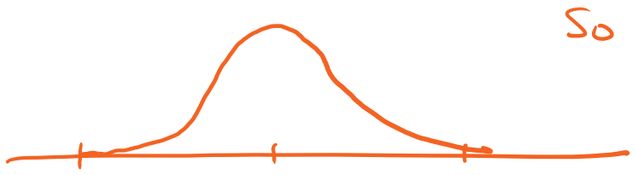
$H(e^{j\omega}) = 1 + 2e^{-j\omega} + e^{-j2\omega}$

$= e^{-j\omega}(2 + 2\cos\omega)$

$= 2e^{-j\omega}(1 + \cos\omega)$

I like this form because I can see

① $M(\omega) = 2(1+\cos\omega)$



So H is a lowpass filter

② $\theta(\omega) = -\omega$

So it is a linear-phase filter.

I cannot see these two elegant facts from any other form.