Signals and Systems HW6
Deadline: 2019/05/10 before 18:30
(You should submit hand-writing paper to BL B1 EE student office.)

1. An FIR filter has a total $M+1$ coefficients, where M is an odd integer. Suppose the impulse response $h[n]$ of this filter is symmetric about the non-integer point $n = M/2$. In addition, define

$$g[n] = 2h\left[\frac{M+1}{2} - n\right], \qquad n = 1,2,\dots,\frac{M+1}{2}.$$

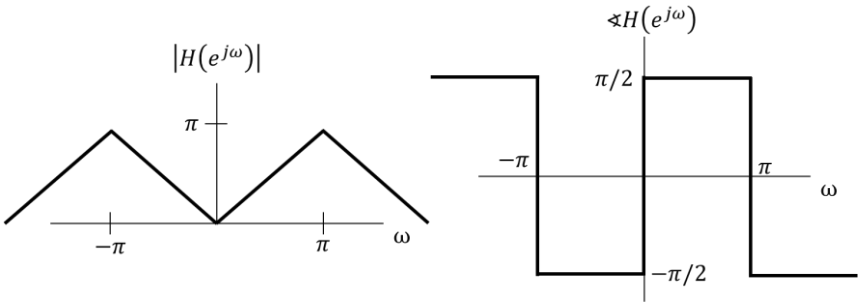
   (a) (20%) Find the frequency response $H(e^{j\omega})$ of the filter in terms of $g[n]$.
   (b) (10%) Show that the phase response $\measuredangle H(e^{j\omega})$ of the filter is linear.
   (c) (10%) Determine $H(e^{j\omega})\big|_{\omega=\pi}$

2. An LTI system generates the output

$$y(t) = (e^{-2t} - e^{-3t})u(t)$$

   in response to the input $x(t) = e^{-2t}u(t)$.
   (a) (15%) Determine the impulse response $h(t)$ of this system.
   (b) (15%) Sketch the bode plot for the amplitude response $|H(j\omega)|$ and the phase response $\measuredangle H(j\omega)$. (Please mark the specific values along both axes.)

3. The system frequency response $H(e^{j\omega})$ of a discrete-time differentiator is shown in below:



   (30%) Determine the output signal $y[n]$ as a function of ω_0, θ if the system input $x[n]$ is

$$x[n] = \cos[\omega_0 n + \theta].$$