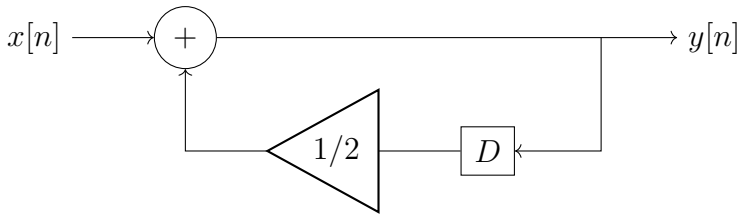
Problem 1: Frequency Response from a DAG Block Diagram

Consider a DT LTI system with input $x[n]$ and output $y[n]$ that is implemented by the following block diagram:



(a) Find the LCCDE that describes this system.

(b) Find the frequency response $H(\omega)$ of this system.

(c) Find the impulse response $h[n]$ of the system. Assume that $h[n] = 0$ for $n < 0$.

Problem 2: Magnitude Response

You are given an LTI system described by the following equation:

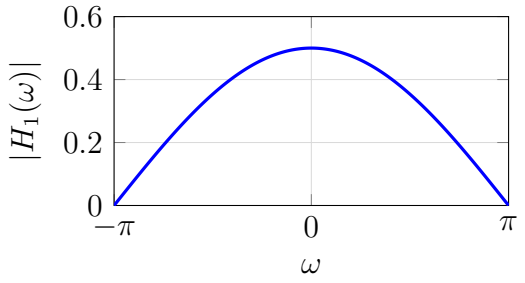
$$y(n) = \frac{1}{4}x[n] - \frac{1}{4}x[n-1].$$

(a) For the system given above, find both the impulse response and the frequency response.

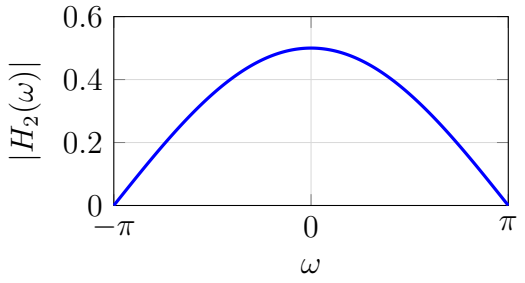
(b) What is the magnitude of the frequency response? Match the frequency response's magnitude to the two correct plots below.

Is this a high-pass or low-pass filter?

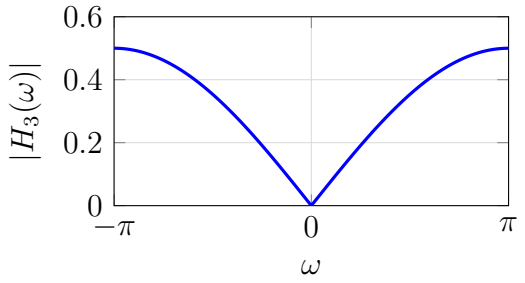
(1)


Magnitude Response of $H_1(\omega)$
$|H_1(\omega)|$
0.6
0.4
0.2
0
$-\pi$
0
π
ω

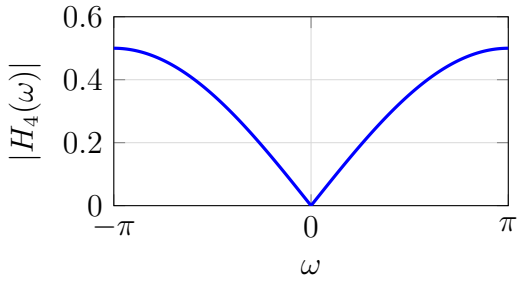
(2)


Magnitude Response of $H_2(\omega)$
$|H_2(\omega)|$
0.6
0.4
0.2
0
$-\pi$
0
π
ω

(3)


Magnitude Response of $H_3(\omega)$
$|H_3(\omega)|$
0.6
0.4
0.2
0
$-\pi$
0
π
ω

(4)


Magnitude Response of $H_4(\omega)$
$|H_4(\omega)|$
0.6
0.4
0.2
0
$-\pi$
0
π
ω

Problem 3: Making LTI more LIT.

Consider a causal LTI system with frequency response:

$$H(\omega) = \frac{1 + \frac{3}{2}e^{-i\omega}}{1 - \frac{1}{2}e^{-i\omega}}$$

(a) Write a difference equation relating $x[n]$ and $y[n]$ for this system.

(b) Draw a block diagram implementing this system with only one delay block.

(c) Determine the impulse response $h[n]$.