

Homework Assignment 1

- Let $x[n] = \sin(n\pi)$. Then plot $x[2n]$, $x[n/2]$, $x[n+1]$, $x[n-1]$
- Give an example of a system that is additive, but not homogeneous.
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- Check whether the following systems are linear, time-invariant, causal and stage. Justify your answers.
 - $y[n] = n \cos(n\pi/4)u[n]$
 - $y[n] = \max(x[n], x[n-1], x[n-2])$
 - $y[n] = (1 + (-1)^n)x[n]$
 - $y[n] = 2x[n+1] + x^2[n-1]$
 - $y[n] = x[2n]$. It is called a down-sampling system.
 - $y[n] = x[n] + 0.5x[n-1] + 0.25x[n-2]$
 - $y[n] = \begin{cases} 0 & \text{if } n \text{ is odd} \\ x[n/2] & \text{if } n \text{ is even} \end{cases}$
 - $y[n] = x_e[n-1]$ where $x_e[n]$ denotes the even part of the signal $x[n]$ and it is defined as

$$x_e[n] = \frac{x[n] + x[-n]}{2}$$

$$(i) y[n] = \begin{cases} x[n] & n \geq 1 \\ 0 & n = 0 \\ x[n+1] & n \leq -1 \end{cases}$$

- Plot $2x[n-4]$, $3x[n-5]$ and $x[3-n]$ for the sequence

$$x[n] = \begin{cases} n & 0 \leq n \leq 10 \\ 0 & \text{else} \end{cases}$$

5. Given that the output of an LTI system to an input $x_0[n] = \delta[n + 1] + 2\delta[n] + \delta[n - 1]$ is $y_0[n] = \delta[n + 2] - 2\delta[n + 1] + 2\delta[n - 1] + \delta[n - 2]$. Find the output of the system to an input $x_1[n] = \delta[n - 1] + 2\delta[n - 2] + 3\delta[n - 3] + 4\delta[n - 4] + 3\delta[n - 5] + 2\delta[n - 6] + \delta[n - 7]$
6. Check whether the following signals are periodic or not. If they are periodic, find their period.
- (a) $x[n] = \frac{\sin(n/6)}{\pi n}$
 - (b) $x[n] = \cos(0.7\pi n) + \sin(1.1\pi n)$
 - (c) $x[n] = (-1)^n + e^{jn\pi/2}$
 - (d) $x[n] = u[n] + u[-n]$