

**Master of Science in Technology Innovation  
University of Washington**

TECHIN 513, Winter 2025  
**Homework 2**

*Instructor:* Dr. Luyao Niu  
**Due Jan. 24 @ 11:59 pm**, on Canvas

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*Instructions:*

1. If a problem involves plotting/ sketching a graph, please make sure that the **axes of the graph are labeled clearly**. You will lose points for every graph axis that is not clearly labeled.
2. You can discuss the homework assignment with peers in the class. However, your submission must be written in your own words.
3. Show your **thought process** and **intermediate steps**. Simply giving the final answer will not earn points. Incorrect final answer with intermediate steps may earn partial credits.
4. **Submit your results in a pdf file. If you use Python to solve the problem, submit your code in a separate file.**

## Problems

1. Determine which of the properties: memoryless, linearity, causality, time invariance, and stability hold for the following systems (you need to justify why the property may or may not hold):

(a)  $y[n] = n^2x[n - 2] - 2x[n - 8];$

(b)  $y[n] = x[4n + 1] + 1;$

(c)  $y[n + 2] = x[n + 2] - x[n - 1].$

2. Determine  $y[n] = x[n] * h[n]$ . Let  $\alpha > 1$ , and:

$$x[n] = \begin{cases} 1, & 0 \leq n \leq 4 \\ 0, & \text{otherwise} \end{cases}$$

$$h[n] = \begin{cases} \alpha^n, & 0 \leq n \leq 6 \\ 0, & \text{otherwise} \end{cases}$$

3. **Optional.** Consider a causal LTI system characterized by  $y[n] + \alpha y[n-1] = x[n]$ ,  $|\alpha| < 1$ . Determine the impulse response  $h[n]$  of the system.

4. **Optional.** Show that for a periodic input to a DT-LTI system with fundamental period  $N_0$ , the output is also periodic with the same fundamental period.

## Answers

**1a.** Not memoryless, causal, not stable, not time invariant, linear.

**1b.** Not memoryless, not causal, stable, not time invariant, not linear.

**1c.** Not memoryless, causal, stable, time invariant, linear.

**2.**

$$y[n] = \begin{cases} 0, & n < 0 \\ \frac{1-\alpha^{n+1}}{1-\alpha}, & n = 0, 1, 2, 3, 4 \\ \frac{\alpha^{n-4}-\alpha^{n+1}}{1-\alpha}, & n = 5, 6 \\ \frac{\alpha^{n-4}-\alpha^7}{1-\alpha}, & n = 7, 8, 9, 10 \\ 0, & n > 10 \end{cases}$$