Assignment - 2

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***Abstract*—This document contains the solution to Exercise 2.39 (b) of Oppenheim.**

Problem 1. Consider a system with input $x[n]$ and output $y[n]$. The input-output relation for the system is defined by following two properties:

1) $y[n] - ay[n-1] = x[n]$,
2) $y[0] = 1$.

Determine whether the system is linear.

Solution: A Linear system has the propery that

$$T\{A\cdot x_1[n]+B\cdot x_2[n]\} = A\cdot T\{x_1[n]\}+B\cdot T\{x_2[n]\} \quad (1)$$

Hence if the input signal is doubled in magnitude, the output signal magnitude should also get doubled for each value of n, but $y[0] = 1$ always and to follow linearity we should get $y[0] = a$ which is not true always.
Hence the system is NOT LINEAR.