

MAT 321 Homework 3

Spring 2021

Due date: Tuesday, Feb 2

For these problems, consider the following five examples of Discrete-Time Systems (or Filters): In each case we describe how the system processes the input x_t to produce the output y_t . For each part answer each of the following questions:

- Is the system Linear? If not, why not?
- Is the system Time-Invariant? If not, why not?
- What is the impulse response of the system?
- Is the system Memoryless? If not, why not?
- Is the system Causal? If not, why not?
- Is the system BIBO Stable? If not, why not?

1. Ideal Delay:

$$y_t = x_{t-c},$$

where c is a positive integer constant.

2. Moving Average:

$$y_t = \frac{1}{M} \sum_{k=-M_1}^{M_2} x_{t-k},$$

where M, M_1 and M_2 are integer constants, $M_1, M_2 \geq 0$, and $M = M_1 + M_2 + 1$.

3. Accumulator:

$$y_t = \sum_{k=-\infty}^t x_k.$$

4. Compressor:

$$y_t = x_{Mt},$$

where M is a positive integer constant.

5. Forward Difference:

$$y_t = x_{t+1} - x_t.$$

6. Backward Difference:

$$y_t = x_t - x_{t-1}.$$