Assignment 5: LTI Assignment

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Q1

An LTI system is a Linear, Time-Invariant system. It follows the properites of linearity and time invariance. Linearity means the system is additive and homogeneous. Time invariance means the system's response to an input signal is independent of when the input signal is applied.

Q2

The system provided is a mapping as follows:

$$\begin{aligned} 0 &\mapsto 5, \\ 1 &\mapsto 10, \\ 2 &\mapsto 15, \end{aligned}$$

Equivalently as a function:

$$y[n] = \begin{cases} 5, & \text{if } n = 0, \\ 10, & \text{if } n = 1, \\ 15, & \text{if } n = 2, \end{cases}$$

- Is it deterministic?

  Yes, the output is deterministic as it is a one-to-one mapping. So we can determine the output for any given input and vice-versa.

- Is it linear?

  The systen is not linear as it does not follow the properties of homogeneous and additive. For example if we give it an input scaled by α, it is not the same as if we scaled the output by α.

  Let the scaling factor be $\alpha = 2$:

  $$y[1 \times \alpha] = y[2] = 15 \neq \alpha \times y[1] = 2 \times 10 = 20$$

  It also does not follow the additive property:

  $$y[0 + 1] = y[1] = 10 \neq y[0] + y[1] = 5 + 10 = 15$$

- Is it time invariant?

  The system is time invariant as the output for a given input is independent of when the input is applied.

- Is it causal?

  Yes, the system only depends on the current input value and not future values.

- Is it stable?

  Yes, the system is stable as the output values are bounded between $[0, 15]$ for the 3 input values.

- Is it discrete?

  Yes, the system is discrete as the input and output are discrete values. We only have the system defined for $n = 0, 1, 2$.

- Is it memoryless?

  Yes, the system is memoryless as the output is only dependent on the current input value.