Quiz1

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Download latex-tikz codes from

https://github.com/adhvik24/EE3900/blob/main/quiz1/main.tex

Download python codes from

https://github.com/adhvik24/EE3900/blob/main/quiz1/plot.py

Problem 2.27(System B)

(2.27(System B)) Three systems A, B, and C have the inputs and outputs indicated in Figure P2.27 - 1. Determine whether each system could be LTI. If your answer is yes, specify whether there could be more than one LTI system with the given input-output pair. Explain your answer.

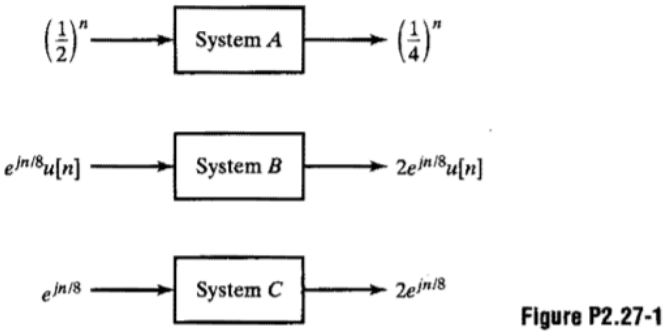

Fig. 1: Systems

Solution

System B:

The input signal x[n] is,

$$x[n] = e^{\frac{jn}{8}}u[n] \tag{0.0.1}$$

The output signal y[n] is,

$$y[n] = 2e^{\frac{jn}{8}}u[n] \tag{0.0.2}$$

Then the fourier transform of x[n] is,

$$X\left(e^{j\omega}\right) = \sum_{n=-\infty}^{n=\infty} x[n]e^{-j\omega n} \tag{0.0.3}$$

$$= \sum_{n=-\infty}^{n=\infty} e^{\frac{jn}{8}}u[n]e^{-j\omega n} \tag{0.0.4}$$

$$= \sum_{n=0}^{n=\infty} e^{\frac{jn}{8}}e^{-j\omega n} \tag{0.0.5}$$

$$= \sum_{n=0}^{n=\infty} e^{-j\left(\omega-\frac{1}{8}\right)n} \tag{0.0.6}$$

$$\implies X\left(e^{j\omega}\right) = \frac{1}{1-e^{-j\left(\omega-\frac{1}{8}\right)}} \tag{0.0.7}$$

As y[n]=2x[n], Then the fourier transform of y[n] is,

$$Y\left(e^{j\omega}\right) = \frac{2}{1-e^{-j\left(\omega-\frac{1}{8}\right)}} \tag{0.0.8}$$

Then the frequency response of the system is,

$$H\left(e^{j\omega}\right) = \frac{Y\left(e^{j\omega}\right)}{X\left(e^{j\omega}\right)} \tag{0.0.9}$$

$$= 2 \tag{0.0.10}$$

$\implies$ The system is a LTI system and it is unique.

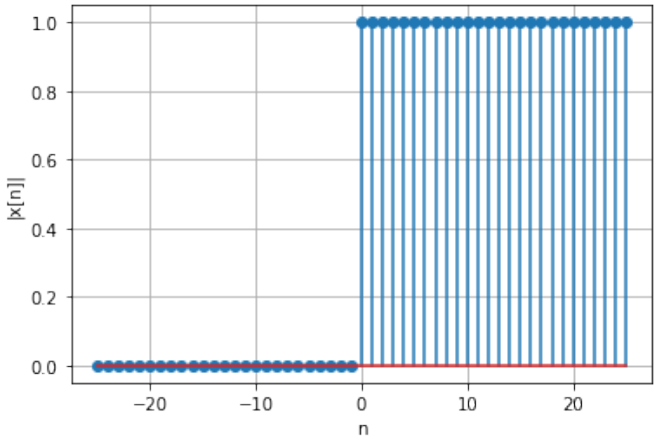

Fig. 2: Amplitude of x[n]

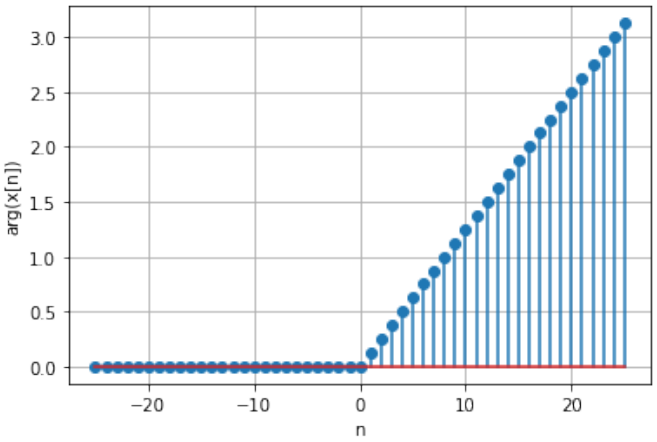

Fig. 3: Phase of x[n]

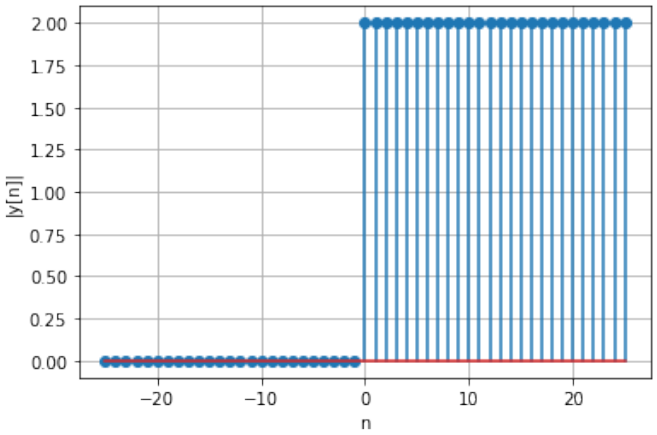

Fig. 4: Amplitude of y[n]

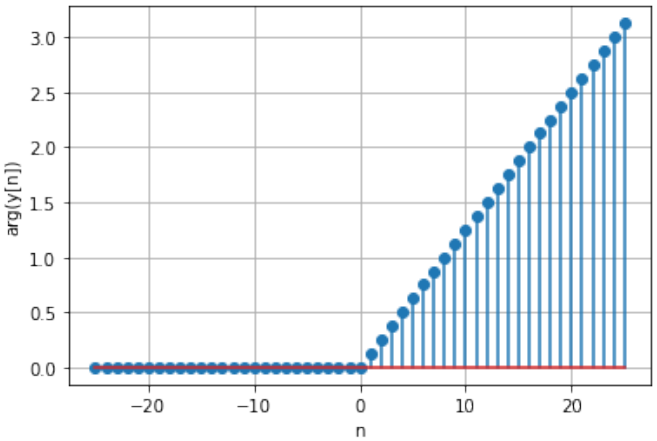

Fig. 5: Phase of y[n]