Report for Programming Problems - SnS (Assignment 2)

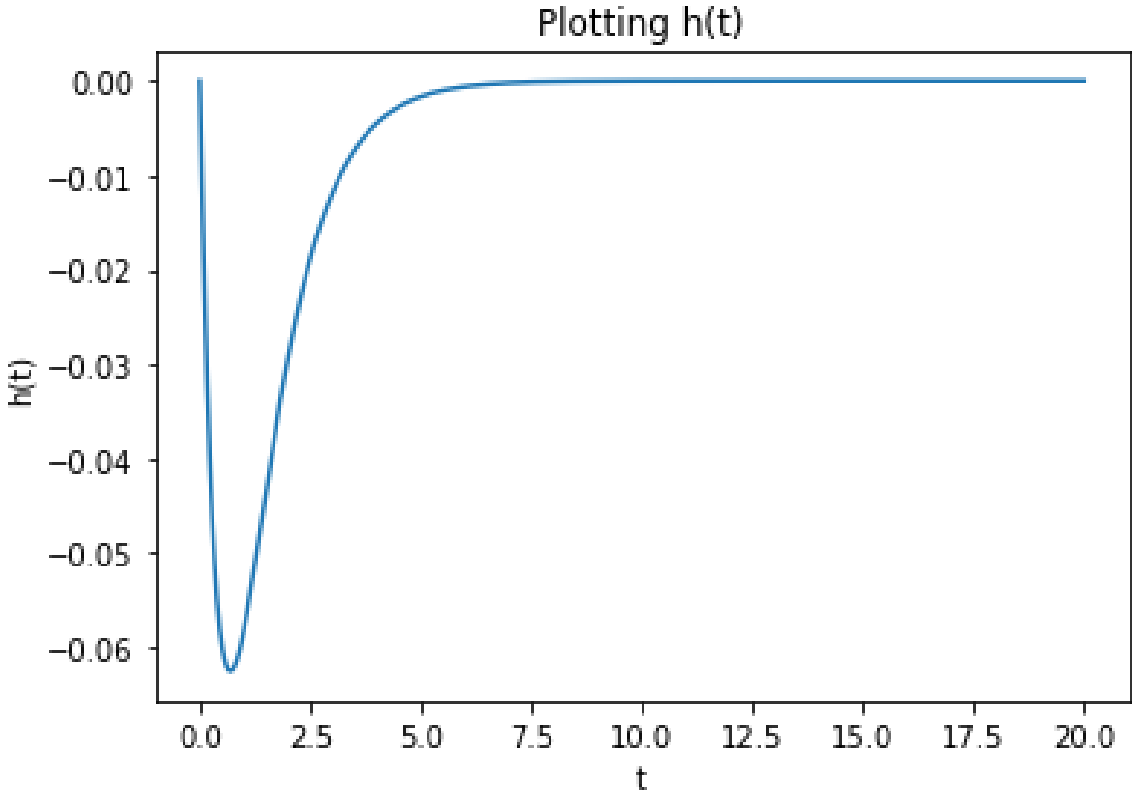
Q1) In this problem we were given two questions where we were given a system S. We are given its input as a continuous signal x(t) and its impulse response h(t). We need to perform convolution on the two signals to get the response of the system S - y(t).

a)

In the first part, the signal given below is the impulse response of the system S i.e. h(t):

$$h(t) = ((e^{-2t} - e^{-t}) * u(t))/4\ ,\ 0 \leq t \leq 20$$

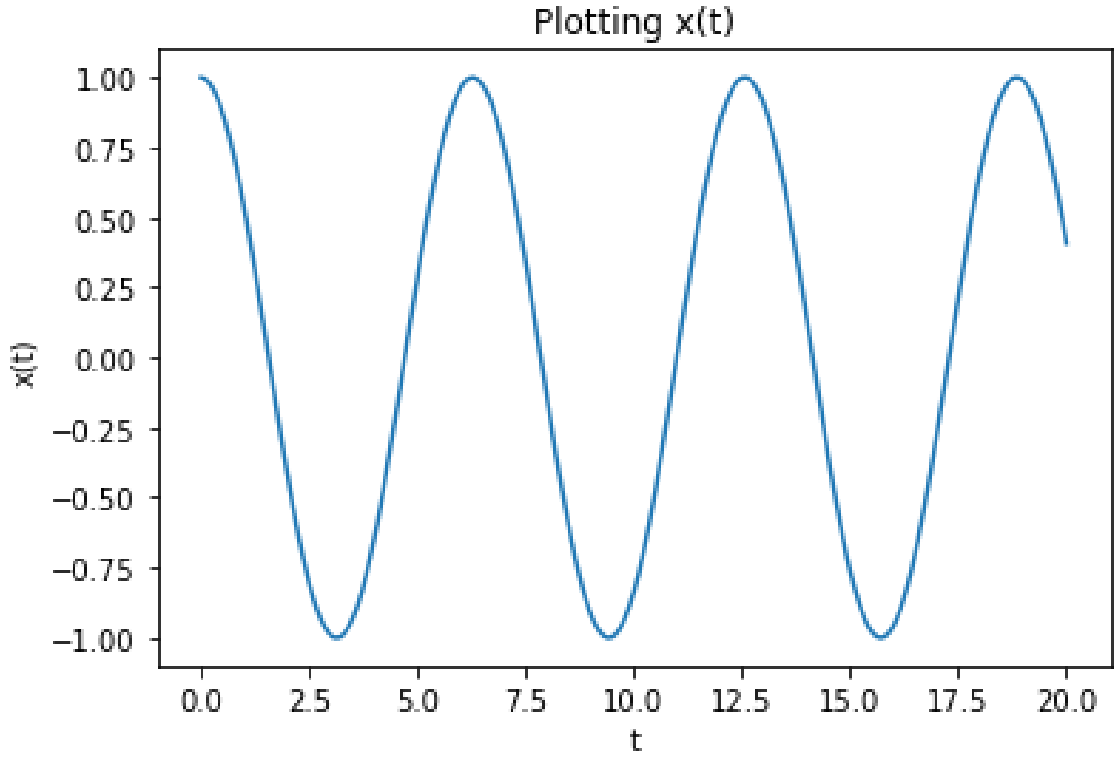
The plot for the signal is as follows:



In the first part, the signal given below is the input to the system i.e. x(t):

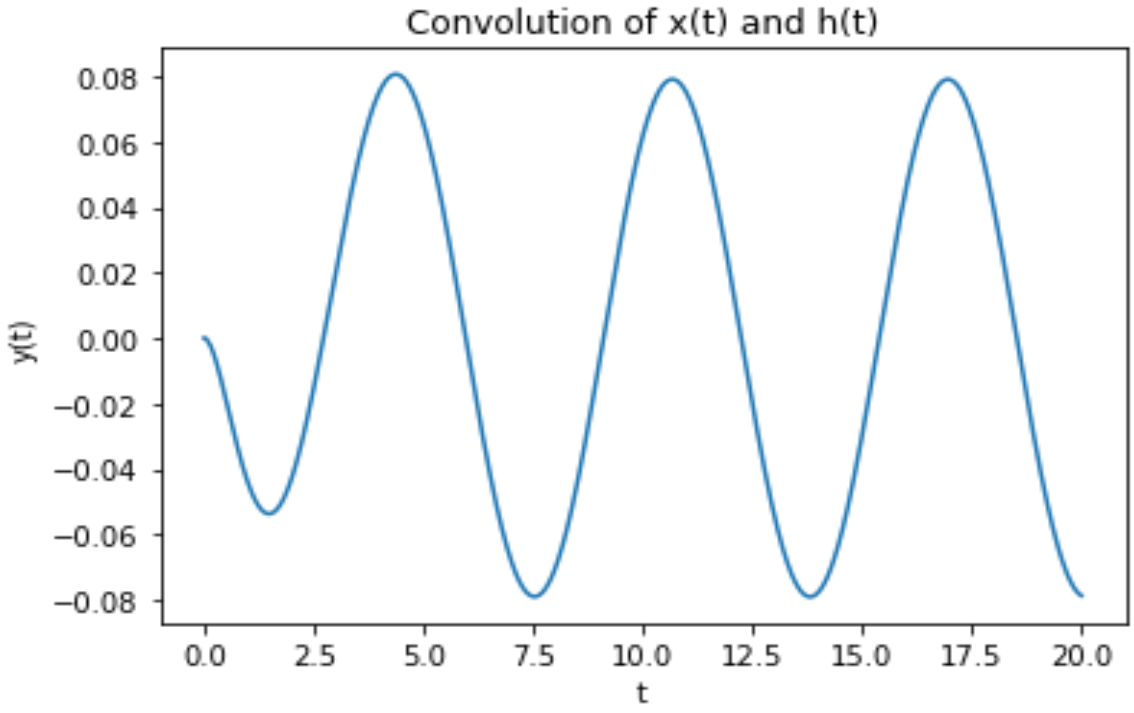
$$x(t) = cos(t) * u(t)\ ,\ 0 \leq t \leq 20$$

The plot for the signal is as follows:



Convolution:

In order to perform convolution, we import the *scipy* library. We use its .integrate() method to ***perform the convolution on x(t) and h(t)***. The integrand we use is ***x(t0)*h(t-t0)*** and we integrate it with respect to ***t0*** from negative to positive infinity to get the following signal **y(t)** which is the response to the **input x(t) to the System S**:



Inference and Explanation:

The convolution graph looks like a sinusoidal graph with a decreasing amplitude or envelope. The amplitude is small as our overlap becomes very small because of small amplitudes of x(t) and h(t). After x = 7.50, as our impulse response h(t) approaches 0 and hence the convolution curve starts becoming progressively smaller.

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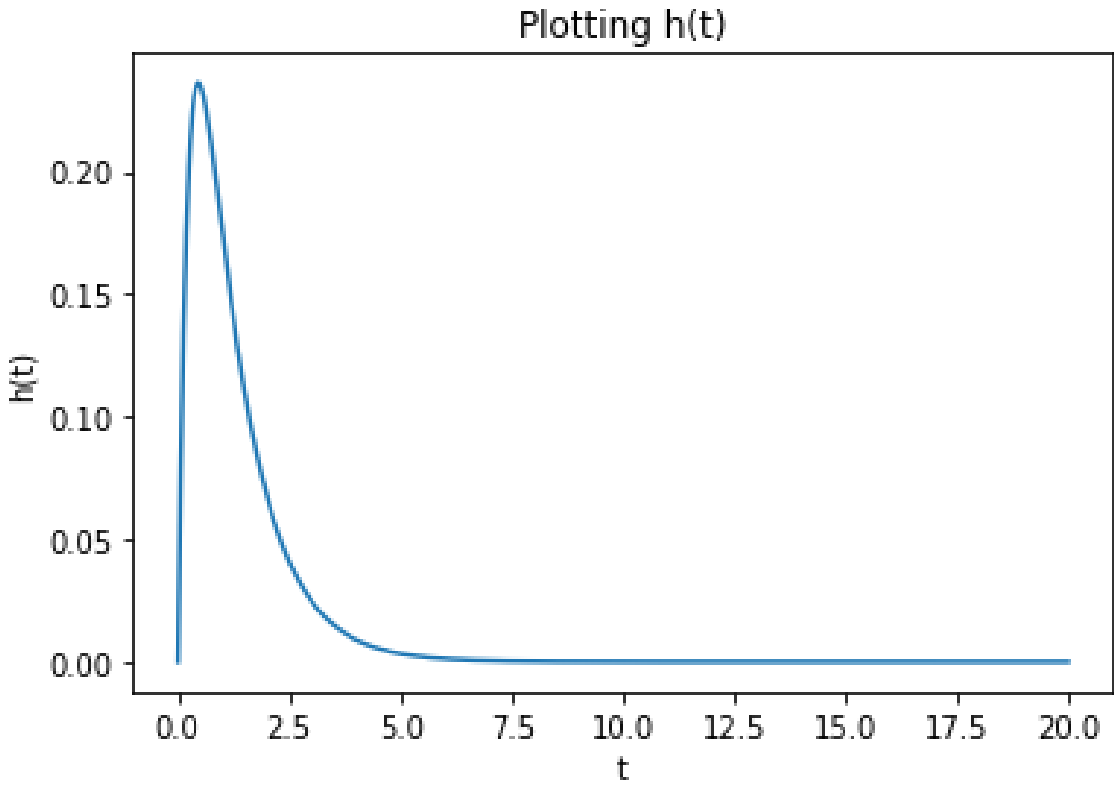
b)

In the second part, the signal given below is the impulse response of the system S i.e. h(t):

$$h(t) = ((e^{-t} - e^{-4t}) * u(t))/2\ ,\ 0 \leq t \leq 20$$

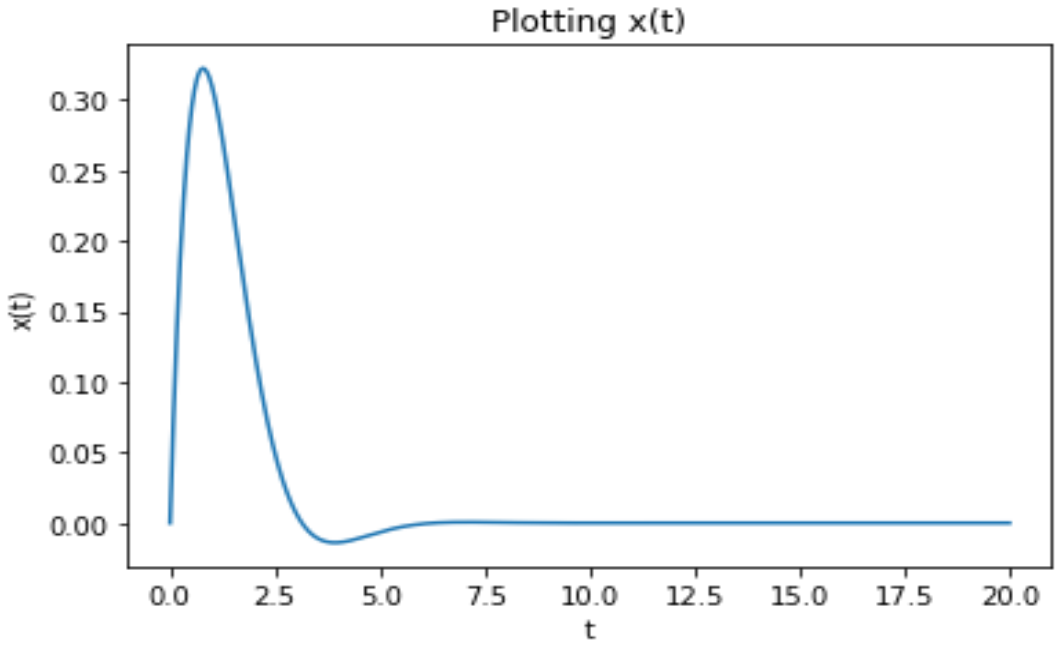
The plot for the signal is as follows:



In the second part, the signal given below is the input to the system i.e. x(t):

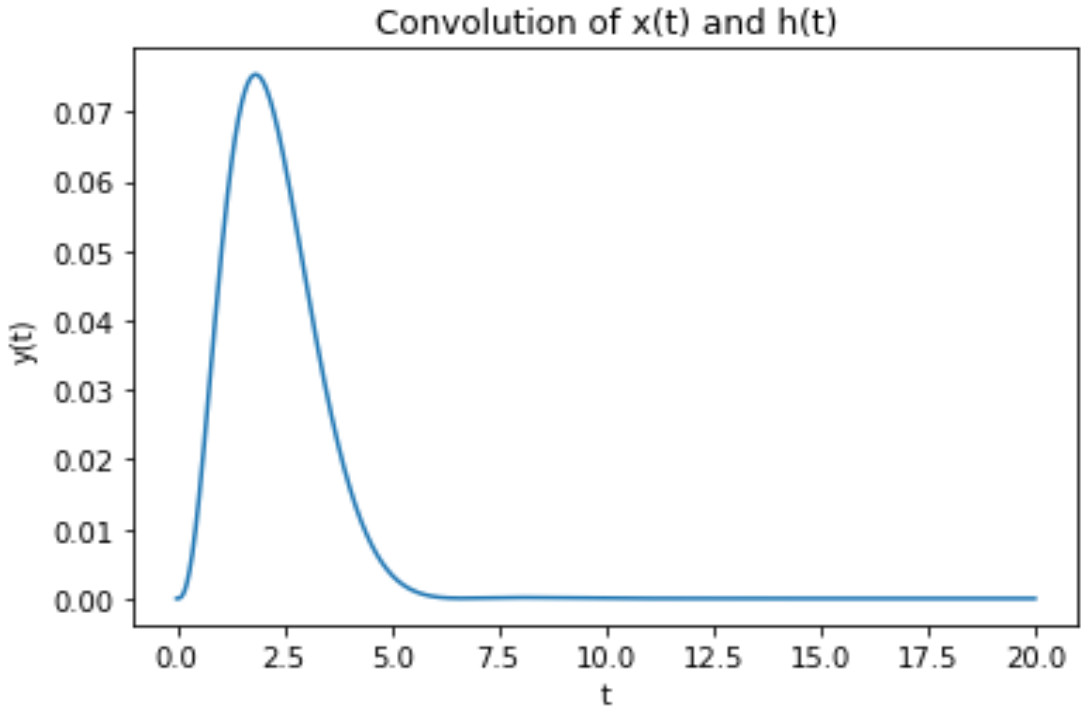
$$x(t) = sin(t) * e^{(-t)} \ , \ 0 \leq t \leq 20$$

The plot for the signal is as follows:



Convolution:

In order to perform convolution, we import the *scipy* library. We use its .integrate() method to ***perform the convolution on x(t) and h(t)***. The integrand we use is



x(t0)*h(t-t0) and we integrate it with respect to ***t0*** from negative to positive infinity to get the following signal **y(t)** which is the response to the **input x(t) to the System S**

Inference and Explanation:

The convolution graph looks like both x(t) and h(t) as they have very similar looking curves. After t>5, as x(t) approaches 0, the convolution integral becomes 0 for all those intervals and hence for t > 5, we see the convolution curve approaching 0 and becoming 0 as we increase the value of t to 20. The convolution curve spikes between 0 and 2.5 and decreases rapidly over remaining values of t in the range of 0 to 20.
