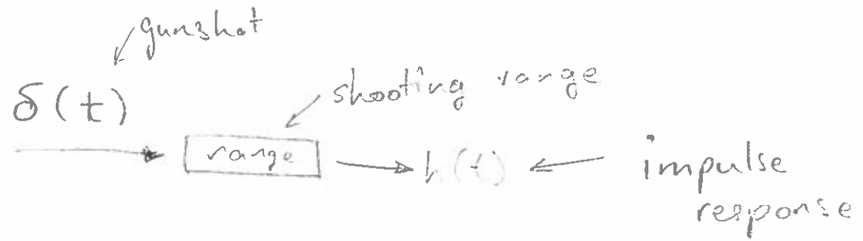
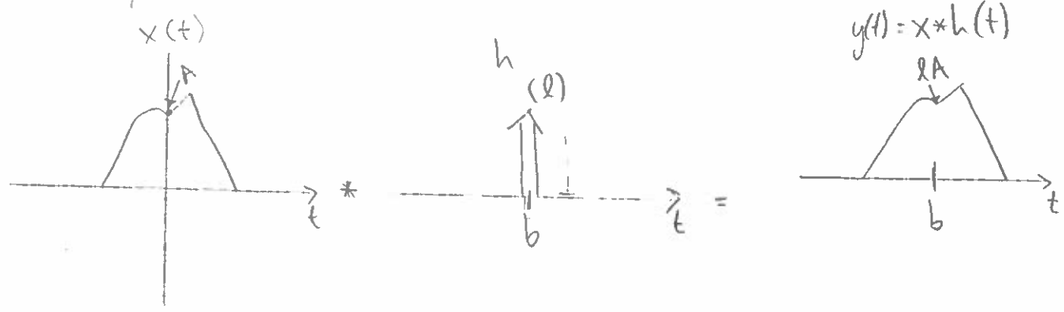
PS06 Madeleine Fort

1.

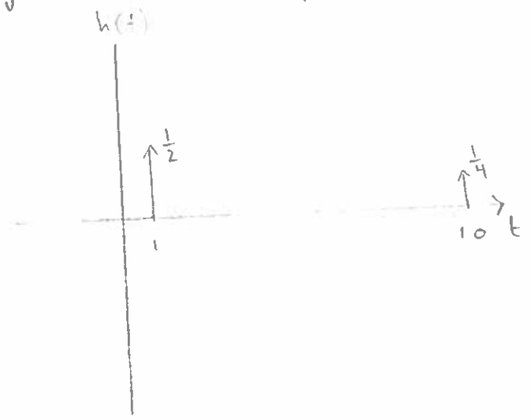


The gunshot was an impulse that caused an impulse response in the system h(t). To get the output of the system for the violin recording, the input, the recording, is convolved with the impulse response h(t). This is like taking x(t) and shifting it and scaling it by h(t).



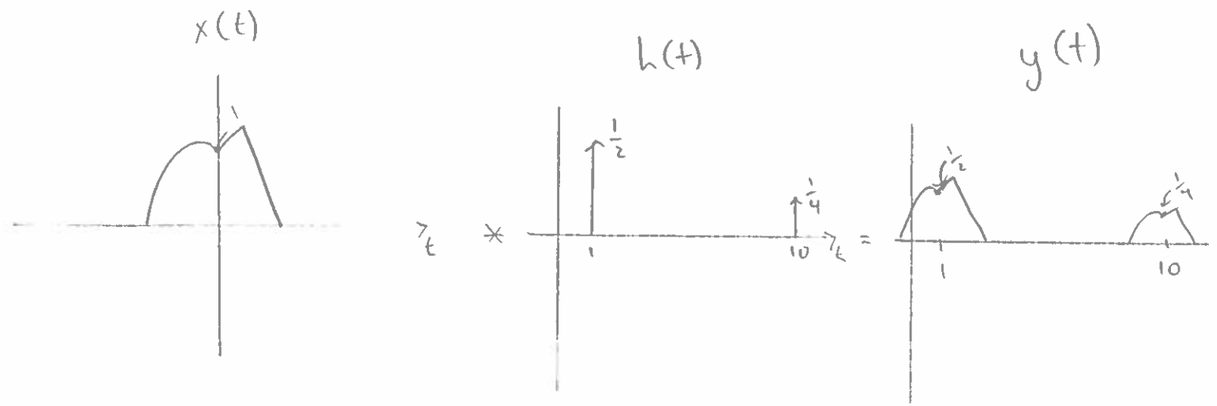
2.

$$y(t) = \frac{1}{2}x(t-1) + \frac{1}{4}x(t-10)$$

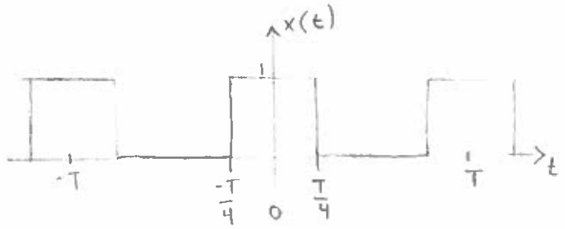


$$h(t) = \frac{1}{2}\delta(t-1) + \frac{1}{4}\delta(t-10)$$

This is called an echo channel because for an input $\delta(t)$ the system echoes it back 9 seconds later at half the strength of the first response.



3. a.



period = T

$-T/4 < t < T/4$

$x(t) = 1$

$$C_k = \frac{1}{T}\int_{-T/4}^{T/4} 1e^{-j\frac{2\pi}{T}kt}\,dt$$

$$C_k = \frac{\sin(\frac{\pi k}{2})}{\pi k}$$

$$C_k = \frac{1e^{\frac{1}{2}j\pi k}}{2\pi k} - \frac{1e^{\frac{-\pi k}{2}}}{2\pi k}$$

$$C_k = \begin{cases} \frac{1}{2} & k = 0 \\ 0 & \text{if } k \text{ is even} \\ \frac{1}{\pi k} & \text{if } k \text{ is odd} \end{cases}$$