Lab 1

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1 Exercies

1.1 Exercise 1

In figure 1 we see the first sinusoid with the function $x(t) = 2 \cdot sin(2 \cdot \pi \cdot 3 \cdot t + \pi/3)$ as a solid blue line. The second sinusoid is shown as a red dashed line representing the function $y(t) = 2 \cdot sin(2 \cdot \pi \cdot t)$.

1.2 Exercise 2

Signals given:

- $x(t) = cos(6 \cdot \pi \cdot t)$
- $y(t) = |t|^{1/3}$
- $z(t) = x(t)y(t)$

The signals $\{x(t), y(t), z(t)\}$ are plotted in picture 2 as separate figures.

1.3 Exercise 3

The three new samples of $\{x(t), y(t), z(t)\}$, $\{x[tT_s], y[tT_s], z[tT_s]\}$ are shown in picture 3.

1.4 Exercise 4

If we insert an impulse $x = \delta$ the impulse response would equal $\frac{1}{8} = 0.125$ when $n - k = 0$ for $\delta[n-k]$. Looking at the equation itself we can clearly see that $n - k = 0$ for $n = 0, 1, 2, .., 7 = [0 - 7]$.But we can confirm this by plotting the spectrum, figure 4. Hence $h[n] = \begin{cases} 0.125, & \text{if } n = [0-7] \\ 0, & \text{otherwise} \end{cases}$

1.5 Exercise 5

The result from the $x[n]$ can be seen as the second plot in figure 5. The output sequence is the result of convolving the impulse response from $y[n]$, $h[n]$ with $x[n]$ which results in the first plot of figure 5.

1.6 Exercise 6

The new output $y[n] = h[n] * x[n+2]$ is shown in figure 6 as the first plot. The input $x[n+2]$ is shown as the second plot.

1.7 Exercise 7

The new output $y[n] = h[-n] * x[n]$ is shown in figure 7 as the first plot. The input $x[n]$ is shown as the second plot.

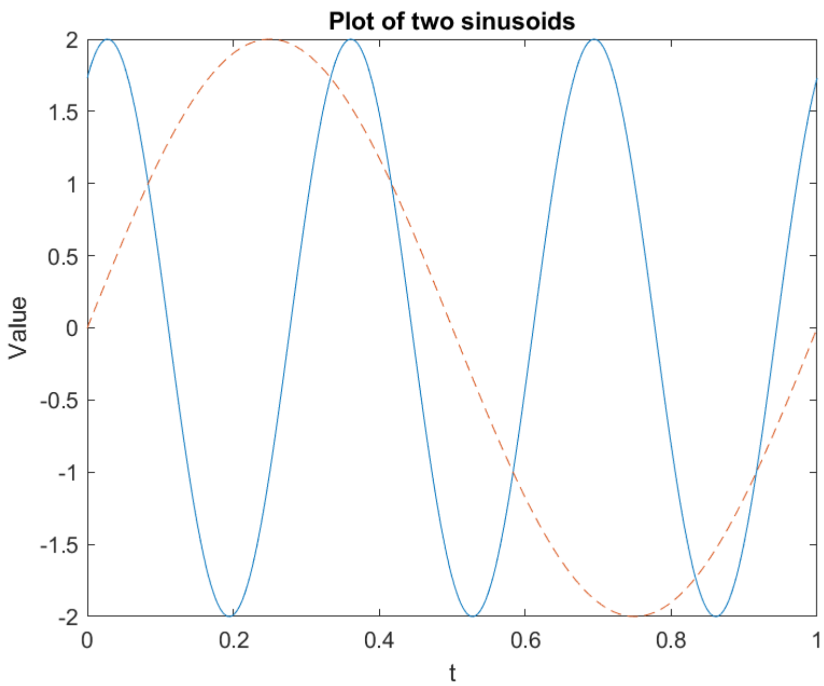

Figure 1: Exercise 1, plot of two sinusoids

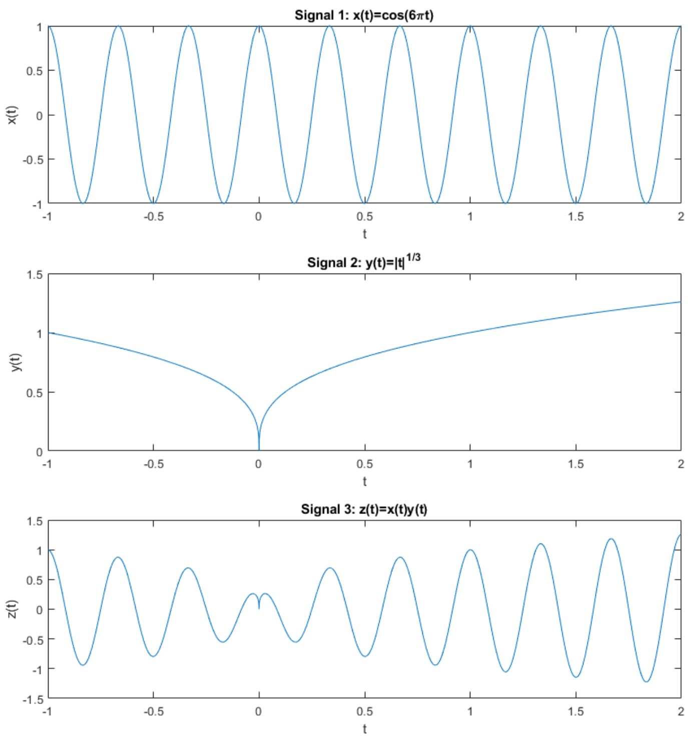

Figure 2: Exercise 2, plot of three signals

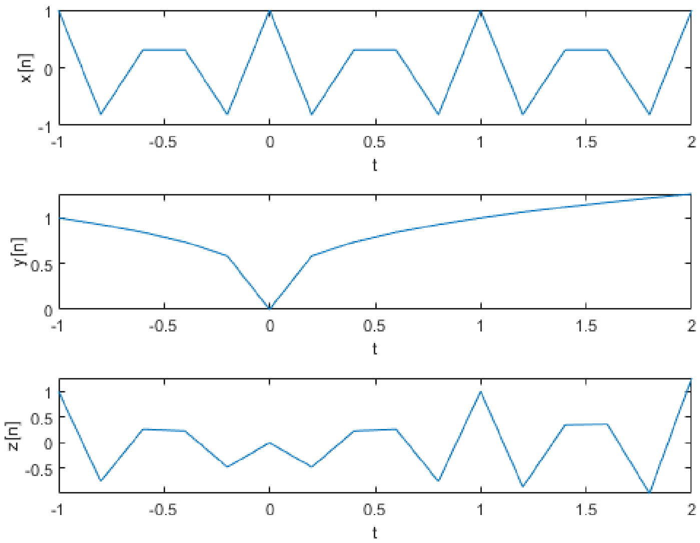

Figure 3: Exercise 3, plot of three samplings of signals

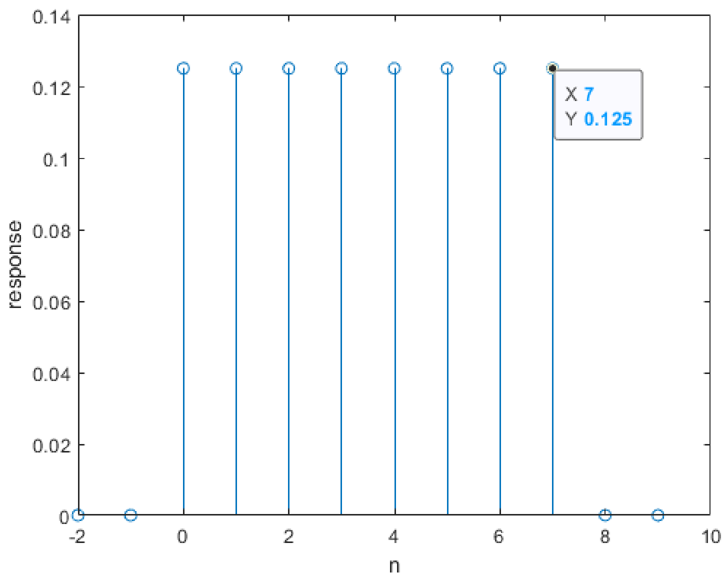

Figure 4: Exercise 4, Impulse Response

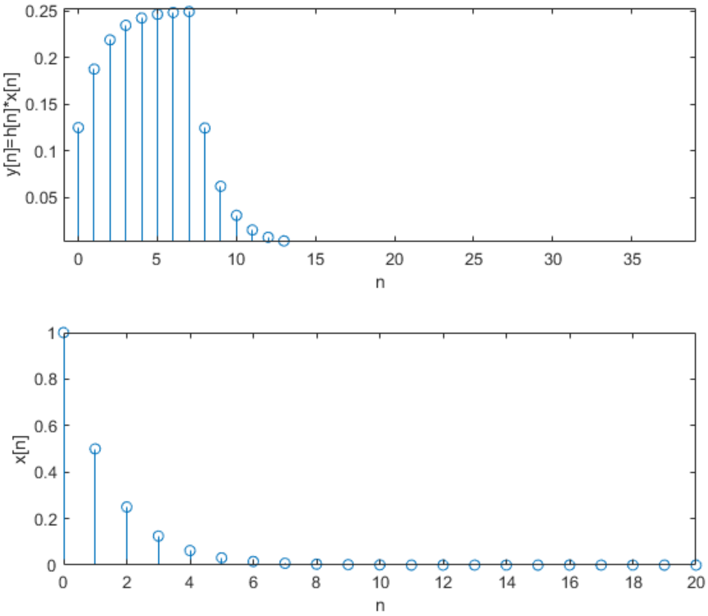

Figure 5: Exercise 5, New input signal

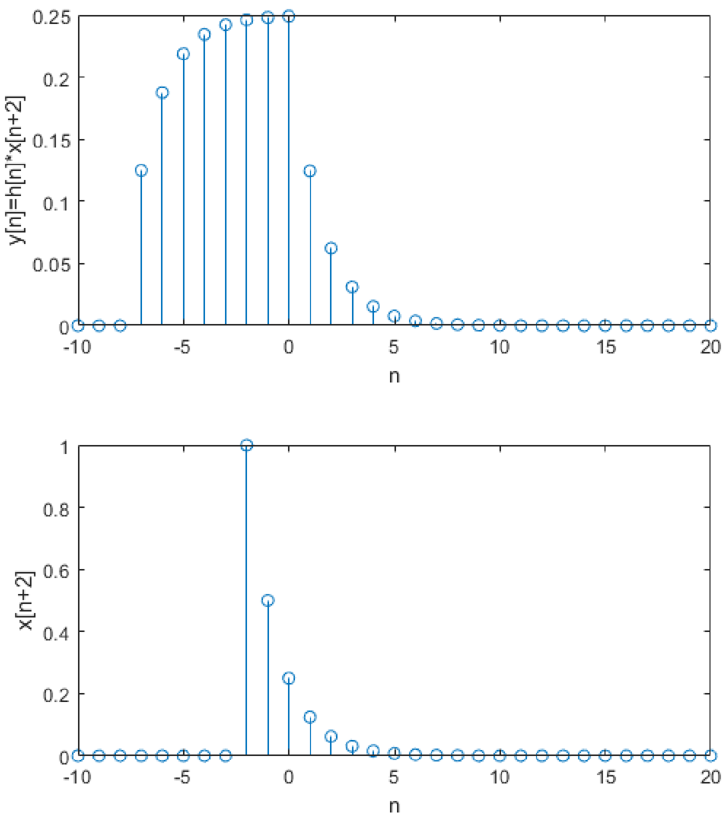

Figure 6: Exercise 6, x[n+2]

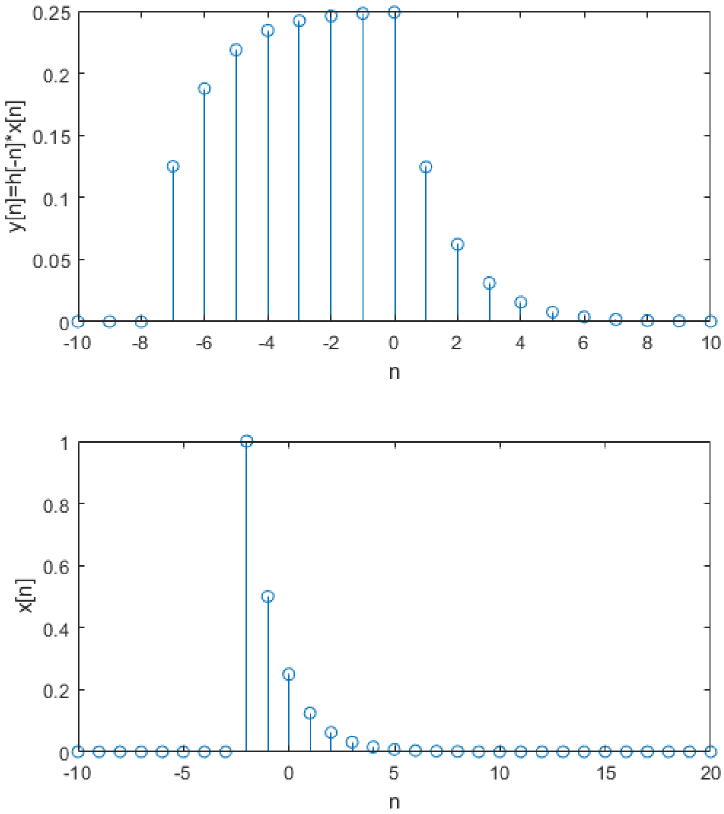

Figure 7: Exercise 7, y[n] with h[-n]

1.8 Exercise 8

The new output $y[n] = h[h] * x[n]$ with $x[n] = cos(\frac{\pi}{8} \cdot n) + cos(\frac{\pi}{4} \cdot b), 0 \leq n \leq 127$ is shown in figure 8 as the first plot. The input $x[n]$ is shown as the second plot.
The frequency of the output seems almost like the reverse of the input signal in shape, but not exactly in value. It acts as a sort of compression of the values in the time-frame (the result is ~half as long with same amount of samples), as though it tries to average out the input.

1.9 Exercise 9

After processed by the system the audio has a reduced audio quality. The sound has been compressed.

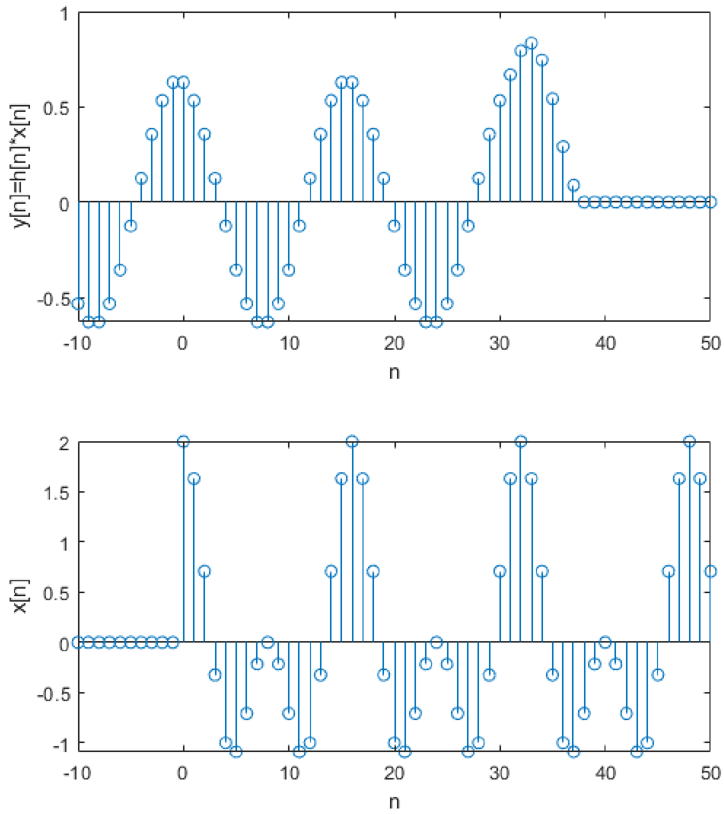

Figure 8: Exercise 8, y[n] with $h_2[n]$