

Worked with: Josh Horejs, David Lay, Luke Tutino

Details: Shared approaches to questions, equations found in lecture notes, and compared answers.

Problem 1

1.

$$\begin{aligned} f_1 &= \frac{144\pi}{2\pi} \\ &= 72Hz \end{aligned}$$

$$\begin{aligned} f_2 &= \frac{36\pi}{2\pi} \\ &= 18Hz \end{aligned}$$

$$\begin{aligned} f_3 &= \frac{4\pi}{2\pi} \\ &= 2Hz \end{aligned}$$

2.

$$\begin{aligned} \omega_0 &= \text{GCD}(144\pi, 36\pi, 4\pi) \\ &= 4\pi \end{aligned}$$

$$\begin{aligned} f_0 &= \frac{4\pi}{2\pi} \\ &= \boxed{2Hz} \end{aligned}$$

3.

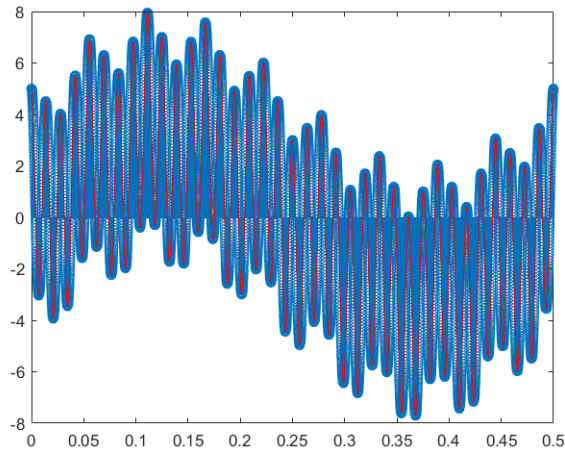
$$\begin{aligned} f_s &\geq 2(75Hz) \\ &\geq \boxed{144Hz} \end{aligned}$$

4.

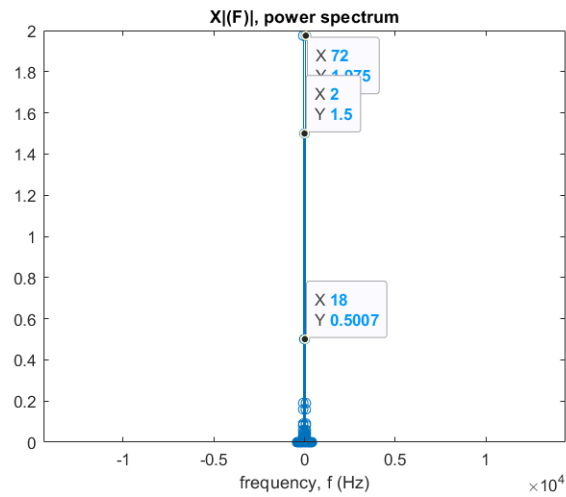
$$\begin{aligned} \frac{14.4KHz}{N} &\geq 144Hz \\ \boxed{N} &\leq 100 \end{aligned}$$

Problem 2

1. The number of data points collected was 7200.

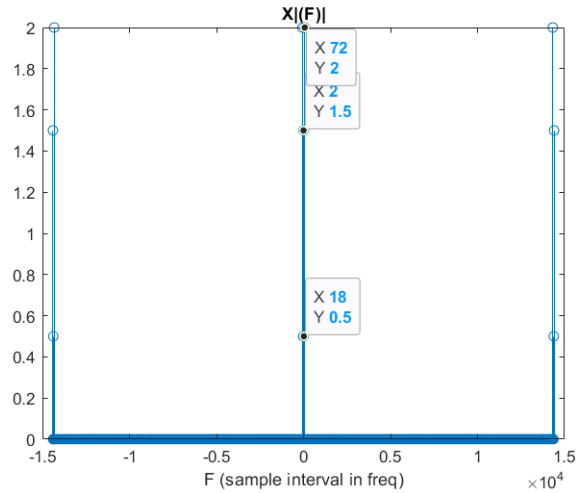


2. The frequencies present in the continuous function are $2Hz$, $18Hz$, and $72Hz$.



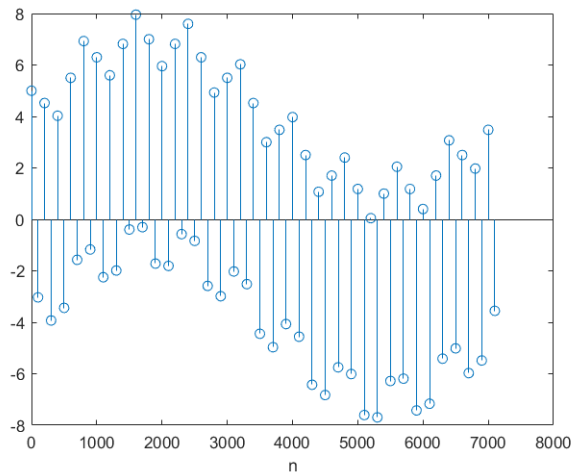
3.

- a. The frequencies present in the discrete function are $2Hz$, $18Hz$, and $72Hz$.

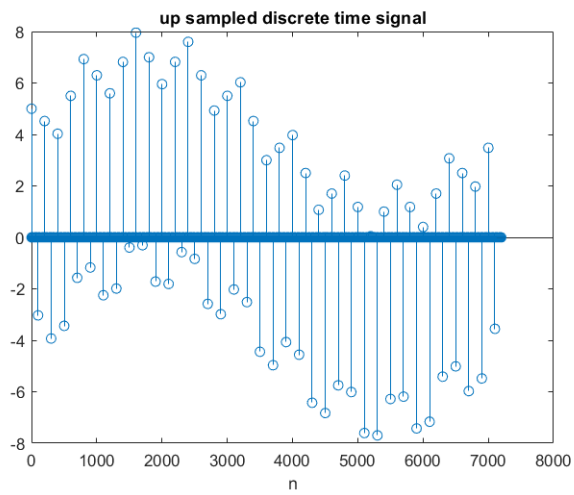


- b. The continuous fft plot does match if you discount the presence of aliasing in the discrete fft plot.

4. With a down sample rate of 100, the function has been reduced to 72 data point.

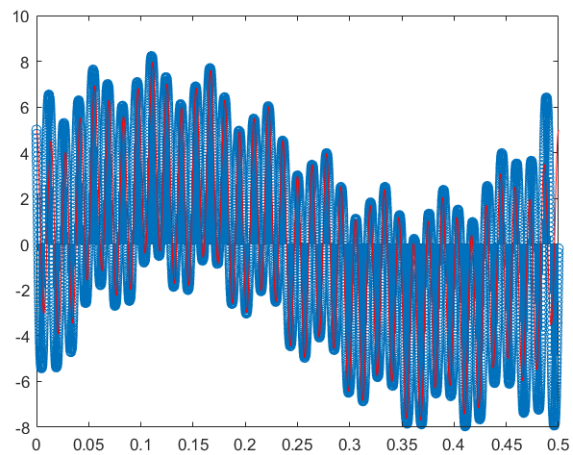


5.



6.

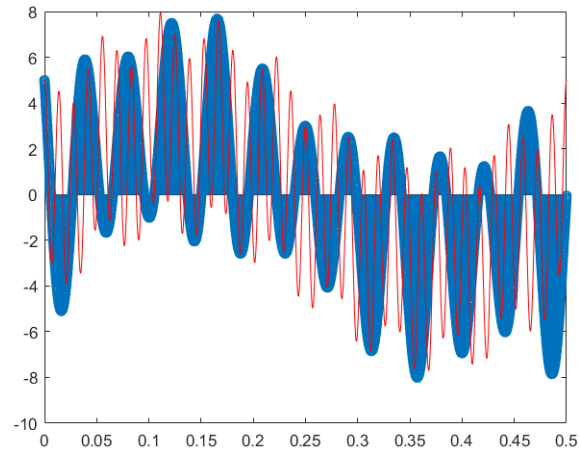
a.



- b. The plot is visually identical to 2.1 with the exception of a slight phasing drift due to the nature of the we are comparing the continuous and discrete forms of the equation.

7.

- a. I changed the up sample factor to 300
- b. The down sample rate is 600
- c. The down sampled and up sampled interpolation plot is not the same as in 2.6 because it was sampled at $48Hz$.



8.

$$x(t) = \cos(280\pi t) + 6\sin(512\pi t)$$

$$f_1 = 140\text{Hz}$$

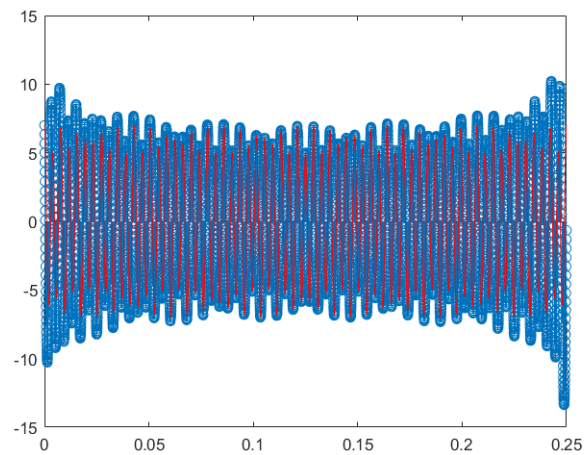
$$f_2 = 256\text{Hz}$$

$$f_0 = 4\text{Hz}$$

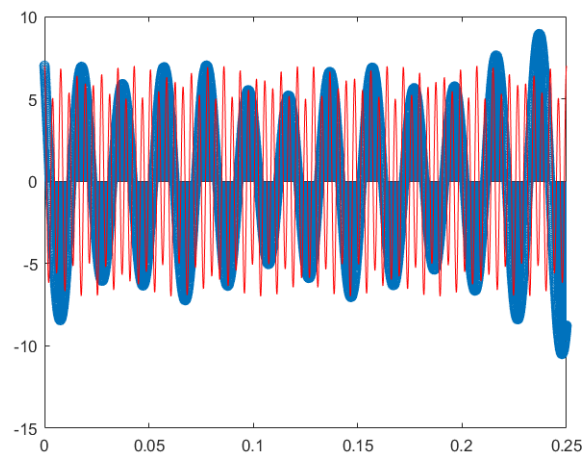
$$f_s = 512\text{Hz}$$

Sampled at 25.6kHz

Correctly sampled



Incorrectly sampled



Problem 3

With a max frequency of 2KHz , the Nyquist rate would be 4KHz , meaning, the song was originally up sampled by 2.25. Since the speaker system expect the song to be sampled at 6KHz , the song can be fed though a low pass filter with a cut toff at 6KHz without loosing any audio data. Alternatively, the song can be down sampled by 1.5 digitally before being played though the audio system.