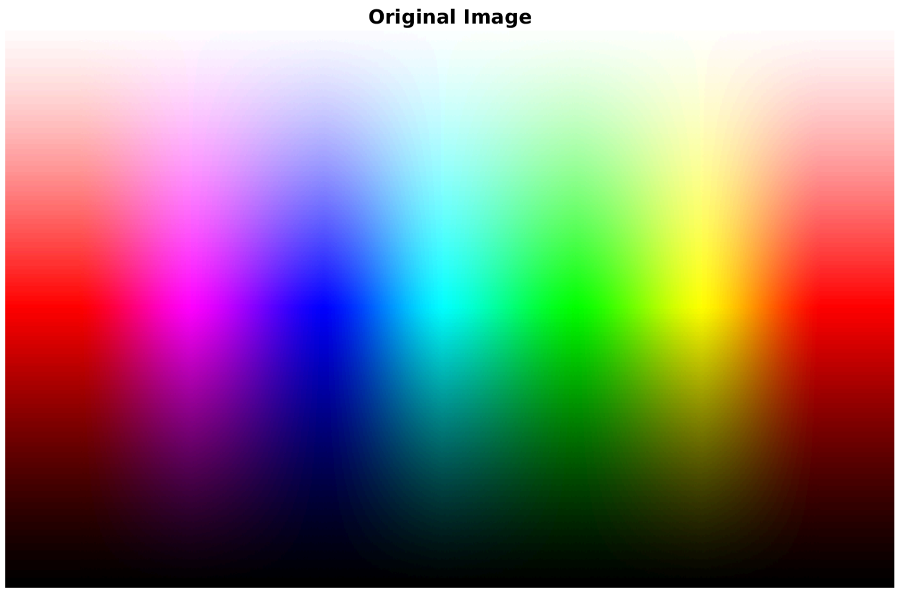
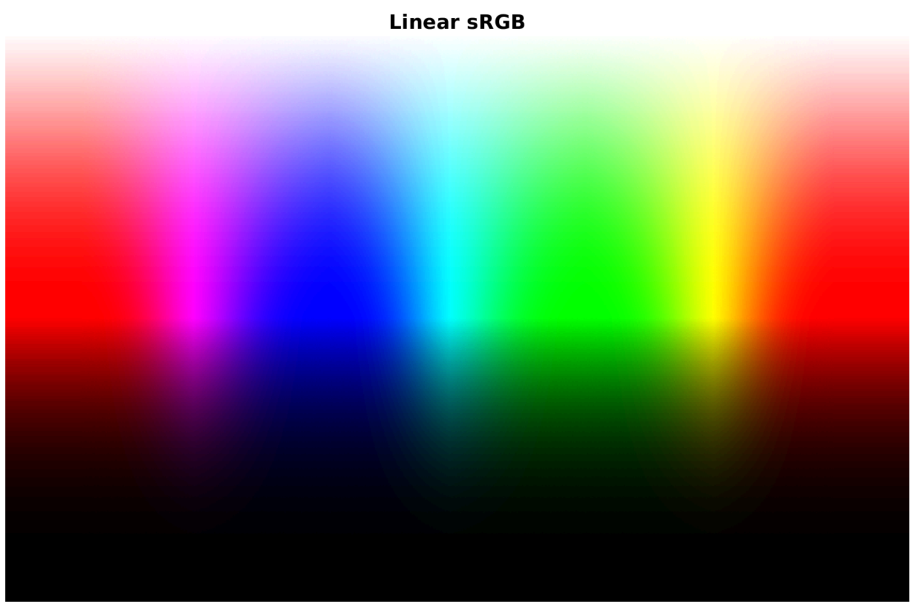
Project 1

Problem 1

1) Here is our original image.



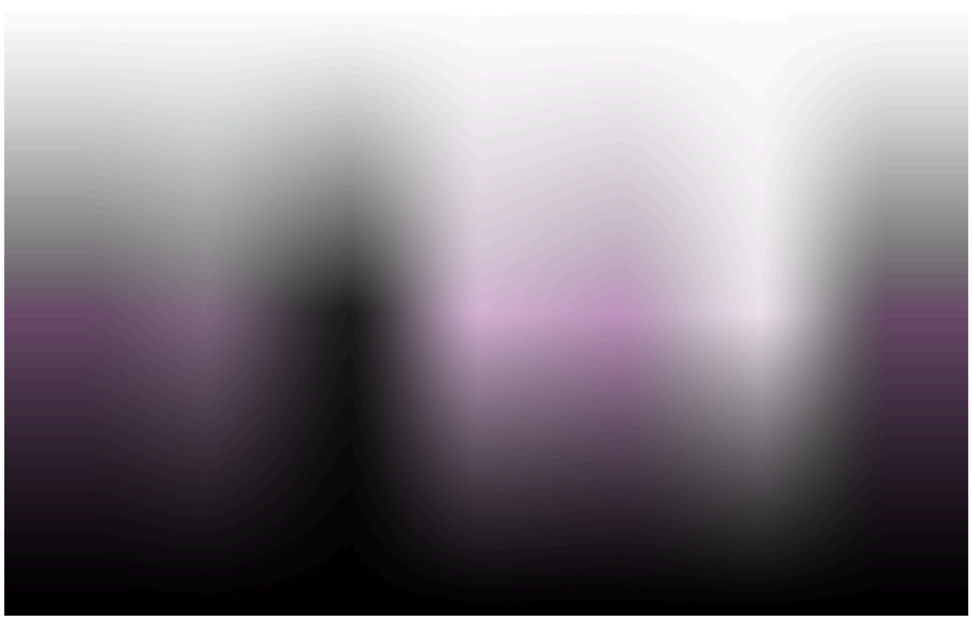
2) The minimum and maximum values of the image are 0 and 255. The generated sRGB image is shown below.



4) Here is the image of nonlinear p3 RGB.

We can see the above nonlinear p3 RGB image looks pale, compared to the original image. This is due to the fact that the nonlinear p3 RGB color space has a different color gamut and tone mapping compared to the original nonlinear sRGB image. When converting from linear p3 RGB to nonlinear p3 RGB, the tone mapping and color rendering changes, resulting in the washed-out or pale appearance of the image. This is because the nonlinear p3 RGB transformation compresses the dynamic range and changes the color balance compared to the original sRGB image.

5) Here we plot the difference between the nonlinear sRGB and nonlinear p3 RGB images.



The **average** and **max** of color difference between linear sRGB and linear p3 RGB (after their conversion to the Lab color space) are **0.0103 and 0.0385**, respectively, when using the **double precision**.

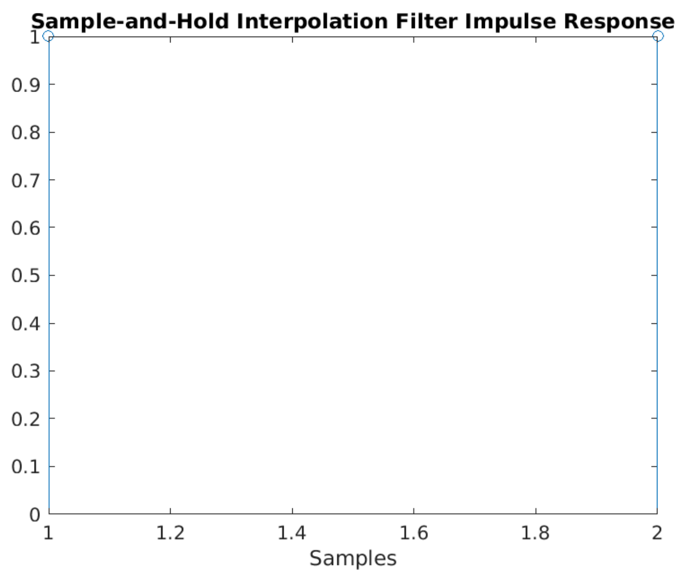
6) When we use 10-bit precision, the average and max of the color distance are **0.2030 and 1.7733**, respectively.

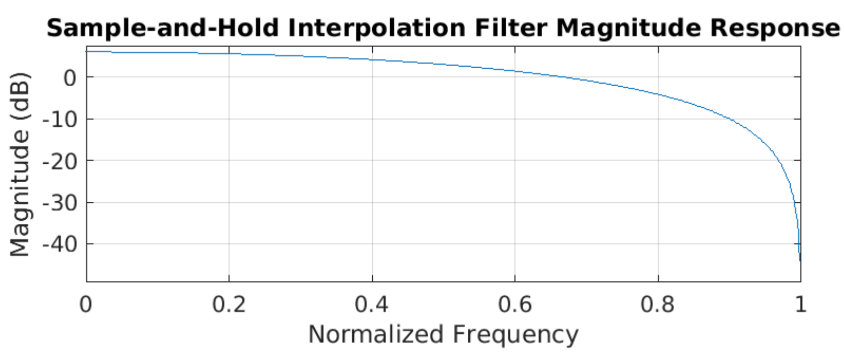
7) When we use 8-bit precision, the average and max of the color distance are **0.6896 and 4.3619**, respectively.

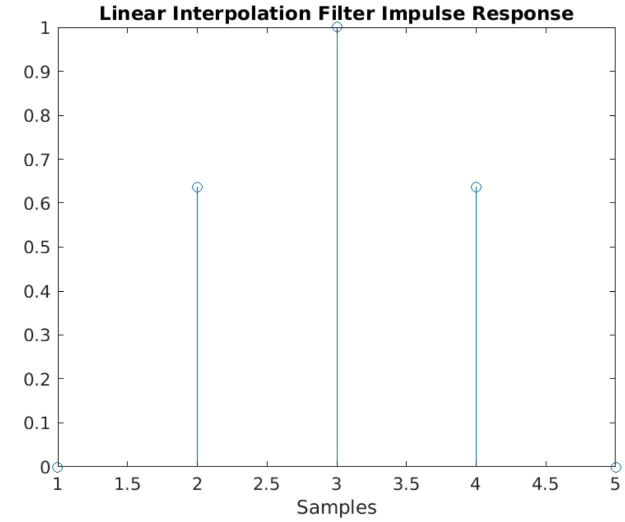
8) So, based on the above results, as expected, the performance of the color space conversion is better when we have higher precision (double > 10-bit > 8-bit).

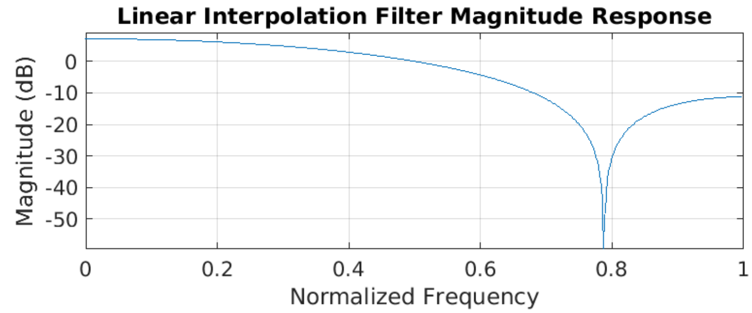
Problem 2

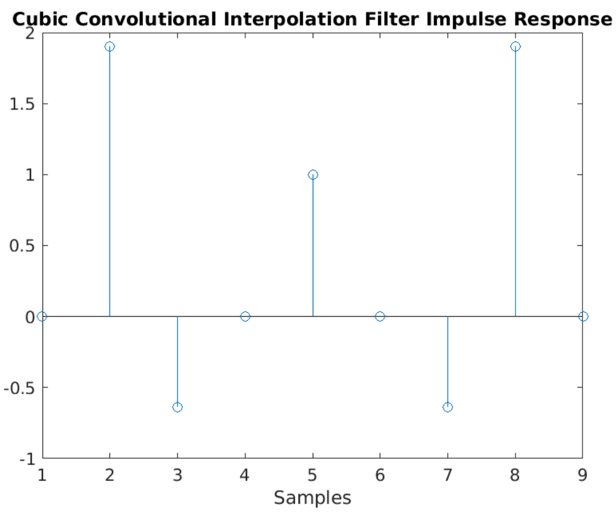
1) Here are the plots of the impulse and magnitude responses of the filters. Here, we have 1D sampling rate conversion for x2 conversion.

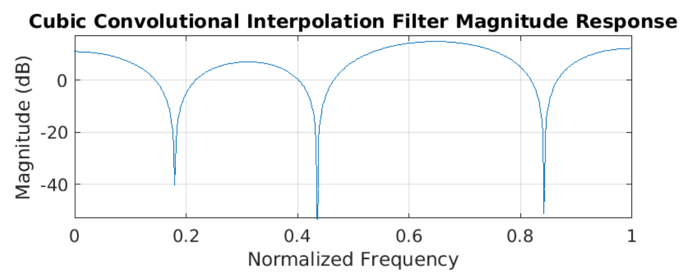




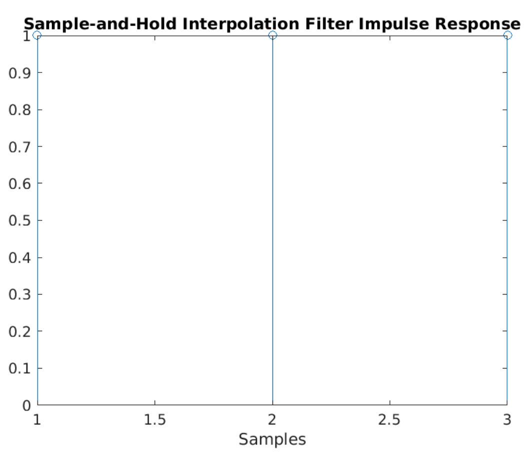


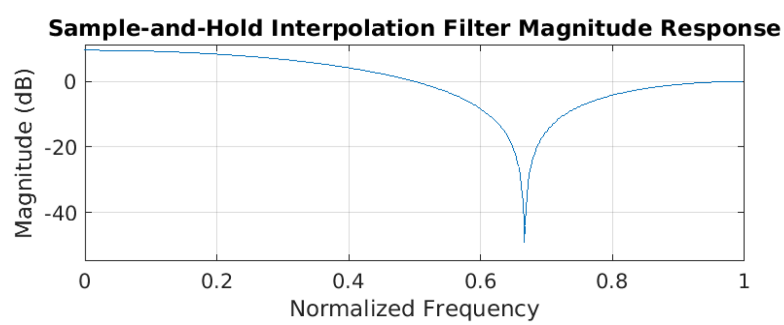


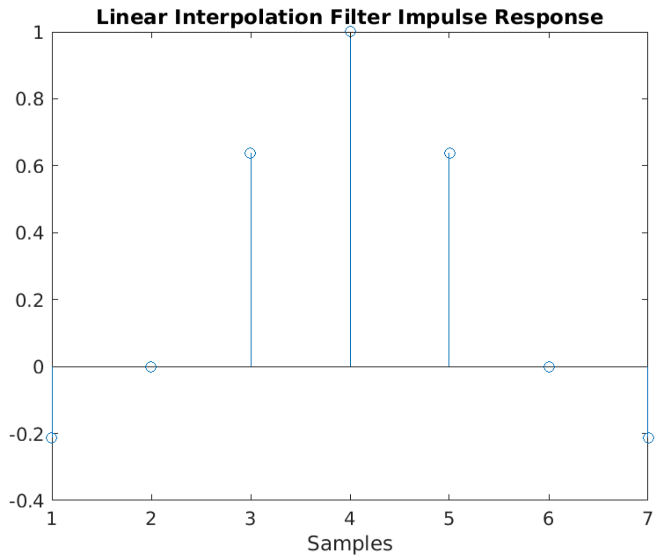


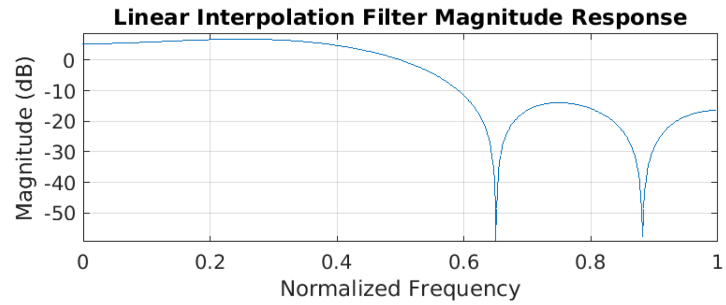


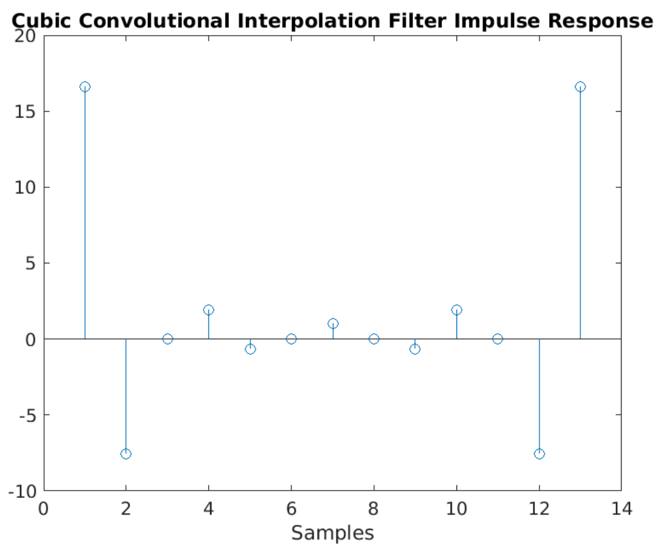
2) Here are the plots of the impulse and magnitude responses of the filters. Here, we have 1D sampling rate conversion for x3 conversion.

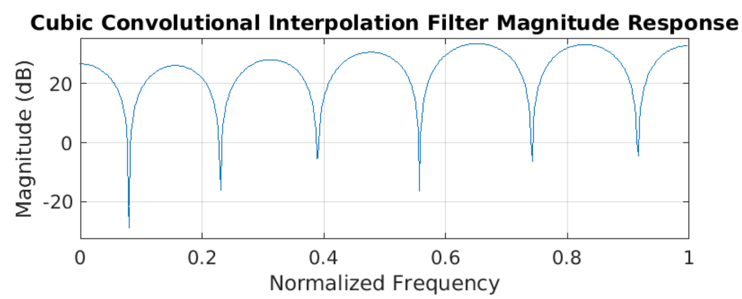




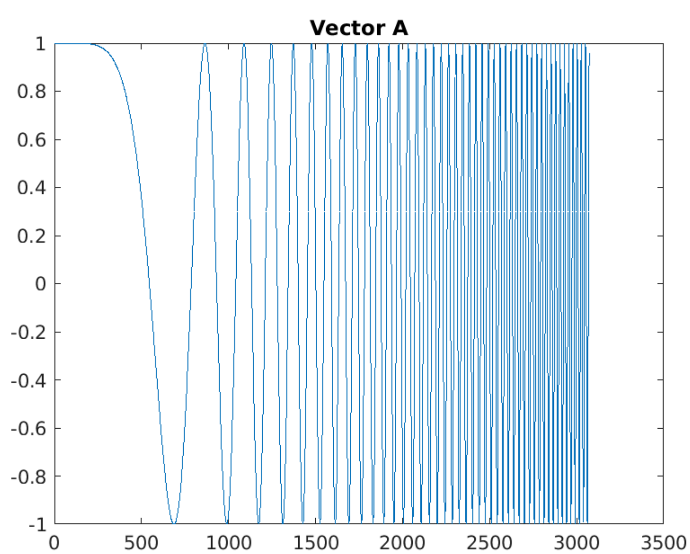




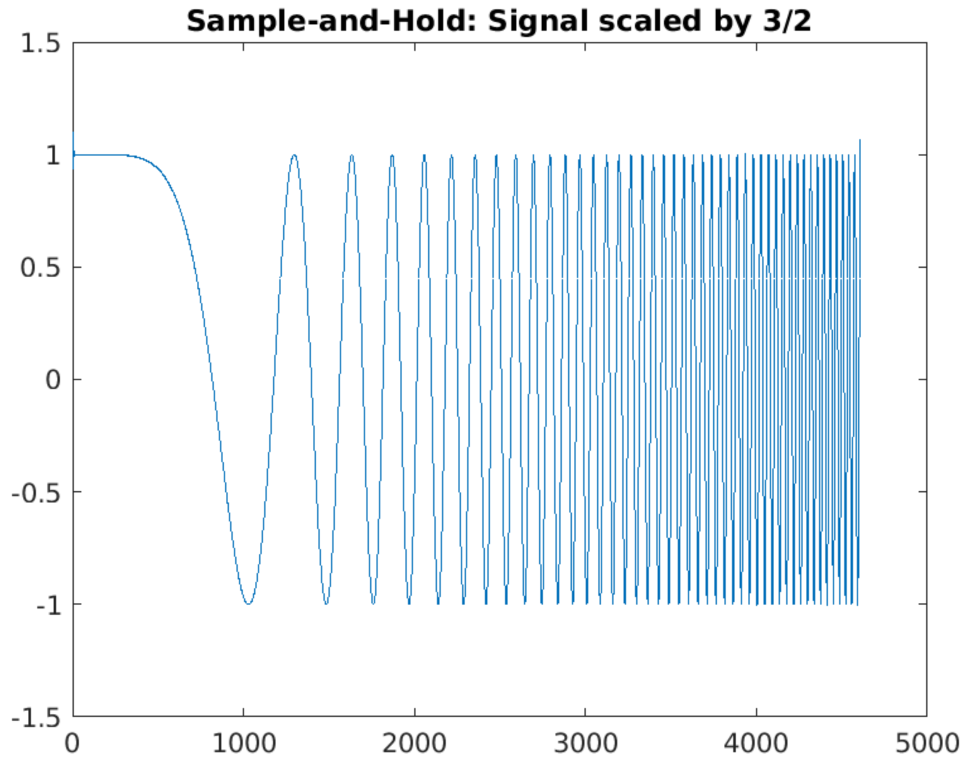




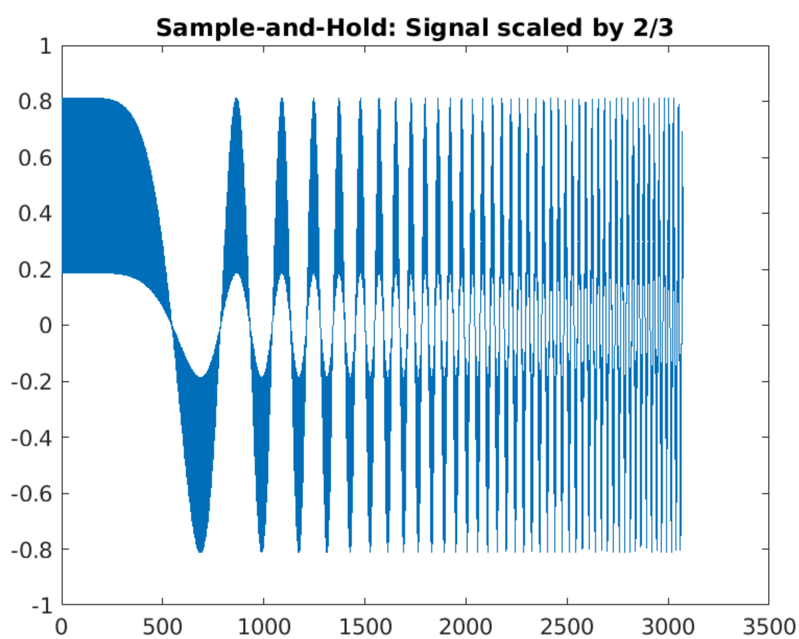
3) Here is the given vector A (a.mat)



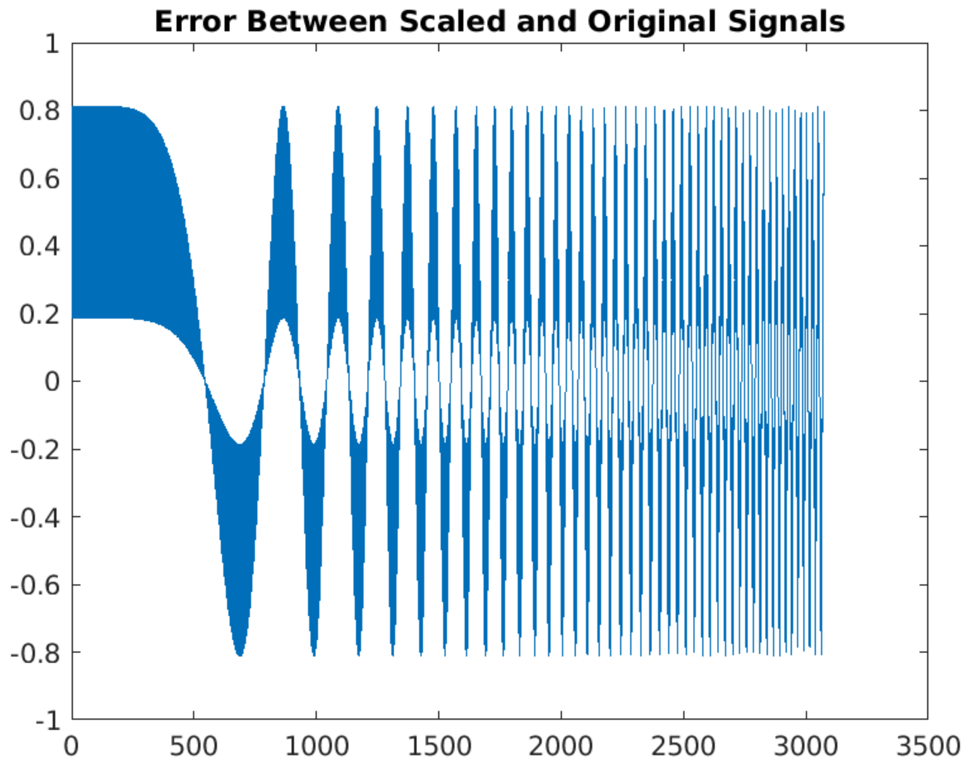
4) Here is the plot of the input signal scaled by 3/2.



5) Here is the plot of the output signal from 4) scaled by 2/3.

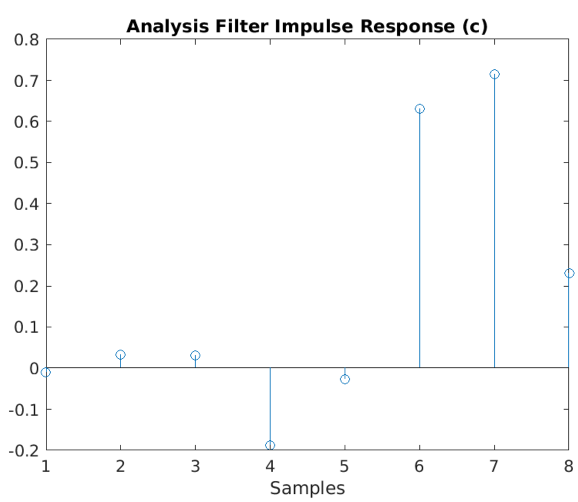


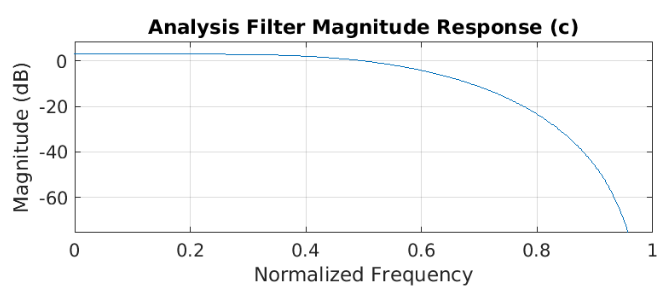
6) Here is the plot of the absolute error between the output signal from 5) and the original signal (after compensating for the group delay). The MSE was 0.1898

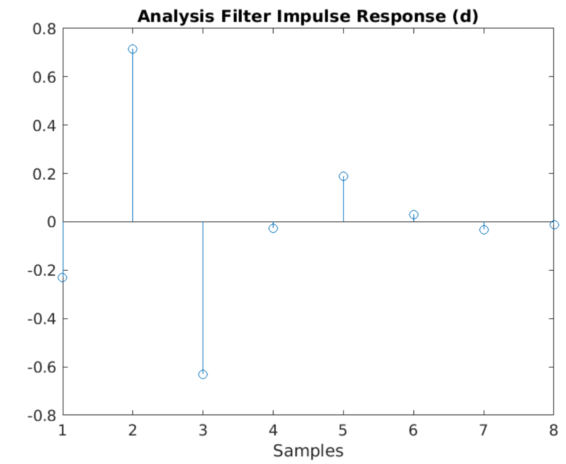


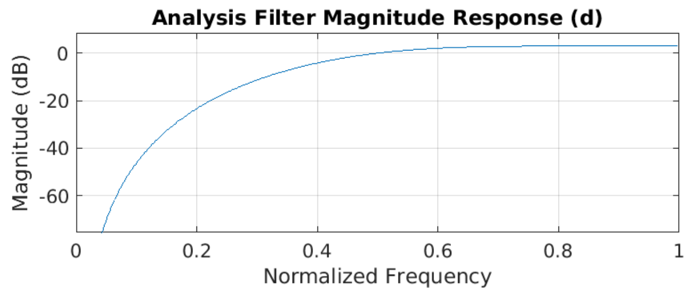
Problem 3

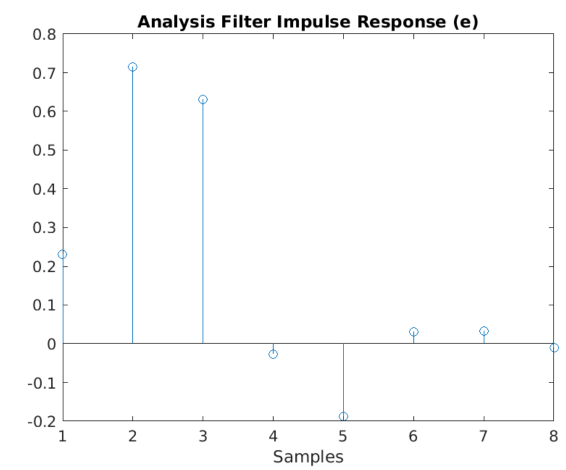
1) Here are the plots of impulse and magnitude response of the filters (wvlet = ‘db8’).

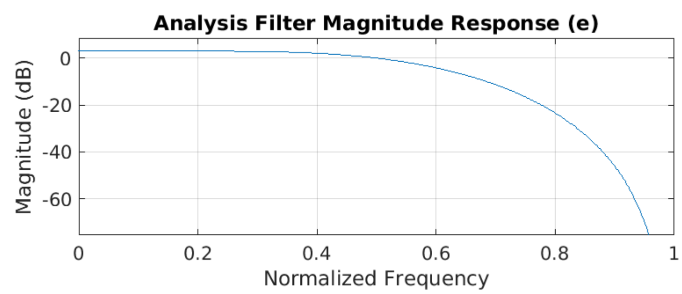


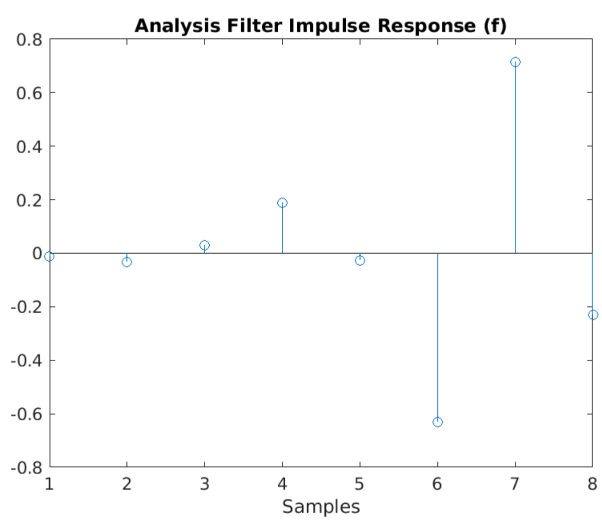


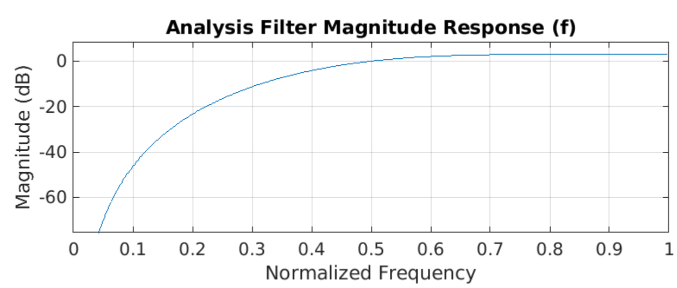

Analysis Filter Impulse Response (d)
Samples


Analysis Filter Magnitude Response (d)
Magnitude (dB)
Normalized Frequency

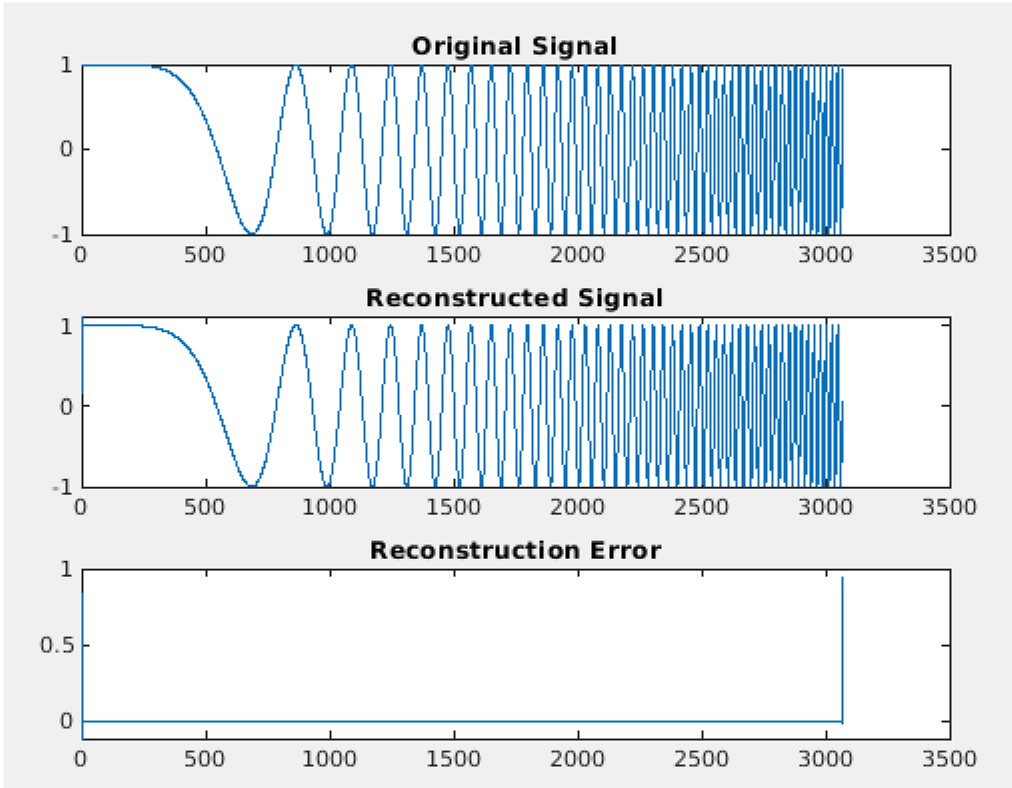

Analysis Filter Impulse Response (e)
Samples


Analysis Filter Magnitude Response (e)
Magnitude (dB)
Normalized Frequency

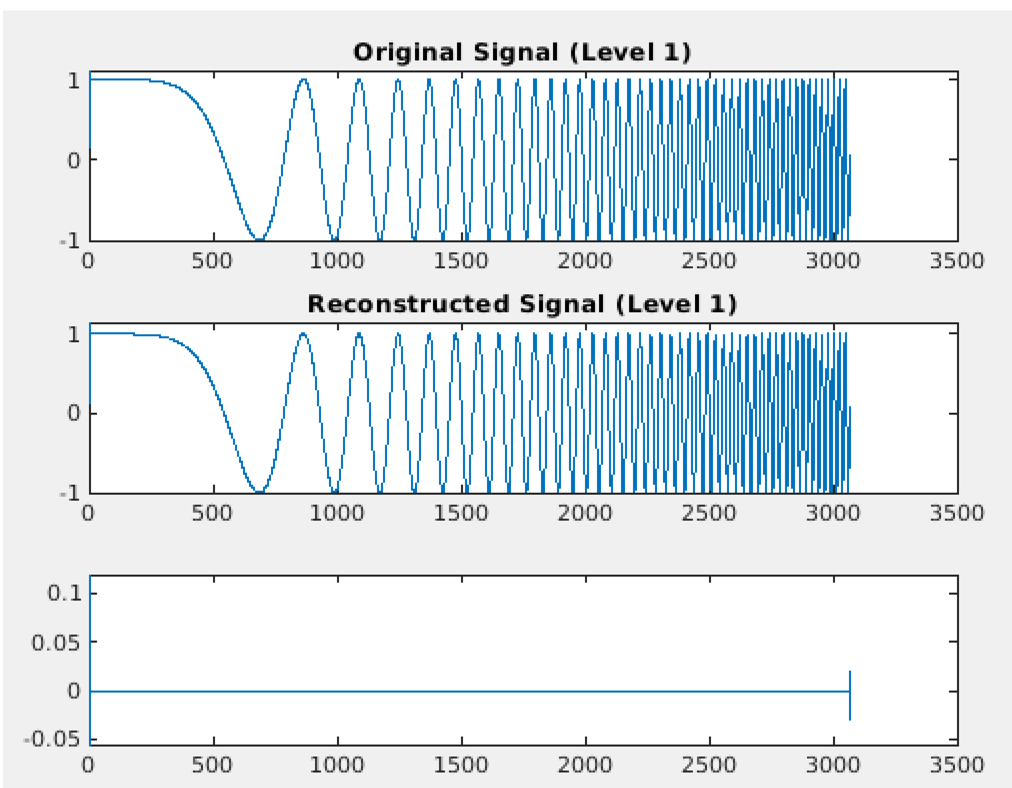

Analysis Filter Impulse Response (f)
Samples


Analysis Filter Magnitude Response (f)
Magnitude (dB)
Normalized Frequency

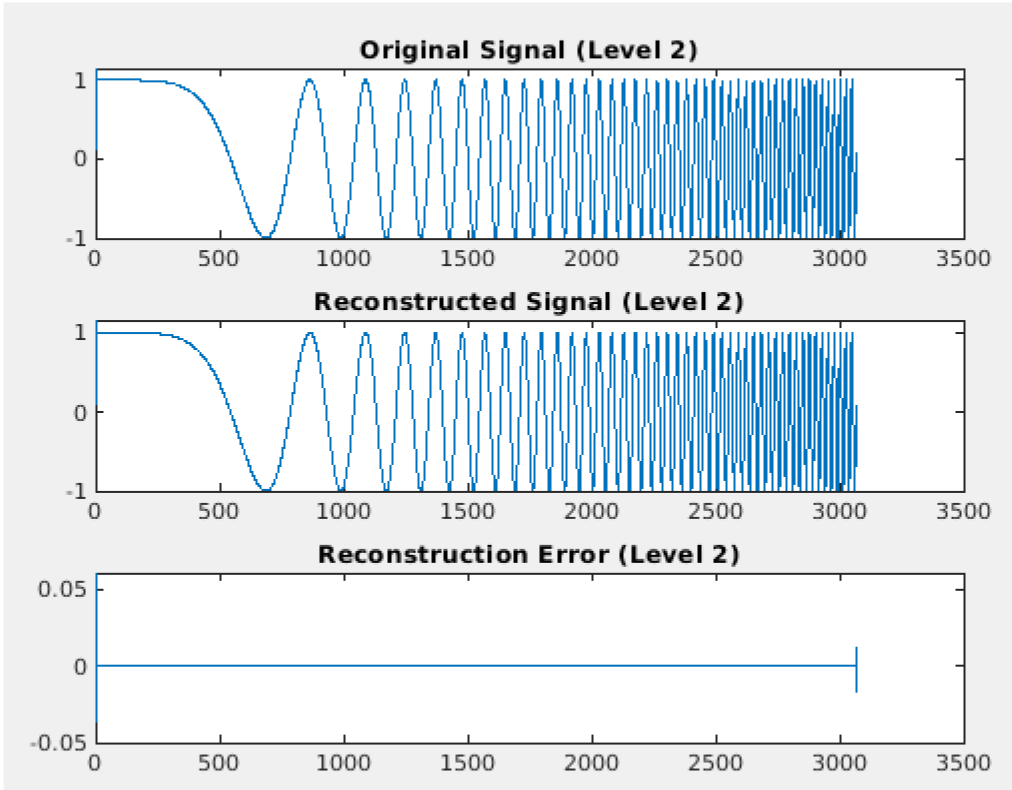
2) Here are the plots for the original signal, reconstructed signal, and the error. The MSE was around 0.001.



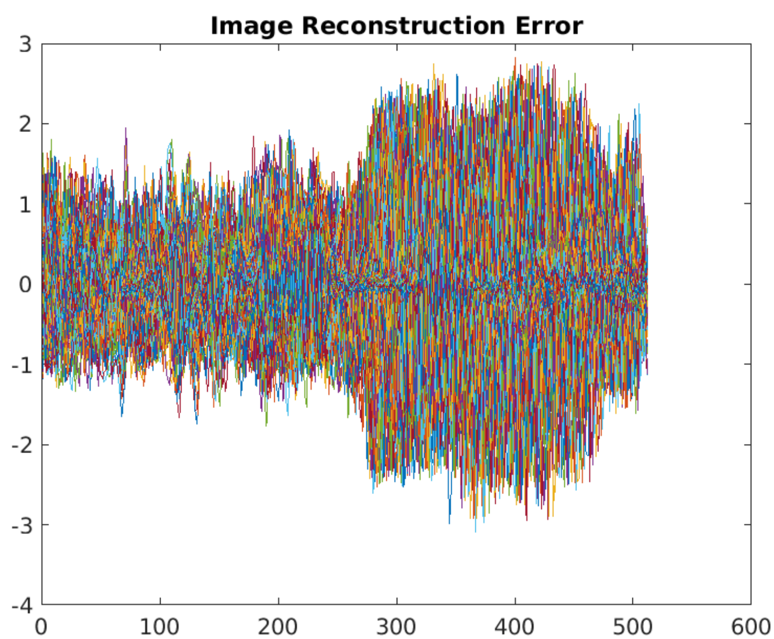
3) Here are the plots from the first recursive step. The MSE was very close to 0.



Here are the plots from the second recursive step. The MSE was extremely close to 0.



4) Here is the reconstructed image error plot. The MSE was extremely close to 0.



5) Here is the reconstruction error plot of the quantized image. The MSE was around 0.56.