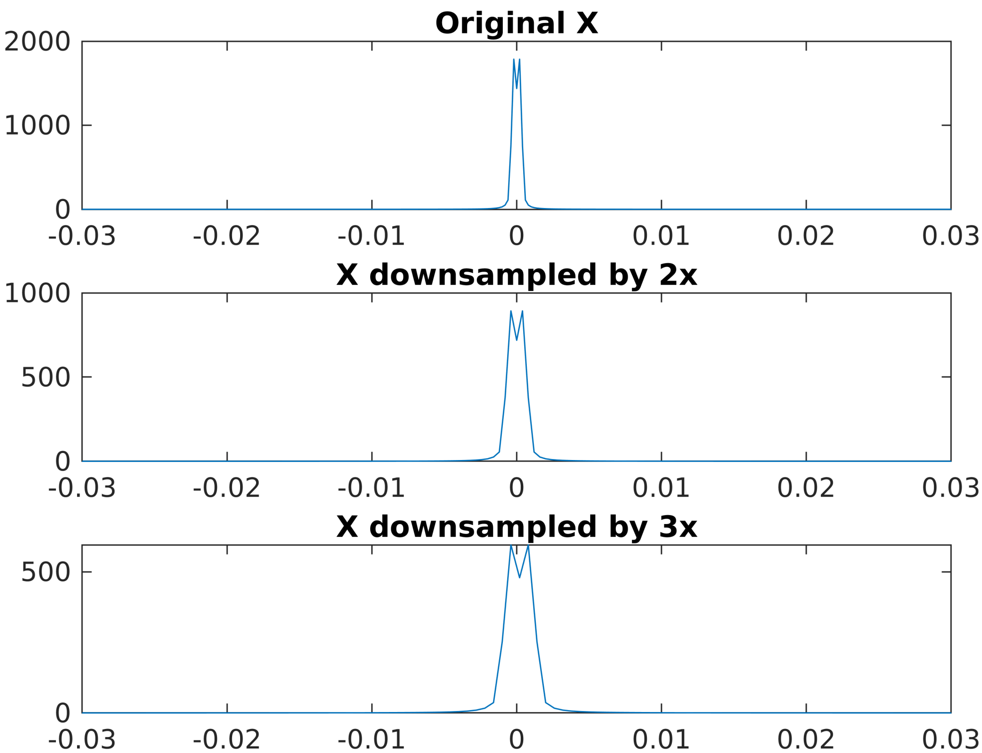
1- Let $x(n) = \frac{\sin(\omega_0 n)}{\pi n}$, and let $x_1(n) = x(2n)$, $x_2(n) = x(3n)$.

Find $X_1(e^{j\omega})$ and $X_2(e^{j\omega})$ and plot their magnitude.

```
w = 1/5;
T = 0.001*w;
n = -10:T:10;
n_1 = -10:2*T:10;
n_2 = -10:3*T:10;

plot_bounds = 0.15*w;

x = (w/pi)*sinc(w*n);
x_1 = (w/pi)*sinc(w*n_1);
x_2 = (w/pi)*sinc(w*n_2);

X = fft(x);
X_1 = fft(x_1);
X_2 = fft(x_2);

subplot(3,1,1)
plot(n,abs(fftshift(X)))
title("Original X")
xlim([-plot_bounds, plot_bounds])

subplot(3,1,2)
plot(n_1,abs(fftshift(X_1)))
title("X downsampled by 2x")
xlim([-plot_bounds,plot_bounds])

subplot(3,1,3)
plot(n_2,abs(fftshift(X_2)))
title("X downsampled by 3x")
xlim([-plot_bounds,plot_bounds])
```

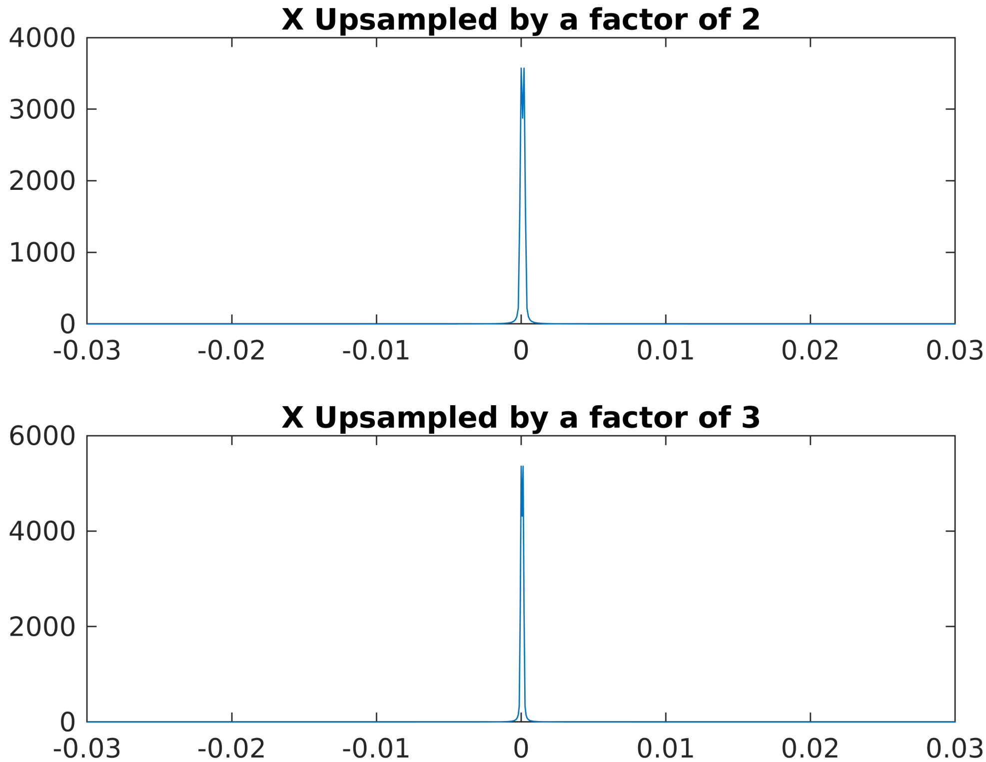


2- Let $x(n)$ be as in (1). Let $x_3(n)$ and $x_4(n)$ be signals resulting from upsampling $x(n)$ by factors of $L = 2, 3$, respectively. Find $X_3(e^{j\omega})$ and $X_4(e^{j\omega})$. Then plot their magnitudes.

```
x_3 = DSP_funcs.resampleSINC(x, 2);
x_4 = DSP_funcs.resampleSINC(x, 3);
```

```
n_3 = -10:T/2:10 + T/2;
n_4 = -10:T/3:10 + 2*T/3;

X_3 = fft(x_3);
X_4 = fft(x_4);

subplot(2,1,1)
plot(n_3, abs(fftshift(X_3)));
title("X Upsampled by a factor of 2")
xlim([-plot_bounds,plot_bounds])
```

```
subplot(2,1,2)
plot(n_4, abs(fftshift(X_4)))
title("X Upsampled by a factor of 3")
xlim([-plot_bounds,plot_bounds])
```




```
```