Digital Signal Processing - Assignment 3

June 6, 2015

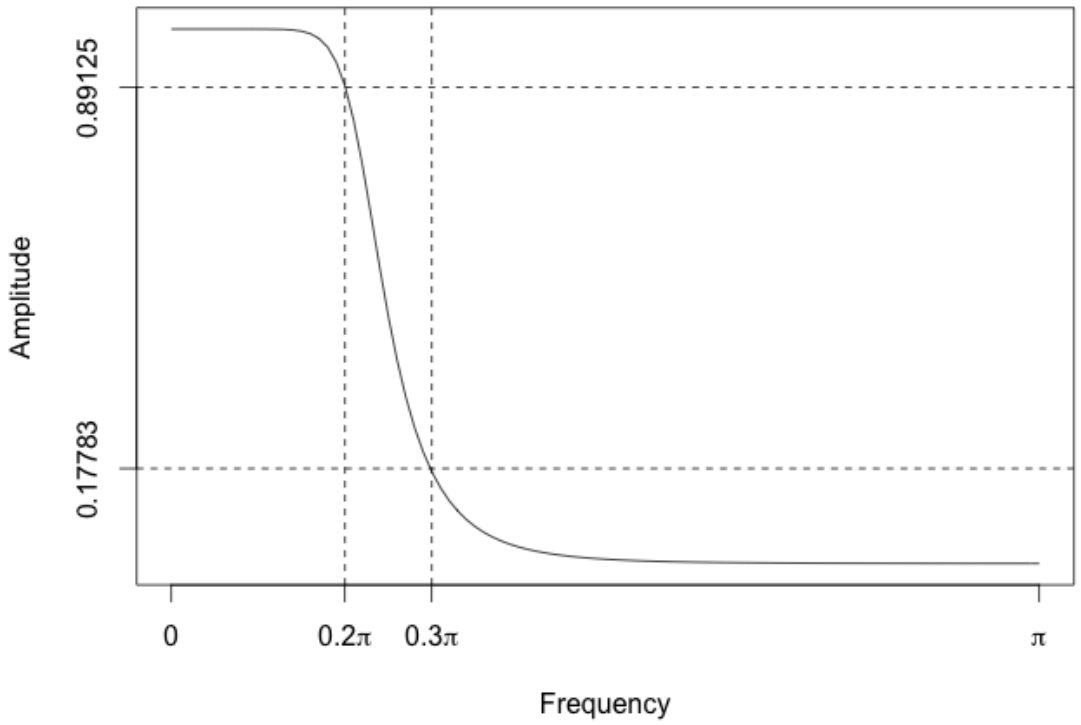
Stephanie Lund (2555914)
Aljoscha Dietrich(2557976)

Exercise 1

By solving the two constraints $|H_c(j0.2\pi)| \geq 0.89125$ and $|H_c(j0.3\pi)| \leq 0.17783$, we get:

$$N = 6$$
$$\omega_c = 0.70474$$

The graph of the magnitude of the frequency response $|H_c(j\omega)|$ is then:



Exercise 2

2.1

a) The minimum sampling frequency is 10kHz, so $T = \frac{1}{f_s} \geq \frac{1}{10{,}000}$.

b) $2\pi f = \frac{\pi/8}{T}$. Solve for f to get $625kHz$.

c) Solve the above equation using $T = \frac{1}{20{,}000}$ to get $f = 1250kHz$.

2.2

In all cases, upsampling by 3 and then downsampling by 3 doesn't change the signal. After applying the low-pass filter to cut off all frequencies above $\frac{\pi}{3}$, (a) and (c) remain unchanged, as their frequencies are below the cutoff, but (b) will be changed, since the frequency is above the cutoff.

Exercise 3

The code is located in the file ex-3.m. The settings chosen for the low-pass filter were a Butterworth filter with $N = 10$ and $\omega_c = 0.02$ radians.

Bonus

T_1 and T_2 are equivalent if N and M are relatively prime, or if $N = M$.