Name: Wenxuan Wang

Q1: 6 hours

Q2:

(a) Consider the rectangular window function

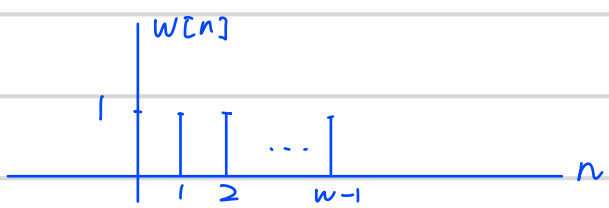
$$w[n] = u[n] - u[n - W] .$$

Show that

$$\sum_{k=-\infty}^{\infty} w\,[n - Wk] = c_1 .$$

Prove this for any W. Determine c_1.

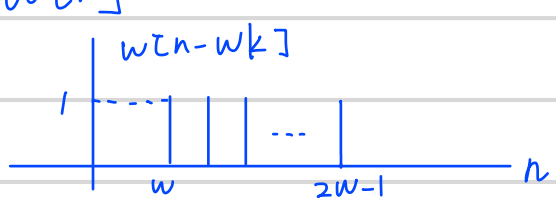
$\because w[n] = u[n] - u[n-W]$ $\therefore$



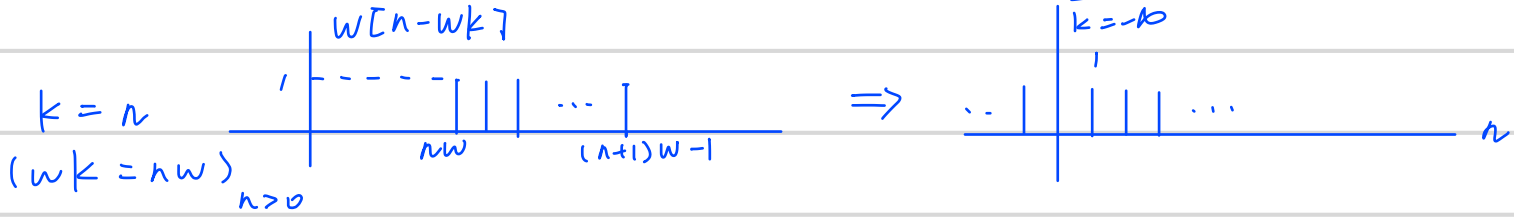
And $w[n-Wk]$ is $w[n]$ move right wk.

$k=0 \Rightarrow w[n]$

$k=1 \Rightarrow$ $(wk = w)$



$\sum_{k=-\infty}^{\infty} w[n-wk]$



$C_1 = 1$

(b) **(EEE 5502 Only)** Consider the rectangular window function

$$w[n] = u[n] - u[n - W] .$$

Show that

$$\sum_{k=-\infty}^{\infty} w\left[n - \left(\frac{W}{2}\right) k\right] = c_2$$

for when W is even. Prove this for any even W. Determine c_2.

$\sum_{k=-\infty}^{\infty} w[n-(\frac{w}{2})k] = c_2$

$= \sum_{k=-\infty}^{\infty} (u[n-(\frac{w}{2})k] - u[n-\underbrace{(\frac{w}{2})k-w}_{\frac{kw+2w}{2} = \frac{(k+2)}{2}w}])$

$= 2$

(c) **(EEE 5502 Only)** Consider the Hann window function

$$w[n] = \frac{1}{2}\left[1 - \cos\left(\frac{2\pi n}{W-1}\right)\right][u[n] - u[n-W]] \ .$$

Show that

$$\sum_{k=-\infty}^{\infty} w\left[n - \left(\frac{W-1}{2}\right)k\right] = c_3$$

for when W is odd. Prove this for any odd W. Determine c_3.

$$\sum_{k=-\infty}^{\infty} w\left[n-\left(\frac{W-1}{2}\right)k\right] = C_3$$

$$= \sum_{k=-\infty}^{\infty}\left[\frac{1}{2}\left(1-\cos\left(\frac{2\pi(n-(\frac{W-1}{2})k)}{W-1}\right)\right)\right]$$

$$= \sum_{k=-\infty}^{\infty} \frac{1}{2}\left[1-\cos\left(\frac{2\pi n}{W-1} - k\pi\right)\right]$$

$$\left(\frac{W-1}{2}k \le n \le \frac{W-1}{2}(k+2)\right)$$

when $k=0$, $k=1$

$$\frac{1}{2}\left[1-\cos\left(\frac{2\pi n}{W-1}\right)\right] + \frac{1}{2}\left[1-\cos\left(\frac{2\pi n}{W-1} - \pi\right)\right]$$

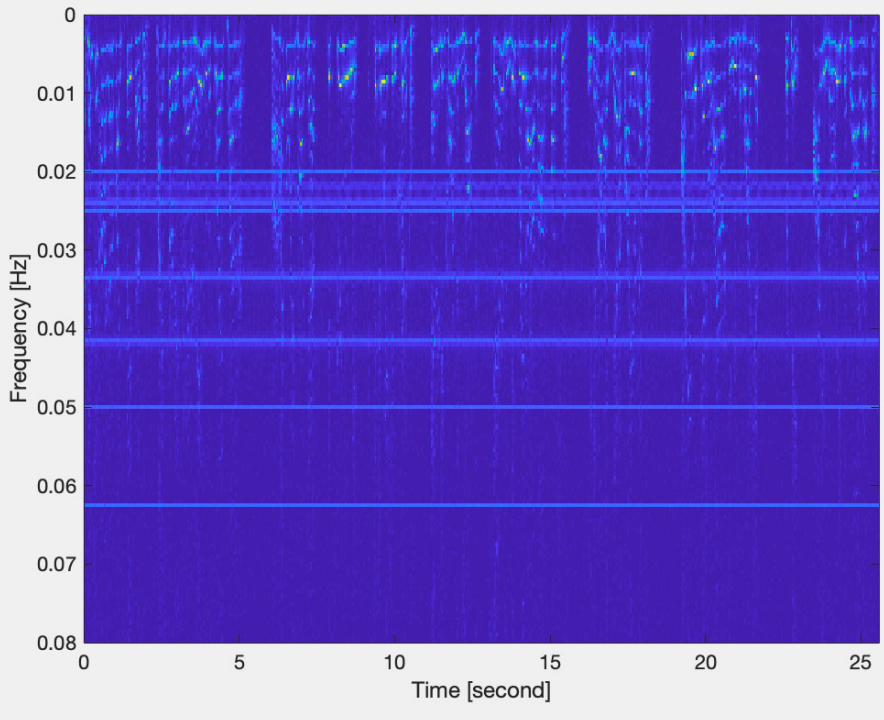
$$= \frac{1}{2} + \frac{1}{2} = 1$$

03

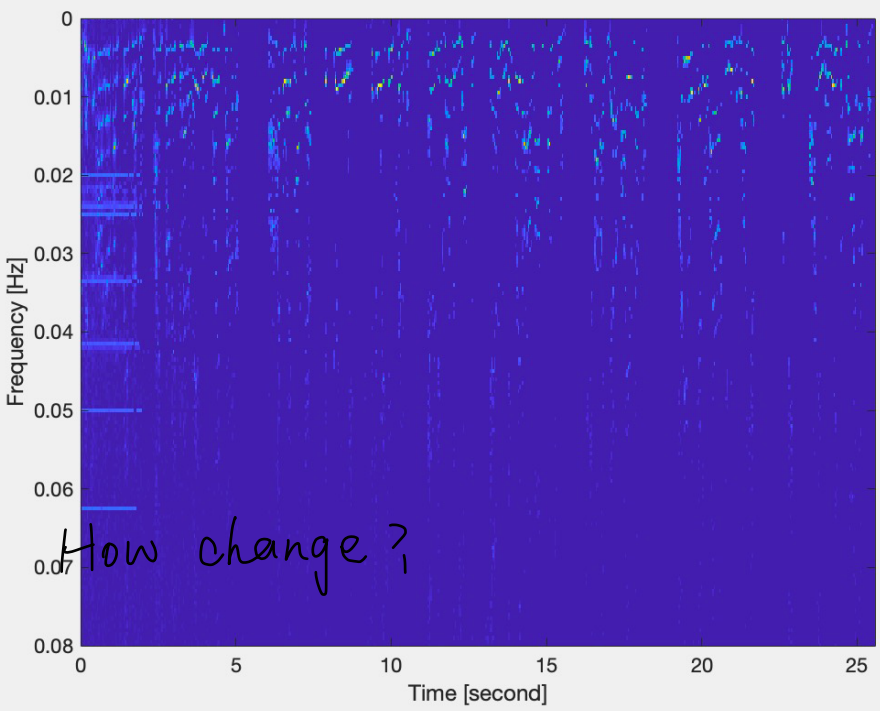
(a) 22K low pass filter. It blur everything.

(b) The first sentence is to get ysTFT, and if the gotten ysTST is less than the two times of msTFT, ysTFT will be reset to be zero.

(c)



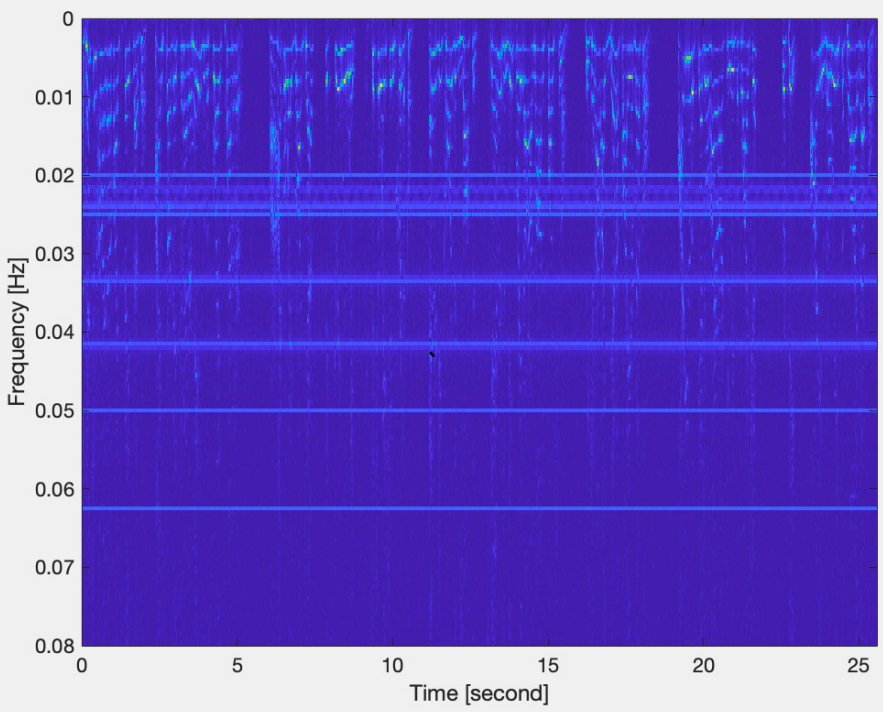
The processing change the noise. Even though I can hear loud noise in the beginning, the processing eliminates noise

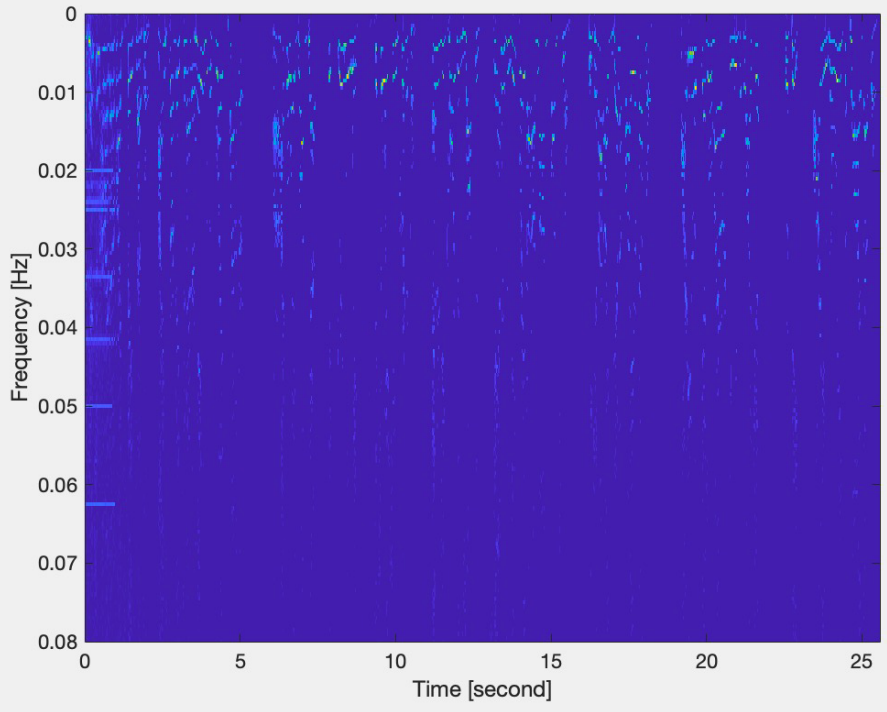


Q4

(a) See the m files

(b)





(c) The audio became smoother.
The result of Q4 is better than Q3.
Maybe because the correlation of the noise signal is improved,
so the SNR is also improved.