Homework 1 (Due: March 22nd)

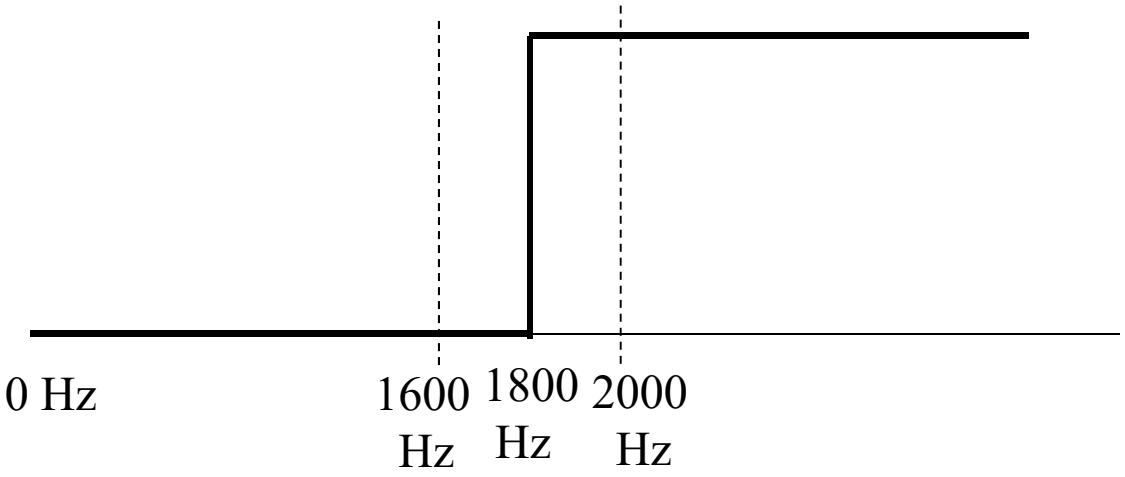
(1) Design a Mini-max **highpass** FIR filter such that (40 scores)

① Filter length = 21, ② Sampling frequency f_s = 8000Hz,

③ Pass Band 0~1600Hz ④ Transition band: 1600~2000 Hz,

⑤ Weighting function: $W(F) = 1$ for passband, $W(F) = 0.8$ for stop band .

⑥ Set $\Delta = 0.0001$ in Step 5.



※ The code should be handed out by NTUCool, too.

Show (a) the frequency response, (b) the impulse response $h[n]$, and (c) the maximal error for each iteration.

(2) (a) Which type of systems can be implemented by convolution?

(b) How do we convert convolution into an addition operation? (10 scores)

(3) (a) Describe three advantages of the FIR filter.

(b) How do we implement $y[n] = x[n] * (0.7^n u[n] + 0.2^n u[n])$ using the recursive method where * means the convolution and $u[n]$ is the unit step function?

(10 scores)

(4) What are the roles of (a) the transition band and (b) the weight function for minimax FIR filter design? (10 scores)

(5) Suppose that $x[n] = y(0.001n)$ and the length of $x[n]$ is 6000. If $X[m]$ is the FFT of $x[n]$, determine m such that $X[m]$ correspond to the frequencies of (a) 200Hz and (b) -100Hz. (10 scores)

(6) Use the MSE method to design the 7-point FIR filter that approximates the band filter of $H_d(F) = 1$ for $0.1 < |F| < 0.4$ and $H_d(F) = 0$ for $|F| < 0.1$ or $|F| > 0.4$.

(10 scores)

(7) Estimate the length of the digital filter if both the passband ripple and the stopband ripple are smaller than 0.01, the sampling interval $\Delta_t = 0.0001$, and the transition band is from 3000Hz to 3300Hz. (10 scores)

(Extra): Answer the questions according to your student ID number.

(ended with 0, 1, 2, 3, 5, 6, 7, 8)