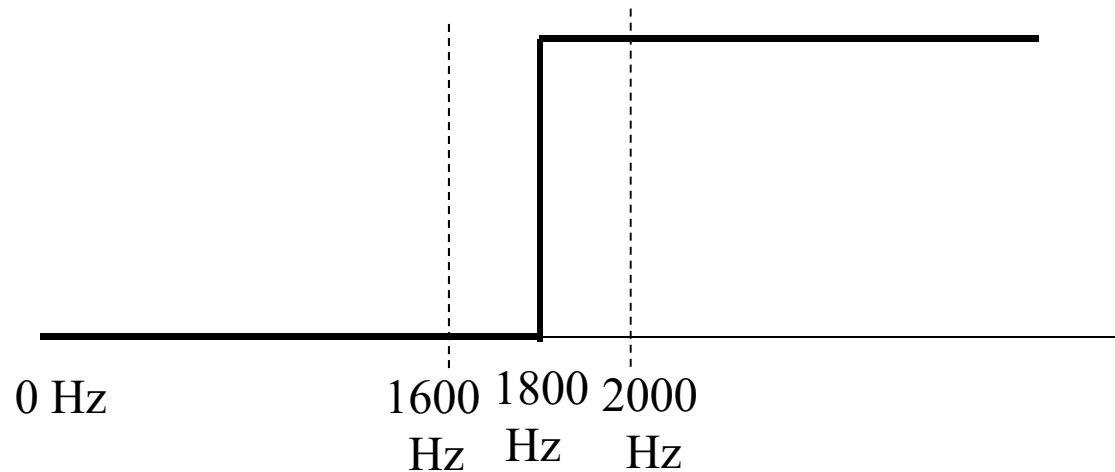


Homework 1 (Due: March 22nd)

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

- ① Filter length = 21, ② Sampling frequency $f_s = 8000\text{Hz}$,
- ③ Pass Band 1800~4000Hz 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)