## Homework 1 (Due: April 10th)

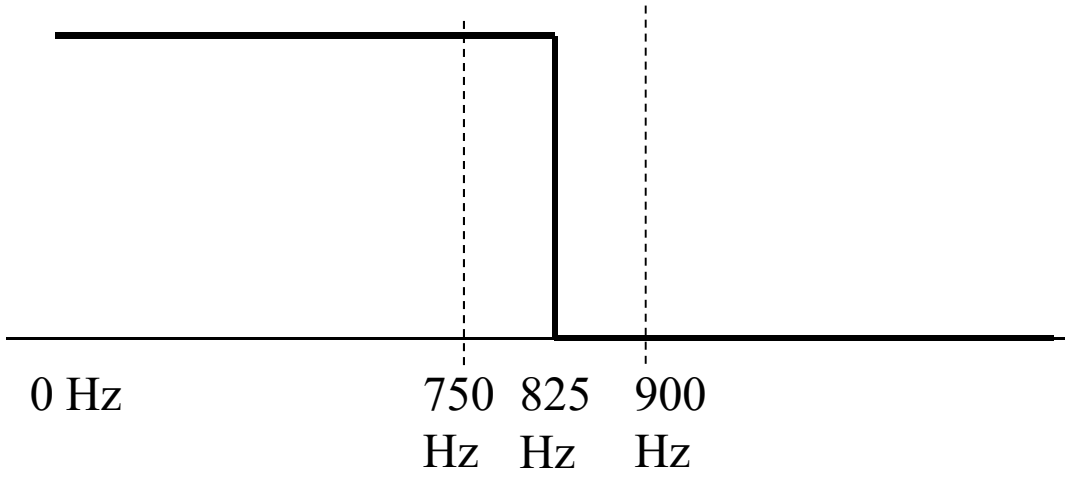
(1) Design a Mini-max **lowpass** FIR filter such that (40 scores)

① Filter length = 17, ② Sampling frequency $f_s$ = 3000Hz,

③ Pass Band 0~750Hz ④ Transition band: 750~900 Hz,

⑤ Weighting function: $W(F) = 1$ for passband, $W(F) = 0.5$ for stop band .

⑥ Set $\Delta = 0.0001$ in Step 5.




※ The code should be handed out through Ceiba

Show (a) the code, (b) the frequency response,

(c) the impulse response $h[n]$, and (d) the maximal error for each iteration.

(2) How do we implement $y[n] = x[n] * (0.6^n u[n] - 0.5^n u[n])$ efficiently where * means convolution and $u[n]$ is the unit step function? (10 scores)

(3) How do we convert convolution into an addition operation? (5 scores)

(4) Why (a) the step invariance method and (b) the bilinear transform can reduce or avoid the aliasing effect in IIR filter design? (10 scores)

(5) Suppose that $x[n] = y(0.005n)$ and the length of $x[n]$ is 800. If $X[m]$ is the FFT of $x[n]$, which frequency do (a) $X[100]$ and (b) $X[600]$ correspond to? (10 scores)

(6) Why ① the transition band and ② the weighting function are important in Minimax FIR digital filter design? (10 scores)

(7) Use the MSE method to design the 7-point FIR filter that approximates the lowpass filter of $H_d(\mathrm{F}) = 1$ for $|F| < 0.25$ and $H_d(\mathrm{F}) = 0$ for $0.25 < |F| < 0.5$. (15 scores)