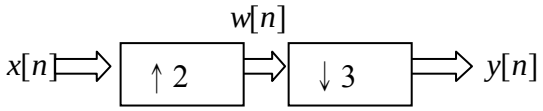
DSP Spring 2009

HW #3 (110%) Due: 04/14

[MATLAB EXERCISE]



1. (25%) x[n] is sampled from a continuous time signal x(t)=sin(2πt), $0 \leqq t \leqq 3$ with sampling period T=0.01s. x[n] is happened to be a sampled sequence from another continuous time signal with sampling period T=0.02s.
   (1) (5%) Show its two corresponding 512-point spectra for T=0.01 and T=0.02 in the same figure. **The abscissa should be in Hz.**
   (2) (10%) Please use MATLAB commands: "downsample" and "upsample" to find w[n] and y[n]. Plot x[n], w[n] and y[n] in the same figure (use the subplot command). Plot the magnitude spectra of x[n], w[n] and y[n] in another figure.
   (3) (5%) Use another command "resample" to get y[n] directly by changing the sampling rate of x[n]. Plot the resampled time sequence and its magnitude spectrum.
   (4) (5%) Compare the results in (2) and (3). Are they the same or not? State your reasons.
   (Hint: the plot(abs(fft(.))) only shows the magnitude spectrum within [0, 2π])

2. (15%) We can read music files into MATLAB by using command wavread or auread such as "[y, fs] = wavread('**.wav');". It returns the sampled data y and the sample rate fs (in Hertz). Please get the music data from the wave file "Peter.wav" and upsample the data to 3 times of the sampling rate; downsample the data to 1/2 of the sampling rate.
   (1) (10%) Plot and compare the magnitude spectra of the original (y), the upsampled data (y_up) and the downsampled date (y_down). **The abscissa should be in Hz.**
   (2) (5%) Try the following commands to hear the modified music clips: soundsc(y, fs); soundsc(y_up, fs); soundsc(y_up, fs*3); soundsc(y_down, fs); soundsc(y_down, fs/2); soundsc(resample(y, 3, 1), fs*3). State what you've heard.
   [The same reason as in Exercise 1-(4) makes the sound generated by soundsc(resample(y,3,1),fs*3) much nicer than the sound generated by soundsc(y_up, fs*3).]

[TEXTBOOK PROBLEMS]

3. (10%) 4.25 (a)(b)
4. (10%) 4.26 (a)
5. (10%) 4.30
6. (10%) 4.38
7. (10%) 4.40
8. (10%) 4.46 (a)(b)
9. (10%) 4.53 (a)(b)