Homework 5 (Due: 5th Jan.)

(1) (a) What is the role of the scaling function in the continuous wavelet transform? (b) What is the role of the generating function in the continuous wavelet transform with discrete coefficients? (10 scores)

(2) What are the vanishing moments of (a) $\frac{d^7}{dt^7} e^{-\pi t^2}$, (b) the 18-point coiflet, (c) $h[0] = h[4] = 1/16$, $h[1] = h[3] = -1/4$, $h[2] = 3/8$, $h[n] = 0$ otherwise.

(Hint: $H(f) = \sum_n h[n] e^{-j2\pi fn} = \left[1 - e^{-j2\pi f}\right]^m / 2^m$ $\frac{d^k}{df^k} H(f) = ?$

(15 scores)

(3) Why the complexity of the 1-D discrete wavelet transform is $O(N)$?

(10 scores)

(4) Why the wavelet transform can be used for (a) directional edge detection, (b) pattern recognition and (c) adaptive filter design? (15 scores)

(5) For a three-point wavelet filter, if $g[0] = 1/2$, $g[1] = b$, $g[2] = c$, and $g[n] = 0$ otherwise.

(a) What are the values of b and c if $g[n]$ is a quadratic mirror filter?

(b) What are the values of b and c if $g[n]$ is an orthonormal filter?

(10 scores)

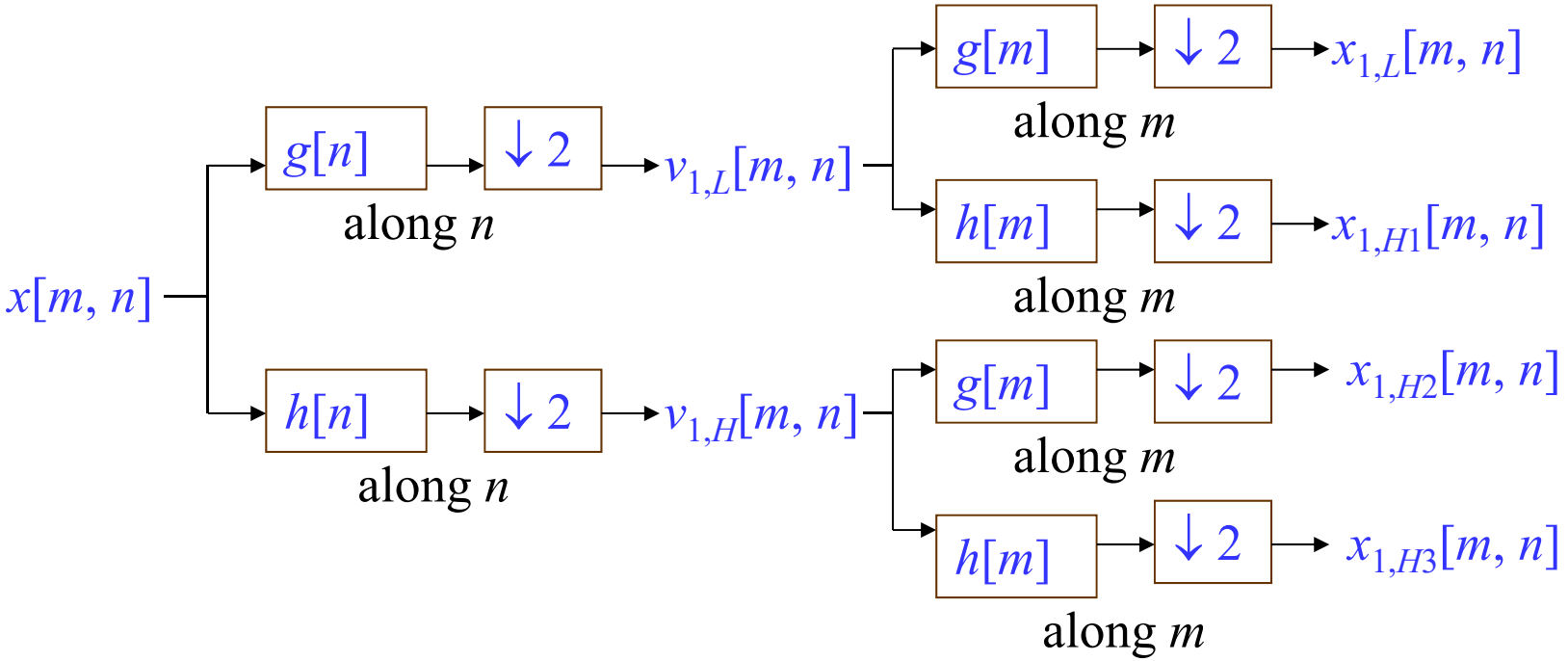
(6) What are the main advantages of (a) the symlet, (b) the coiflet?

(10 scores)

(7) (a) Write a Matlab or Python code for the following 2-D discrete 6-point Daubechies wavelet.

x = double(imread('filename'))

[x1L, x1H1, x1H2, x1H3] = wavedbc6(x)



(b) Also write the program for the inverse 2-D discrete 6-point Daubechies wavelet transform.

x = iwavedbc6(x1L, x1H1, x1H2, x1H3)

The code should be handed out by NTUCool. (30 scores)

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

(ended with 1, 2, 3, 4, 6, 7, 8, 9)