暨大資工系期末考 (data compression) - 99.1.12

1. (20%) (20%) Do the type-II differential encoding and decoding for the input sequence {5.6, 6, 6.7, 7.2, 8, 7, 4, 1.8}. (in pp. 4 of DPCM)
2. (20%) For the input sequence {5.6, 6, 6.7, 7.2, 8, 7, 4, 1.8}, find the coefficients a_1 and a_2 of the DPCM predictor of order 2. (in pp. 6-7 of DPCM)
3. (20%) A. For a given input data sequence $f_{i,j}$, $0 \le i \le N\text{-}1$, $0 \le j \le N\text{-}1$, the 2-D DCT is given by

$$F_{m,n} = \frac{2}{N} c_m c_n \sum_{i=0}^{N-1}\sum_{j=0}^{N-1} f_{i,j} \cos\frac{(2i+1)m\pi}{2N} \cos\frac{(2j+1)n\pi}{2N}, \quad 0 \le m \le N\text{-}1,\ 0 \le n \le N\text{-}1$$

and

$$f_{i,j} = \frac{2}{N} \sum_{m=0}^{N-1}\sum_{n=0}^{N-1} c_m c_n f_{i,j} \cos\frac{(2i+1)m\pi}{2N} \cos\frac{(2j+1)n\pi}{2N}, \quad 0 \le m \le N\text{-}1,\ 0 \le n \le N\text{-}1$$

where $c_k = \frac{1}{\sqrt{2}}$ if k=0, or c_k =1, otherwise.

   (a) Find A such that the above 2D-DCT can be formulated as $F=AfA^T$. (N=2)
   (b) Explain that (a) is a separable transform. (N=2)
   (c) Re-formulate (a) as $f = A^T F A$ and find the basis. (N=2)
4. (20%) Given an input sequence $x_n = \begin{cases} 1, n = 0, 1, 2, \ldots \\ 0, \text{otherwise} \end{cases}$

   (a) Find the output sequence y_n if the filter impulse response is $h_n = \begin{cases} 1/\sqrt{2}, n = 0,1 \\ 0, \text{otherwise.} \end{cases}$
   (b) Find the output sequence w_n if the filter impulse response is $h_n = \begin{cases} 1/\sqrt{2}, n = 0 \\ -1/\sqrt{2}, n = 1 \\ 0, \text{otherwise.} \end{cases}$
   (c) Looking at the sequence y_n and w_n what can you say about the sequence x_n ?

5. (20%) For the seven-level decomposition shown below:

19	6	12	10
-6	3	6	3
3	-3	0	-3
3	0	0	0

   (a) Find the bitstream generated by the SPIHT encoder. (just two passes)
   (b) Decode the bitstream generated in (a).

6. (20%) Describe how do we encode a macroblock in MPEG-I ?