T-61.5100 Digital image processing, Exercise 8/07

Image compression

1. Consider an 8-pixel line of gray-scale data, {12, 12, 13, 13, 10, 13, 57, 54}, which has been uniformly quantized with 6-bit accuracy. Redundant information should be removed. Construct its

   (a) 3-bit IGS code

   (b) shortest possible code

   Compare average code lengths to the plain binary code, when there are 64 gray levels. How could redundancy between pixels be reduced?

2. The source alphabet has 8 symbols a_i, $i = 1, ..., 8$, whose probabilities are 0.6, 0.2, 0.08, 0.06, 0.02, 0.02, 0.01 and 0.01. Construct for the alphabet its

   (a) Huffman code

   (b) B_2 code

   (c) S_2 code (shift code, block size 2)

   Calculate also entropy and compare average word lengths to it.

3. A 64-bit wide binary image has been coded with one-dimensional WBS code with blocks of four pixels and white blocks are marked with a 0-bit. The WBS code for the example line is

   $$011001000000100001001000000,$$

   where 0 is used to mark black pixels.

   (a) Decode the line.

   (b) Create a 1-D recursive WBS procedure that begins by looking for all white lines (a 64-pixel block) and successively halves nonwhite intervals until four pixel blocks are reached.

   (c) Use your algorithm to code the previously decoded line. It should require fewer bits.

4. Devise an algorithm for decoding the following LZW encoded line (Example 8.12 in the textbook):

   39 39 126 126 256 258 260 259 257 126

   Since the dictionary that was used during encoding is not available, the code book must be reproduced as the output is decoded.

5. Predictive coding (Fig 8.21) for the gray level line

   30 29 29 28 20 15 12 10 9 8 9 10 11 11 11 11 11

   Create delta modulation code (DM), when $\alpha = 1$ and error is coded using values ± 2. Compare required number of bits to corresponding non-lossy coding. What are the disadvantages of DM?