Digital Image Processing, 2017

Exercise 10

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Problem 33: Run-length Encoding (RLE)

a) A grey-scale image (8 bit per pixel) is 10 by 10 pixels large and shows a cross with a line thickness of two pixels. The center of the cross is in the middle of the image, and the horizontal and vertical lines extend all the way to the edge of the image. The cross has uniform colour, and the background is uniform as well.

   Perform run-length encoding on this image. What is the compression ratio?

b) A grey-scale image (8 bit per pixel) is 10 by 10 pixels large, and the pixels are alternately black and white (quasi a pixelwise checkerboard). What "compression" ratio would RLE achieve? How can you generalize RLE to get a better compression ratio, and which compression ratio can you achieve?

Problem 34: Huffman coding

Determine the Huffman coding for the following images and determine the bit rate and compression ratio of the image using Huffman coding:

a) An image with 4 bits per pixel and the following histogram:
   0,0,55,44,201,393,153,57,0,90,599,5,2,0,0,1

b) The image with the cross from above

c) The pixelwise checkerboard image from above

What kind of image would be the worst case for Huffman coding?

Problem 35: JPEG Image Size and Quality

Open each of the three test images (`testimage1.png`, `testimage2.png`, `testimage3.png`) with some standard image displaying software and then repeatedly save it as JPEG image with different quality (the image display program should ask you about the quality setting when you save as JPEG). Choose 4 different qualities, the highest possible (probably called 100%, or 1.0, depending on the software), the lowest possible (0% or 0.0) and two intermediate ones – don't forget to give different names to the different saved images!

a) Compare the file sizes of the PNG version and the 4 JPEG versions. What is different for the 3 test images, and why?

b) Can you see how the image degrades for the low quality JPEG (zoom into the image, maybe 400%, so that the individual pixels are visible). What degrades? Why?