Image Compression Lecture Assignment-1

An image of size M ×N is loaded into Matlab with I = imread(filename), where I become a three dimensional matrix of size M ×N ×3 representing the image in RGB format. The image should be read as an 8-bit image, i.e., each value is between 0–255.

1. Implement the JPEG compression algorithm except for the Huffman coding. The function should take an RGB-image (as a matrix or its filename) and return the image as “blocked-DCT”.

To get better compression the image is converted from RGB to YCbCr, where Y is the gray scale (luminance) and Cb/Cr consist of the color information (chrominance). This is done because the human eye is not so sensitive to changes in the chrominance, and therefore these components can be compressed harder than the luminance. Given an 8-bit RGB-image the YCbCr-image is computed as (the resulting values are between 0–255):

$$Y = 0.299R + 0.587G + 0.114B$$
$$Cb = -0.1687R - 0.3313G + 0.5B + 128$$
$$Cr = 0.5R - 0.4187G - 0.0813B + 128$$

and to convert back to RGB:

$$R = Y + 1.402(Cr - 128)$$
$$G = Y - 0.34414(Cb - 128) - 0.71414(Cr - 128)$$
$$B = Y + 1.772(Cb - 128)$$

If you like, you are allowed to use the Matlab functions rgb2ycbcr and ycbcr2rgb.

You must implement the discrete cosine transform (DCT) by yourself and it must be done in matrix form. To compute the DCT matrix T for an n × n block, n = 8 for JPEG, the Matlab function dctmtx can be used. If you like, you can implement this function also.

The two Quantization tables you need are:

$$Q_{luma} = \begin{bmatrix} 16 & 11 & 10 & 16 & 24 & 40 & 51 & 61 \\ 12 & 12 & 14 & 19 & 26 & 58 & 60 & 55 \\ 14 & 13 & 16 & 24 & 40 & 57 & 69 & 56 \\ 14 & 17 & 22 & 29 & 51 & 87 & 80 & 62 \\ 18 & 22 & 37 & 56 & 68 & 109 & 103 & 77 \\ 24 & 35 & 55 & 64 & 81 & 104 & 113 & 92 \\ 49 & 64 & 78 & 87 & 103 & 121 & 120 & 101 \\ 72 & 92 & 95 & 98 & 112 & 100 & 103 & 99 \end{bmatrix}$$

$$Q_{chroma} = \begin{bmatrix} 17 & 18 & 24 & 47 & 99 & 99 & 99 & 99 \\ 18 & 21 & 26 & 66 & 99 & 99 & 99 & 99 \\ 24 & 26 & 56 & 99 & 99 & 99 & 99 & 99 \\ 47 & 66 & 99 & 99 & 99 & 99 & 99 & 99 \\ 99 & 99 & 99 & 99 & 99 & 99 & 99 & 99 \\ 99 & 99 & 99 & 99 & 99 & 99 & 99 & 99 \\ 99 & 99 & 99 & 99 & 99 & 99 & 99 & 99 \\ 99 & 99 & 99 & 99 & 99 & 99 & 99 & 99 \end{bmatrix},$$

where the first is for the Y-component and the second for the Cb- and Cr-components.

2. Plot the blocked DCT-images with the Matlab function spy.
3. Implement the function for the JPEG decompression, which take a blocked DCT-image and returnthe image in RGB.