Multimedia Processing and Communications **Fall-2020**

Homework # 4 **Due Date: Dec 10th, 2020**

Programming exercises

Please submit all the plots and your code. Put title and labels on your plots; include comments throughout your code.

Discrete Cosine Transform (DCT) based Image Coding

In this problem, we study the use of the DCT for coding images. DCT is a very useful technique since the energy of transformed coefficients is mostly packed into the low-frequency coefficients. Apply the following steps for DCT coding of **lena512** for two different values of step size **q** (e.g., q=4,8)**:**

1. Divide **lena512** into 8x8 subblocks.
2. Transform each 8x8 subblock using 2-D DCT (*dct2* in MATLAB, *scipy.fftpack.dct* in Python).
3. For each subblock, perform uniform quantization with step size **q**.
4. Reconstruct the image using inverse DCT on each 8x8 subblock.
5. Plot the reconstructed image.
6. Compute the PSNR between the reconstructed and original images. Plot the error image and comment on the quality of the reconstructed image.

In the second part of the assignment, you are asked to estimate the required bitrate for DCT coding of **lena512** image:

1. Perform zig-zag scanning on each 8x8 quantized DCT subblock.
2. Turn the AC coefficients into (run-length, value) pairs, with EOB (end-of-block) symbol indicating the trailing run of zeros.
3. Compute the histogram of (run-length, value) and EOB symbols over the whole image.
4. Find the entropy of computed histogram. Multiply entropy with the total number of coded symbols. This is your estimated bitrate (ignoring the bitrate required for DC coefficients).

Repeat above steps for the two different values of **q.** Comment on the PSNR vs. bitrate trade-off. Which value of **q** is preferable and why?