EECS 225B Problem Set 7

Due on 04/20/2020 at 9am on Gradescope

In this assignment, you explore some image compression techniques, and evaluate their performances by fidelity criteria.

Part I: Objective Fidelity Criteria

Write a program to compute the root-mean-square error [see Eq. (8-10)] and mean-square signal-to-noise ratio [per Eq. (8-11)] of a compressed- decompressed image. This project is generic in the sense that it will be used in other projects that follow.

Use Figure 1.1 and write a program to generate the results using uniform quantization and IGS quantization. Use your fidelity criteria program to characterize any loss of visual information and comment on your results.

Part II: Image Entropy

Write a program to compute the entropy of an image [see Eq. (8-7)]. With Figures 1.2(a) and 1.2(b), use your program to estimate their entropies.

Part III: Transform Coding

Write a program to compute the information loss associated with the following transform coding schemes:

	Case 1	Case 2
Transform	Fourier	Cosine
Subimage Size	8x8	8x8
Bit Allocation	8-largest coding	8-largest coding

[a] Use the routines developed in Part I to quantify the loss of information.

[b] With Figure 1.3, use the program to compare Cases 1 and 2.

Gradually decrease the number of retained coefficients until the reconstruction error for Case 2 becomes objectionable. That is, try 7-largest, 6-largest, ... coding as the bit allocation method. Display the output images for each class as well as the computed ‘loss of information’ required by [a] for 8/7/6/../1 bit allocations.

Here are some helpful Matlab commands:

`X = fft2(x)`	Computes the 2D-DFT of a matrix x
`x = ifft2(X)`	Computes the inverse 2D-DFT of matrix X
`X = dct2(x)`	Computes the 2D-DCT of matrix x
`x = idct2(X)`	Computes the inverse 2D-DCT of matrix X
`[B I] = sort(A, mode)`	Sorts the array A

If you choose to do this homework in Python, you can use library functions analogous to the ones given above.

Note:

1. For each problem, you need to:
    1. Email your source code (zip it before you email) to eecs225bsp20@gmail.com if the question asks for any implementations.
        1. Make sure your code is executable. Either MATLAB or Python is okay. Please avoid C/C++ if possible (appreciate it!). If using Python, Jupyter Notebooks are preferred.
        2. Email title: FirstName_LastName_HW#. For example, Scott_McCrae_HW1.
        3. Submit a single PDF file on Gradescope which contains: i. your answer for each problem; ii. your source code (please also paste your source code here; screenshots are okay); iii. your output image(s). Make sure to prepare your solution to each problem on a separate page. On Gradescope, please select and match each page to the corresponding problems.
2. Remember to follow the course homework policies on collaboration. You're allowed to collaborate with other students on homework, but each student needs to write up their own original solutions. **Please do not submit the exact same writeup or code, as this is considered academic dishonesty. Copying solutions from any source is considered academic dishonesty.**