CS 423/523 Introduction to Computer Vision - Assignment 1

Due: 8th of November 23:55

JPEG Compression

Description:

In this assignment, you will apply JPEG compression to four given grayscale images and observe the changes in frequency domain. For a given image, apply manual JPEG compression via DCT (Discrete Cosine Transform) as described in the course slides. Then, compare and report the frequency domain properties of the original and compressed/decompressed images with respect to the given quantization tables.

Details:

Here is a step by step guide to jpeg compression:

1. Divide the image into 8x8 blocks
2. Apply DCT to each block
3. Compress each block using the given quantization tables.

You must use Q_{50}, Q_{10} and Q_{90} tables which are as follows:

$$Q_{50} = \begin{bmatrix} 16 & 11 & 10 & 16 & 24 & 40 & 51 & 61 \\ 12 & 12 & 14 & 19 & 26 & 58 & 60 & 55 \\ 14 & 13 & 16 & 24 & 40 & 57 & 69 & 56 \\ 14 & 17 & 22 & 29 & 51 & 87 & 80 & 62 \\ 18 & 22 & 37 & 56 & 68 & 109 & 103 & 77 \\ 24 & 35 & 55 & 64 & 81 & 104 & 113 & 92 \\ 49 & 64 & 78 & 87 & 103 & 121 & 120 & 101 \\ 72 & 92 & 95 & 98 & 112 & 100 & 103 & 99 \end{bmatrix}$$

$$Q_{90} = \begin{bmatrix} 3 & 2 & 2 & 3 & 5 & 8 & 10 & 12 \\ 2 & 2 & 3 & 4 & 5 & 12 & 12 & 11 \\ 3 & 3 & 3 & 5 & 8 & 11 & 14 & 11 \\ 3 & 3 & 4 & 6 & 10 & 17 & 16 & 12 \\ 4 & 4 & 7 & 11 & 14 & 22 & 21 & 15 \\ 5 & 7 & 11 & 13 & 16 & 12 & 23 & 18 \\ 10 & 13 & 16 & 17 & 21 & 24 & 24 & 21 \\ 14 & 18 & 19 & 20 & 22 & 20 & 20 & 20 \end{bmatrix}$$

$$Q_{10} = \begin{bmatrix} 80 & 60 & 50 & 80 & 120 & 200 & 255 & 255 \\ 55 & 60 & 70 & 95 & 130 & 255 & 255 & 255 \\ 70 & 65 & 80 & 120 & 200 & 255 & 255 & 255 \\ 70 & 85 & 110 & 145 & 255 & 255 & 255 & 255 \\ 90 & 110 & 185 & 255 & 255 & 255 & 255 & 255 \\ 120 & 175 & 255 & 255 & 255 & 255 & 255 & 255 \\ 245 & 255 & 255 & 255 & 255 & 255 & 255 & 255 \\ 255 & 255 & 255 & 255 & 255 & 255 & 255 & 255 \end{bmatrix}$$

You must report how each quantization matrix affects the compression and the frequency domain properties of resulting images. For compression, write the DCT coefficients before quantization to a file and then ZIP it. Also write the DCT coefficients after quantization to a file and ZIP it as well. Then compare their sizes. To understand the frequency changes, you need to apply FFT to both pre-compressed and the compressed/decompressed image and compare their FFT magnitudes. Taking the logarithm of magnitudes may assist your visual comprehension. Note that, before applying FFT you need to decompress it via inverse DCT.

Important notes:

- **Python 3.6 or higher is a must.**
- **Test your code before submitting, it must not crash.**
- **You may only use Opencv, Numpy and Matplotlib.**
- **Your Assignment will be disregarded if your code does not work or a report is not submitted!**
- **Your Assignment will be disregarded if you use any other library than the ones stated above!**

Grading:

Your grade will be penalized 10 out of 100 points for each minor fix before running the code regarding the assignment details.
50%: Image Compression
20%: Transformation to frequency domain.
30%: Report

Submission Information:

Send all your source codes and report to the LMS. Your code should be clean and easy to read by possessing the following properties;

- *Clean structure:* The overall code should be neatly organized, where the related statements are grouped together with enough spacing among them.
- *Appropriate use of comments:* There should be comments explaining what the program, and different groups of statements are supposed to do. Don't overdo it.
- *Meaningful and consistent variable naming:* The names of variables should be meaningful with respect to the purpose and usage of these variables.

Submission: By uploading your code and report to LMS as a single ZIP archive. No other methods (e.g., by e-mail) accepted. (You may resubmit as many times as you want until the deadline).
Warning: DO NOT SHARE YOUR CODE WITH OTHERS. Your programs are checked and compared against each other using automated tools. Any act of cheating will be punished severely.
Also:

- Name your archive file uploaded exactly as requested. Your archive file must be named as **<NAME>_<SURNAME>_<STUDENTID>.zip.**
- Make sure that your program runs and gives the **expected output.**
- The first lines of your code must include your name, surname, student number, and department as a **comment**. An example comment is as follows:
  / John Smith S0001 Department of Computer Science */*
- **Don't include your image and video files** in your archive

Good luck ☺