198:334 Digital Imaging and Multimedia
Fall 2021

Assignment 5

Submission instruction:

1- Report: You need to prepare a report containing all your answers, results, images, plots, and codes you wrote in one document. For example, you can use MS Word or any similar software to create a document and copy and paste the resulting images into it. Submit the report as one file through sakai.

2- Code: You also need to submit an electronic copy of your code. This applies only to any code you write. Zip all your code in one file and email it to the TA.

3- You can use ImageJ or Python for your implementation. Useful implementations of ImageJ plugins can be found at: http://rsb.info.nih.gov/ij/developer/source/

- *Late submission policy:* 10% penalty for late submission. Late submissions after last day of class will not be accepted.

The images for this assignment can be found under Sakai resources

[Q1 – 40 points]

In the exercise, the goal is to use the image "flowers" To experiment with color spaces. Convert the image to the following color spaces and show the color components as indicated. Scale down your resulting component images and show the results in a table form with two or three images per row. You can use built in color conversion functions.

1. Show the R,G,B components for RGB
2. Convert the image to HSV and show the H, S, and V components.

3. Convert the image to CIE xy and show the x, and y components.
4. Convert the image to L*a*b* and show the L*, a*, and b* components.

[Q2 – 30 points]

In this exercise, the goal is to experiment with color quantization. Use the median cut algorithm to quantize the image "Fruits-RGB.tif" into:
1) quantize the image to 128 colors
2) quantize the image to 64 colors
3) quantize the image to 16 colors

- In each of the cases, show the quantized RGB images

- In each of the cases, convert the image to CIE-xy and plot the CIE-xy color space (a 2D plot from 0-1) with the colored pixels plotted as points in that space.

Note: an imageJ implementation of median cut can be found at: http://rsb.info.nih.gov/ij/developer/source/

[Q3 – Compression – 10 points]
You are given a data stream that has been compressed to a length of 100,000 bits, and told that it is the result of running an "ideal" entropy coder on a sequence of data. You are also told that the original data consists of samples of a continuous waveform, quantized to 2 bits per sample. The probabilities of the uncompressed values are as follows:
00 1/2 01 3/8 10 1/16 11 1/16.
What (approximately) was the length of the uncompressed signal?

[Q4 – 30 points]

1) Use LZW compression to encode the following string

BABBACABBAACABBB

Show (step by step) the resulting dictionary and the output Use the initial dictionary A=1, B=2, C=3

2) What is the entropy of the string above (using the frequencies of the symbols in the string to compute their probabilities).

3) Build a Huffman tree for the string above. What is the resulting compressed string? What is the efficiency of that code (Efficiency is defined as entropy/average code length)