Assignment 1: Image Representation

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Handed out: August 22, 2022
Due: 11:59pm, September 2, 2022
Handed in: 1:30am, August 31, 2022

Important Notes:

- Feel free discuss the homework with the instructor or the TAs.
- Handwritten solutions will not be accepted.
- Turn in a PDF report and .m/.py files through Canvas as a compressed (.zip) file; turn in a hardcopy of PDF printout in class)

Question 1

(a) My function outputted the following info for cameraman.tif and cell.tif respectively:

cameraman.tif:

My answers:
Min: 7
Max: 253
Mean: 118.725056
Standard Deviation: 62.332743

Matlab answers:
Min: 7
Max: 253
Mean: 118.724487
Standard Deviation: 62.341715

cell.tif:

My answers:
Min: 28
Max: 212
Mean: 118.169707

Standard Deviation: 13.824995

Matlab answers:
Min: 28
Max: 212
Mean: 118.169713
Standard Deviation: 13.861571

My computed answers were very close to the Matlab ones and it was accurate up to the first and second decimal places.

(b) Given that only a single pixel is being changed, the min, max, mean, and standard deviation doesn't make any dramatic changes unless the single pixel is set to the new min or max. I believe this is due to the sheer number of pixels that exist within the image itself.

(c) My function outputted the following info for bowl_fruit.png and edin_castle.png respectively:

bowl_fruit.png:

My answers:
Min: R:8 G:0 B:0
Max: R:255 G:255 B:255
Mean: R: 184.167641 G: 161.997580 B: 124.318966
Standard Deviation: R: 56.882771 G: 57.130736 B: 64.366452

Matlab answers:
Min: R:8 G:0 B:0 Max: R:255 G:255 B:255
Mean: R:184.167673 G:161.997609 B:124.318985
Standard Deviation: R:56.891569 G:57.139496 B:64.374229

edin_castle.png:

My answers:
Min: R:0 G:0 B:0
Max: R:255 G:255 B:255
Mean: R: 95.399849 G: 104.979886 B: 105.074853
Standard Deviation: R: 64.215089 G: 71.539604 B: 93.353734

Matlab answers:
Min: R:0 G:0 B:0
Max: R:255 G:255 B:255
Mean: R:95.399928 G:104.979880 B:105.074658
Standard Deviation: R:64.222980 G:71.546710 B:93.359242

My computed answers were very close to the Matlab ones and it was accurate up to the first and second decimal places.

(d) Adding a scalar to a single channel enhances that channel's color on the entire image (increasing red will make the entire image take a prominent red tint effect). If all channels are added to, the entire image either becomes brighter or dimmer depending on the input value.

(e) With different dynamic ranges using the parula color map, the image of the spine and the more dense regions become easier to see with larger ranges, and the details are less prominent with smaller ranges.

Question 2

(a) After resizing to a fraction of the image's original size and then resizing back to the original size, the image gets noticeably more pixelated. The smaller the image is resized, less pixels are present to make up the image which greatly distorts the original image.

(b) The further we go down the bits to be spiced, the more noise becomes present until the image is entirely unrecognizable by the 1st bit spliced image. The bits that are visually significant, with the image being still somewhat recognizable, would be the 8th bit to the 7th bit with the 1st bit spliced image being completely unrecognizable. The compression ratio would be 1:8 (?) since only one bit is being saved to make up the new image.

Question 3

The format that is lossy is .jpeg while formats that are lossless are .png and .tiff. If you zoom into the original image and the new format image, you can tell that .jpeg has introduced artifacts and visual inconsistencies to the original image as opposed to .png and .tiff, in which the two formats have none.

Question 4

(a) The converted image to the HSV format looks like the original image except the colors have all been over exaggerated. The hue channel focuses on the value of the color within the image with the range of 0 to 255 being specific colors. The saturation shows how strong each color is to show up on the image. The value channel shows how bright or dim pixels on the image are to appear.

(b) The weighing factors do seem to change between images. I don't know why that would be because I double checked my answers and it seemed to give me the same thing.

Question 5

(a) The function, divideRangeOfIntensitiesIntoBins, does this.

(b) Adding more bins creates more values that each pixel can have. Two bins, for example, create essentially a binary image while 5 bins creates 5 different values for which each pixel of the image can have. Having more bins creates a smoother transition between the pixels. The top half of the bins seem to contain the indy toys.

(c) The function, distinguisBackgroundAndForground, does this. Because I noticed that the top half of the bins seems to contain the pixels of interest, this function isolates the bin pixels at half of the range and displays the top half of the bins as black and the bottom half of the bins as white.

(d) First, create an area of interest, kind of like a scanning area at the grocery store, maybe a big square in the center of the image. I would then distinguish the pixels with different values. I would get the top most 0 value pixel within the area of interest, and the same for the bottom, left, and right most pixels and then I would create a rectangle using those points as the edges and draw it on the image.

(e) I ran out of time to do this.