UNIVERSITY OF CALIFORNIA, SANTA BARBARA
Department of Electrical and Computer Engineering

ECE 178 **Image Processing** Fall 2020

Homework Assignment #7

(Due on Thursday 12/3/2020 by 11:59 pm)

This homework only consists of "hands-on" problems.

Problem # 1. Performing edge enhancement on color images:
In this problem you will perform edge enhancement on the attached image *peppers_color.png*, using the Laplacian operator that also accounts for diagonal edges (as discussed in the lecture), and with scaling $\alpha = 1$. You will use and compare two approaches:

a) Perform separate edge enhancement on the R, G, and B channels. Save the resulting color image (name: *peppers_enhanced_RGB.png*).

b) Convert the image into YIQ space and only apply edge enhancement to the Y channel. Next, convert the enhanced image back to RGB and save the final image (name: *peppers_enhanced_Y.png*).

Compare and comment on the quality of the enhanced images obtained by the two approaches - what artifacts do you see in the two images (if any)? Caution: pay attention to appropriate data-type conversions. Use the 2D convolution, YIQ conversion code from past homeworks (**do not use inbuilt libraries**).

Problem # 2. Investigating an affine transformation for color calibration:
You are provided with an original image *q2_orig.png* and an image resulting from color calibration *q2_affine_txm.png*, which was performed in RGB space. Your challenge is to estimate the affine color transformation used. Instead of the "color pallet" technique discussed in the lecture, you will pick a few "before and after" pixels in the respective images.

a) First, pick 4 pixels in the original image and their calibrated counterparts in the corrected image. Use the 4 input-output data points to obtain an estimate of the affine transformation, apply the transformation you discovered to the entire original image, and save the resulting output image (name: *q2_calibrated_4p.png*). Compute the mean square error between your output image and the given calibrated image. Submit your code, your estimate of the affine transformation, the output image and the calculated MSE.

b) Next, worrying about quantization errors in the given original and calibrated images, you decide to use more data points. Repeat all the steps of part (a) except that now you select 8 pixels in the original image and their calibrated counterparts. Name the output image *q2_calibrated_8p.png*. Explain any differences in the outcomes of (a) and (b), if (and how) you believe the estimate can be further improved.

Note that selecting a set of pixels with significantly different colors helps the estimate of the color transformation. For solving a set of linear equations you may use Matlab's linsolve, or python's numpy.linalg.lstsq