CSC317 Digital Image Processing
Homework Assignment #1
2/8/2022

1. (25 points) If you use any online tutoring website, e.g., Chegg, to find a solution, you will receive a zero grade because the solution is possibly wrong. When the object is 20 meters away from the central projection point of the camera, what are the x-coordinate(u) and the y-coordinate(v) of the pixel associated with the object point on the image? You are given a camera with the focal length of a single-lens camera of 2 centimeter, the object has a point located at (4 meters, 2 meters) as the x- and y-axis, respectively. (1 meter = 100 centimeter). Please study ***Course Note #2*** to find examples.
2. (25 points) Given an image with 9 pixels having the grayscale level values as {5, 3, 5, 4, 4, 4, 10, 4, 5}, respectively. You need to expand the range of the grayscale level values to the range between 2 and 40. (a) Draw a Histogram using the grayscale values, (b) Draw a mapping diagram to show the mapping between the old and the new values including the straight line, (c) Find the equation for the mapping function, (d) Show the new histogram, and (e) What can we use the Histogram Stretching for? Please study ***Course Note #4 Histogram Stretching***.
3. (25 points) You are required to use python and OpenCV to solve this problem. You need to (a) use the **VideoCapture ()** function in OpenCV to capture yourself and use the function **cv2.imwrite('output.jpg', frame)** to save your photo to a JPG file, (b) use the OpenCV to generate the histogram, and (c) apply the principle of Histogram Equalization. Note: If your PC does not have a camera, you can replace (a) with a color image and use cv2.imread() to input the image and use imshow() to display the image.
4. (25 points) Pick any colored image you like, (a) split the image color into RGB color space and display only blue channel, green channel, and the red channel; then (b) merge three channels to compare with the original image; and (c) keep only the green and blue channels and set the value of red channel pixels to 0. (d) What happens if you merge ((b, b, b))? Answer this question by describing the type of image CV2 generates.

   Hint: To display the *blue* channel only, you need to do the following:

   ```
   b_img = image.copy ()   # image is the original color image
   b_img [ : , : , 1] = 0  # set green channel to 0
   b_img [ : , : , 2] = 0  # set red channel to 0
   ```

Submission Instructions

1. Submit two files for each homework: (1) A Word document **showing** answers and **execution results** to all questions including math-related questions and programming-related questions. (2) A compressed file containing the programs you used with the name **HW#1-LastName-FirstName.zip**.
2. Do not submit the code or the execution results alone. You need to show both the code AND the execution results.

3. DO **NOT** INCLUDE THE WORD DOCUMENT IN THE COMPRESSED FILE. NAME YOUR COMPRESSED FILE WITH THE NAMEING RULE MENTIONED.
4. When you submit a math problem, you can submit a photo of a hand-written note, word document, text, etc., if the procedure of deriving the result is included. You don't want to submit just the results.
5. When you submit a programming-related problem, you need to submit the executable python code either in a compressed folder or as individual python files, e.g., ".py" files. Without the source code, I cannot judge the soundness of your solution. I will have to deduct points depending on severity.
6. Late penalty will begin to impose after the deadline. The late penalty is -10/100 per day late including weekends.
7. For Math-related problems, you need to include the procedure to show how the results are derived. If you simply write down the answers, your solution is incomplete, and you will receive penalty of at least 50% of the grade for that question if your answer is correct. If your answer is wrong, you will receive nothing for that question. There will be no way to assign a partial credit.
8. Grading criteria include, but are not limited to punctuality, soundness, compliance of submission rules and requirements, originality (if you check website like Chegg), and completeness (documentation and compressed file).