Due date: Thursday 9:00am, Oct. 22, 2020

Please do not use the function/library/API of OpenCV to solve the homework problem.

1. Zooming and Shrinking (C/C++) (30%)

   Using C/C++ to perform the following tests on *lena_256.raw*

   (1) Zooming the eyes area of Lena in lena_256.raw with the zooming raito 2:1. (Figure, 3%; Discussion, 5%)

   (2) Shrinking the image with ratio 1:2 *raw-column deletion*. (Figure, 3%; Discussion, 5%)

   (3) Use Xnview to blur the *lena_256.raw*. Compare ↑2.5↓2 and ↓2↑2.5 and ↑1.25 with nearest neighbor, bilinear and bicubic (study yourself) interpolation approaches. Please discuss the difference in execution time, image quality and any other issues. Explain the difference with reason (Figure, 9%; Discussion, 5%)

2. Gray-level resolution(C/C++) (20%; Figure, 10%; Discussion, 10%)

   (1) Using C/C++ to quantize the gray-level resolution of lena_256.raw and baboon_256.raw from 8 bits to 1 bit. Show the results of these quantize images and the corresponding with MSE (Mean Square Error, study yourself) and PSNR value. Discuss the bit rate saving.

3. Isopreference test on gray-level resolution(C/C++)(10%, Figure, 5%; Discussion, 5%)

   (1) Test the isopreference on *lena_256.raw* and *baboon_256.raw* images using the programs written in Problems 1 and 2.

4. Bit Plane(C/C++) (25%; Figure, 10%; Discussion, 15%)

   (1) Hide your student ID number and name in baboon_256.raw (more than 2 bit-planes). Before doing this, you need to first create two binary images of size 256x256 pixels for your student ID number and name, respectively(You can **use the functions (e.g. drawing api) of OpenCV**). Explain your method (Figure, 3%; Discussion,5%)

   (2) Hide baboon_256.raw in lena_256.raw and save the file as lena_with_baboon.raw. Explain your method. Try not to visually alter baboon_256.raw and lena_256.raw as much as you can. Show your results of lena_with_baboon.raw. Calculate MSE and PNSR of your lena_with_baboon.raw with respect to the original lena_256.raw. The PSNR value should be as high as possible. (Figure, 3%; Discussion,5%)

   (3) Extract your modified baboon_256.raw from lena_with_baboon.raw. Calculate MSE and PNSR of your extracted baboon_256.raw with respect to the original baboon_256.raw. The PSNR value should be as high as possible. (Figure, 4%; Discussion,5%)

5. Distance and Path (C/C++) (15%; Figure, 10%; Discussion, 5%) (renew the map)

Given an image *map.raw* of size 20x20 pixels as below. Find out the distance values from (0,0) [the upper left corner] to (19,19) [the lower right corner] using D_4, D_8 and D_m distance, and show their corresponding shortest paths in the images (Don't use ad hoc method to build the path).

(1) Gray-value of the road {80}.

(2) Gray-value of the road {80,160}.

(3) Gray-value of the road {80,160,255}.