**Digital Image Processing (261453)**

**Computer Assignment 1**

Due Date 19 กุมภาพันธ์ 2561 ภายในเวลา 23.55 น.

ทำรายงานส่งที่ elearning.cmu.ac.th โดยส่งเป็น pdf file เท่านั้น

**ให้แนบ Program มาในภาคผนวกด้วย**

**1. Histogram and Object Moment**

Let the binary image *f(x*,*y*) of an object be defined by

http://sansanee.cpe.eng.cmu.ac.th/DIPUnG/Y2017/CompHw1_files/image002.gif

The *pq*-moment *mpq* of an object is defined as

http://sansanee.cpe.eng.cmu.ac.th/DIPUnG/Y2017/CompHw1_files/image004.gif

Where *D* denotes the domain of the image. The central moments *pq* of the object are defined as

http://sansanee.cpe.eng.cmu.ac.th/DIPUnG/Y2017/CompHw1_files/image006.gif

Where http://sansanee.cpe.eng.cmu.ac.th/DIPUnG/Y2017/CompHw1_files/image008.gif and http://sansanee.cpe.eng.cmu.ac.th/DIPUnG/Y2017/CompHw1_files/image010.gif. (These two quantities represent the coordinates of the “center of mass” of the object.) In the discrete case, the integrals are replaced by summations. Normalized moments are defined by

http://sansanee.cpe.eng.cmu.ac.th/DIPUnG/Y2017/CompHw1_files/image012.gif

In theory, the quantity

**1 = **20 + **02

is invariant to translation, rotation and scaling of the object. In this project, you will compute this quantity for various translated, rotated and scaled version of shape and check its invariance. The name of the image containing the various version of the object is “[scaled\_shapes.pgm](http://sansanee.cpe.eng.cmu.ac.th/DIPUnG/dataset/scaled_shapes.pgm)” (image size = 325x553). Each version of the object has been given a different “color” (i.e., gray value). Your tasks are the following:

          1. Compute the histogram of the image and determine how many objects are in the image and the gray level of each.

          2. Write a procedure to compute the (central)moment of an object given its gray level and use this procedure to compute the central moments **20 and **02. Using this value, compute **1 and verify its invariance (proof that **1is constant).

**2. Point Operations**

          This part of the assignment involves two images, “[Cameraman.pgm](http://sansanee.cpe.eng.cmu.ac.th/DIPUnG/dataset/Cameraman.pgm)” (200 x 200) and “[SEM256\_256.pgm](http://sansanee.cpe.eng.cmu.ac.th/DIPUnG/dataset/SEM256_256.pgm)” (256 x 256). The image of Cameraman is rather bright and the seed image is dark. Your goal is to improve the appearance and bring out the details using point operations. You can use any software to do histogram equalization. You may also use your own programs if you wish. Your report in this part must include a description of the method you used to enhance the image, and the histograms and images before and after enhancement. Discuss your results and say what is good or bad about them.

**3. Algebraic Operations**

          You will find the red, green and blue component images of 414 x 800 outdoor scene. The three color channels of this color image are called “[SanFranPeak\_red.pgm](http://sansanee.cpe.eng.cmu.ac.th/DIPUnG/dataset/SanFranPeak_red.pgm)” (red), “[SanFranPeak\_green.pgm](http://sansanee.cpe.eng.cmu.ac.th/DIPUnG/dataset/SanFranPeak_green.pgm)” (green), and “[San\_FranPeak\_blue.pgm](http://sansanee.cpe.eng.cmu.ac.th/DIPUnG/dataset/SanFranPeak_blue.pgm)” (blue). You task is to combine the images using algebraic operations so that the different parts of the image are emphasized. Let *g* be the green image, *r* be the red image, and *b* be the blue image. Some traditional favorite are 2*g*-*r*-*b* (excess green) and *r*-*b* (red-blue difference). Actually (*r*+*b*+*g*)/3 creates a gray-level (intensity) image. The excess green image generally emphasizes trees and grass. You can invent your own algebraic combinations to bring out different objects. Your report on this part must include description of the algebraic operation you used to bring out different objects, and the images after the operation. Discuss your results and say what is good or bad about them.

**4. Geometric Operations**

          You are given a 256 x 256 grid image called “[grid.pgm](http://sansanee.cpe.eng.cmu.ac.th/DIPUnG/dataset/grid.pgm)” and a distorted version “[distgrid.pgm](http://sansanee.cpe.eng.cmu.ac.th/DIPUnG/dataset/distgrid.pgm)”. Use these images to derive a set of spatial transformations between chosen control regions. Use the set of spatial transformations to “undistort” poor old “Lenna”. The distorted Lenna may be found in “[distlenna.pgm](http://sansanee.cpe.eng.cmu.ac.th/DIPUnG/dataset/distlenna.pgm)”. Note that you may also need an interpolation algorithm. You may use as many control regions as you wish, depending on your patience. You report on this part must include a description of the transformation and interpolation method you used, the number of control regions used, and the images before and after the operation. Discuss your results and say what is good or bad about them

**Note** สำหรับข้อ 1, 3 และ 4 ห้ามใช้ library หรือ โปรแกรม สำเร็จรูปใดๆทั้งสิ้น ให้เขียน โปรแกรมเองทั้งหมด และให้แนบโปรแกรมทั้งหมดในภาคผนวก

Your report should consist of a brief description of the algorithms/formulas used, print-out of the results, a discussion of the results, and a well documented program listing.