Special Assignment in lieu of Semester End Practical Examination May-June 2020
B.Sc. (Hons) Computer Science Semester VI
Paper Code: 32347610 Paper Name: Digital Image Processing

Set – 3

The questions below are fairly independent of the requirement of a computer system. However, it is advised that you use R to implement the solutions you propose. Not only will this help you make better analysis, but will also serve as an indicator of your understanding of the following problems.

1. An image was taken using a defective camera. The image thus had dark spots all over the image area. We wish to remove these dark spots using Median Filtering. Shown below (Fig1.) is a small image `f(x,y)`. Assume values outside this region to be zero.

12	11	10	12	15
12	11	0	11	14
13	12	12	12	10
12	10	13	12	11

Fig1. Binary image `f(x,y)`

   (a) Apply 3 X 3 median filtering to region above to obtain `out1(x,y).`

   (b) Apply 1 X 3 (1 row, 3 columns) median filter and then a 3 X 1 (3 rows, 1 column) median filter to obtain `out2(x,y).`

   (c) How are `out1(x,y)` and `out2(x,y)` same/different?

   (d) If the size of these dark spots is 2 X 2, which method of median filtering will you choose from (a) and (b). Explain with reasons.

   (e) If we had a much bigger image than Fig1 and it contains sharp rectangular objects, which method of median filtering will you choose from (a) and (b). Explain with reasons.

   (f) The methods described above will change values of pixels despite the absence of dark spots. Propose a 3 X 3 median filtering method that leaves pixel values unchanged if they are not dark spots.

Note:
The solution to (f) is not unique. Think of as many solutions as you can (more methods proposed -> more credit)

2. Choose the most appropriate option(s). Give reasons for your choice.

   (a) Affine transformations are ____ transformations. (linear/quadratic/higher-order/cannot say)

   (b) After performing 45° rotation on input image, the output image ____. (size increases, size decreases, no change, cannot say)

   (c) Which interpolation works better when up-scaling the image by a factor of 4? (linear/bi-linear/bi-cubic/All)

   (d) Which of the two following operations lead to same effect on the image?

      i. Scaling -> Rotation -> Translation

      ii. Scaling -> Translation -> Rotation

iii. Translation -> Rotation -> Scaling

iv. Rotation ->Scaling -> Translation

(e) Write the series of steps required to transform Fig2 to Fig3.

Fig2. car.png
300 X 300

Fig3. car_modified.png
150 x 150

3. You are given the following spatial domain filter:

0.15	0.35	0	-0.35	-0.15

(a) Can you predict `F(0)` without actually calculating it? If yes, how?

(b) Compute the spectrum and phase of this filter.

(c) Based on results from (a), what type of filter do you think this is? Give reasons.

4. Consider the following code:

```
1. library(magick)
2. im = image_read("/home/sakeena_shahid/Desktop/car.png")
3. newim = image_quantize(im, max=4, colorspace= "gray")
4. newim2 = image_quantize(im, max=512, colorspace=”gray”)
```

where car.png (300 X 300, 8-bit gray-scale image) is shown in Fig2.

(a) What does ***image_quantize()*** do? What results do you expect after line 3 is run?

(b) What does the parameter ***max*** signify?

(c) Will the bit depth of `im` and `newim` be same? Why?

(d) How does `im` and `newim` differ from one another? Why do these differences occur?

(e) What is the relationship between `newim` and `newim2`?

Note:
You can find the bit-depth of an image by running the following command on Linux terminal.
`$identify -verbose name_of_image.png` (any image format can be used)

5. Analyze and Answer:

(a) Propose an algorithm to count the number of discs in Fig3. Ideally you may want to implement the algorithm to see the results for yourself. In case, you do not have a computer system, a pseudo-code with a block diagram will be accepted as an answer.

Expected Output for Fig3: `Number of discs in image: 4`

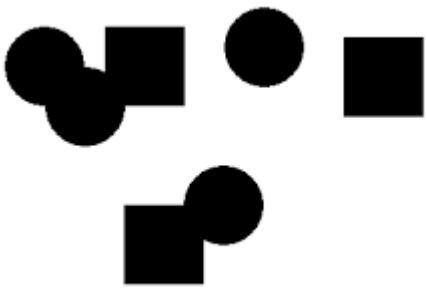

Fig3. discsAndSquares,png

(b) Apply a threshold value of 0.5 Consider filters used for frequency domain (`H(u,v)`). Determine the effect of using the following filters:

i. $H(u,v)=\exp\left(\frac{-u^2+v^2}{D_0}\right)$ where $D_0 \rightarrow \infty$

ii. $H(u,v)=\exp\left(\frac{-u^2+v^2}{D_0}\right)$ where $D^0 \rightarrow 0$

(c) How will the resulting histogram change of an image if the following modifications are made?

i. Add 50 to every pixel value

ii. Negate the image

iii. Apply a threshold value of 0.5

Deliverables:

Make sure you send files/bundles named as UPC_RollNo. Ensure you have the following:

(a) R scripts, if any.
(b) Scanned copies of solutions.
(c) Images, if used any apart from the ones provided in folder.
(d) Output screenshots, if any.
(e) Documentation, if any.
(f) Header information.

Failure to follow rules mentioned in Schedule Notification for sending completed assignments will cause deduction in marks.