DUBLIN CITY UNIVERSITY

SEMESTER 2 EXAMINATIONS 2018/2019

MODULE: CA4007 - Computer Graphics and Image Processing

PROGRAMME(S):

CASE	BSc in Computer Applications (Sft.Eng.)
CPSSD	BSc in ComputationalProblem Solv&SW Dev.
ECSAO	Study Abroad (Engineering & Computing)

YEAR OF STUDY: 4,O

EXAMINER(S):

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Prof. Brendan Tangney	(External)
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TIME ALLOWED: 3 Hours

INSTRUCTIONS: Answer two questions from Section 1 and two questions from Section 2. All questions carry equal marks.

PLEASE DO NOT TURN OVER THIS PAGE UNTIL YOU ARE INSTRUCTED TO DO SO.
The use of programmable or text storing calculators is expressly forbidden.
Please note that where a candidate answers more than the required number of questions, the examiner will mark all questions attempted and then select the highest scoring ones.

There are no additional requirements for this paper.

SECTION 1 IMAGE PROCESSING

QUESTION 1 ***[TOTAL MARKS: 25]***

Please put all your answers for this question into a Word doc called Q1.doc

Load the image `discs`, which contains discs with diameters of 10,20,30 and 60. Display the image on your screen.

Load the file `mask30`, which contains a multiple band-pass filter which is designed to let through parts of the Fourier Transform (FT) of the disc with diameter 30.

For your information you can display `mask30` on your screen. You can compare it to the FT of disc 30.

Q 1(a) **[5 Marks]**

Multiply the FT of `discs` by the band-pass filter `mask30` and Inverse Transform it. Display the filtered image using the `gray(256)` colormap and copy it into Q1.doc. Now display the filtered image using the `'default'` colormap and copy it into Q1.doc

Copy the Matlab commands into Q1.doc.

Describe the structure of the filtered image (as seen in each colormap) . How does it differ from the original `discs` image?

Q 1(b) **[5 Marks]**

Compute the Impulse Response corresponding to `mask30`.

Copy the Matlab commands into Q1.doc.

Display the real part of the Impulse Response using surf. Copy it into Q1.doc

Use the stem command to plot the first row of the Impulse Response. Copy it into Q1.doc

Q 1(c) **[15 Marks]**

Explain why convolving the `discs` image with this Impulse Response would have the effects shown in part (b). Explain the effect on each of the four discs.

[End of Question 1]

QUESTION 2 ***[TOTAL MARKS: 25]***

Please put all your answers for this question into a Word doc called Q2.doc

Q 2(a) **[4 Marks]**

Load the image `chrysler`, which contains an image of the Chrysler Building in New York. Fourier Transform (FT) the image and display the log of the FT on your screen using the `gray(256)` colormap. Copy the FT into Q2.doc

Q 2(b) **[21 Marks]**

For each of the following parts of the image, identify which structures in the FT correspond to that part:

1. The frieze on the wall at the bottom of the image
2. The front wall of the Chrysler Building.
3. The sides of the roof of the Chrysler Building

In Q2.doc indicate using arrows or boxes on the FT which structures correspond to which of the above parts of the image.

Explain why these structures lie in those particular locations in the FT. In your explanations you can use the principles of shifting and scaling, sampling and replication, and convolution.

Construct masks to filter out each structure. Display the mask on your screen and copy it into Q2.doc

In Matlab multiply the FT by the masks and Inverse Transform them. Display the filtered images and copy them into Q2.doc

[End of Question2]

QUESTION 3 ***[TOTAL MARKS: 25]***

Please put all your answers for this question into a Word doc called Q3.doc

Q 3(a) **[5 Marks]**

Load the image `ritz` into Matlab, which shows a line of squares along one of the diagonals of the image.

You can regard this image as a convolution. What is being convolved with what?

Q 3(b) **[4 Marks]**

Fourier Transform (FT) the image and display the FT (not the log of the FT) using the default colormap on your screen. Copy it into Q3.doc.

Q 3(c) **[10 Marks]**

Explain the structure of the FT using the Convolution Theorem. You should refer to your answer to part (a) above. You should fully explain how each structure in the FT relates to the `ritz` image.

Create masks and filtered images to support your answer. Display them on your screen and copy them into Q3.doc

Q 3(d) **[6 Marks]**

Now load the file `ritzx`. Fourier Transform the image and display the FT (not the log of the FT) using the default colormap on your screen. Copy it into Q3.doc

Explain the differences between this FT and the FT of `ritz`.

[End of Question3]

SECTION 2 GRAPHICS

QUESTION 4 ***[TOTAL MARKS: 25]***

Please note, this question asks you to save two separate programs

Q 4(a) **[14 Marks]**

Edit the example program `simple.c` so that the white square is replaced by a 10x10 grid of white squares with black lines between them. When you click the left mouse button in one of the squares, it should change colour from white to black and vice versa.

Save the program as `mouse1.c`

Q 4(b) **[11 Marks]**

Add a menu to the previous program. The menu should be attached to the right mouse button. The menu should allow you to select a colour from a range. When you click in one of the squares of the grid, the square should fill with the colour, which you selected.

Save the program as `mouse2.c` Please note, this should be a different file from the program for part 4(a)

[End of Question4]

QUESTION 5 ***[TOTAL MARKS: 25]***

Q 5(a) **[10 Marks]**

Edit the example program `cube.c` so that you can make the cube rotate around the y-axis using the left and right arrow keys or around the x-axis using the up and down arrow keys.

Save the program as `MoveCube.c`

Q 5(b) **[15 Marks]**

Now edit the above program so that, when you move the mouse with the left button down, the cube will rotate so that one of the corners follows the mouse.

Save the program as `MoveCube.c`

[End of Question5]

QUESTION 6 ***[TOTAL MARKS: 25]***

Q 6(a) **[13 Marks]**

Edit the example program `cube.c` so that a cuboid of length 0.5 and side 0.2 is located on each of the six faces of the cube. The length of each cuboid should be perpendicular to the face.

Save the program as `cuboids.c`

Q 6(b) **[12 Marks]**

Now add an Idle Function to the above program so that cube (with the cuboids attached) rotates about the z axis. And each cuboid rotates about its own axis.

Save the program as `cuboids.c`

[End of Question6]

[END OF EXAM]