DUBLIN CITY UNIVERSITY

SUMMER RESIT 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):

Alistair Sutherland (ph 5511)	(Internal)
Prof. Brendan Tangney	(External)
Dr. Hitesh Tewari	(External)

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 `ringsquare`, which contains a ring with diameter of 30 and a square of side 30. Display the image on your screen.

Load the file `maskring`, which contains a multiple band-pass filter which is designed to let through the high-frequency parts of the Fourier Transform (FT) of the ring.

For your information you can display `maskring` on your screen. You can compare it to the FT of `ringsquare`.

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

Multiply the FT of `ringsquare` by the band-pass filter `maskring` and Inverse Transform it. Display the filtered image using the `gray(256)` colormap and copy it into Q1.doc.

Copy the Matlab commands into Q1.doc.

Describe the structure of the filtered image. How does it differ from the original `ringsquare` image?

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

Compute the Impulse Response corresponding to `maskring`. The Impulse Response is the FT of `maskring`

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 `ringsquare` image with this Impulse Response would have the effects shown in part (a). Explain the effect on each of the two shapes.

[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 `cottage`, which contains an image of a wooden cottage. 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 edges of the roofs and the edges of the windows of the cottage
2. The trees.
3. The back of the bench next to the near wall of the cottage

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 `wallpaper` into Matlab, which contains a wallpaper pattern

This pattern contains both sampling and replication. What is being sampled and what is being replicated?

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

Fourier Transform (FT) the image and display the log of FT using the `gray(256)` colormap on your screen. Copy it into Q3.doc.

Q 3(c) **[16 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 which structures in the FT are caused by the replication in the `wallpaper` image and which structures are caused by the sampling in the `wallpaper` image.

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

[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 white circle of radius 0.5. When you click the left mouse button in the circle, 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 the circle, it 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 move to the left or right using the left and right arrow keys or up or down using the up and down arrow keys or in or out using the “a” and “s” 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 in the direction of motion of 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 you can add a "wheel" to each corner of the base of the cube. Each wheel can be represented by a torus of inner radius 0.1 and outer radius 0.2. The axis of each torus should be parallel to the x-axis.

Save the program as `wheels.c`

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

Now add an Idle Function to the above program so that cube (with the wheels attached) moves backwards and forwards along the z axis. And each wheel rotates about its own axis.

Save the program as `wheels.c`

[End of Question6]

[END OF EXAM]