DUBLIN CITY UNIVERSITY

SEMESTER 2 EXAMINATIONS 2017/2018

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

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

Load the images `smalldisc` and `disc`, which contain images of discs. The disc in `disc` has twice the radius of the disc in `smalldisc`.

Fourier Transform the images and display the Fourier Transforms (FTs) (not the log of the FTs) on your screen using the default colormap. Remember to scale them. Copy the FTs into Q1.doc. Explain the differences between the two FTs.

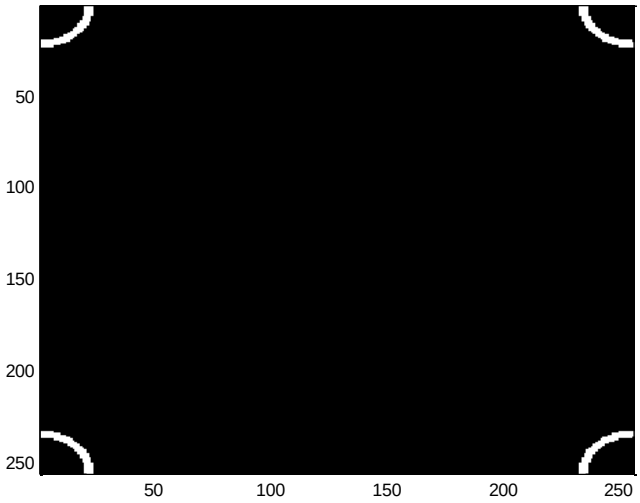
Q 1(b) **[5 Marks]**

Now create an image `x` which is the sum of `disc` and `smalldisc`. Compute the FT of `x`.

```
x = disc + smalldisc
```

The code below constructs a mask such as the one below, known as a circular band-pass filter, where `r1` is the inner radius and `r2` is the outer radius. The centre of the circles is the point `(1,1)`.

```
load dist;
mask = dist > r1 & dist < r2;
```



You can construct a mask consisting of multiple band-pass filters like this

```
mask = (dist > r1 & dist < r2) + (dist > r3 & dist < r4) ...;
```

Construct a multiple band-pass filter which lets through parts of the FT of `x` which contain mainly data due to `smalldisc` and excludes data due to `disc`.

Copy the Matlab commands into Q1.doc

Display your mask and copy it into Q1.doc

Explain why you chose the particular bands in your mask.

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

Multiply the FT of x by the band-pass filter and Inverse Transform it. Display the filtered image and copy it into Q1.doc.

Copy the Matlab commands into Q1.doc.

Explain the structure of the filtered image.

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

Compute the Impulse Response corresponding to your mask.

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(e) **[5 Marks]**

Explain why convolving the x image with this Impulse Response would have the effect shown in part (c).

[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) **[5 Marks]**

Load the image `hello`, which contains an image of a wall with the word "HELLO" carved into it.

Fourier Transform 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) **[5 Marks]**

In Q2.doc indicate using arrows or boxes on the FT which structures correspond to the areas of the wall surrounding the word HELLO.

Explain why these structures lie in those particular locations.

Q 2(c) **[5 Marks]**

Using Matlab construct a mask that will let through one of these structures

Display the mask on your screen and copy it into Q2.doc

Multiply the FT of the `hello` image by your mask and Inverse Transform it. Display the filtered image and copy it into Q2.doc.

Q 2(d) **[5 Marks]**

In Q2.doc indicate using arrows or boxes on the FT which structures correspond to the vertical columns of the wall around the word HELLO.

Explain why you think this is.

Q 2(e) **[5 Marks]**

Construct a mask which will filter out one of these structures. Display your mask on the screen and copy it into Q2.doc.

In Matlab multiply the FT by the mask and Inverse Transform it. Display the filtered image and copy it into a Q2.doc. Explain the effect of the mask on the image.

[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 `squares` into Matlab, which shows a set of nested squares. 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.

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

Construct a mask that will select the structure which is located in the middle of the top and bottom edges of the FT.

Display the mask on your screen and copy it into Q3.doc

Multiply the FT by the mask, Inverse Transform it and display the filtered image on your screen. Copy it into Q3.doc

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

Construct a mask that will select the structure which is located in the middle of the left and right edges of the FT.

Display the mask on your screen and copy it into Q3.doc

Multiply the FT by the mask, Inverse Transform it and display the filtered image on your screen. Copy it into Q3.doc

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

Construct a mask that will select the structure which is located in the four corners of the FT.

Display the mask on your screen and copy it into Q3.doc

Multiply the FT by the mask, Inverse Transform it and display the filtered image on your screen. Copy it into Q3.doc

Q 3(e) **[8 Marks]**

Explain why each of these structures is located, where it is. Explain why each structure has the shape, that it has.

[End of Question3]

SECTION 2 GRAPHICS

QUESTION 4 *[TOTAL MARKS: 25]*

Q 4(a) **[12 Marks]**

Edit the example program `simple.c` so that, when you click the left mouse button, the square is redisplayed with its centre at the mouse location.

Save the program as `mouse.c`

Q 4(b) **[13 Marks]**

Add a menu to the previous program. The menu should be attached to the right mouse button. The menu should allow you to change the orientation of the square and to change its size.

Save the program as `mouse.c`

[End of Question4]

QUESTION 5 *[TOTAL MARKS: 25]*

Q 5(a) **[12 Marks]**

Edit the example program `cube.c` so that the cube appears to rotate around the z axis

Save the program as `MoveCube.c`

Q 5(b) **[13 Marks]**

Now edit the above program so that you can change the position of the cube in the x and y directions using the arrow keys

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 cone of height 0.5 is located on each of the six faces of the cube.

Save the program as `cones.c`

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

Now edit the above program so that there is a point light source on the points of each of the six cones.

Save the program as `cones.c`

[End of Question6]

[END OF EXAM]