DUBLIN CITY UNIVERSITY

SUMMER RESIT EXAMINATIONS 2016/2017

MODULE: CA4007 – Computer Graphics and Image Processing

PROGRAMME(S):

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

YEAR OF STUDY: 4,O,X

EXAMINERS:

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Dr. Ian Pitt
Dr. Alistair Sutherland (x5511)

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]***

Q 1(a) **[8 Marks]**

In Matlab create a 240x240 image containing a rectangle of dimensions 40 rows by 120 columns against a black background.

Compute the Fourier Transform (FT) of the image and display the log of the Fourier Transform on your screen. Remember to scale the brightness of the FT. Sketch the FT in your exam booklet.

Q 1(b) **[9 Marks]**

Construct a mask which will let through as much as possible of the Fourier Transform of the rectangle from part 1(a) and exclude as much as possible of the FT of any other object.

You can do this by creating a mask which has the value 1, wherever the log of the FT is above a certain threshold, and 0 everywhere else. You can set the threshold to be 0.5 of the maximum value of the log of the FT.

Write the Matlab commands in your exam booklet.

Sketch the mask in your exam booklet.

Q 1(c) **[8 Marks]**

Load the image `docklands`, which contains a satellite image of an area of London. There is a large rectangular building labelled ExCel London. This building has the same dimensions as the rectangle in part (a).

Multiply the Fourier Transform of `docklands` by your mask and Inverse Transform it. Sketch the filtered image in your exam booklet. Write the Matlab commands in your exam booklet.

What effect has your mask had on the image? Explain why.

[End of Question 1]

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

Q 2(a) **[7 Marks]**

Load the image `thurohus`, which contains an image of a building.

Fourier Transform the image and display the log of the Fourier Transform (FT) on your screen. You can use the gray(256) colormap. Remember to scale the brightness of the FT. Sketch the FT in your exam booklet.

Q 2(b) **[18 Marks]**

For each of the following parts of the image, explain which structures in the FT correspond to that part and why. In your explanations you can use the principles of shifting and scaling, convolution and sampling and replication.

I. The near gable wall
II. The near roof
III. The eaves of each of the roofs

[End of Question 2]

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

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

Using Matlab load the file `checkerboard`

The image contains an 8x8 checkerboard in the top left corner.

Compute the Fourier Transform (FT) of this image and display it (not the log of the FT!) on the screen. It is probably better to use the default colormap. Remember to scale the brightness of the Fourier Transform. Sketch it in your exam booklet.

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

[2 Marks]

You could regard the checkerboard image as a convolution of a 4x4 square with another object. What is the other object?

[3 Marks]

Using the Convolution Theorem explain how you could deconvolve the checkerboard image to obtain the other object.

[3 Marks]

Using Matlab carry out the deconvolution operation. Write the Matlab commands in your exam booklet

[2 Marks]

Display the output from the deconvolution on your screen and sketch it in your exam booklet.

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

[2 Marks]

You could regard the deconvolved object from part (b) as a sampled version of yet another object. What is the other object?

[3 Marks]

Using the Convolution Theorem explain how you could obtain the unsampled version of this other object.

[3 Marks]

Carry out the process in Matlab. Write the Matlab commands in your exam booklet

[2 Marks]

Display the output from the process on your screen and sketch it in your exam booklet.

[End of Question 3]

SECTION 2 COMPUTER GRAPHICS

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

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

An epicycloid is a curve generated by a point moving in a circle whose centre is moving around a second circle. Let `r1` and `r2` be the radii of the two circles and `theta1` be the rotation rate of the point around the first circle and `theta2` be the rotation rate of the centre of the first circle around the second circle.

Edit `simple.c` to display a point moving along an epicycloid with `r1=.2, r2=.5, theta1=0.01` and `theta2=0.001`.

Save the program as `epicycloid.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 choose values for `r1, r2, theta1` and `theta2`

Save the program as `epicycloid.c`

[End of Question 4]

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

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

Edit `simple.c` to create three squares each of side of length 0.2 and whose centres are 0.3 units apart.

If you right click with the mouse in square 1, then the background colour should turn red. If you right click with the mouse in square 2, then the background colour should turn blue. If you right click with the mouse in square 3, then the background colour should turn green.

Save the program as `squares.c`

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

Edit the previous program so that when you mouse enters a square, that square becomes brighter.

Save the program as `squares.c`

[End of Question 5]

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

Q 6(a) **[9 Marks]**

Edit the example program `cube.c` and create a strip of 10 quadrilaterals in an S shape

Save the program as `quads.c`

Q 6(b) **[16 Marks]**

Now create an array containing a checkerboard pattern and texture map it onto the strip.

Save the program as `quads.c`

[End of Question 6]

[END OF EXAM]