Candidates are admitted to the examination room ten minutes before the start of the examination. On admission to the examination room, you are permitted to acquaint yourself with the instructions below and to read the question paper.

Do not write anything until the invigilator informs you that you may start the examination. You will be given five minutes at the end of the examination to complete the front of any answer books used.

May/June 2013 **SE3IA11 2012/13 A 001**

3 Answer Books
Any calculator (including programmable calculator) permitted

UNIVERSITY OF READING

IMAGE ANALYSIS (SE3IA11)

Two hours

Answer any **THREE** out of FOUR questions.

Use a separate Answer Book for **EACH** Question.

EACH Question is worth 20 marks.

1. (a) When a Fourier transform is applied to a two-dimensional image, what is given as the output and how can this ouput be displayed? What is the Fourier spectrum and comment on its information content?

(4 marks)

(b) Define the main steps to achieve filtering in the frequency domain.

(5 marks)

(c) The two-dimensional Fourier transform is an integral part of the JPEG compression scheme. Explain how the frequency domain representation of a two-dimensional image is used to achieve compression within the scheme. How can different levels of compression be achieved? What causes compression artifacts in the JPEG compression scheme and how may they be reduced?

(11 marks)

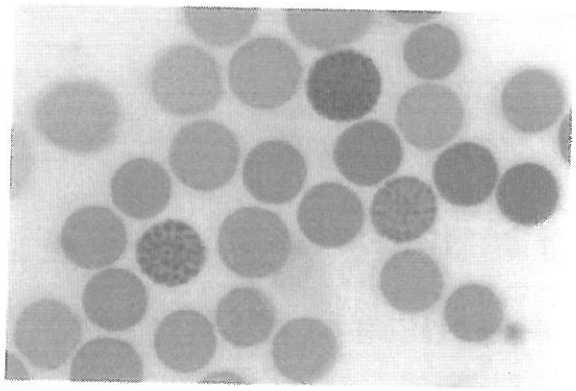
2. (a) Why are symbolic image features useful for image analysis?

(3 marks)

(b) Describe in detail the main parts of the Canny algorithm for detecting and locating the significant edge elements in an image. Explain clearly why the different parts of the algorithm are necessary.

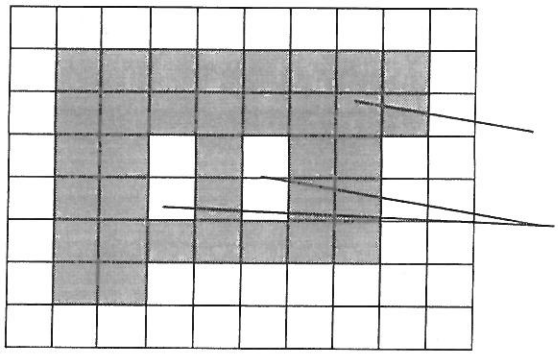
(8 marks)

(c) Consider the following image of a slide depicting red blood cells. In this example, three of the cells have a property which gives the cells a "golf-ball like" appearance. Using appropriate symbolic feature extraction techniques, describe an approach to automatically count the number of cell within the image. Comment on how the three "golf-ball like" cells could be distinguished. (9 marks)



3. (a) Give the definition of digital image quantisation. Explain how the image quantisation affects image quality using examples if needed. (5 marks)

(b) A binary image contains an object in Set {1} in an integer space Z^2 as shown in the following figure. Design morphological operations to fill holes inside the object and keep the outside shape unchanged. State your processes step by step.



(7 marks)

(c) Given a grey-level image with bright objects and dark background, describe a global thresholding process to segment these objects from the background. Explain how Otsu's algorithm can optimise the threshold.

State any assumptions you make in your answer. (8 marks)

4. (a) Briefly describe the HSI colour space, and give definitions of hue, saturation, and intensity in this space. You may use diagrams to illustrate your answer. (5 marks)

(b) An image patch is given in the following figure with the kernel pixel value of 5. Using the concept of local binary pattern (LBP), calculate the image's LBP code. Show your work step by step.

8	3	6
9	5	0
4	1	7

(7 marks)

(c) A given video footage contains a moving vehicle. Design a segmentation algorithm which can automatically extract the vehicle from each frame of the footage. Explain how your algorithm works for the purpose.

State any assumptions you make in your answer, and possible flaws of the final result. (8 marks)

(End of Question Paper)