



THE UNIVERSITY
of LIVERPOOL

MAY 2003 EXAMINATIONS

Bachelor of Arts : Year 3
Bachelor of Engineering : Year 3
Bachelor of Science : Year 3
Bachelor of Science : Year 4

PATTERN RECOGNITION AND IMAGE ANALYSIS IN PRACTICE

TIME ALLOWED : Two Hours and a Half

INSTRUCTIONS TO CANDIDATES

If you attempt to answer more than the required number of questions (in any section), the marks awarded for the excess questions will be discarded (starting with your lowest mark).



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Section A

Answer **ALL** questions. This section is worth 50% of the marks available.

- A1.** What are the stages to be followed when *designing* a pattern recognition system (the design cycle)? Explain briefly, and illustrate your discussion with a diagram. [10 marks]
- A2.** Describe what is meant by *image enhancement* and what operations can be used to achieve it. [8 marks]
- A3.** Explain what is meant when a colour system is referred to as *perceptually uniform*. Give an example of a colour system that is perceptually uniform and one of a colour system that is not. [8 marks]
- A4.** List two main approaches to *pattern classification*. For each approach, list the *representation* used, the *recognition function* and the typical criterion employed in that approach. [8 marks]
- A5.** Describe a *pattern classification* approach using a *quantitative* representation of objects and a pattern classification approach that uses a *qualitative* representation. Discuss the differences between the two approaches. [8 marks]
- A6.** Explain the differences between *supervised* and *unsupervised* pattern classification approaches. [8 marks]



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Section B

Answer **TWO** questions. This section is worth 50% of the marks available.

B1. You are given a series of printed magazine articles and you are told that there is no electronic source available. Your task is to devise a system that will convert the printed articles into a computer-editable form. Looking at some sample pages, you discover that on a single page, apart from the text, there may be illustrations in the form of pictures (images) and line art.

- a) Describe the steps you would take to design such a conversion system (based on the principles of Pattern Recognition system design cycle). [10 marks]
- b) In the resulting Document Image Analysis system, describe the stages involved in the processing and analysis of the image data. For each stage, describe possible methods that you could use. [15 marks]

- B2.** a) In what type of situations is *k-means clustering* most applicable? [8 marks]
- b) Give the algorithm for standard *k-means clustering*. [8 marks]
- c) Discuss the issues surrounding the performance of *k-means clustering*. [9 marks]

B3. You are given the task to produce a system that identifies airfield runways in Synthetic Aperture Radar (SAR) images. You are given the hint that each runway has lights along its edges, and that these lights can, in theory, be seen in the SAR image.

- a) Describe the application domain and any special characteristics/difficulties present in the image. [10 marks]
- b) Describe each of the stages involved in the runway identification system and give a brief outline of the processes involved in each stage. Describe also any specific transform used. [15 marks]