GX2776

OLLSCOIL NA hÉIREANN GAILLIMH

NATIONAL UNIVERSITY OF IRELAND GALWAY

SUMMER EXAMINATIONS 2001

Third University Examination in Biomedical Science

Biomedical Systems (CT323)

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Time allowed: **Two hours**
Answer three questions, with at least one question from each Section.
Please use seperate answerbooks for each Section.

Section A

1. The three most common laboratory models that are applicable in a wide variety of real-world scenarios include the Analytical Control model, the Quality Control model, and the Research and Development model. Outline the differences between the three, and as such, discuss the LIMS specific solutions relevant to each.

2. You work for an large U.S. multinational company based in the Galway area that plans to manufacture a range of products for haemophiliacs, following a large expansion in terms of infrastructure and personnel. The Board of Directors have asked you to prepare a report outlining the process by which a LIMS would be ideally implemented - outline what you would include in this submission to the Board.

3. (a) Why is sequence alignment analysis so important contemporary biological research, and how has it formed one of the principal areas of research in the new field of Bioinformatics?
   (b) What role do homology, similarity, substitutions, insertions and deletions have in the process of sequence alignment?

4. Most sequence alignment algorithms are based on the idea of finding an 'optimal path' represented in terms of a score, where the shortest path (or score) 'wins'. Given two sample sequences α = TTGTCAGACGA and β = TGCAGGGT, and assuming that one scores a +1 for a match, -1 for a mismatch and -2 for a gap, outline four possible sequence alignnment algorithms applicable indicating the one that 'wins' in this limited scenario.

p.t.o.

Section B

5. (a) Briefly explain the difference between (i) analog and digital images; (ii) vector graphics and raster graphics.

   (b) Describe approaches that could be taken to obtain 3D information from single images, using the following schemes (i) confocal microscopy; (ii) electron microscopy

   (c) Describe the following 3D graphics techniques: (i) hidden surface removal, (ii) surface shading, (iii) bump mapping, (iv) event modelling, (v) opacity variation. Selecting two of these techniques, describe their use in an application such as the Visible Human Project.

6. (a) Explain the difference between global (point) and local image processing operations.

   (b) What does the term "image convolution" refer to? Describe two important biomedical applications of image convolution, and sketch the process of convolution with a 7x7 Gaussian kernel (the coefficients need not be mathematically exact).

   (c) Describe what is meant by image deconvolution, and briefly compare two common deconvolution algorithms. How does the presence of noise impact on the deconvolution of images, for example medical X-rays?

7. (a) Describe the process of determining the optimal edge map(s), containing both magnitude and direction information, for the outline of an approximately circular cell against a noisy background.

   (b) The thresholded (i.e. binary) image below is of fungal growth in a laboratory. Presuming that the total length of growth is to be monitored over time via a series of such images, describe a suitable sequence of steps for automatically performing this task.