UNIVERSITY OF LONDON
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 2001

BEng Honours Degree in Computing Part III
MSc in Computing Science
BEng Honours Degree in Information Systems Engineering Part III
MEng Honours Degree in Information Systems Engineering Part III
MEng Honours Degree in Information Systems Engineering Part IV
for Internal Students of the Imperial College of Science, Technology and Medicine

This paper is also taken for the relevant examinations for the Associateship of the City and Guilds of London Institute

PAPER C346=I3.12

MULTIMEDIA SYSTEMS

Tuesday 1 May 2001, 10:00
Duration: 120 minutes

Answer THREE questions

Paper contains 4 questions
Calculators required

1a i) Use sketches to describe two chroma subsampling image formats, each of which provides a different level of compression. Explain the compression achieved in each case.

ii) Explain the function of inter frames and intra frames in the H.261 video coding standard. What additional type of frame is employed by MPEG-1 and MPEG-2 video coding?

iii) ISO/IEC Standard 11172, specified an audio/visual decompression system now known as MPEG-1. What is the significance of only specifying the standard for decompression?

b i) What is the difference between a Quality of Service Guarantee and a Priority Mechanism? Include in your answer what circumstances dictate whether either might be available and why.

ii) Give an example of a priority mechanism only suitable for use within a local area network, explaining why this is the case.

iii) Give an example of a priority mechanism that is suitable for use over wide area networks, such as the Internet, explaining why this is the case.

The two parts carry, respectively, 60%, 40% of the marks.

2a A text file only contains characters 'a', 'b', 'c' and 'd'. The frequency of each character appearing in the text is P(a) = 0.30, P(b) = 0.34, P(c) = 0.16, and P(d) = 0.20, respectively.

i) What are the Huffman codes for these characters?

ii) If 1 byte is used to encode each character in the original file, what is the compression ratio when Huffman coding is used?

b List (but do not explain) the major steps in JPEG image compression and MPEG audio compression. For each technique, what inaccuracies (artefacts) may become visible/audible if very high compression ratios are used.

c List *three* features associated with human perception of sound. Explain how psycho-acoustic models are used in audio compression.

d You are asked to develop a technique that has a high compression ratio for the National Fingerprint Database, where the clarity of ridges in the images is important to the correct identification.

i) Explain why it is *inappropriate* to adopt JPEG image compression for this purpose.

ii) Based on the basic principle of JPEG, propose a new compression technique that provides a high image compression ratio without sacrificing image details that are essential to the fingerprint database.

To remind you what a fingerprint looks like, here is an example.

The four parts carry, respectively, 15%, 35%, 20%, 30% of the marks.

3a i) Compare the "pull" and "push" methods of delivering streamed audio/video to a user. Include in your answer what circumstances dictate which is most appropriate.

ii) "Video-on-Demand" is an overall term for a wide set of technologies. Differentiate between the possible levels of service, indicating the resources that each requires.

iii) Outline three methods of delivering high-bandwidth interactive services to the home user. What are the advantages and disadvantages of each technology?

b i) Explain the meaning of "Hypertext", as referred to in Hypertext Markup Language (HTML) and Hypertext Transfer Protocol (HTTP). Is Hypertext the most appropriate term?

ii) Compare the requirements for using a Java applet and a third-party plug-in, such as Macromedia Flash, to provide additional interactive content in a World Wide Web page, both for the content provider and the end user.

iii) A television company wishes to transmit WWW pages that complement its programming over unused picture lines during the vertical blanking interval. What data rate would you expect to be achieved using six lines per field? Do you think the throughput would be sufficient for the requirement? Justify your answers.

The two parts carry, respectively, 50%, 50% of the marks.

4a For each of the following compression schemes, explain in detail which parameters of the algorithm can be adjusted to control the compression ratio.

i) JPEG compression of a still colour image
ii) IFS fractal compression of a greyscale image
iii) MPEG compression of motion pictures

b List the processing steps involved in IFS fractal compression by using Jacquin's approach, and explain how the seed image affects the final decompressed result.

c Explain the rating of perceptual quality when IFS fractal compression is used for compressing the following three types of images:

i) Text and line art
ii) Computer graphics
iii) Photorealistic images

d You are asked to analyse a video sequence acquired from a camera mounted on a moving police highway patrol car.

i) Explain what *optical flow* is and how it can be used to calculate the motion of other vehicles on the motorway. What is the main problem associated with *optical flow* based motion detection techniques?

ii) The motion derived from the above step is the relative motion between the police car and the target vehicle. What would be your method for estimating the absolute speed of the target vehicle? Explain all the necessary steps involved.

The four parts carry, respectively, 20%, 30%, 20%, 30% of the marks.