UNIVERSITY OF LONDON

IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 1999

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

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

PAPER 3.46 / I 3.12

MULTI-MEDIA SYSTEMS

Wednesday, May 5th 1999, 10.00 – 12.00

Answer THREE questions

For admin. only:
paper contains 4 questions

1a A motion image compression method, J-, is proposed that subtracts successive frames pixel by pixel and transmits a JPEG encoding of the difference pictures.

List and briefly explain the advantages and disadvantages of J- compared with

i) A sequence of JPEG frames

ii) MPEG

Your list should include information about
- the quality of the compressed image
- the types of image that result in good compression
- the effects of errors in transmission

iii) What is the most serious problem with J- and how would you correct it?

b A system uses arithmetic coding to send three symbols, A, B and C, each of probability 1/3. A is coded using a smaller value than B, which in turn is coded using a smaller value than C.

i) Using a clearly labelled diagram and, explaining your working, show how the message A,B,C would be coded as a binary fraction.

ii) How many bits are required in the number that encodes the sequence A, B, C?

iii) What other information is needed for the message to be successfully received?

iv) How many bits per symbol on average would you expect if Huffman coding was used to represent sequences of A, B and C?

v) How many bits per symbol on average would you expect if arithmetic coding was used to send sequences of A, B and C? What percentage saving is this?

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

2a Using clearly labelled diagrams where appropriate, explain the limitations of the human ear that can be exploited by audio compression algorithms. Indicate, in principle, how the limitations can be exploited.

b A 16-bit stereo 44.1kHz CD-audio recording of a string quartet is hand-translated into a simple MIDI sequence for transmission down a 31.25kbit/sec link.

i) What information is captured in the MIDI sequence and what is lost?

ii) Estimate the compression ratio achieved.

iii) If the string quartet contains semi-quavers on all instruments, what is the maximum speed in beats per minute at which it can be played?

iv) What delay does MIDI introduce between notes that are meant to start simultaneously on all four instruments?

v) Would the delay be audible if each instrument sounded all four strings simultaneously?

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

3a Explain the difference between frame rate and refresh rate. Describe a situation in which the two are related and another in which they are not.

b Give an example of a symmetric and an asymmetric application of digital video. Describe the resource requirements for each.

c What compression rate is needed to send 10 QCIF frames per second using both B channels of a basic rate interface ISDN link?

d i) State the aims of the MPEG-1 and MPEG-2 standards. Outline how these requirements are met in the two standards and list the additional features of MPEG-2.

ii) MPEG video requires specialised hardware to achieve acceptable decompression. Describe two proprietary software-only video compression codecs with which you are familiar, including any specific strengths and weaknesses of each.

The four parts carry, respectively, 20%, 20%, 20%, 40% of the marks.

[Turn over ...

4a Quality of service (QoS) is described in CCITT Recommendation E.800 as:

"The collective effect of service performance which determines the degree of satisfaction of a user of the service."

i) What factors affect the QoS of network multimedia applications? Explain how different types of such applications are affected differently.

Describe how QoS requirements can be catered for over

ii) An ATM network.

iii) The Internet.

b HTML provides a level of interactivity in a WWW page by providing static links to other content. Discuss three ways of adding more interactivity to a WWW page. Include any advantages and disadvantages of each technique.

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

[End of paper