

OLLSCOIL NA hÉIREANN
THE NATIONAL UNIVERSITY OF IRELAND, CORK
COLÁISTE NA hOLLSCOILE, CORCAIGH
UNIVERSITY COLLEGE, CORK

SUMMER EXAMINATION 2014

BSc in Computer Science

CS4405: Multimedia Compression and Delivery

Professor Ian Gent
Professor Barry O'Sullivan
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The use of electronic calculators is permitted

Answer ALL questions

Total Marks
80

Time Allowed
 $1\frac{1}{2}$ Hours

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1. Topic: Image Coding (24 MARKS)

- a) Colour quantisation reduces the number of distinct colours in an image, with the intention that the new image should be as visually similar as possible to the original image. The *popularity algorithm* selects the n most frequent colours in an image as the set of representative colours.
- List the main steps in this algorithm. (2 marks)
 - Describe where this algorithm would *not be effective* in yielding a visually similar image. (2 marks)
 - Suggest a way of improving the algorithm to yield a more visually similar image. (4 marks)
- b) Baseline JPEG is a lossy compression technique that achieves a high compression ratio by exploiting the weaknesses in the human visual system.
- List the steps a baseline JPEG codec would use to encode RGB image data. (2 marks)
 - For each step, state whether the technique used is lossy or lossless. If the step is lossy justify why losses are allowed. (6 marks)
- c) Masking provides a means for hiding portions of visual elements.
- Describe using code, how to mask a JPEG image using *CSS masking*. (2 marks)
 - Describe an alternative HTML5-based solution. (6 marks)

2. Topic: Audio and Video Coding (28 MARKS)

- a) List the steps in digitising and coding audio signals. *DCT* (2 marks)
- b) Explain why differential pulse code modulation encoding is used for representing digital audio. *PCM* (2 marks)
- c) One approach for compressing digital audio data is to apply a discrete cosine transform to a list of audio samples.
- Describe how this compression scheme could be implemented. (6 marks)
 - What are the limitations of this approach? (4 marks)
- d) Video encoding in MPEG-1 consists of five steps (motion estimation, coding-block preparation, discrete cosine transform, quantisation and entropy encoding). Describe each of these five steps. Be sure to include the choices (if any) an encoding application can make at each step. (8 marks)
- e) An MPEG-1 closed group of pictures (GOP) consists of the following pictures shown in *playback order*.

I B B P B B P B B P B B P B P

- Write out the *encoding order* of the above GOP. (2 marks)
- If the frame size is 352×288 pixels, calculate the *maximum* number of motion vectors that could result when encoding the GOP. (2 marks)
- Why is it likely that an encoding application will use fewer motion vectors? (2 marks)

3. Topic: Media Delivery and Presentation (28 MARKS)

- a) Progressive JPEG mode delivers an initial low-quality version of the image, followed by higher-quality refinements. Assuming the main steps of the JPEG algorithm are the same as sequential JPEG mode, suggest how this mode could be implemented. *(4 marks)*
- b) What features of a typical video codec make the compressed bitstream sensitive to transmission errors? *(3 marks)*
- c) Describe two techniques that can suppress error propagation after a transmission loss? *(4 marks)*
- d) ISO/IEC developed the MPEG-DASH standard allowing for dynamic adaptive streaming of media content over HTTP.
- i. What caused the need for delivery platforms such as MPEG-DASH? *(3 marks)*
 - ii. Describe the general architecture of an MPEG-DASH delivery system. *(4 marks)*
 - iii. Outline an algorithm that an MPEG-DASH client could use to control the delivery of content from a server. List the limitations of your solution. *(6 marks)*
 - iv. Usually MPEG-DASH systems offer multiple representations of each of video as separate files. It is also possible to offer all representations embedded in one file using Scalable Video Coding (SVC). Explain the potential advantages of the SVC approach. *(4 marks)*

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