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THE NATIONAL UNIVERSITY OF IRELAND, CORK

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BSc in Computer Science

CS4405: Multimedia Compression and Delivery

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Answer all questions.

90 minutes

1. Consider a low-end screen or printer with a resolution of 320x240 (this resolution is also known as *Quarter VGA*). We assume that the device is only capable of switching output pixels on or off (it has 1-bit colour depth). For example, monochrome LCD screens on certain portable gadgets or printers in cash registers may fall in this category.
   The questions below deal with algorithms that display *grey-scale images* on a device with above specification.

   a) Which algorithm would you use to display a grey-scale image with resolution 320x240 on such a device? Justify your answer. (*8 marks*)

   b) Which algorithm would you use to display a grey-scale image with resolution 80x60 on such a device? Justify your answer. (*7 marks*)

2. The questions below deal with still colour images and their visualization.

   a) Typically, the colour model at *hardware side* (where images are captured or displayed) is the *additive RGB* model. However, a different colour model is usually preferred for *storage and transport* of digital images.
   Name this other colour model and briefly explain its advantage over RGB for storage and transport. (*8 marks*)

   b) Explain how the utilization of a *color look-up table* can reduce the file size of digital images. (*8 marks*)

   c) Briefly explain the meaning of the *gamma value* and why this value is almost always greater than 1. (*9 marks*)

3. For various encoding tasks, an alphabet of 64 symbols is often used. One reason for using 64 symbols is the possibility to agree on a set of 64 printable characters which are supported by all derivatives of the Latin keyboard layout. For example, the widely accepted MIME standard for email attachments employs, so called, Base64 encoding.
   The questions below deal the concept of *information entropy* of memory-less sources that are composed from 64 different symbols.

   a) Calculate the maximum possible value for the entropy of such a source. (*8 marks*)

   b) We now consider that 14 symbols from the alphabet *never occur* in the source. Give a simple numerical expression for the maximum possible entropy in this case. Your answer may contain irrational functions such as $\sqrt{2}$. (*8 marks*)

   c) We assume that the entropy of such a source equals 3 bits per symbol. Now consider that the symbol stream is to be compressed by a very good algorithm. Calculate the best theoretically achievable compression ratio. (*9 marks*)

4. These questions deal with general aspects of digital sound sampling and compression.

   a) The CD standard prescribes a sampling rate of 44.1KHz. Explain why this value has been chosen. (*7 marks*)

   b) In most lossy compression algorithms, the original signal is replaced by a *weighted sum of orthogonal functions*.
   Explain how this method can help to discard unimportant information in favour of higher compression ratio. (*8 marks*)