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# 2910325 Data compression

## Examiner's report: Zone B

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### General remarks

CIS325 examination papers cover typically the most important topics of the course material. As an examination candidate, you are expected to have fully understood issues and techniques learnt from the course.

To achieve a good grade, you need to demonstrate successfully the required knowledge and skills in the examination. It is hence essential for you to be able to present the solutions in the best possible way. For example, the answers on scripts should be written in logical and coherent steps. You should demonstrate the entire process of deriving a final result in the answer. The corresponding question numbers (e.g. Question 1, Question 3) and part numbers (e.g. (a), (b), ii, iii.) of your answers should be clearly marked. The solution to each question should begin on a new page if possible. The handwriting should be easy to read. You may use pens of any natural dark colour preferably black or blue, but never red or green which are reserved for marking your exam scripts. It is a good practice sometimes to leave a note for the marker to clarify or highlight things, especially when solutions to some parts of a question are presented in different places. Most importantly, candidates need to read questions **carefully**.

Good timing in an examination is critical for your success. You should therefore make a plan quickly at the beginning of the examination to allocate the time for each question. This is to avoid the situation that you spend too much time on one question and do not have enough time for another. Similar timing approaches should be applied to each sub-question or part of the question.

There are a total of five questions in this year's exam paper. Candidates are required to attempt three out of the five. We discuss the questions one-by-one in the following paragraphs:

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### Specific remarks

#### Question 1

A good answer to this part of the question would consist of two paragraphs. The first paragraph would offer a brief description of a variable-to-variable model for data compression. The second would present an example to clarify your points made in the first paragraph.

There are two requirements in this part of the question. The first requires an explanation of the sampling concept and the second asks for the minimum sample rate. The key step for answering the sample rate part is to work out first the maximum frequency of the signal from the given frequency spectrum diagram.

An easy way to answer this part of the question is to first state 'yes' or 'no' in one paragraph. In the second paragraph, explain your reasons to support your statement earlier. One common mistake made by some candidates this year was to have misunderstood the question. For example, some candidates failed to realise that a statement such as 'it is possible to find a prefix code of the given codeword lengths' is quite different from saying 'the given code is a prefix code'.

This part of the question is straightforward. A good answer would consist of two sections. The first would outline the decoding algorithm and the second demonstrate step-by-step how the original message can be decoded from the given decimal code.

## Question 2

A good answer to this part of the question is to explain briefly the concept of P picture and then give an example to demonstrate your understanding.

A good answer to this part of the question would consist of four sections. The first section would show the decoding process step by step. The second would explain the meaning of all the control symbols used. The third section would compute the compression ratio and the fourth compute the entropy. Few candidates attempted the entropy part this year.

There are two requirements in this part of the question and your answer should consist of two sections accordingly. The first is to show how the image can be pre-processed by decomposing an array into a number of bi-level bit-planes. The second is to show how a better compression ratio may be achieved. Most candidates this year realised the need to convert the given decimal entries of array A to the binary before the decomposition for the bi-planes. However, few candidates did actually attempt the encoding on each bit-planes. They did not realise that, without the code, the compression ratio cannot be computed.

## Question 3

A good answer to this part of the question would consist of two sections. The first section would explain in one paragraph the differences between a lossy and lossless data compression, and the next paragraph would give the aim of a lossy compression. The second section would show an example of real data that are suitable for lossless compression.

A good approach for this part of the question is to explain the predictive rule first and then support your explanation by a small example. A common mistake made by candidates this year was to have misunderstood the question.

This part of the question continues the previous part (b). It requires a computation of the squared error on the given matrix. You need to show all the steps of your work, which is more important than the final numerical result itself.

A good answer to this part of the question would consist of two sections. The first would describe briefly the canonical minimum-variance Huffman encoding algorithm. The second part would give an example to show how the algorithm works step by step. A common mistake made by candidates this year was to have missed out one part (e.g. the algorithm, example or explanation).

**Question 4**

This part of the question tests your general knowledge of mathematical modelling techniques for data compression. It is 'unseen' but some modelling techniques for general problems solving can be adopted for data compression. You should not hesitate to demonstrate your relevant experience and knowledge.

A good answer to this part of the question is to explain briefly the concept of Discrete-tone image and then give an example to demonstrate your understanding.

A good answer to this part of the question would consist of steps of encoding the given string using LZ77 algorithm. You should summarise the final decoded tokens at the end of your answer.

An easy way to answer this part of the question is to first outline the efficient implementation of the static Huffman coding by maintaining two lists, one is for the singletons and the other is for the combination items. You would then give an example using the given data to show how this approach works step-by-step.

**Question 5**

There are two requirements in this part of the question. The first requires an explanation of the concept of prefix code. The second seeks some comments and examples. One common mistake made by candidates this year was to have misunderstood the question in the second half. Here, in addition to understanding the question, you need to present your answer well. It would perhaps be better if you could decide your approach first. For example, decide first whether or not to give your argument at the beginning. This would then be followed by the justification.

A good answer to this part of the question would consist of two paragraphs. The first would offer a concise explanation why data compression techniques are necessary especially for image files. The second would present an example to support your arguments in the first paragraph.

A good answer to this part of the question would first explain the concept of reflected gray code in the first paragraph and then show all your work in deriving the code in the second.

A good answer to this part of the question would consist of two sections. The first section would describe briefly the adaptive Huffman decoding algorithm. The second section would give an example to show your understandings of the algorithm. Of course, you need to encode the given example first and then show the steps of decoding. A common mistake made by candidates this year was to have missed out the algorithm, example or explanation.

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**Summary**

Good performance in the examination depends not only upon your sound knowledge covering all the required topics but also upon effective ways to demonstrate your knowledge, your understanding and analytical skills. The importance of understanding questions in the examination cannot be emphasised more. Examinees are, again, advised to read the questions **carefully**. You should make sure that you fully understand what is required and what parts or sub-questions are involved for each question explicitly and implicitly. You are encouraged to take notes, if necessary, while reading or attempting the questions. Above all, you should be completely familiar with the course materials. Good students should prepare to solve problems in some unseen form by applying their knowledge gained from the course.