

TOTAL: 50 MARKS Answer **all** questions.

This assignment contributes 5% of your overall course mark. Submit your assignment as a single PDF file to Assignment Drop Box. Include all workings and explanations. Marks will be deducted for ambiguous solutions. Zero marks are awarded if the answers contain no explanation. Also, refer to the Departmental policy on cheating and plagiarism. Cut-and-paste without acknowledgment of the source is not acceptable.

Assignment Drop Box (<https://adb.ec.auckland.ac.nz/adb/>).

Departmental Policy on Cheating on Assignments: see Assignments page of the course web site.

Due date: 11:59 pm, Friday 17 August, 2012

1. Consider the following assignments:

$$\begin{pmatrix} & code_1 & code_2 & code_3 & code_4 \\ A & 0 & 0 & 1 & 1 \\ B & 100 & 1 & 01 & 01 \\ C & 10 & 00 & 001 & 001 \\ D & 11 & 11 & 0001 & 000 \end{pmatrix}$$

- (a) Which of the above assignments are codes? Justify your answer. [2 marks]
- (b) Which of the above codes are prefix free? Justify your answer. [2 marks]
- (c) Which of the above codes are uniquely decodable? Justify your answer. [2 marks]
- (d) For those codes that are uniquely decodable, give the encoding of ABBCCDDDD. [2 marks]
- (e) For each of the following strings
- (i) 010011
 - (ii) 1000
 - (iii) 11110000001

indicate whether they are encodings in each of the uniquely decodable codes above of some string over the alphabet $\{A, B, C, D\}$; for each affirmative answer give the string encoded.

[2 marks]

2. Is $\{1, 011, 01110, 1110, 10011\}$ uniquely decodable? Justify your answer; in case of negative answer, find a string with two encodings.

[10 marks]

3. For each set of natural numbers:

i) 133333333333, 2, 1.

[3 marks]

ii) 32, 16, 8, 4, 2

[2 marks]

iii) 3, 1, 4, 3.

[2 marks]

iv) 1, 2, 50, 2.

[3 marks]

check whether there is a prefix binary code whose codewords lengths are exactly the provided numbers. In each case justify your yes or no answer; in case of affirmative answer construct a code with the specified requirements.

4. Devise two correct Huffman trees and their corresponding codewords for the letters A, B, C, D, E, F with frequencies given in the following table:

Letter	Frequency
A	15%
B	15%
C	10%
D	10%
E	30%
F	20%

[10 marks]

5. A file F consisting of n characters, formed with lower-case letters (26), upper-case letters, and extra m characters, has to be efficiently stored.

(a) How many bits do you need to store F using the ASCII code?

[2 marks]

(b) What is the maximum valued for m to be able to store F using a 6-bit code? Present your solution and calculate the size of the compressed file.

[6 marks]

(c) How much size reduction (percentage) have you obtained?

[2 marks]