THE UNIVERSITY OF AUCKLAND
NEW ZEALAND
Tamaki Campus

COMPSCI.314.S2.T. Data Communications Fundamentals

Assignment 1: Signals, Codes, Compression, Integrity, Skype, and Powerline Communications

Posted: 27 July 2007
Due: 11.59 pm, Saturday 11 August 2007

This assignment is worth **100 marks** representing **5%** of your total mark.

Questions

Solve the following problems (present each solution in detail):

1. (*4 marks*) a) Distinguish between a digital and analog signal. b) What components describe an analog signal?

2. (*6 marks*) People often casually refer to a 'high-speed connection'. Strictly speaking, this is technically incorrect. Name and describe three factors affecting a connection's performance that have an impact on the user's perception of 'connection speed'.

3. (*10 marks*) a) Define a signal's period and frequency. b) How are they related? c) Suppose the period is 10 nanoseconds, what is its frequency?

4. (*10 marks*) Using a Baudot code, how can we tell a digit from a letter? Illustrate your answer by computing the Baudot code of the string G564FSDH6.

5. (*30 marks*) a) Define the notion of prefix code. b) Give an example of prefix code and an example of non-prefix code; justify your answers. c) Using the algorithm in Kraft's theorem construct a prefix code whose codewords have exactly the lengths $5, 2, 1, 3$. d) Is the prefix code constructed at c) unique (justify your answer)? e) Is your solution for c) extendable, i.e. can you add a new codeword without violating the prefix property?

6. (*10 marks*) a) What is the signal-to-noise ratio (S/N)? b) How can we use S/N to distinguish a clear signal from a less clear one?

7. (*20 marks*) a) State Shannon's theorem. b) Assume the maximum bandwidth of a medium is 6000 Hz. According to Shannon's theorem, what is the maximum bit rate if the signal-to-noise ratio is 40 dB? You are allowed to approximate where this is appropriate.

8. (*10 marks*) Devise a Huffman tree and the corresponding codewords for letters whose frequency of occurrence is in the following table:

Letter	Frequency
A	15%
B	25%
C	20%
D	10%
E	10%
F	20%

Submission

The due date is 11.59pm, Saturday, 11 August 2007. (ADB time); penalty linearly grows in time from 0% to 50% on 11.59pm, 13 August 2007; no submission afterwards.

Submit your assignment to the Assignment Dropbox (ADB) system, `https:adb.ec.auckland.ac.nz/adb`. Electronically hand in a pdf-file `Assignment1.pdf` with your answers to Questions 1–8.

You may use any platform and text editor to prepare your submission, but please check at the Faculty of Science Tamaki Computer Labs that your final pdf-file is readable. Hand-made pictures scanned and embedded in the file are acceptable, but scanned hand-written notes embedded as images into a pdf file **will not be accepted** for marking.

Plagiarism will not be tolerated. Your solutions and explanations must be in your own words.