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Problem set 5
May 13, 2016
Summer Semester 2016

Online and Approximation Algorithms

Due May 20, 2016 before 10:00

Exercise 1 (Linear List Compression - 8 points)

Consider the alphabet $\Sigma = \{\mathrm{b}, \mathrm{n}, \mathrm{o}\}$ and the string $S =$ 'boonobo' obtained from Σ.

(a) Show the encoding procedure of S by using Linear List compression and the Move-To-Front algorithm, assuming that the initial list is $\{\mathrm{b}, \mathrm{n}, \mathrm{o}\}$.

(b) Give the binary encoding of the integer list found in (a), using a variable-length prefix code.

(c) Show the decoding procedure of the string S.

Exercise 2 (Burrows-Wheeler Transformation - 12 points)

Consider the alphabet $\Sigma = \{\mathrm{b}, \mathrm{n}, \mathrm{o}\}$ and the string $S =$ 'boonobo' obtained from Σ.
Show all the steps of both directions of the Burrows-Wheeler transformation using linear space.

Exercise 3 (Linear List Compression with Limited List Length - 10 points)

Consider the alphabet Σ with n symbols. Recall that a compression with a linear list requires maintaining a linear list of all the symbols in Σ. In order to use less space, we shorten the length of the list to $n^{1/k}$, where k is a positive integer.

(a) Extend the compression scheme presented in class to the new setting.

Hint: Assume that we have at our disposal a fixed-length encoding of all the symbols in Σ which can be used in the case where a symbol is not in the list.

(b) Show that the encoding length increases by a factor of at most $O(k)$ due to the decrease of the list's length.

Exercise 4 (Huffman-code - 10 points)

(a) Encode the string 'rhabarber' using the Huffman-code. Include the resulting tree as well as the encoding table.

(b) Decode the encoded string from (a). Include intermediate steps.