**Algorithm Engineering**

**16 July 2013**

**Exercise [rank 2+2+3]**

1. Given a text T define what is a suffix array SA for T
2. Show the SA for the text T=abraabba
3. Comment how it is executed the search for P=ra in the SA of item 2

**Exercise [rank 3+3]**

Given the probabilities p(a)=0.1; p(b)=0.15; p(c)=0.2; p(d)=0.25; p(e)=0.3,

1. Construct the Canonical Huffman code, showing the steps followed by the algorithm.
2. Then use it to decode the bit sequence 1001001, showing each decoding step.

**Exercise [rank 2+3+2]**

Consider the encoding of a sequence of integers:

1. Define the variable-byte code of an integer x, and specify how many bytes it occupies as a function of the value of x.
2. Define the (s,c)-dense code, where assuming s+c=256, specify how many bytes it occupies to represent integer x as a function of s and c, and comment when it can be better than variable-byte code.
3. Show the (4,4)-dense code for the integer 10. (Here groups are of 3 bits each, since s+c=8.)

**Exercise [rank 2+3+2+3]**

1. Comment on the space occupancy of the classic quicksort during the recursive calls.
2. Propose a QS-variant which uses O(log n) additional space.
3. Describe the multi-way quicksort for atomic items and compute its I/O complexity by properly setting its parameters.
4. State the main theoretical result at the core of the selection of “k good pivots”, and prove it.

**Exercise [rank \*]**

Prove that the Arithmetic coder achieves nH+2 bits of occupancy.