

# Algorithms, Data Structures, and Complexity Theory

Spring, 2002

Do all problems.

1. A prefix code for an alphabet  $A = \{a_1, \dots, a_n\}$  is an assignment of a binary string  $s(a_i)$  to each letter  $a_i \in A$  in such a way that no string  $s(a_i)$  is a proper prefix of another string  $s(a_j)$ . The Huffman algorithm assigns a prefix code to the letters in a given text file in such a way that the length of the file obtained by replacing the letter  $a_i$  of the text file by the bits in  $s(a_i)$  is minimized. **Briefly describe** this algorithm and indicate which of the classic data structures are used. **Prove** that its complexity is linear in the size of the original text file.
2. **Prove** that it is NOT the case that  $O(n^2) \subseteq O(n)$ , where  $O(g(n))$  is the collection of all functions  $f : N \rightarrow R$  such that for some positive  $c, K$ ,  $0 \leq f(n) \leq cg(n)$ , when  $n > K$ .
3.
  - **Define** the meaning of the phrase “problem A is polynomially reducible to problem B”.
  - **Define:** an NP problem? an NP complete problem?
  - **Define** both of the problems 2SAT and 3SAT.
4. What is the complexity of 2SAT? of 3SAT. Prove ONE of your answers.