SCI 199 (Beautiful Algorithms)

Assignment #3 Due: Nov. 15, 2001 (in tutorial)

Note: In all questions, the better the algorithm, the better the mark.

1. **[3 marks]** Consider the following sorting algorithm:

a. for j from 2 to n do
b.   begin
c. $key \leftarrow L(j)$
d. $i \leftarrow j - 1$
e.   while $i > 0$ and $L(i) > key$ do
f.   begin
g. $L(i+1) \leftarrow L(i)$
h. $i \leftarrow i - 1$
i.   end
j. $L(i+1) \leftarrow key$
k.   end

Note that the begin, end pairs in lines b, k and f, i are used to bracket the contained statements.

(a) Briefly describe how this algorithm works and illustrate the algorithm by means of a small meaningful example.

(b) What is the time complexity of this algorithm? Briefly justify.

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2. **[4 marks]** A sorting method is called *stable* if equal keys remain in the same order in the sorted list as they were in the original file. (i.e. a sorting method is said to be stable if for any $i < j$ such that initially $L(i) = L(j)$, the sort moves $L(i)$ to $L(h)$ and moves $L(j)$ to $L(k)$ for some h and k such that $h < k$.) Which of the following algorithms are stable? If the algorithm is stable, give a brief justification; if it is not stable, then give an example in which the relative position of two equal keys is changed.

   (a) Bucketsort

   (b) Bubblesort

   (c) Mergesort

   (d) Heapsort

   (e) The sort in question 1

3. **[3 marks]** In class we saw Mergesort where the list is recursively divided into 2 equal sized sublists. Now consider a 3-way-Mergesort where the list is recursively divided into 3 equal sized sublists.

   (a) Outline the major steps of this algorithm. Do **not** give the details of the merging part of the algorithm.

   (b) What is the time complexity of this algorithm? Briefly justify.

   (c) **EXTRA:** Give the details of the merging part of the algorithm.