CS 141, Advanced Topics in Algorithms
Spring 2004
Homework 4a
Due Monday, February 11

1. **[20 Points] The Dynamic List Access Problem.** In class we looked at the MTF online algorithm for the List Access Problem. Specifically, we looked at the **Static** List Access Problem where only FINDs were allowed - there were no INSERT and DELETE operations permitted in the request sequence.

   Now, consider the more general **Dynamic** List Access Problem which differs from the static version in three ways:

   (a) Any FIND operation may fail. That is, the item might not be found. In this case, the actual cost is $\ell + 1$ where ℓ was the length of the list at the time that the FIND was performed.

   (b) INSERT operations are permitted in the request sequence. An inserted object is placed at the end of the list. If the length of the list prior to the INSERT was ℓ, then the actual cost of this operation is $\ell + 1$. After inserting the element at cost $\ell + 1$, you may move it to any position earlier in the list at no cost (just like in a successful FIND operation).

   (c) DELETE operations are permitted in the request sequence. The cost of the DELETE is simply the cost of finding the object. (However, the potential function changes as a consequence of the DELETE, so a DELETE differs from a FIND in this way!)

   Describe a modification of the MTF algorithm to handle all three of these operations. Show that when your modified MTF algorithm is applied to the Dynamic List Access Problem, it still maintains a competitive ratio of 2. (That is, it is 2-competitive with respect to an optimal offline algorithm.)