

# FOURTH QUIZ

You have 15 minutes from the start of class to complete this quiz. Read the questions with care; work with deliberate speed. Don't give us more than we ask for. The usual instructions apply. Good luck!

**Problem 1 (25 points)**

Annette Anteater owns a used car lot in Irvine, where she sells a wide variety of previously owned vehicles. She has asked you to computerize her inventory (containing information on each car such as make, model, and price) and you decide to use a table (a map) to implement it, with each car's VIN (vehicle ID number, a 17-character string) as the key. You consider four different data structures for your implementation:

Structure I – An unordered array with all the items stored contiguously (i.e., without gaps) starting in the first cell, plus an additional single integer to store the number of items in the table.

Structure II – A doubly-linked list (with links to the head and tail, and links from each node to its predecessor and its successor) maintained in order by VIN, plus an additional single integer to store the number of items.

Structure III – A reasonably balanced binary search tree, ordered by VIN.

Structure IV – A hash table with an ideally random hash function based on the VIN, in which collisions are resolved by linear chaining.

(a) (15 points) Complete the following table, giving the best (closest-fit) O-notation for each task on each data structure, assuming that each task is implemented in Java using the most efficient algorithm available (without changing the structure described above). Assume there are  $v$  vehicles in the collection, that the array's capacity is  $a$  items, and that the hash table's size is  $t$ .

Tasks:	I: Array	II: Linked List	III: BST	IV: Hash Table
Add a new vehicle				
Find a vehicle, given its VIN				
Find all vehicles matching a given make, model, and year				
Remove a vehicle, given its VIN				
Print all the vehicles in order by VIN				

(b) (2 points) Which, if any, of the data structures, based on the operations shown above, would never be the best choice (because another data structure is an equivalent or better alternative for every task)?

- (c.1) (1 point) What's the maximum number of cars that Annette is likely to have on her lot (in her inventory) at any given time? Just come up with a realistic number; there's no trick here.
- (c.2) (2 points) Suppose that a single operation—a data movement (assignment statement) or comparison—takes at most a hundred-thousandth of a second ( $1/100,000$  second, or .00001 second) on Annette's computer. How long (in seconds) would a linear-time task take on a table containing the maximum number of cars you estimated in part (c.1)?
- (c.3) (2 points) Given your calculation above, how important is your choice of data structure for this problem? Explain your answer in one brief sentence.
- (c.4) (3 points) Suppose Annette creates AACars.com and sells used cars nationwide over the web. Does that change your answer to (c.3)? If so, what's your changed answer and why did it change? If not, why doesn't this new information matter? Explain in one brief sentence.