CAS CS 112A1 – Spring 2008
Practice Midterm Questions

Problem 1

Write a function **int findMin(Queue q)**, which takes a queue of integers as input, and returns the minimum element in the queue, without changing the order of the elements. You can assume that the queue is non-empty and implements the usual operations (enqueue(), dequeue(), isEmpty()).

Problem 2

Write a function **void reverseList(Node head)**, which takes the head of a singly-linked list as an argument and reverses the list, such that **head** now points to the beginning of the reversed list. Your answer should run in linear time.

Problem 3

Write a function **void removeLast(Node head)**, which takes the head of a doubly-linked list as an argument and removes the last element of the list, such that **head** now points to the list with the last element removed.

Problem 4

State whether each of the following statements is true of false and briefly explain why:

1. The **get(index)** and **set(index,value)** operations of the List ADT can be implemented faster using an array-based list rather than a linked list.

2. The **add(value)** operation of a linked list, which adds the value to the back of the list, can be implemented in constant time if we keep a reference to the back of the list.

3. An array list implementation is preferred if we are doing a lot of inserting into the front and the back of the list, while a linked list implementation is preferred if we are performing a lot of get and set operations.

4. Quicksort always runs in $O(n \ log \ n)$ while mergesort runs in $O(n \log \ n)$ in the average case.

5. Bubble sort and insertion sort are faster than mergesort and quicksort on some inputs.

Problem 5

Consider an implementation of quicksort which picks the pivot as the first element of the array. Draw a diagram to illustrate how this implementaion performs on the following array of numbers: $\{1, 8, 4, 3, 5, 9, 2, 6, 10, 3, 5, 8, 7\}$. At each iteration, show how the array is partitioned and the location where the pivot is fixed. You can assume that the recursion bottoms out when the size of the array is 3 or less (at which point another sort (in this case your head) is used), and that elements equal to the pivot go to the left.

Problem 6

Why is the runtime of quicksort $O(n^2)$ in the worst-case? Use a recurrence relation in your answer if you can.

Problem 7

A level-order traversal of a tree visits the nodes top to bottom, left to right. Draw a tree with 5 elements such that its inorder and level-order traversals are the same.

Problem 8

Draw the tree resulting from inserting the following items into an empty binary search tree:$\{5, 3, 8, 12, 6, 7, 4, 2, 1\}$. Now remove the root node, and draw the resulting tree. List the nodes of the new tree (with the root removed) using a preorder traversal.