When you have finished the exam please write and sign the Honor Pledge on the last page.

The 7 numbered questions are equally weighted.

1. In each part give a Big-Oh estimate of the **worst-case** time it takes to find a specific entry in the given structure
   a. An unsorted Linked List with \(n\) entries
   
   b. A sorted Array List with \(n\) entries
   
   c. A sorted Linked List with \(n\) entries
   
   d. A Binary Search tree with \(n\) entries
   
   e. An AVL Tree with \(n\) entries
   
   f. A Heap (Priority Queue) with \(n\) entries
   
   g. A directed graph with \(n\) Vertices and \(m\) Edges, using the graph structure from Lab 9 (so a Graph has a Hashmap of Vertices and a Vertex has a Linked List of Edges). Here the entries you are looking through are stored in the Vertices of the graph.
2. We might have a binary tree structure with integer nodes defined as
   class Tree {
       int data;
       Tree left, right;
   }

   Let’s assume missing or empty trees are represented as null and a leaf is a tree that has
   null left and right children. **Write a method int height( )** for this Tree class that returns
   the height of the tree rooted at the current node. Leaves should have height 0, a tree
   with leaves for both children should have height 1, and so forth. Note that this method
   is slightly different from the code you wrote for Lab 5 because there is no EmptyTree
   class; you have to handle the base case of the recursion yourself.
3. Here is a picture of a binary tree with 10 nodes.

I am going to run an algorithm that uses a “structure” that might be a stack or a queue. I start by putting the root node A into the structure. Then at each step I remove the next node from the structure, print its letter, add its left child into the structure and then add its right child into the structure. This continues until the structure is empty.

A) In what order are the nodes printed if the structure is a stack? An answer might look like “AGHBCDFEIJ” (though that’s not the right answer).

B) In what order are the nodes printed is the structure is a queue?
4. I have a priority queue with 9 entries stored as a heap in the following array:

```
  0 1 2 3 4 5 6 7 8 9 10 11 ..
  5 30 10 40 35 15 20 50 60 ..
```

The small digits on top are the array indices. I want to add entry 13 to this priority queue. What is the sequence of entries in the array after this addition?
Your answer should look like this: 5 30 10 40 35 15 20 50 60 13, though that isn’t the correct answer.
5. I want to build a HashMap in an array of size 10 (so the array indices are 0 through 9). I will use linear open addressing to resolve collisions. Here is a table of 9 entries and their hash values:

<table>
<thead>
<tr>
<th>Entry</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hash Value</td>
<td>0</td>
<td>8</td>
<td>9</td>
<td>6</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

I add the data in the order: D B C I G A E F H

List the entries in the order they appear in the array: index 0 first, then index 1, and so forth.
6. Hackers have broken into Oberlin’s database and destroyed all grade information for last semester except for one backup file. Each line of the file has the format
   
   <student-name>|<class-name>#!<grade>
   
   The lines of the file are in no particular order. You need to read this file and produce a list of every student and their GPA for the term, and also a list of all of the classes that were offered, the students in the class, and the grade for each student for the class. The first list might look like:
   
   Barney Rubble  2.1
   Fred Flintstone 3.2
   ...........
   
   and the second list might be
   
   CINE 101
   Rocket J. Squirrel A
   Bullwinkle Moose C-
   Boris Badenov D
   ....
   CINE 102
   Yogi Bear   B
   Booboo Bear  B+
   Mr. Ranger  A-
   ........
   
   How will you use data structures to solve this problem? Your answers should be in English, not code. In particular:
   
   a. What will you do with each line of the file?
   b. How will you print the first list of students and their GPAs?
   c. How will you print the second list of classes, their students and grades?
7. We might have a Node class defined as
   
   ```java
   class Node {
       private int data;
       private Node next;
   }
   ```
   
   and a List class with an empty sentinel node Head at the front and a variable Tail pointing to the last node in the list. Here is a picture of such a list containing the data 10, 20, 30:

   ![List Diagram](image)

   Write a method `List reverse(List L)` that will build the reversal of List L. So if L starts as the list shown, `reverse(L)` will produce the list 30, 20, 10. It is acceptable to destroy L in the process of making its reversal (for example, you might want to make the Head node point to the node containing 30, and that node point to the one containing 20, and so forth.)
This page is for extra work on any question

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