**Computer Science II Exam #1**

**Summer 2010**

**Date: 6/17/2010**

**Last Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, First Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1) (9 pts) Solve the following recurrence relations using the Master Theorem:

a) T(n) = 3T(n/2) + O(n2)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) T(n) = 9T(n/3) + O(n2)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c) T(n) = 8T(n/4) + O(n)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2) (5 pts) Consider a disjoint set of ten items, 1, 2, 3, …, 10. Draw a tree representation of this disjoint set based on the array representation shown below. (Note: index 0 is not being used at all.)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Index | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Value |  | 1 | 2 | 1 | 2 | 4 | 1 | 6 | 4 | 9 | 3 |

3) (15 pts) Using the subtraction method shown in class, determine the value of $\sum\_{i=1}^{n}i2^{i-1}$ in terms of n. Credit for this problem will be assigned for doing the following steps:

a) Writing out S =, followed by several terms of the sum, some space and the last term.

b) Determining a value to multiply the first equation by.

c) Writing out a new equation, which is a result of multiplying the one form a.

d) Lining up the two equations to subtract.

e) Correctly doing the subtraction.

f) Evaluating the resulting sum and solving the variable, S, assigned to the original sum.

4) (15 pts) Consider writing a class that implements a hash table of Strings using quadratic probing. Fill in the insert method for the class below, so that it utilizes this collision strategy. Comments have been provided to guide you in writing this method.

public class HashTableQuad {

 private String[] words;

 public HashTableQuad(int size) {

 words = new String[size];

 for (int i=0; i<size; i++)

 words[i] = null;

 }

 public int hashfunction(String word) {

 int ans = 0;

 for (int i=0; i<word.length(); i++)

 ans = (256\*ans + (int)word.charAt(i))%words.length;

 return ans;

 }

 public void insert(String word) {

 // Calculate original hash value

 // Loop through until an empty spot is found,

 // going through indexes using quadratic probing.

 // Place the string in the appropriate slot in the table.

 }

}

5) (20 pts) The following class contains one public method. Answer the following questions about the public method below.

public class exam1 {

 public static void whatdoesitdo(String[] list) {

 String[] temp = new String[list.length];

 for (int i=0; i<list.length; i++) {

 int index = getplace(i, list);

 temp[index] = list[i];

 }

 for (int i=0; i<list.length; i++)

 list[i] = temp[i];

 }

 private static int getplace(int loc, String[] list) {

 int cnt = 0;

 for (String s: list)

 if (list[loc].compareTo(s) > 0)

 cnt++;

 return cnt;

 }

}

a) What does this method, whatdoesitdo, do (usually)?

b) What pre-condition must be specified for this method to work properly?

c) Do a detailed run-time analysis of this method in terms of the length of the list. You may refer to this length as n.

d) What would happen if this method were run in a situation that the pre-condition specified in part b wasn’t met?

6) (16 pts) Match the recurrence relation with the algorithm and designated run-time it’s analyzing:

Merge Sort average case T(n) = T(n – 1) + O(1)

Quick Sort worst case T(n) = T(n – 1) + O(n)

Quick Sort average case T(n) = 2T(n/2) + O(n)

Insertion Sort best case T(n) = $\frac{1}{n}\sum\_{i=1}^{n-1}(2T\left(i\right)+O\left(n\right))$

For each choice, give a rationale for the recurrence relation.

Merge Sort average case Recurrence Relation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Rationale:

Quick Sort worst case Recurrence Relation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Rationale:

Quick Sort average case Recurrence Relation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Rationale:

Insertion Sort best case Recurrence Relation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Rationale:

7) (5 pts) Show the result of inserting the value 5 into the 2-4 tree shown below:

 10, 20, 30

 / | | \

 3, 7, 9 11, 18 22 35, 40, 56

8) (5 pts) Show the result of deleting the value 18 from the 2-4 tree shown below:

 10, 20, 30

 / | | \

 3, 9 18 22 35, 40, 56

9) (5 pts) Show the result of deleting the value 18 from the 2-4 tree shown below:

 10, 20, 30

 / | | \

 3 18 22 35, 40, 56

10) (5 pts) South Africa is currently hosting the most famous soccer tournament in the world, World Cup. In what continent is the tournament currently occurring?

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