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BRAC University
Department of Computer Science and Engineering
FINAL EXAMINATION FALL 2020

CSE 220: Data Structures

Total Marks: 30

Time Allowed: 120 minutes

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- Answer ALL **THREE (3)** questions in any order; number each answer.
 - Figure in bracket [] next to each question indicates marks for that question.
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Question No. 1

[10 marks]

- a. On a boring Friday, you are sitting alone in your room. Due to the lockdown, you cannot go out to play with your friends, so you had nothing to do at home. Suddenly, your little sister comes and tells you that some of your family members want to play an interesting game called “Friday Fun”. Therefore, you decided to join in the game. There are few rules in the game:
- i. All the members that will play the game must sit in a circular manner.
 - ii. There will be a song playing in the background. The lyrics will be a string containing three letters ‘a’, ‘b’ and ‘c’ [Assume a single character represents a lyric of the song].
 - iii. There is a gift box that the player must pass while playing the game.
 - iv. If the lyric is ‘a’, then the player containing the gift, passes it to the next member (sitting to his/her right).
 - v. If the lyric is ‘b’, then the player containing the gift is in danger but does not get eliminated, so the player has to pass it to the next member (sitting to his/her right).
 - vi. If the lyric is ‘c’, then the player containing the gift is eliminated in this round and he passes the gift to the next member (sitting to his/her right).
 - vii. The game continues until there is only one member left and he/she will get the gift.
 - viii. The song repeats continuously until the winner is found.

Write a method that finds out the winner of the ‘Friday Fun’ game, you will be given as input the number of family members playing and the song lyrics. **[You must use recursion for solving this problem.]**

[7 marks]

Sample Input	Sample Output	Explanation
3, "acb"	1	<p>1st turn: Starting from 1, the lyric is 'a', so the player passes it to the second member.</p> <p>2nd turn: lyric is 'c', so the second member gets eliminated and passes it to the third member. Now there is only the first and third member playing the game.</p> <p>3rd turn: lyric is 'b', so the third member passes it to the first member.</p> <p>4th turn: lyric is 'a', so the first member passes it to the third member.</p> <p>5th turn: lyric is 'c' so the third member gets eliminated.</p> <p>No further round is required as there is only one member so the winner is the first member.</p>

- b. Draw the **recursive flow diagram/memory stack** (draw each methods and their behavior in the way they are being called and executed) of the code given below: **[3 marks]**

```

public class Surprise{

    public static int mystery(int n) {

        System.out.println("hello");

        if (n == 0) {

            System.out.println("value: 0");

            return 0;

        }else if(n == 1){

            System.out.println("value: 1");

            return 1;

        }else {

            System.out.println("going down");

            int temp = mystery (n / 3) + mystery (n - 2) + 2;

            System.out.println("h(" + n + ") --> " + temp);

            return temp;

        }

    }

    public static void main(String [] args){

        mystery(5);

    }

}

```

OR

```
class Surprise:
    def mystery(self,n):
        print("hello")
        if n==0:
            print("value: 0")
            return 0
        elif n==1:
            print("value: 1")
            return 1
        else:
            print("going down")
            temp = self.mystery(n//3) + self.mystery(n-2) + 2
            print("h(",n,") --> ",temp)
            return temp

#Tester
s = Surprise()
s.mystery(5)
```

Question No. 2

[10 marks]

- a. Given an array containing Strings, you need to **write a code** to store them in a **hashtable**. Assume that the Strings contain a combination of capital letters and numbers, and the String array will contain no more than 9 values.

Use the **hash function** to be the

$$(\text{total number of consonants} * 24 + \text{summation of the digits}) \% 9.$$

In case of a collision, **use linear probing**.

For a String "ST1E89B8A32", it's hash function will produce the value = $(3 * 24 + (1 + 8 + 9 + 8 + 3 + 2)) \% 9 = 4$, hence it will be stored in index 4 of the hash table.

[6 marks]

- b. Using the hash function in part a) store the following Strings in a hashtable
"ST132E89B8A", "ST2H9SAE7896DU", "ST3XVTEEFGA2W", "ST4JG1ES5UCB",
"ST56BFGE4Z1"

Draw the final hash table containing the Strings above (since the Strings are long, use only the first three letters to denote them in the hash table). You must show the calculation of the hash function for each string to obtain full marks.

[4 marks]

Question No. 3

[10 marks]

Suppose an array is given

A = [A, C, E, F, K, L, M, N, Y, Z]

- a. Draw a complete **BINARY** tree from array A **[1 mark]**
- b. Write preorder, inorder, and postorder traversal for the created complete binary tree **[3 marks]**
- c. Draw a complete **TERNARY** tree from array A **[1 mark]**
- d. Write preorder and postorder traversal for the created complete ternary tree **[2 marks]**
- e. Draw the adjacency matrix and adjacency list for the complete ternary tree/graph. [You must consider the **tree direction from top to bottom** when drawing adjacency matrix and list] **[3 marks]**