Hands-on Experiment # 10 : Worksheet (2020)

Section___3___ Date__03/11/2020__

Student ID __6338213221__ Name __Siwat Sirichai__

Part A: Getting Familiar with Writing Recursive Methods

1) Consider the following recursive definition of "Motzkin number" and write a java program "MotzkinNumber.java", where *int M(int n)* is a recursion method as follows:

$$M_n = \begin{cases} 1, n = 0 \; or \; n = 1 \\ M_{n-1} + \sum_{k=0}^{n-2} M_k \times M_{n-2-k}, n \geq 2 \end{cases}$$

Find the value of *M(n)* for all values of *n* listed in the table below. Please print the output with 4 decimal points.

n	M(n)
0	1
1	1
2	2
3	4
4	9
5	21

List all your source code below.

```java
public class MotzkinNumber {

    public static void main(String[] args) {
        for(int i=0;i<=20;i++)System.out.format("%d:%d%n",i,M(i));

    }
    public static int M(int n) {
        if(n==0 || n==1)
            return 1;
        int temp = 0;
        for(int i = 0;i<=n-2;i++)temp+=M(i)*M(n-2-i);
        return M(n-1)+temp;
    }

}
```

Part B: Thinking Recursively

We will be writing recursive methods that operate on arrays. To do so, we imagine an array to consist of

- Head: a data in the first slot.
- Tail: an array containing all but the data in the first slot.

For example: {1,2,3,4,5} has head = 1, tail = {2,3,4,5}.

Operations that allow us to write arrays codes in recursive ways are written in class MyArrayUtil. Please read methods in class MyArrayUtil. (We will ignore loops in MyArrayUtil).

A class called RecursiveExercise (with main method to test your other methods) is given for this question. Then, inside RecursiveExercise.java, do the followings:

1) Write a <u>recursive</u> method **public static boolean** isIn(**int** x, **int**[] a) **throws** Exception
    a.   This method returns true if x is stored inside array a, and false otherwise.
    b.   If a is null, this method returns false.

    List your source code below:

```
public static boolean isIn(int x, int[] a) throws Exception {
    // fill your code here
    if (a[0] == x)
        return true;
    if (a.length == 1)
        return false;
    return isIn(x, MyArrayUtil.tail(a.clone()));
}
```

2) Write a <u>recursive</u> method **public static boolean** subArray(**int**[] a1, **int**[] a2) **throws**
    Exception .
    a.   This method returns true if all data in a1 are also in a2 (the method returns true if a1 == null),
         and false otherwise.

    For example:

    subArray({1,3,4,5}, {0,1,2,3,4,5,6,7}) returns true.

    subArray({1,3,4,5}, {1,2,3,5}) returns false.

    List your source code below:

```
public static boolean subArray(int[] a1, int[] a2) throws Exception {
    // fill your code here
    if (a1 == null)
        return true;
    if (isIn(a1[0], a2))
        return subArray(MyArrayUtil.tail(a1.clone()), a2);
    if (a1.length == 1)
        return true;
    return false;
}
```

3) Write a <u>recursive</u> method **public static int**[] reverse(**int**[] ht) **throws** Exception .
    a.   This method returns an array that orders data in reverse of ht. For example, if ht = {1,2,3,4,5},
         then this method will return {5,4,3,2,1}.
    b.   This method returns null if ht is null.
    List your source code below:

```
public static int[] reverse(int[] ht) throws Exception {
    // fill your code here
    if(ht == null) return null;
    if (ht.length == 1)
        return ht.clone();
    int temp = ht[0];
    ht[0] = ht[ht.length - 1];
    ht[ht.length - 1] = temp;
    return recursiveInnerSandwich(reverse(MyArrayUtil.tail(removeLast(ht, new int[ht.length-1], 0))),ht.clone());
}
//This method make an array sandwich excluding the bread (index 0 and index last)
public static int[] recursiveInnerSandwich(int[] src,int[] dest) throws Exception{
    if (src==null)return dest;
    dest[dest.length-src.length-1] = src[0];
    recursiveInnerSandwich(MyArrayUtil.tail(src),dest);
    return dest;
}
//Remove the last element
public static int[] removeLast(int[] ia1,int[] ia2,int i) {
    ia2[i]=ia1[i];
    if (i==ia2.length-1)return ia2;
    return removeLast(ia1,ia2,i+1);
}
```

4) Write a recursive method **public static int[] shift(int[] ht, int n) throws** Exception

    a. This method returns an array that stores the same data as ht, but the first n data are moved to the back of the array.

       For example, shift({1,2,3,4,5}, 3) will return {4,5,1,2,3}.
                shift({1,2,3,4,5}, 2) will return {3,4,5,1,2}.

    b. If ht is null, this method returns null.

List your source code below:

```
// return array similar to a, but without the first data.
public static int[] tail(int[] a) throws Exception {
    if (a == null)
        throw new Exception("Array is empty! No tail.");
    if (a.length == 1)
        return null;
    return Arrays.copyOfRange(a, 1, a.length);
}
```

Part C: Experimenting with ArrayList
Read **ArrayList.docx** and complete the exercise.

Update the program "SchoolLottery.java" (Application in ArrayList) to be "SchoolLotteryFromFile.java" (template is given) in order to obtain the list from file instead of keyboard. Also, a name in the list cannot be duplicated.

List your source code below:

```java
import java.io.File;
import java.io.FileNotFoundException;
import java.util.ArrayList;
import java.util.Random;
import java.util.Scanner;

public class SchoolLotteryFromFile{
    private ArrayList<String> entries;  // holds Student references
    public SchoolLotteryFromFile(){
        entries = new ArrayList<>();
    }

    public void addStudents(String name){
        if(entries.contains(name)) {
            System.out.println("Duplicate Detected!, You think you're so smart? "+name);
            return;
        }
        System.out.println(name + " entered in the lottery.");
        entries.add(name);
    }

    public void pickWinner(){
        // chooses a random entry and displays winners name
        int numEntries = entries.size();    // size of ArrayList
        if(numEntries == 0)
            System.out.println("*** No participants ***");
        else{
            Random random = new Random();
            String winner = entries.get(random.nextInt(numEntries));
            System.out.print("\n*** The winner is " + winner + " ***");
        }
    }

    public static void main(String[] args){
        SchoolLotteryFromFile lottery = new SchoolLotteryFromFile();
        Scanner sc;
        try {
            sc = new Scanner(new File("studentList.txt"));
            while(sc.hasNextLine())lottery.addStudents(sc.nextLine());
            lottery.pickWinner();
        } catch (FileNotFoundException e) {
            e.printStackTrace();
        }

    }
}
```

Capture the result here:

Mr. Prem Pattanapitoon entered in the lottery.

Miss Praewpun Cheevamongkol entered in the lottery.

Mr. Nutthakom Trongjitraksa entered in the lottery.

Mr. Trivit Damrongrat entered in the lottery.

Mr. Pasutha Daichi Ide entered in the lottery.

Mr. Akarawut Krinukul entered in the lottery.

Mr. Athichat Chindaudom entered in the lottery.

Miss Claire Claude Prevost entered in the lottery.

Miss Nao Komada entered in the lottery.

Miss Clemence Muriel Berenice Jean-Louis Dit Montout entered in the lottery.

Miss Kim Zaatar entered in the lottery.

Mr. Jules Joseph Jean-Claude Victor Lestrade entered in the lottery.

Miss Noor Kardache entered in the lottery.

Miss Marie Charlotte Josephine Leygue entered in the lottery.

Mr. Marin Neyret entered in the lottery.

Miss Alice Francoise Lucienne Cabane entered in the lottery.

Mr. Adrien Manhieu Zychowski entered in the lottery.

Miss Aurore Marie Garrigoux-Desmoulins entered in the lottery.

Miss Charlotte Roppelt-Saint-Lebe entered in the lottery.

Mr. Pierre Antoine Claret entered in the lottery.

Mr. Louis Pierre Nouguerede entered in the lottery.

Miss Annika Ulrike Glaseke entered in the lottery.

Mr. Kornrapee Suthicharoenpanich entered in the lottery.

Mr. Krittanut Mongkolkulsat entered in the lottery.

Mr. Krittapat Onthuam entered in the lottery.

Mr. Krittapak Udompanich entered in the lottery.

Mr. Krittaphat Maiklad entered in the lottery.

Mr. Krittawat Archathawan entered in the lottery.

Mr. Kritasak Udompongsanont entered in the lottery.

Mr. Krittin Punpermcharoenkit entered in the lottery.

Mr. Krit Uthaisang entered in the lottery.

Mr. Gawin Lohaburananont entered in the lottery.

Miss Kavisara Jantarakolica entered in the lottery.

Mr. Kasidit Pratumtin entered in the lottery.

Mr. Kongpop Panya entered in the lottery.

Mr. Korpoj Piya-asdarat entered in the lottery.

Mr. Gunn Kanchanaraksa entered in the lottery.

Mr. Kan Jitpakdi entered in the lottery.

Mr. Karnthiti Thitikarn entered in the lottery.

Mr. Chris Vataniyapramote entered in the lottery.

Miss Kunanya Vuthilertdacha entered in the lottery.

Mr. Ken Kanate Wichiramala entered in the lottery.

Mr. Krit Sanguannapaporn entered in the lottery.

Mr. Chongchate Kumpeerichaya entered in the lottery.

Mr. Jomphat Itsarawisut entered in the lottery.

Mr. Jakkaphan Ekrojrattana entered in the lottery.

Mr. Jamorn Wacharasing entered in the lottery.

Miss Jinnipha Bhumtakwong entered in the lottery.

Mr. Jitrabhanu Simaraks entered in the lottery.

Mr. Jeerapat Thansuwanwong entered in the lottery.

Mr. Jade Udomkittivorakul entered in the lottery.

Mr. Jenwit Ratanapusdeekul entered in the lottery.

Mr. Chatr Tharachatr entered in the lottery.

Mr. Chonlasit Thangkasemsan entered in the lottery.

Mr. Chanon Wanasinchai entered in the lottery.

Mr. Chitipat Trachu entered in the lottery.

Mr. Chuwong Kulrattanarak entered in the lottery.

Duplicate Detected!, You think you're so smart? Mr. Athichat Chindaudom

Duplicate Detected!, You think you're so smart? Miss Claire Claude Prevost

Duplicate Detected!, You think you're so smart? Miss Nao Komada

Duplicate Detected!, You think you're so smart? Miss Clemence Muriel Berenice Jean-Louis Dit Montout

Duplicate Detected!, You think you're so smart? Miss Kim Zaatar

Duplicate Detected!, You think you're so smart? Mr. Jules Joseph Jean-Claude Victor Lestrade

Duplicate Detected!, You think you're so smart? Miss Noor Kardache

Duplicate Detected!, You think you're so smart? Miss Marie Charlotte Josephine Leygue

Duplicate Detected!, You think you're so smart? Mr. Marin Neyret

Duplicate Detected!, You think you're so smart? Miss Alice Francoise Lucienne Cabane

Miss Chotika Truengjitvilas entered in the lottery.

Mr. Chotipat Chaiyarat entered in the lottery.

Mr. Nakrit Panjasanka entered in the lottery.

Mr. Nachanon Rimsmutchai entered in the lottery.

Mr. Naphat Pattayanun entered in the lottery.

Mr. Napat Suwansujira entered in the lottery.

Mr. Napat Asavarojkul entered in the lottery.

Mr. Natthakit Kitrueangphatchara entered in the lottery.

Mr. Natchanon Auewetchanichkul entered in the lottery.

Mr. Natthorn Suwannapasri entered in the lottery.

Miss Nutthawadee Sungvonwattana entered in the lottery.

Mr. Nattawat Chongpita entered in the lottery.

Mr. Nattawat Pornthisan entered in the lottery.

Mr. Natthawat Piyanonthaya entered in the lottery.

Mr. Nuttawut Janwimaluang entered in the lottery.

Mr. Nat Sakdasak entered in the lottery.

Mr. Thinteerachot Hansnontchot entered in the lottery.

Mr. Tinnawish Tungphitukkul entered in the lottery.

Mr. Taksin Faikhao entered in the lottery.

Mr. Thanthai Udcharchon entered in the lottery.

Mr. Tanaseth Julerttrakul entered in the lottery.

Mr. Thanachot Sappakit entered in the lottery.

Mr. Thanatath Jiravanich entered in the lottery.

Mr. Dhanabordee Mekintharanggur entered in the lottery.

Mr. Tanabodee Wanitnunttada entered in the lottery.

Mr. Thanapat Pornsirianant entered in the lottery.

Mr. Tanawat Rattanagowin entered in the lottery.

Mr. Tanat Sangwong entered in the lottery.

Miss Tananyapat Wareechuensuk entered in the lottery.

Miss Thanaree Rongkavilit entered in the lottery.

Mr. Thatchapan Pianpucktr entered in the lottery.

Mr. Tatchapol Jetanachai entered in the lottery.

Mr. Thanyapat Khorporn entered in the lottery.

Mr. Tanmine Mesatien entered in the lottery.

Mr. Tissarut Suntreekasem entered in the lottery.

Mr. Teeratat Bunsantrakul entered in the lottery.

Mr. Noparuj Tantisoonthorn entered in the lottery.

Mr. Noppasin Ajchareeyasoontorn entered in the lottery.

Mr. Norrawee Charnpinyo entered in the lottery.

Mr. Nantanit Vittayaporn entered in the lottery.

Mr. Naris Limpapaswat entered in the lottery.

Mr. Nittun Lertwirojkul entered in the lottery.

Mr. Patiphol Vongsirisap entered in the lottery.

Mr. Panoj Kamolrattanawech entered in the lottery.

Mr. Panidh Mingmalairak entered in the lottery.

Mr. Pathanin Runggeratigul entered in the lottery.

Miss Papitchaya Iemtananon entered in the lottery.

Mr. Papatchol Thientong entered in the lottery.

Duplicate Detected!, You think you're so smart? Mr. Noppasin Ajchareeyasoontorn

Duplicate Detected!, You think you're so smart? Mr. Norrawee Charnpinyo

Mr. Nantanit Vittayapo entered in the lottery.

Miss Paphawee Rattanagosol entered in the lottery.

Miss Prapaluck Pugkhem entered in the lottery.

Mr. Prapas Arayasaeng entered in the lottery.

Mr. Prat Prasertsup entered in the lottery.

Mr. Punn Damrongratnuwong entered in the lottery.

Mr. Pannaton Kerdkaewfah entered in the lottery.

Mr. Pannavich Setawanna entered in the lottery.

Mr. Panud Chamnanratanakul entered in the lottery.

Miss Pinpinut Teerawesagapawanis entered in the lottery.

Miss Punyada Jantananont entered in the lottery.

Mr. Bhunaron Sornklin entered in the lottery.

Mr. Punnatt Punnotok entered in the lottery.

Mr. Purapat Rattanatraipop entered in the lottery.

Miss Premika Prachayamongkol entered in the lottery.

Mr. Pongpao Nanami Pongponrat entered in the lottery.

Mr. Pongsapak Sajjapong entered in the lottery.

Miss Prim Viriyasopon entered in the lottery.

Mr. Pasin Kanchanarusmeechoti entered in the lottery.

Miss Pattanun Sangvijitr entered in the lottery.

Mr. Pitchakorn Watcharodomprasert entered in the lottery.

Mr. Pirat Pothavorn entered in the lottery.

Mr. Phawat Borisuitsawat entered in the lottery.

Mr. Peemapol Tangamonsiri entered in the lottery.

Mr. Yodsapat Jiravipapan entered in the lottery.

Mr. Rattanapong Wongcharoensin entered in the lottery.

Mr. Waritnan Kositcharoensuk entered in the lottery.

Mr. Sattra Piyapunsutti entered in the lottery.

Mr. Supphaset Engphaiboon entered in the lottery.

Mr. Sirapop Rojanakul entered in the lottery.

Mr. Sukit Sukittanon entered in the lottery.

Mr. Athit Arsirakarn entered in the lottery.

Miss Oranich Jamkachornkiat entered in the lottery.

Miss Unna Talomsin entered in the lottery.

Miss Reena Lim entered in the lottery.

Mr. Eisen Lance Tamayao De Guzman entered in the lottery.

*** The winner is Mr. Sukit Sukittanon ***

Submit this worksheet (by only one member of the group) via http://www.myCourseVille.com (Assignments > Hands-on Experiment # 10) before noon of the day after your lecture.