Competitive Programming Lab - 4

Academic year: 2020-2021 **Semester:** Long Sem

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Q1.) Highest and lowest array sum and product with removing duplicates.

A[ ]= [a0, a1, a2, a3....an]

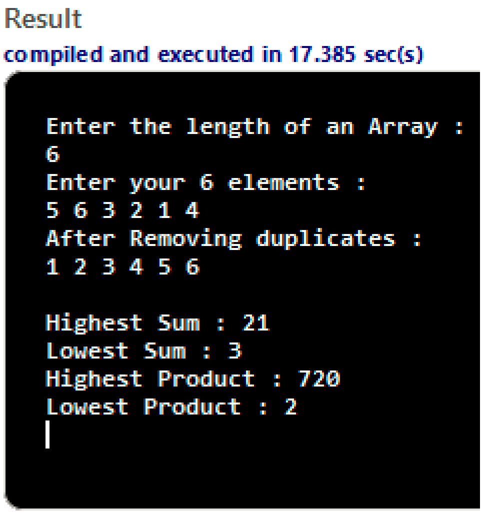
Range 2>=n

Sample I/P= [5,6,3,2,1,4]

Sample O/P:

Highest Product=720 Highest Sum=21

Lowest Product =2 Lowest Sum=3



Result

compiled and executed in 17.385 sec(s)

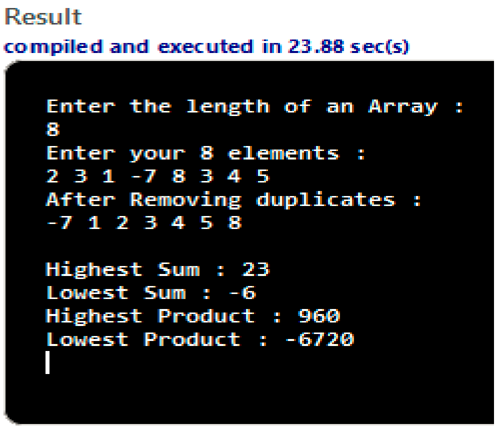
```
Enter the length of an Array :
6
Enter your 6 elements :
5 6 3 2 1 4
After Removing duplicates :
1 2 3 4 5 6

Highest Sum : 21
Lowest Sum : 3
Highest Product : 720
Lowest Product : 2
```

CODE:

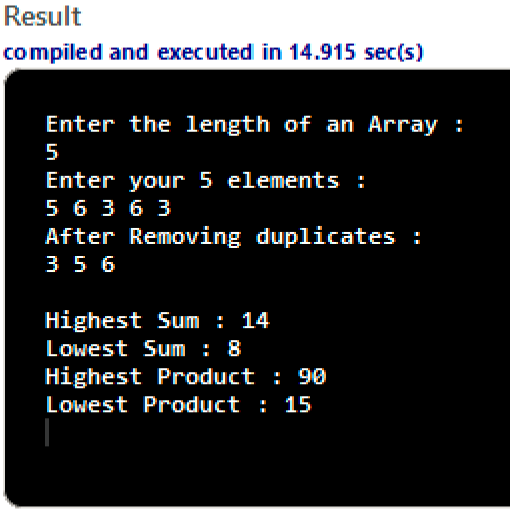
```
import java.io.*;

public class Combination {
      static int h = 0, l = 0;
      static void checkHSum(int sum){
      int s = h;
      if(s < sum){
            h=sum;
      }else{
            h=s;
      }
      }
      static void checkLSum(int sum){
      int t = l;
      if(t > sum){
            l=sum;
      }else{
            l=t;
      }
      }

    static void combinationUtil(int arr[], int data[], int start,
                                           int end, int index, int r)
    {
       int sum = 0;
       int pro = 0;
       if (index == r)
       {
             for (int j=0; j<r; j++){
             System.out.print(data[j]+" ");
             System.out.println("");
             sum = sum + data[j];
             pro = pro * data[j];
             }
             checkHSum(sum);
             checkLSum(sum);
             return;
       }

//           if (index == r)
//           {
//                 for (int j=0; j<r; j++)
//                       System.out.print(data[j]+" ");
//                 System.out.println("");
//                 return;
//           }


       for (int i=start; i<=end && end-i+1 >= r-index; i++)
       {
             data[index] = arr[i];
             combinationUtil(arr, data, i+1, end, index+1, r);
       }
    }
```

```
        static void printCombination(int arr[], int n, int r)
        {

            int data[]=new int[r];


            combinationUtil(arr, data, 0, n-1, 0, r);
        }

        /*Driver function to check for above function*/
        public static void main (String[] args) {
            int arr[] = {1, 2, 3, 4, 5};
            int r = 5;
            int n = arr.length;
            printCombination(arr, n, r);
            System.out.println("highest sum : "+h);
            System.out.println("lowest sum : "+l);
        }
    }
```

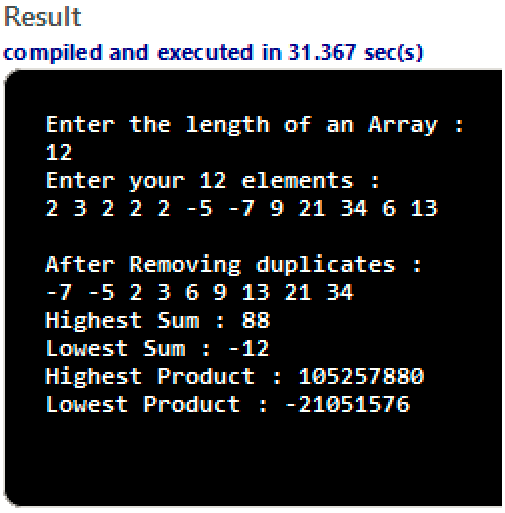
Output:



```
Result
compiled and executed in 23.88 sec(s)

Enter the length of an Array :
8
Enter your 8 elements :
2 3 1 -7 8 3 4 5
After Removing duplicates :
-7 1 2 3 4 5 8

Highest Sum : 23
Lowest Sum : -6
Highest Product : 960
Lowest Product : -6720
```



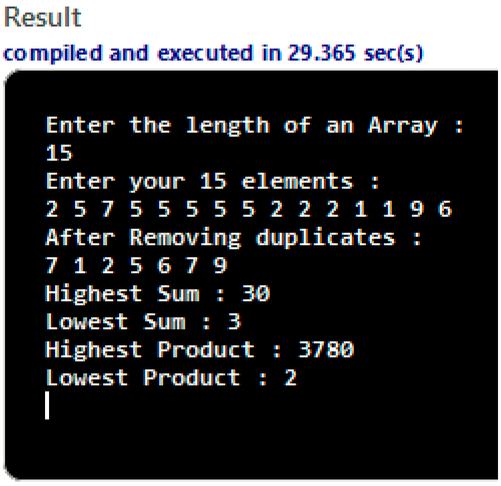
```
Result
compiled and executed in 14.915 sec(s)

Enter the length of an Array :
5
Enter your 5 elements :
5 6 3 6 3
After Removing duplicates :
3 5 6

Highest Sum : 14
Lowest Sum : 8
Highest Product : 90
Lowest Product : 15
```



Result

compiled and executed in 31.367 sec(s)

```
Enter the length of an Array :
12
Enter your 12 elements :
2 3 2 2 2 -5 -7 9 21 34 6 13

After Removing duplicates :
-7 -5 2 3 6 9 13 21 34
Highest Sum : 88
Lowest Sum : -12
Highest Product : 105257880
Lowest Product : -21051576
```



Result

compiled and executed in 29.365 sec(s)

```
Enter the length of an Array :
15
Enter your 15 elements :
2 5 7 5 5 5 5 5 2 2 2 1 1 9 6
After Removing duplicates :
7 1 2 5 6 7 9
Highest Sum : 30
Lowest Sum : 3
Highest Product : 3780
Lowest Product : 2
```

Part-2

if m=3

Sample O/P:

Highest Product= 120 Highest Sum=15

Lowest Product = 6 Lowest Sum=6

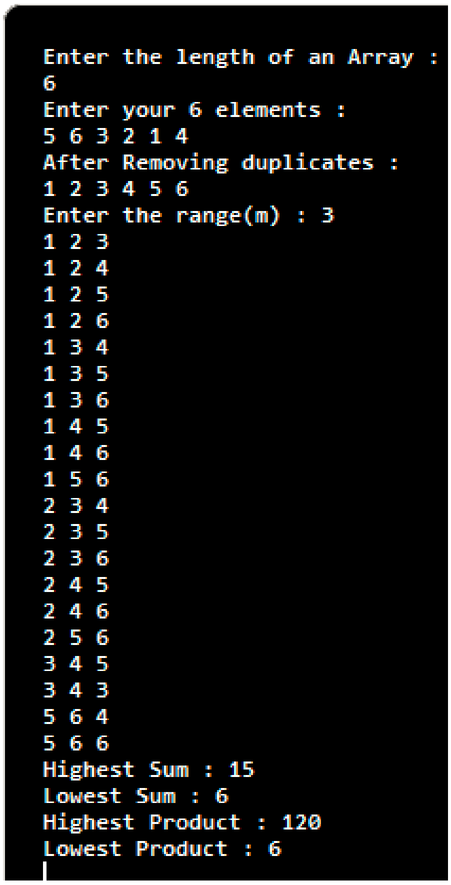
CODE:

```
import java.io.*;

public class Combination {
     static int h = 0, l = 0;
     static void checkHSum(int sum){
     int s = h;
     if(s < sum){
          h=sum;
     }else{
          h=s;
     }
     }
     static void checkLSum(int sum){
     int t = l;
     if(t > sum){
          l=sum;
     }else{
          l=t;
     }
     }

    static void combinationUtil(int arr[], int data[], int start,
                                    int end, int index, int r)
    {
      int sum = 0;
      int pro = 0;
      if (index == r)
      {
            for (int j=0; j<r; j++){
            System.out.print(data[j]+" ");
            System.out.println("");
            sum = sum + data[j];
            pro = pro * data[j];
            }
            checkHSum(sum);
            checkLSum(sum);
            return;
      }

//          if (index == r)
//          {
//               for (int j=0; j<r; j++)
//                      System.out.print(data[j]+" ");
//                 System.out.println("");
//                 return;
//            }


        for (int i=start; i<=end && end-i+1 >= r-index; i++)
        {
             data[index] = arr[i];
             combinationUtil(arr, data, i+1, end, index+1, r);
        }
    }



    static void printCombination(int arr[], int n, int r)
    {

        int data[]=new int[r];


        combinationUtil(arr, data, 0, n-1, 0, r);
    }

    /*Driver function to check for above function*/
    public static void main (String[] args) {
        int arr[] = {1, 2, 3, 4, 5};
        int r = 5;
        int n = arr.length;
        printCombination(arr, n, r);
        System.out.println("highest sum pair : "+h);
        System.out.println("lowest sum pair : "+l);
    }
}
```

Output:

Result

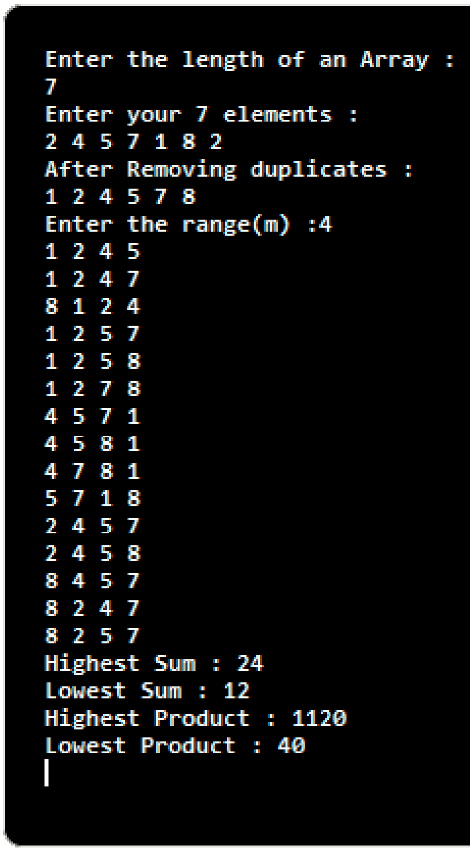
compiled and executed in 29.349 sec(s)



```
Enter the length of an Array :
6
Enter your 6 elements :
5 6 3 2 1 4
After Removing duplicates :
1 2 3 4 5 6
Enter the range(m) : 3
1 2 3
1 2 4
1 2 5
1 2 6
1 3 4
1 3 5
1 3 6
1 4 5
1 4 6
1 5 6
2 3 4
2 3 5
2 3 6
2 4 5
2 4 6
2 5 6
3 4 5
3 4 3
5 6 4
5 6 6
Highest Sum : 15
Lowest Sum : 6
Highest Product : 120
Lowest Product : 6
```

Result

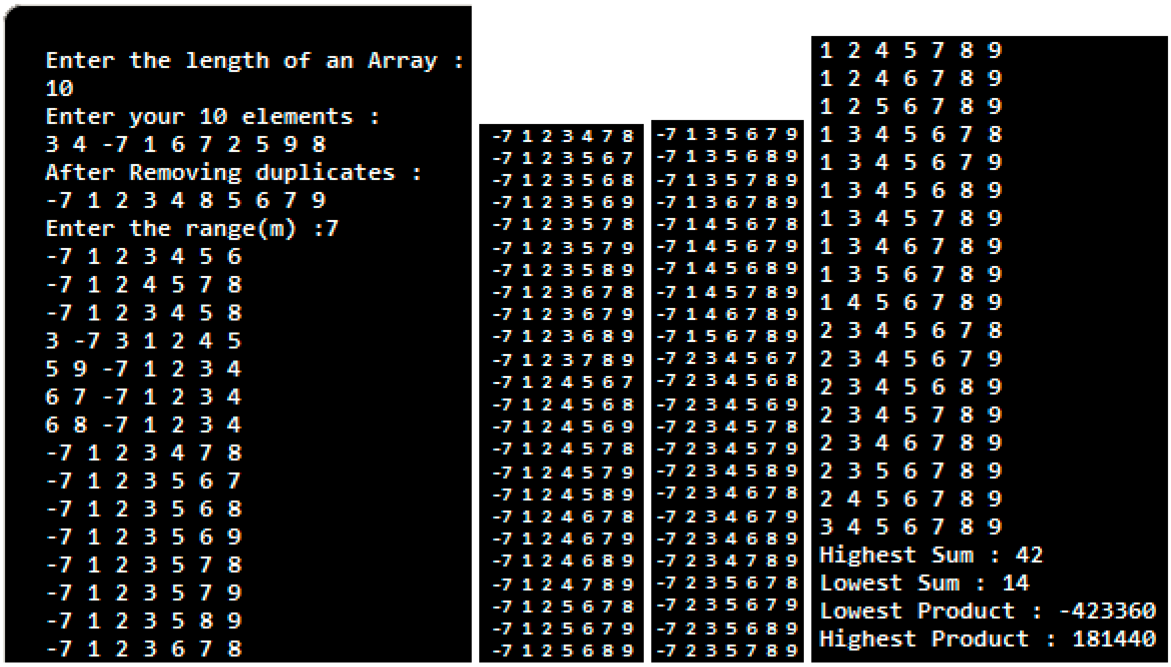
compiled and executed in 26.895 sec(s)



```
Enter the length of an Array :
7
Enter your 7 elements :
2 4 5 7 1 8 2
After Removing duplicates :
1 2 4 5 7 8
Enter the range(m) :4
1 2 4 5
1 2 4 7
8 1 2 4
1 2 5 7
1 2 5 8
1 2 7 8
4 5 7 1
4 5 8 1
4 7 8 1
5 7 1 8
2 4 5 7
2 4 5 8
8 4 5 7
8 2 4 7
8 2 5 7
Highest Sum : 24
Lowest Sum : 12
Highest Product : 1120
Lowest Product : 40
```

Result

compiled and executed in 35.859 sec(s)



```
Enter the length of an Array :
10
Enter your 10 elements :
3 4 -7 1 6 7 2 5 9 8
After Removing duplicates :
-7 1 2 3 4 8 5 6 7 9
Enter the range(m) :7
-7 1 2 3 4 5 6
-7 1 2 4 5 7 8
-7 1 2 3 4 5 8
3 -7 3 1 2 4 5
5 9 -7 1 2 3 4
6 7 -7 1 2 3 4
6 8 -7 1 2 3 4
-7 1 2 3 4 7 8
-7 1 2 3 5 6 7
-7 1 2 3 5 6 8
-7 1 2 3 5 6 9
-7 1 2 3 5 7 8
-7 1 2 3 5 7 9
-7 1 2 3 5 8 9
-7 1 2 3 6 7 8
```

```
-7 1 2 3 4 7 8
-7 1 2 3 5 6 7
-7 1 2 3 5 6 8
-7 1 2 3 5 6 9
-7 1 2 3 5 7 8
-7 1 2 3 5 7 9
-7 1 2 3 5 8 9
-7 1 2 3 6 7 8
-7 1 2 3 6 7 9
-7 1 2 3 6 8 9
-7 1 2 3 7 8 9
-7 1 2 4 5 6 7
-7 1 2 4 5 6 8
-7 1 2 4 5 6 9
-7 1 2 4 5 7 8
-7 1 2 4 5 7 9
-7 1 2 4 5 8 9
-7 1 2 4 6 7 8
-7 1 2 4 6 7 9
-7 1 2 4 6 8 9
-7 1 2 4 7 8 9
-7 1 2 5 6 7 8
-7 1 2 5 6 7 9
-7 1 2 5 6 8 9
```

```
-7 1 3 5 6 7 9
-7 1 3 5 6 8 9
-7 1 3 5 7 8 9
-7 1 3 6 7 8 9
-7 1 4 5 6 7 8
-7 1 4 5 6 7 9
-7 1 4 5 6 8 9
-7 1 4 5 7 8 9
-7 1 4 6 7 8 9
-7 1 5 6 7 8 9
-7 2 3 4 5 6 7
-7 2 3 4 5 6 8
-7 2 3 4 5 6 9
-7 2 3 4 5 7 8
-7 2 3 4 5 7 9
-7 2 3 4 5 8 9
-7 2 3 4 6 7 8
-7 2 3 4 6 7 9
-7 2 3 4 6 8 9
-7 2 3 4 7 8 9
-7 2 3 5 6 7 8
-7 2 3 5 6 7 9
-7 2 3 5 6 8 9
-7 2 3 5 7 8 9
```

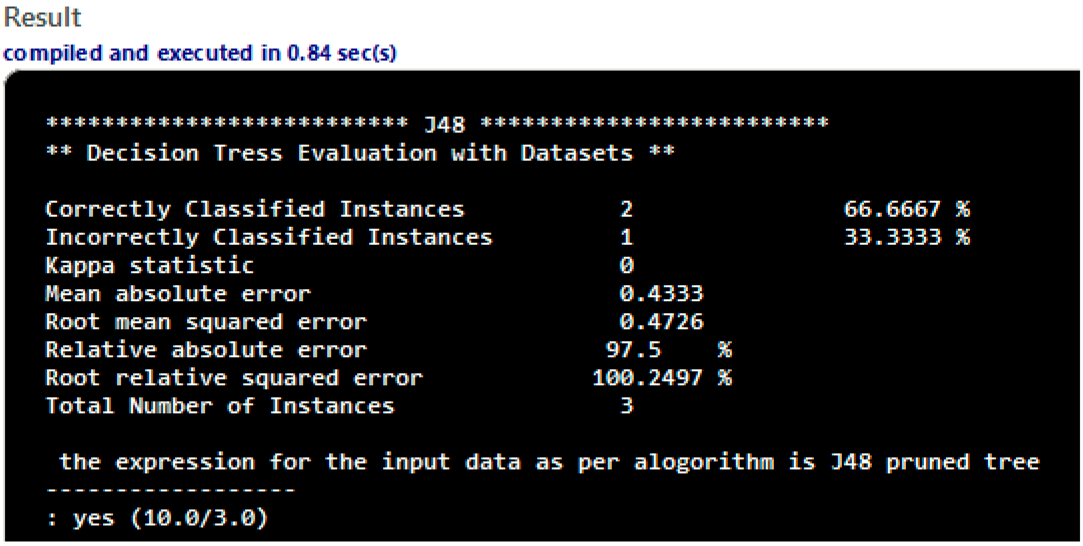
```
1 2 4 5 7 8 9
1 2 4 6 7 8 9
1 2 5 6 7 8 9
1 3 4 5 6 7 8
1 3 4 5 6 7 9
1 3 4 5 6 8 9
1 3 4 5 7 8 9
1 3 4 6 7 8 9
1 3 5 6 7 8 9
1 4 5 6 7 8 9
2 3 4 5 6 7 8
2 3 4 5 6 7 9
2 3 4 5 6 8 9
2 3 4 5 7 8 9
2 3 4 6 7 8 9
2 3 5 6 7 8 9
2 4 5 6 7 8 9
3 4 5 6 7 8 9
Highest Sum : 42
Lowest Sum : 14
Lowest Product : -423360
Highest Product : 181440
```

Q2.) Implement Supervised and Unsupervised algorithm

CODE:(Decision Tree)

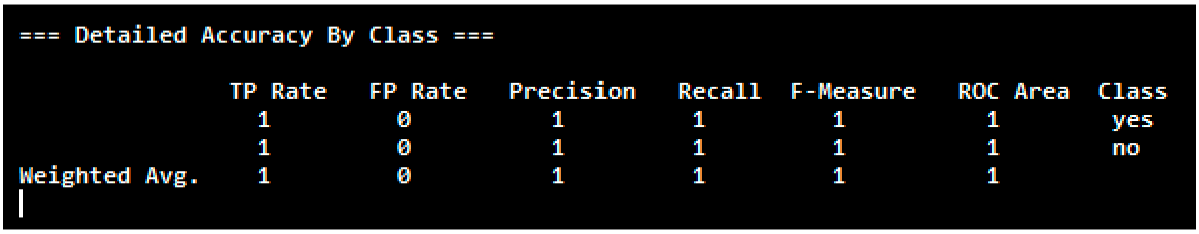
```
import java.io.IOException;

public class DecisionTree {


    public static final String
TRAINING_DATA_SET_FILENAME="decision-train.arff";
    public static final String
TESTING_DATA_SET_FILENAME="decision-test.arff";


    public static Instances getDataSet(String fileName) throws
IOException {

      int classIdx = 1;
      /** the arffloader to load the arff file */
      ArffLoader loader = new ArffLoader();
      /** load the traing data */
      loader.setSource(DecisionTree.class.getResourceAsStream("/"
+ fileName));

      Instances dataSet = loader.getDataSet();
      /** set the index based on the data given in the arff files
*/
      dataSet.setClassIndex(classIdx);
      return dataSet;
    }

    public static void process() throws Exception {

      Instances trainingDataSet =
getDataSet(TRAINING_DATA_SET_FILENAME);
      Instances testingDataSet =
getDataSet(TESTING_DATA_SET_FILENAME);

      System.out.println("************************** J48
*************************");
      /** Classifier here is Linear Regression */
      Classifier classifier = new J48();

      classifier.buildClassifier(trainingDataSet);

      Evaluation eval = new Evaluation(trainingDataSet);
      eval.evaluateModel(classifier, testingDataSet);
      /** Print the algorithm summary */
      System.out.println("** Decision Tress Evaluation with
Datasets **");
      System.out.println(eval.toSummaryString());
      System.out.print(" the expression for the input data as per
alogorithm is ");
      System.out.println(classifier);
      System.out.println(eval.toMatrixString());
      System.out.println(eval.toClassDetailsString());

      System.out.println("************************** ID3
*************************");
      /** Classifier here is Linear Regression */
      Classifier id3Classifier = new Id3();

      id3Classifier.buildClassifier(trainingDataSet);
      /**
       * train the alogorithm with the training data and evaluate
the
       * algorithm with testing data
       */
      Evaluation evalId3 = new Evaluation(trainingDataSet);
      evalId3.evaluateModel(id3Classifier, testingDataSet);
      /** Print the algorithm summary */
      System.out.println("** Decision Tress Evaluation with
Datasets **");
      System.out.println(evalId3.toSummaryString());
      System.out.print(" the expression for the input data as per
alogorithm is ");
      System.out.println(id3Classifier);
      System.out.println(evalId3.toMatrixString());
      System.out.println(evalId3.toClassDetailsString());

    }

}
```

Output:



Result
compiled and executed in 0.84 sec(s)

```
************************** J48 *************************
** Decision Tress Evaluation with Datasets **

Correctly Classified Instances          2               66.6667 %
Incorrectly Classified Instances        1               33.3333 %
Kappa statistic                         0
Mean absolute error                     0.4333
Root mean squared error                 0.4726
Relative absolute error                97.5     %
Root relative squared error           100.2497 %
Total Number of Instances               3

 the expression for the input data as per alogorithm is J48 pruned tree
------------------
: yes (10.0/3.0)
```

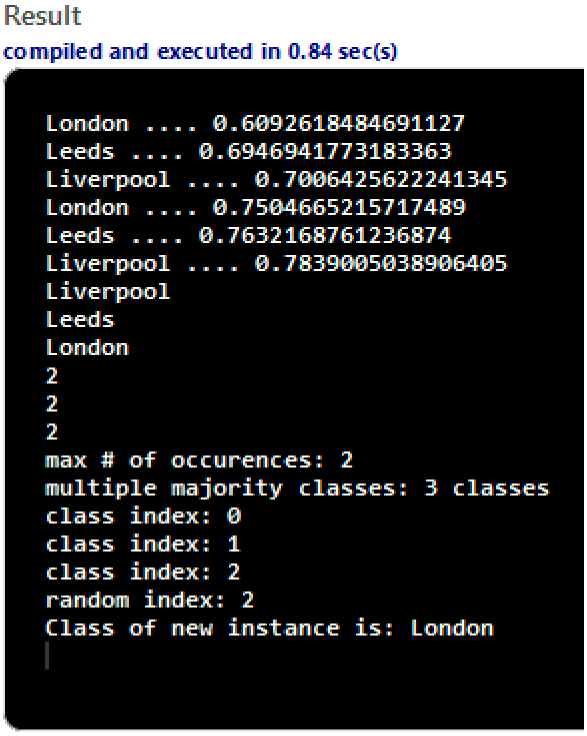


```
=== Detailed Accuracy By Class ===

               TP Rate   FP Rate   Precision   Recall  F-Measure   ROC Area  Class
                 1         0          1          1         1          1        yes
                 1         0          1          1         1          1        no
Weighted Avg.    1         0          1          1         1          1
```

CODE:(KNN)

```
import java.util.*;

public class KNN
{
    // the data
    static double[][] instances = {
       {0.35,0.91,0.86,0.42,0.71},
       {0.21,0.12,0.76,0.22,0.92},
       {0.41,0.58,0.73,0.21,0.09},
       {0.71,0.34,0.55,0.19,0.80},
       {0.79,0.45,0.79,0.21,0.44},
       {0.61,0.37,0.34,0.81,0.42},
       {0.78,0.12,0.31,0.83,0.87},
       {0.52,0.23,0.73,0.45,0.78},
       {0.53,0.17,0.63,0.29,0.72},
    };
    private static String findMajorityClass(String[] array)
    {
       //add the String array to a HashSet to get unique String values
       Set<String> h = new HashSet<String>(Arrays.asList(array));
       //convert the HashSet back to array
       String[] uniqueValues = h.toArray(new String[0]);
       //counts for unique strings
       int[] counts = new int[uniqueValues.length];
       // loop thru unique strings and count how many times they appear
in origianl array
       for (int i = 0; i < uniqueValues.length; i++) {
             for (int j = 0; j < array.length; j++) {
                   if(array[j].equals(uniqueValues[i])){
                         counts[i]++;
                   }
             }
       }

       for (int i = 0; i < uniqueValues.length; i++)
             System.out.println(uniqueValues[i]);
       for (int i = 0; i < counts.length; i++)
             System.out.println(counts[i]);


       int max = counts[0];
       for (int counter = 1; counter < counts.length; counter++) {
             if (counts[counter] > max) {
                   max = counts[counter];
             }
       }
       System.out.println("max # of occurences: "+max);

       int freq = 0;
       for (int counter = 0; counter < counts.length; counter++) {
             if (counts[counter] == max) {
                   freq++;
             }
       }

       //index of most freq value if we have only one mode
       int index = -1;
       if(freq==1){
             for (int counter = 0; counter < counts.length; counter++) {
                   if (counts[counter] == max) {
                         index = counter;
                         break;
                   }
             }

             return uniqueValues[index];
       } else{//we have multiple modes
             int[] ix = new int[freq];//array of indices of modes
             System.out.println("multiple majority classes: "+freq+"
classes");
             int ixi = 0;
             for (int counter = 0; counter < counts.length; counter++) {
                   if (counts[counter] == max) {
                         ix[ixi] = counter;//save index of each max count
value
                         ixi++; // increase index of ix array
                   }
             }

             for (int counter = 0; counter < ix.length; counter++)
                   System.out.println("class index: "+ix[counter]);

             //now choose one at random
             Random generator = new Random();
             //get random number 0 <= rIndex < size of ix
             int rIndex = generator.nextInt(ix.length);
             System.out.println("random index: "+rIndex);
             int nIndex = ix[rIndex];
             //return unique value at that index
             return uniqueValues[nIndex];
       }

    }


    private static double meanOfArray(double[] m) {
       double sum = 0.0;
       for (int j = 0; j < m.length; j++){
             sum += m[j];
       }
       return sum/m.length;
    }
    public static void main(String args[]){

       int k = 6;// # of neighbours
       //list to save city data
       List<City> cityList = new ArrayList<City>();

       List<Result> resultList = new ArrayList<Result>();
       // add city data to cityList
       cityList.add(new City(instances[0],"London"));
       cityList.add(new City(instances[1],"Leeds"));
       cityList.add(new City(instances[2],"Liverpool"));
       cityList.add(new City(instances[3],"London"));
       cityList.add(new City(instances[4],"Liverpool"));
       cityList.add(new City(instances[5],"Leeds"));
       cityList.add(new City(instances[6],"London"));
       cityList.add(new City(instances[7],"Liverpool"));
       cityList.add(new City(instances[8],"Leeds"));
       //data about unknown city
       double[] query = {0.65,0.78,0.21,0.29,0.58};
       //find disnaces
       for(City city : cityList){
             double dist = 0.0;
             for(int j = 0; j < city.cityAttributes.length; j++){

                   dist += Math.pow(city.cityAttributes[j] - query[j],
2) ;
                   //System.out.print(city.cityAttributes[j]+" ");

             }
             double distance = Math.sqrt( dist );
             resultList.add(new Result(distance,city.cityName));
             //System.out.println(distance);
       }

       //System.out.println(resultList);
       Collections.sort(resultList, new DistanceComparator());
       String[] ss = new String[k];
       for(int x = 0; x < k; x++){
             System.out.println(resultList.get(x).cityName+ " .... " +
resultList.get(x).distance);
             //get classes of k nearest instances (city names) from the
list into an array
             ss[x] = resultList.get(x).cityName;
       }
       String majClass = findMajorityClass(ss);
       System.out.println("Class of new instance is: "+majClass);

    }//end main

    //simple class to model instances (features + class)
    static class City {
       double[] cityAttributes;
       String cityName;
       public City(double[] cityAttributes, String cityName){
             this.cityName = cityName;
             this.cityAttributes = cityAttributes;
       }
    }
    //simple class to model results (distance + class)
    static class Result {
       double distance;
       String cityName;
       public Result(double distance, String cityName){
             this.cityName = cityName;
             this.distance = distance;
       }
    }
    //simple comparator class used to compare results via distances
    static class DistanceComparator implements Comparator<Result> {
       @Override
       public int compare(Result a, Result b) {
             return a.distance < b.distance ? -1 : a.distance ==
b.distance ? 0 : 1;
       }
    }

}
```

Output:



Result

compiled and executed in 0.84 sec(s)

```
London .... 0.6092618484691127
Leeds .... 0.6946941773183363
Liverpool .... 0.7006425622241345
London .... 0.7504665215717489
Leeds .... 0.7632168761236874
Liverpool .... 0.7839005038906405
Liverpool
Leeds
London
2
2
2
max # of occurences: 2
multiple majority classes: 3 classes
class index: 0
class index: 1
class index: 2
random index: 2
Class of new instance is: London
```