PONDICHERRY UNIVERSITY

Public university in Pondicherry

DATA MINING LAB– CSCE627

DHIVYA. K

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PG Scholar

Master of Technology

Department of Computer Science and Engineering

I – Year & II – Semester

(Date of Submission - 18/06/2022)

Submitted to

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Assistant Professor

Department of Computer Science and Engineering

LIST OF EXPERIMENTS:

LAB EXERCISE:

1. **HADOOP – WORD COUNT BY MAP REDUCE**
2. **SPARK WORD COUNT**
3. **HADOOP – MATRIX MULTIPLICATION**
4. **APRIORI IN R**
5. **APRIORI IN WEKA**
6. **APRIORI IN PYTHON**
7. **BAYES IN WEKA**
8. **BAYES CLASSIFIER USING R**
9. **BAYESIAN IN PYTHON**

INTERNAL – 1:

10. **Demonstration of Association rule process on dataset contactlenses using apriori algorithm in WEKA**
11. **Create a dataset in .arff file format. Demonstration of preprocessing using weka dataset**
12. **Demonstration of Association rule process on any supermarket dataset using Apriori algorithm using R.**
13. **Demonstration of classification ruleprocess on WEKA dataset using j48 algorithm**
14. **Demonstration of classification rule process on WEKA dataset using naïve bayes algorithm. Compute the accuracy of the classifier, precision, and recall.**
15. **Demonstration of clustering rule process on data set iris.arff using simple K.Means**
16. **Demonstration of classification rule a process on student dataset using KNN algorithm in Python.**
17. **Demonstration of classification rule a process on student dataset using KNN algorithm in Python.**
18. **Write a Program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/ Python ML library classes can be used for this problem.**

INTERNAL – 2:

19. **KMEANS Clustering for IRIS DATASET using R**
20. **Outliner Detection using K Means Classification algorithm on IRIS dataset using R**
21. **KNN Algorithm in BodyFat dataset using R.**
22. **Generate a decision tree using ID3 algorithm for iris dataset using R studio**
23. **Apply random forest algorithm for bodyfat dataset using R**
24. **Multiple Linear Regression using bodyfat dataset**

LAB EXERCISE:

1. HADOOP – WORD COUNT BY MAP REDUCE

AIM:

To find the number of words in a given data using Hadoop.

PROCEDURE:

Step 1: After installing Hadoop, navigate to assigned path of the Hadoop in command prompt.

Step 2: Start HDFS (Name node & Datanode) and YARN (Resource Manager and Node Manager)

 Start –all.cmd

 Start –dfs

 Start –yarn

Step 3: Run word count Map Reduce Job.

 Create a text file with same content c;\file1.txt (Pass this file as input to MapReduce)

 Create a directory (input) in HDFS to keep all the text files by the command.

Hdfs dfs-mkdir input

 Copy the text file (file1.text) from local disk to the newly created input directory in HDFS.

Hdfs dfs – copy From Local
C:/file1.txt input

 Check content of the copied file

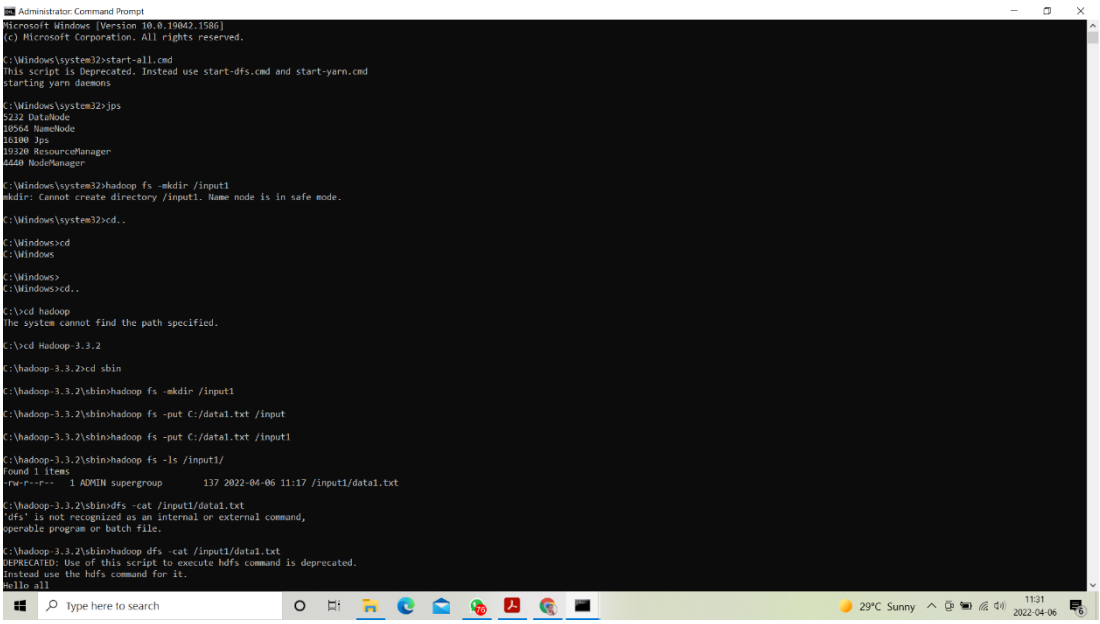
Hdfs dfs – ls input

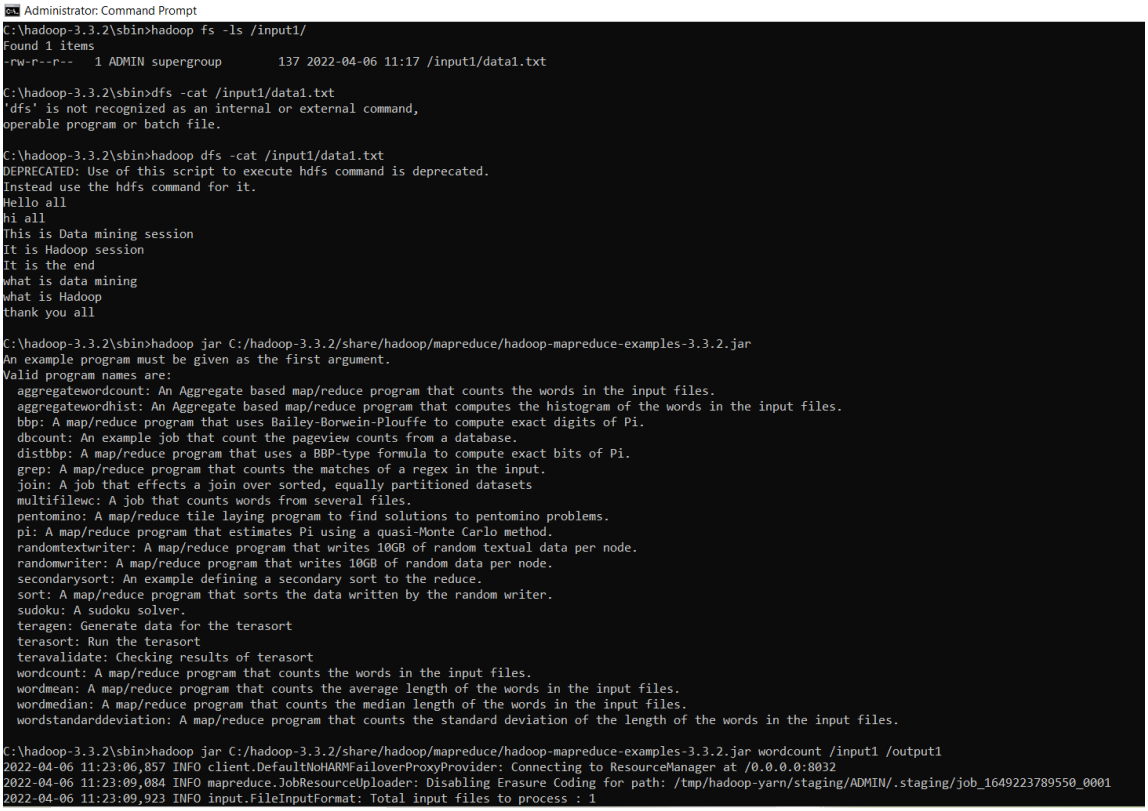
Step 4: Run the wordcount Map Reduce job bin\yarn jar share/Hadoop/mapreduce Hadoop-mapreduce-examples – 2.2.0.jar wordcount input output.

Step 5: check Output

Hdfs dfs – cat output/*

OUTPUT:

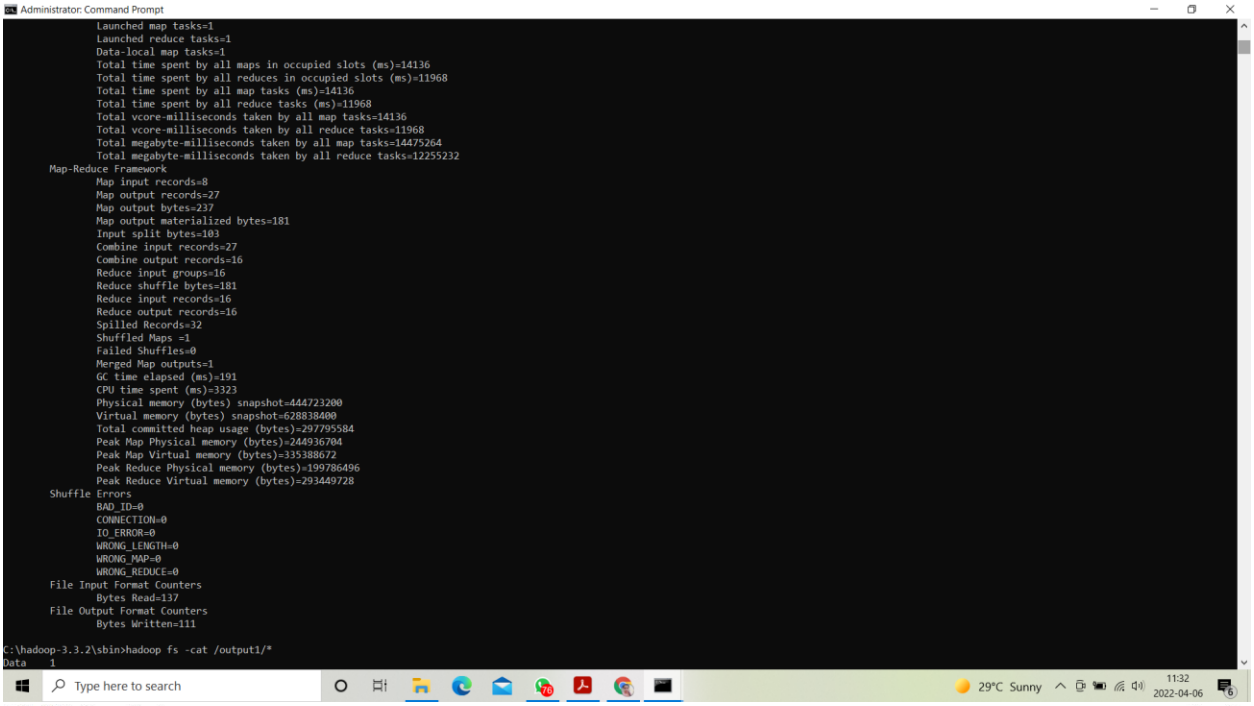

Administrator: Command Prompt
Microsoft Windows [Version 10.0.19042.1586]
(c) Microsoft Corporation. All rights reserved.
C:\Windows\system32>start-all.cmd
This script is Deprecated. Instead use start-dfs.cmd and start-yarn.cmd
starting yarn daemons
C:\Windows\system32>jps
5232 DataNode
10564 NameNode
16100 Jps
19320 ResourceManager
4440 NodeManager
C:\Windows\system32>hadoop fs -mkdir /input1
mkdir: Cannot create directory /input1. Name node is in safe mode.
C:\Windows\system32>cd..
C:\Windows>cd
C:\Windows
C:\Windows>
C:\Windows>cd..
C:\>cd hadoop
The system cannot find the path specified.
C:\>cd Hadoop-3.3.2
C:\hadoop-3.3.2>cd sbin
C:\hadoop-3.3.2\sbin>hadoop fs -mkdir /input1
C:\hadoop-3.3.2\sbin>hadoop fs -put C:/data1.txt /input
C:\hadoop-3.3.2\sbin>hadoop fs -put C:/data1.txt /input1
C:\hadoop-3.3.2\sbin>hadoop fs -ls /input1/
Found 1 items
-rw-r--r--   1 ADMIN supergroup   137 2022-04-06 11:17 /input1/data1.txt
C:\hadoop-3.3.2\sbin>dfs -cat /input1/data1.txt
'dfs' is not recognized as an internal or external command,
operable program or batch file.
C:\hadoop-3.3.2\sbin>hadoop dfs -cat /input1/data1.txt
DEPRECATED: Use of this script to execute hdfs command is deprecated.
Instead use the hdfs command for it.
Hello all
Type here to search
29°C Sunny
11:21
2022-04-06

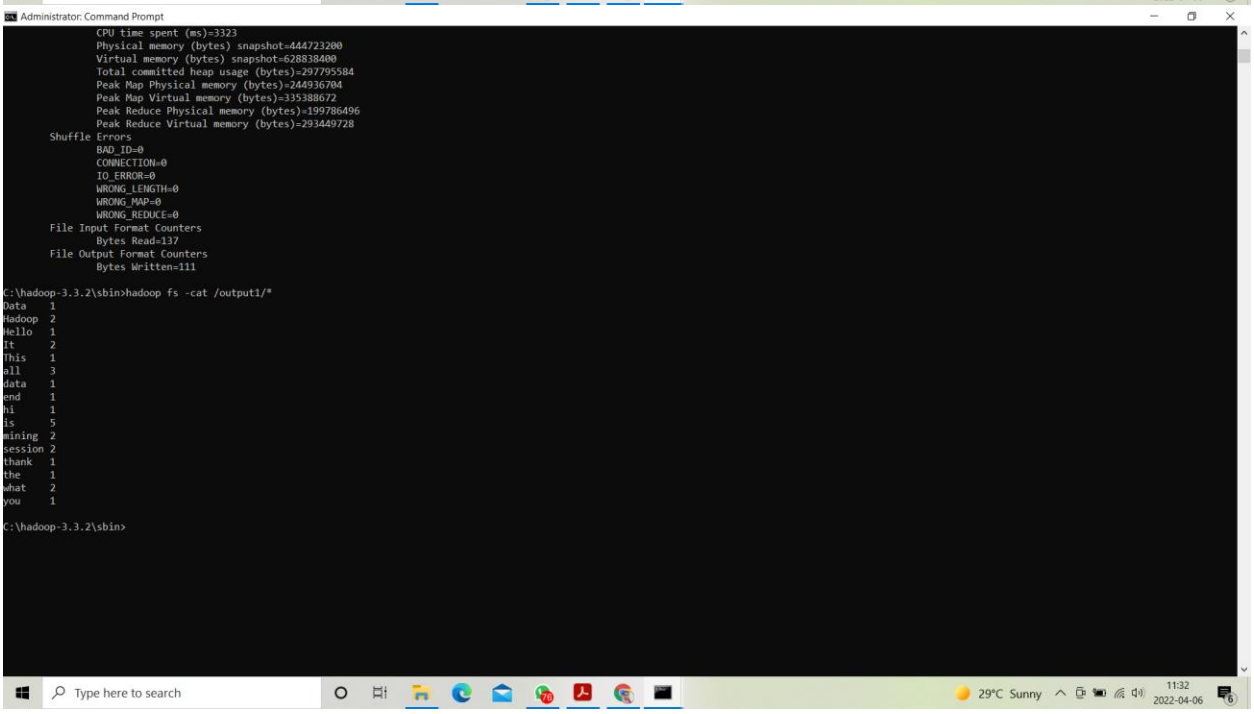

Administrator: Command Prompt
C:\hadoop-3.3.2\sbin>hadoop fs -ls /input1/
Found 1 items
-rw-r--r--   1 ADMIN supergroup   137 2022-04-06 11:17 /input1/data1.txt
C:\hadoop-3.3.2\sbin>dfs -cat /input1/data1.txt
'dfs' is not recognized as an internal or external command,
operable program or batch file.
C:\hadoop-3.3.2\sbin>hadoop dfs -cat /input1/data1.txt
DEPRECATED: Use of this script to execute hdfs command is deprecated.
Instead use the hdfs command for it.
Hello all
hi all
This is Data mining session
It is Hadoop session
It is the end
what is data mining
what is Hadoop
thank you all
C:\hadoop-3.3.2\sbin>hadoop jar C:/hadoop-3.3.2/share/hadoop/mapreduce/hadoop-mapreduce-examples-3.3.2.jar
An example program must be given as the first argument.
Valid program names are:
aggregatewordcount: An Aggregate based map/reduce program that counts the words in the input files.
aggregatewordhist: An Aggregate based map/reduce program that computes the histogram of the words in the input files.
bbp: A map/reduce program that uses Bailey-Borwein-Plouffe to compute exact digits of Pi.
dbcount: An example job that count the pageview counts from a database.
distbbp: A map/reduce program that uses a BBP-type formula to compute exact bits of Pi.
grep: A map/reduce program that counts the matches of a regex in the input.
join: A job that effects a join over sorted, equally partitioned datasets
multifilewc: A job that counts words from several files.
pentomino: A map/reduce tile laying program to find solutions to pentomino problems.
pi: A map/reduce program that estimates Pi using a quasi-Monte Carlo method.
randomtextwriter: A map/reduce program that writes 10GB of random textual data per node.
randomwriter: A map/reduce program that writes 10GB of random data per node.
secondarysort: An example defining a secondary sort to the reduce.
sort: A map/reduce program that sorts the data written by the random writer.
sudoku: A sudoku solver.
teragen: Generate data for the terasort
terasort: Run the terasort
teravalidate: Checking results of terasort
wordcount: A map/reduce program that counts the words in the input files.
wordmean: A map/reduce program that counts the average length of the words in the input files.
wordmedian: A map/reduce program that counts the median length of the words in the input files.
wordstandarddeviation: A map/reduce program that counts the standard deviation of the length of the words in the input files.
C:\hadoop-3.3.2\sbin>hadoop jar C:/hadoop-3.3.2/share/hadoop/mapreduce/hadoop-mapreduce-examples-3.3.2.jar wordcount /input1 /output1
2022-04-06 11:23:06,857 INFO client.DefaultNoHARMFailoverProxyProvider: Connecting to ResourceManager at /0.0.0.0:8032
2022-04-06 11:23:09,084 INFO mapreduce.JobResourceUploader: Disabling Erasure Coding for path: /tmp/hadoop-yarn/staging/ADMIN/.staging/job_1649223789550_0001
2022-04-06 11:23:09,923 INFO input.FileInputFormat: Total input files to process : 1

Administrator: Command Prompt

```
  teragen: Generate data for the terasort
  terasort: Run the terasort
  teravalidate: Checking results of terasort
  wordcount: A map/reduce program that counts the words in the input files.
  wordmean: A map/reduce program that counts the average length of the words in the input files.
  wordmedian: A map/reduce program that counts the median length of the words in the input files.
  wordstandarddeviation: A map/reduce program that counts the standard deviation of the length of the words in the input files.

C:\hadoop-3.3.2\sbin>hadoop jar C:/hadoop-3.3.2/share/hadoop/mapreduce/hadoop-mapreduce-examples-3.3.2.jar wordcount /input1 /output1
2022-04-06 11:23:06,857 INFO client.DefaultNoHARMFailoverProxyProvider: Connecting to ResourceManager at /0.0.0.0:8032
2022-04-06 11:23:09,084 INFO mapreduce.JobResourceUploader: Disabling Erasure Coding for path: /tmp/hadoop-yarn/staging/ADMIN/.staging/job_1649223789550_0001
2022-04-06 11:23:09,923 INFO input.FileInputFormat: Total input files to process : 1
2022-04-06 11:23:10,139 INFO mapreduce.JobSubmitter: number of splits:1
2022-04-06 11:23:10,724 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1649223789550_0001
2022-04-06 11:23:10,724 INFO mapreduce.JobSubmitter: Executing with tokens: []
2022-04-06 11:23:11,309 INFO conf.Configuration: resource-types.xml not found
2022-04-06 11:23:11,314 INFO resource.ResourceUtils: Unable to find 'resource-types.xml'.
2022-04-06 11:23:12,763 INFO impl.YarnClientImpl: Submitted application application_1649223789550_0001
2022-04-06 11:23:13,733 INFO mapreduce.Job: The url to track the job: http://DESKTOP-A2FPIHT:8088/proxy/application_1649223789550_0001/
2022-04-06 11:23:13,804 INFO mapreduce.Job: Running job: job_1649223789550_0001
2022-04-06 11:23:47,254 INFO mapreduce.Job: Job job_1649223789550_0001 running in uber mode : false
2022-04-06 11:23:47,265 INFO mapreduce.Job:  map 0% reduce 0%
2022-04-06 11:24:04,077 INFO mapreduce.Job:  map 100% reduce 0%
2022-04-06 11:24:18,486 INFO mapreduce.Job:  map 100% reduce 100%
2022-04-06 11:24:24,588 INFO mapreduce.Job: Job job_1649223789550_0001 completed successfully
2022-04-06 11:24:25,036 INFO mapreduce.Job: Counters: 54
        File System Counters
                FILE: Number of bytes read=181
                FILE: Number of bytes written=554093
                FILE: Number of read operations=0
                FILE: Number of large read operations=0
                FILE: Number of write operations=0
                HDFS: Number of bytes read=240
                HDFS: Number of bytes written=111
                HDFS: Number of read operations=8
                HDFS: Number of large read operations=0
                HDFS: Number of write operations=2
                HDFS: Number of bytes read erasure-coded=0
        Job Counters
                Launched map tasks=1
                Launched reduce tasks=1
                Data-local map tasks=1
                Total time spent by all maps in occupied slots (ms)=14136
                Total time spent by all reduces in occupied slots (ms)=11968
                Total time spent by all map tasks (ms)=14136
                Total time spent by all reduce tasks (ms)=11968
                Total vcore-milliseconds taken by all map tasks=14136
                Total vcore-milliseconds taken by all reduce tasks=11968
                Total megabyte-milliseconds taken by all map tasks=14475264
                Total megabyte-milliseconds taken by all reduce tasks=12255232
```


Administrator: Command Prompt
Launched map tasks=1
Launched reduce tasks=1
Data-local map tasks=1
Total time spent by all maps in occupied slots (ms)=14136
Total time spent by all reduces in occupied slots (ms)=11968
Total time spent by all map tasks (ms)=14136
Total time spent by all reduce tasks (ms)=11968
Total vcore-milliseconds taken by all map tasks=14136
Total vcore-milliseconds taken by all reduce tasks=11968
Total megabyte-milliseconds taken by all map tasks=14475264
Total megabyte-milliseconds taken by all reduce tasks=12255232
Map-Reduce Framework
Map input records=8
Map output records=27
Map output bytes=237
Map output materialized bytes=181
Input split bytes=103
Combine input records=27
Combine output records=16
Reduce input groups=16
Reduce shuffle bytes=181
Reduce input records=16
Reduce output records=16
Spilled Records=32
Shuffled Maps =1
Failed Shuffles=0
Merged Map outputs=1
GC time elapsed (ms)=191
CPU time spent (ms)=3323
Physical memory (bytes) snapshot=444723200
Virtual memory (bytes) snapshot=628838400
Total committed heap usage (bytes)=297795584
Peak Map Physical memory (bytes)=244936704
Peak Map Virtual memory (bytes)=335388672
Peak Reduce Physical memory (bytes)=199786496
Peak Reduce Virtual memory (bytes)=293449728
Shuffle Errors
BAD_ID=0
CONNECTION=0
IO_ERROR=0
WRONG_LENGTH=0
WRONG_MAP=0
WRONG_REDUCE=0
File Input Format Counters
Bytes Read=137
File Output Format Counters
Bytes Written=111
C:\hadoop-3.3.2\sbin>hadoop fs -cat /output1/*
Data 1
Type here to search
29°C Sunny
11:32
2022-04-06


Administrator: Command Prompt
CPU time spent (ms)=3323
Physical memory (bytes) snapshot=444723200
Virtual memory (bytes) snapshot=628838400
Total committed heap usage (bytes)=297795584
Peak Map Physical memory (bytes)=244936704
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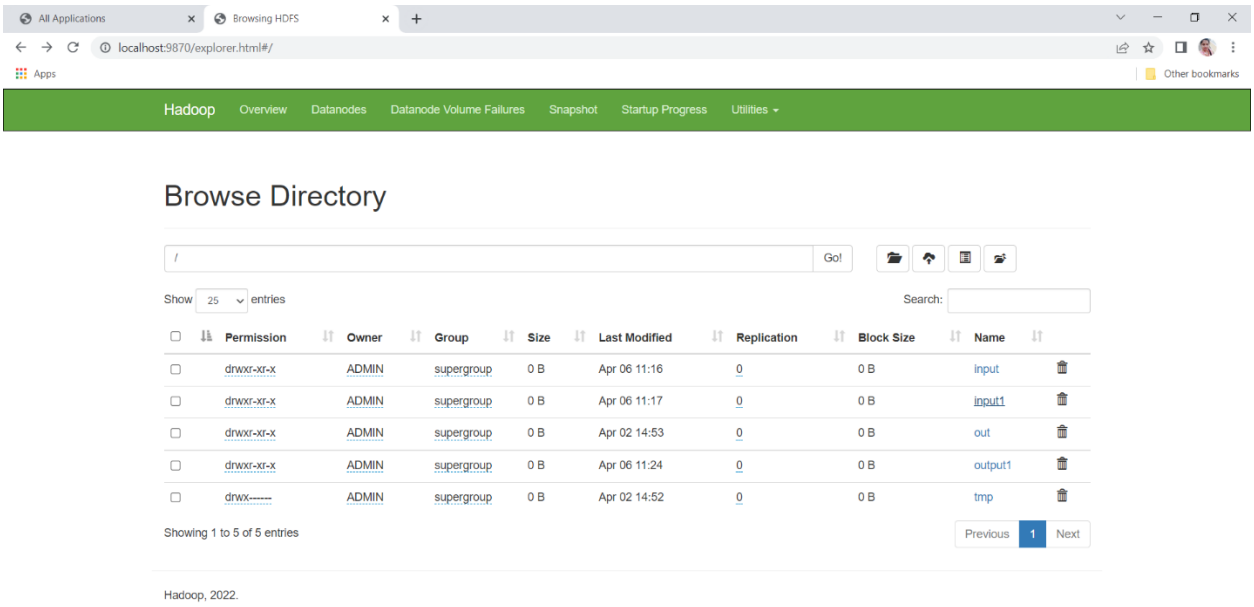
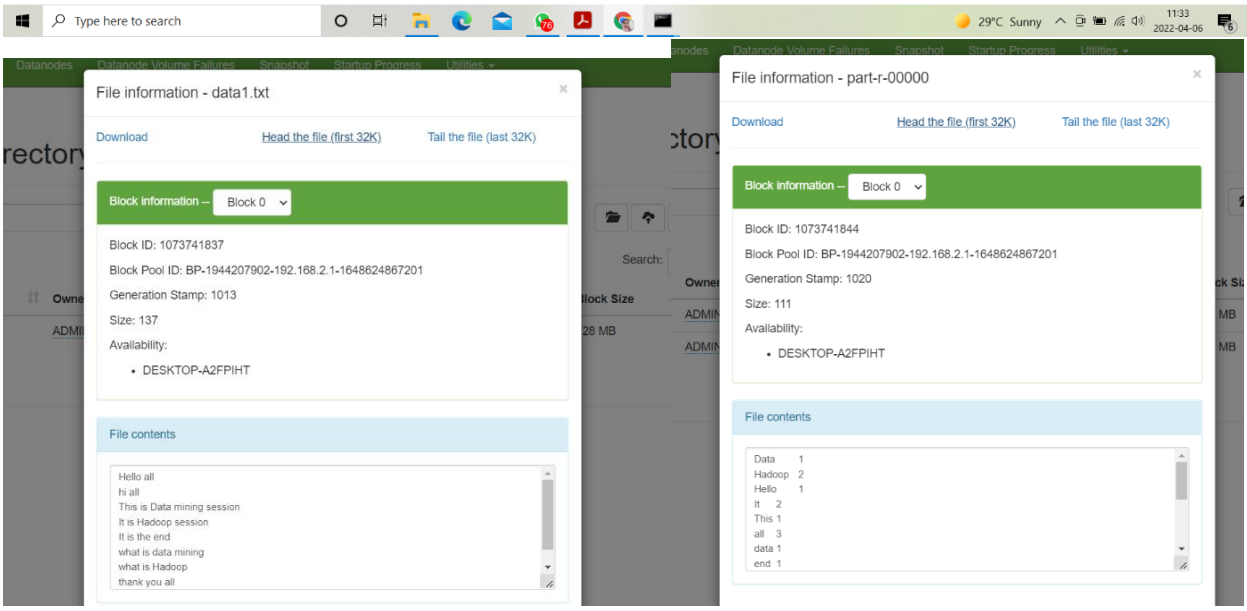
Peak Reduce Physical memory (bytes)=199786496
Peak Reduce Virtual memory (bytes)=293449728
Shuffle Errors
BAD_ID=0
CONNECTION=0
IO_ERROR=0
WRONG_LENGTH=0
WRONG_MAP=0
WRONG_REDUCE=0
File Input Format Counters
Bytes Read=137
File Output Format Counters
Bytes Written=111
C:\hadoop-3.3.2\sbin>hadoop fs -cat /output1/*
Data 1
Hadoop 2
Hello 1
it 2
this 1
all 3
data 1
end 1
hi 1
is 5
mining 2
session 2
thank 1
the 1
what 2
you 1
C:\hadoop-3.3.2\sbin>
Type here to search
29°C Sunny
11:32
2022-04-06





RESULT:

Thus, the word count has successfully implemented using Hadoop.

2. SPARK WORD COUNT

AIM:

To find the number of words in complex word file using SPARK

PROCEDURE:

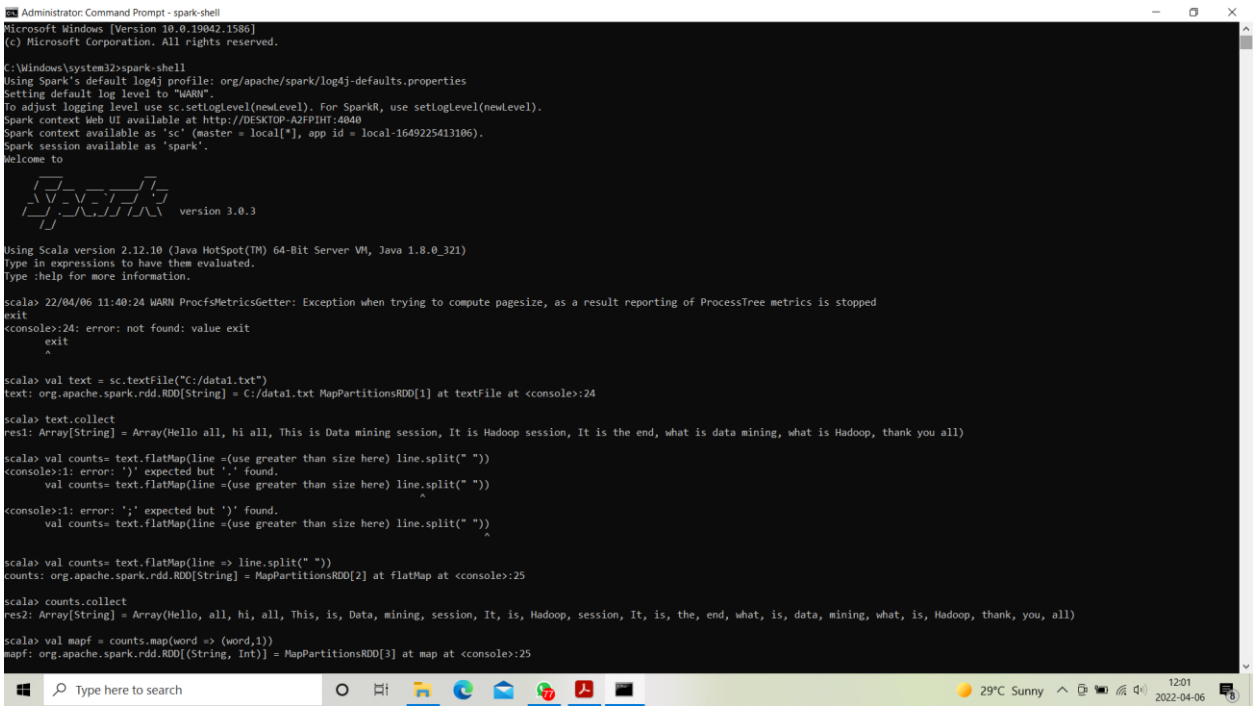
STEP 1: Install SPARK in Windows

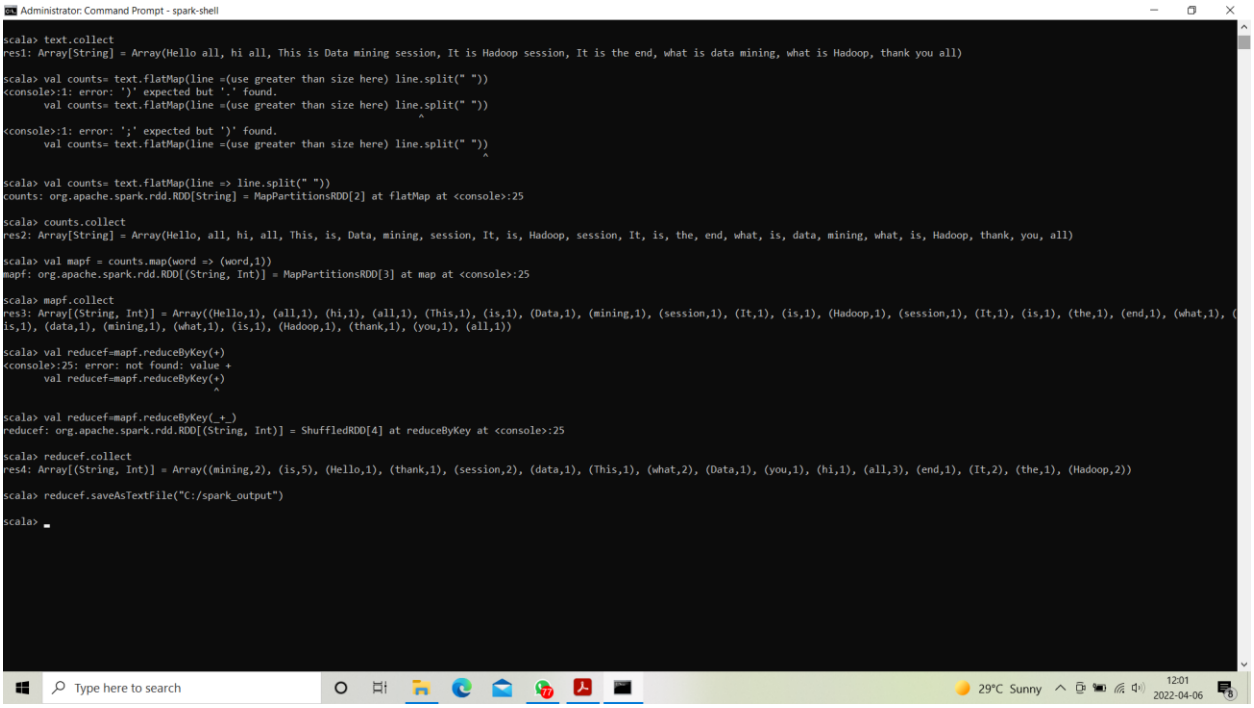
STEP 2: Create one-word file and save it in C:\data.txt

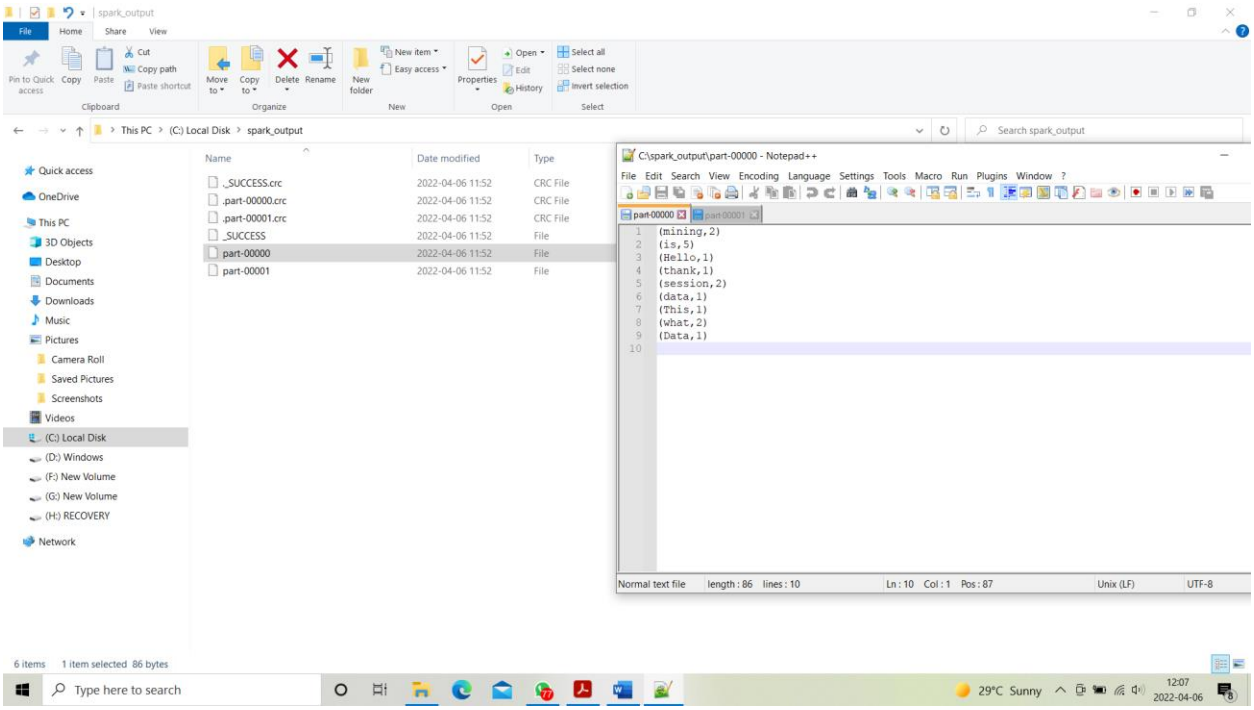
STEP 3: Open New terminal and Type the Following command line by line

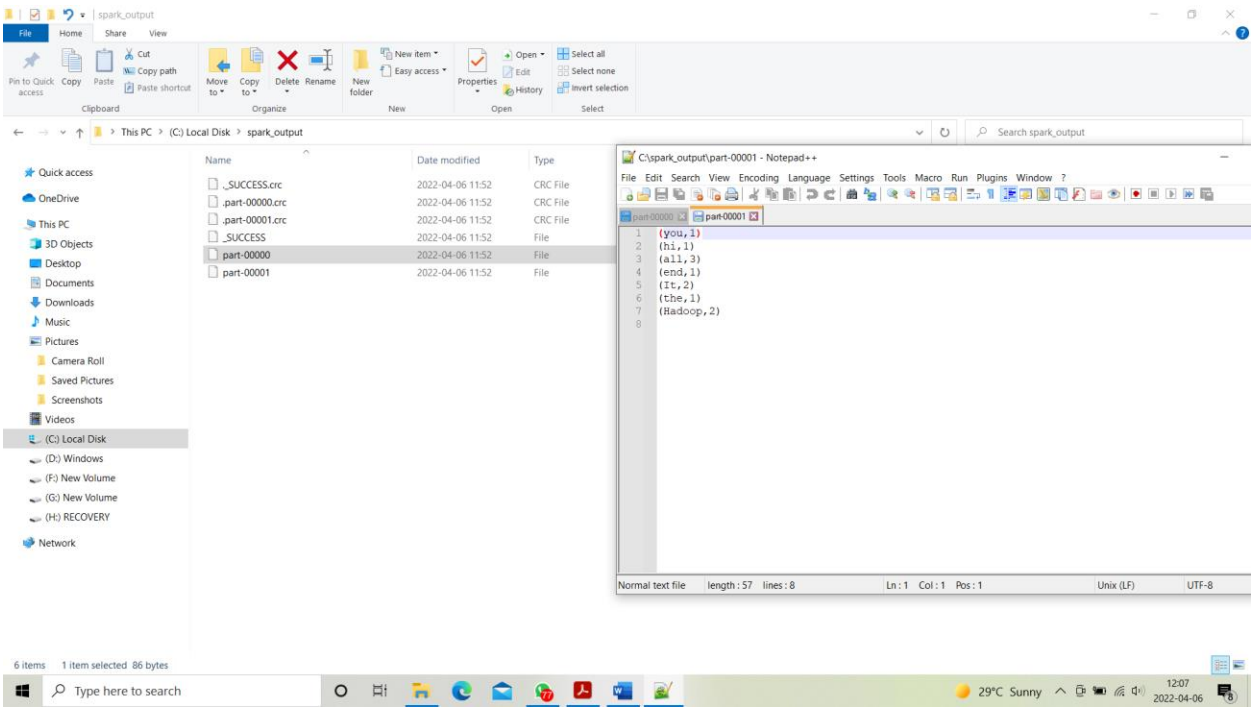
1. spark-shell
2. val data=sc.textFile("c:/data.txt")
3. data.collect;
4. val splitdata = data.flatMap(line => line.split(" "));
5. splitdata.collect;
6. val mapdata = splitdata.map(word => (word,1));
7. mapdata.collect;
8. val reducedata = mapdata.reduceByKey(_+_);
9. reducedata.collect;
10. stop-all (after completing stop SPARK to run at background)

OUTPUT:




Administrator: Command Prompt - spark-shell
scala> text.collect
res1: Array[String] = Array(Hello all, hi all, This is Data mining session, It is Hadoop session, It is the end, what is data mining, what is Hadoop, thank you all)
scala> val counts= text.flatMap(line =(use greater than size here) line.split(" "))
<console>:1: error: ')' expected but '.' found.
val counts= text.flatMap(line =(use greater than size here) line.split(" "))
^
<console>:1: error: ';' expected but ')' found.
val counts= text.flatMap(line =(use greater than size here) line.split(" "))
^
scala> val counts= text.flatMap(line => line.split(" "))
counts: org.apache.spark.rdd.RDD[String] = MapPartitionsRDD[2] at flatMap at <console>:25
scala> counts.collect
res2: Array[String] = Array(Hello, all, hi, all, This, is, Data, mining, session, It, is, Hadoop, session, It, is, the, end, what, is, data, mining, what, is, Hadoop, thank, you, all)
scala> val mapf = counts.map(word => (word,1))
mapf: org.apache.spark.rdd.RDD[(String, Int)] = MapPartitionsRDD[3] at map at <console>:25
scala> mapf.collect
res3: Array[(String, Int)] = Array((Hello,1), (all,1), (hi,1), (all,1), (This,1), (is,1), (Data,1), (mining,1), (session,1), (It,1), (is,1), (Hadoop,1), (session,1), (It,1), (is,1), (the,1), (end,1), (what,1), (
is,1), (data,1), (mining,1), (what,1), (is,1), (Hadoop,1), (thank,1), (you,1), (all,1))
scala> val reducef=mapf.reduceByKey(+)
<console>:25: error: not found: value +
val reducef=mapf.reduceByKey(+)
^
scala> val reducef=mapf.reduceByKey(_+_)
reducef: org.apache.spark.rdd.RDD[(String, Int)] = ShuffledRDD[4] at reduceByKey at <console>:25
scala> reducef.collect
res4: Array[(String, Int)] = Array((mining,2), (is,5), (Hello,1), (thank,1), (session,2), (data,1), (This,1), (what,2), (Data,1), (you,1), (hi,1), (all,3), (end,1), (It,2), (the,1), (Hadoop,2))
scala> reducef.saveAsTextFile("C:/spark_output")
scala>
Type here to search
29°C Sunny
12:01
2022-04-06


spark_output
File Home Share View
This PC > (C:) Local Disk > spark_output
Search spark_output
Quick access
OneDrive
This PC
3D Objects
Desktop
Documents
Downloads
Music
Pictures
Camera Roll
Saved Pictures
Screenshots
Videos
(C:) Local Disk
(D:) Windows
(F:) New Volume
(G:) New Volume
(H:) RECOVERY
Network
Name
Date modified
Type
_SUCCESS.crc 2022-04-06 11:52 CRC File
.part-00000.crc 2022-04-06 11:52 CRC File
.part-00001.crc 2022-04-06 11:52 CRC File
_SUCCESS 2022-04-06 11:52 File
part-00000 2022-04-06 11:52 File
part-00001 2022-04-06 11:52 File
C:\spark_output\part-00000 - Notepad++
File Edit Search View Encoding Language Settings Tools Macro Run Plugins Window ?
part-00000
part-00001
(mining,2)
(is,5)
(Hello,1)
(thank,1)
(session,2)
(data,1)
(This,1)
(what,2)
(Data,1)
Normal text file length : 86 lines : 10 Ln : 10 Col : 1 Pos : 87 Unix (LF) UTF-8
6 items 1 item selected 86 bytes
Type here to search
29°C Sunny
12:07
2022-04-06



RESULT:

Thus, the word count has successfully implemented using SPARK.

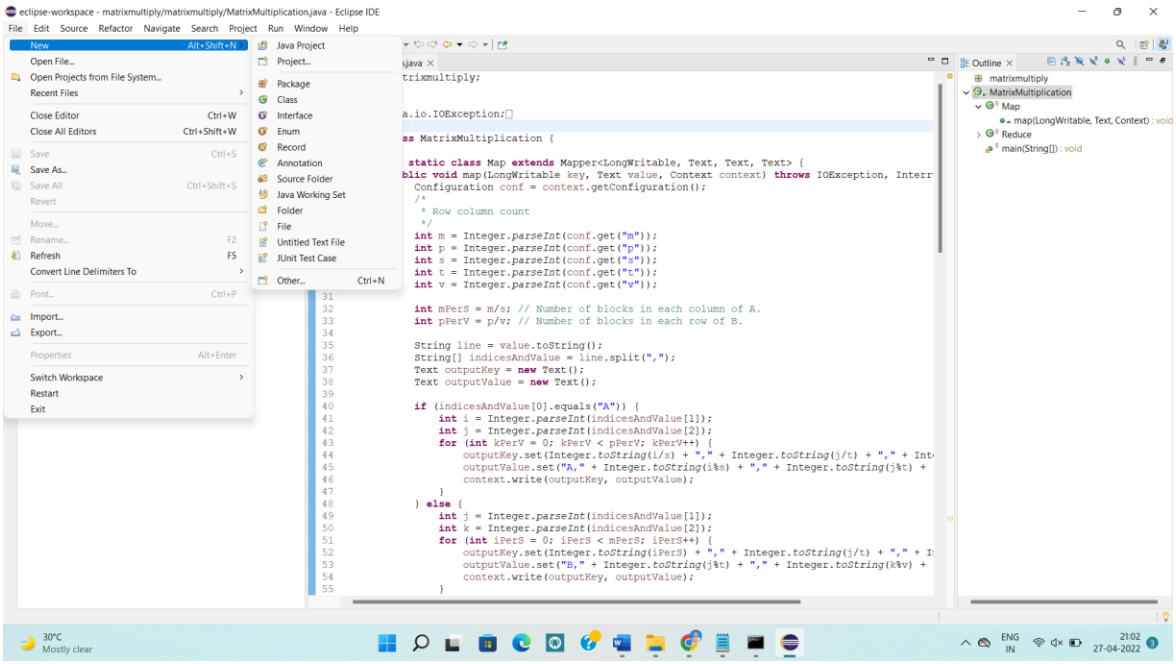
3. HADOOP – MATRIX MULTIPLITATION

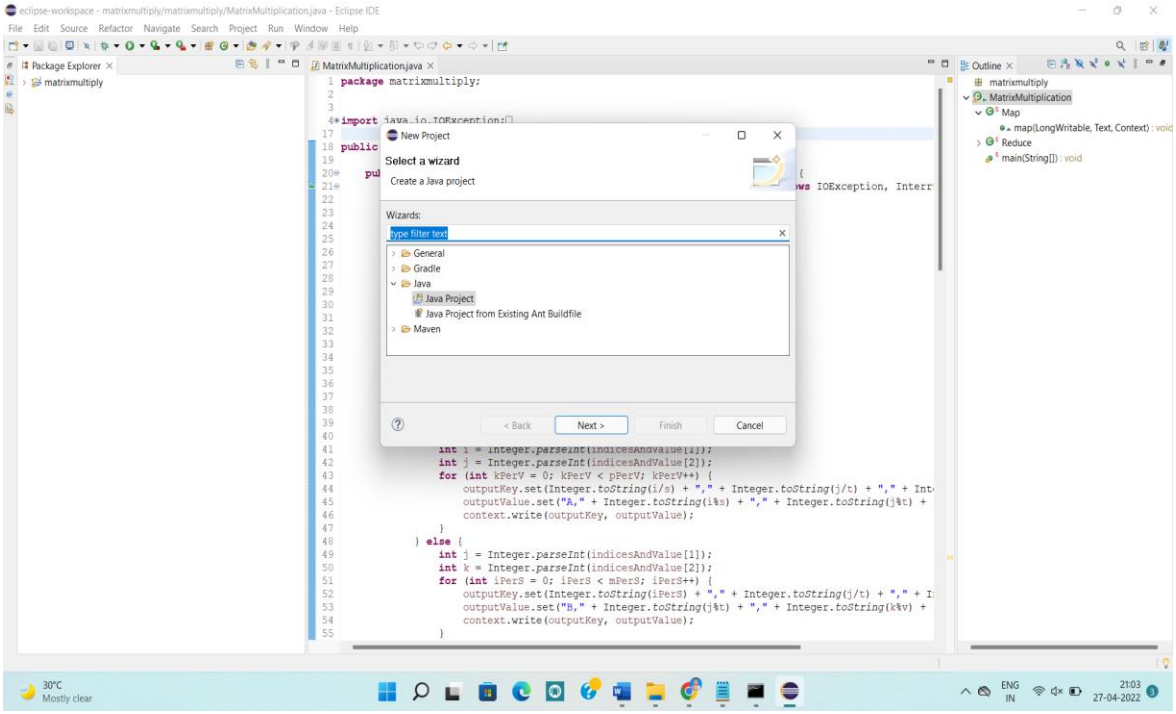
AIM:

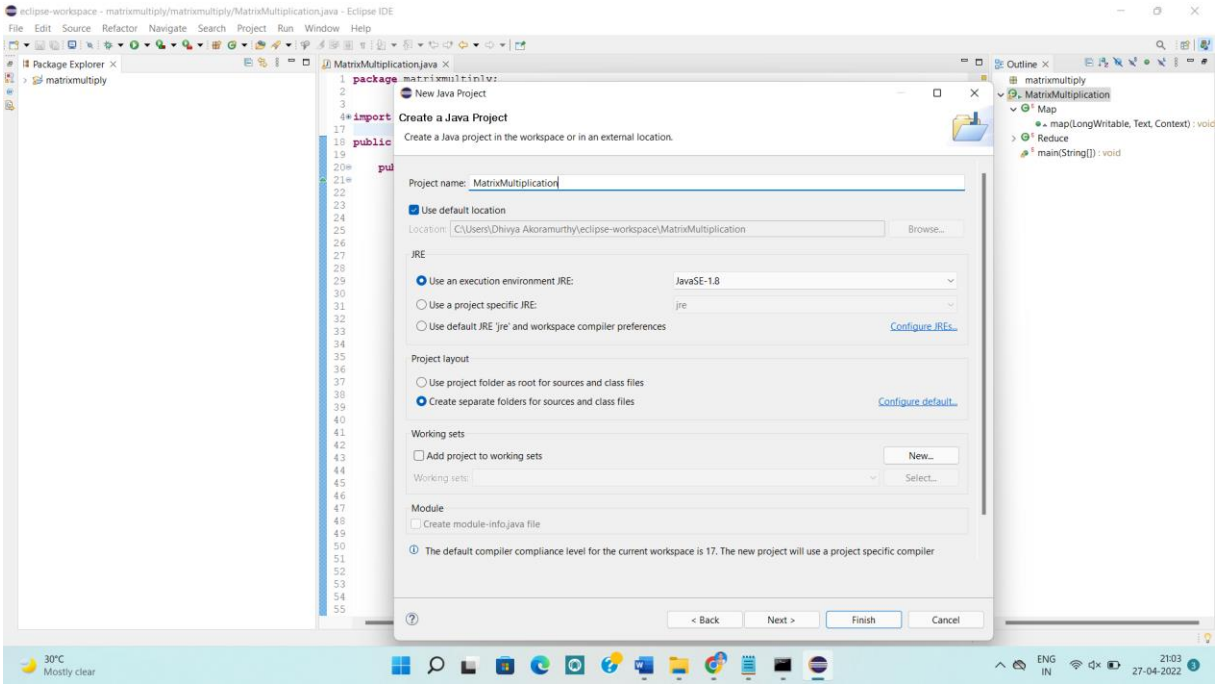
To implement matrix multiplication in Hadoop map reduce

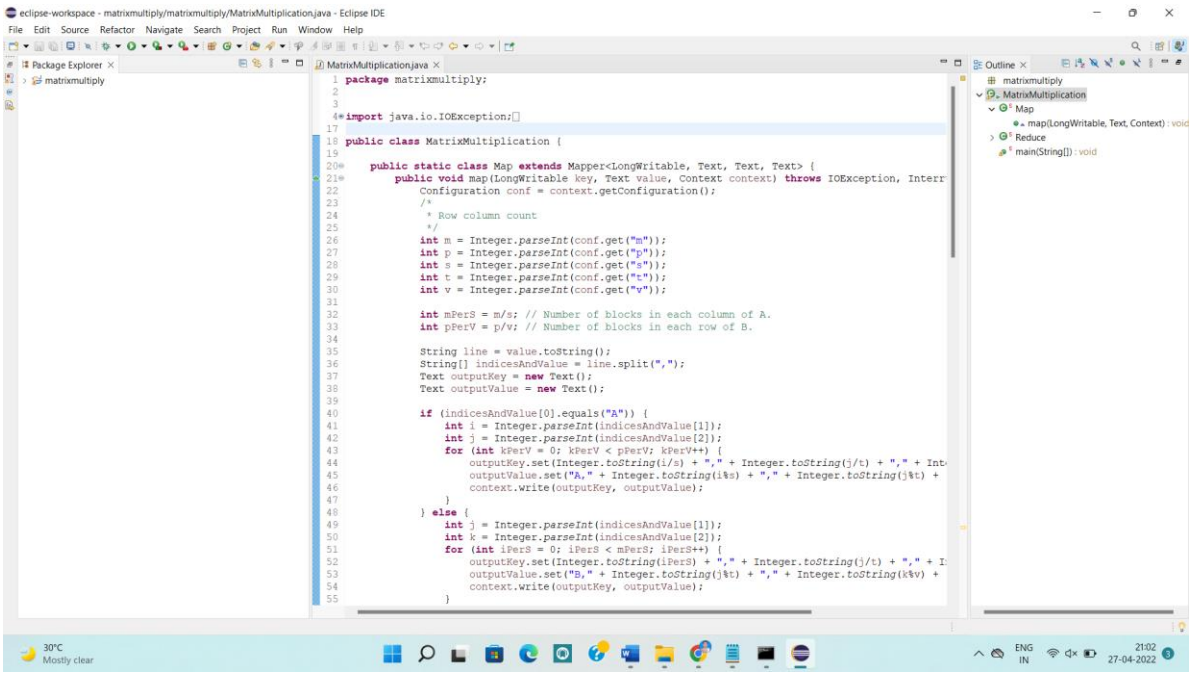
PROCEDURE:

In Eclipse workspace – java file name as MatrixMultiplication.java
Go to: File – new – project – java project – project name(Path name)




eclipse-workspace - matrixmultiply/matrixmultiply/MatrixMultiplication.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
Package Explorer
matrixmultiply
MatrixMultiplication.java
package matrixmultiply;
import java.io.IOException;
public
pu
New Project
Select a wizard
Create a Java project
Wizards:
type filter text
General
Gradle
Java
Java Project
Java Project from Existing Ant Buildfile
Maven
< Back
Next >
Finish
Cancel
int i = Integer.parseInt(indicesAndValue[1]);
int j = Integer.parseInt(indicesAndValue[2]);
for (int kPerV = 0; kPerV < pPerV; kPerV++) {
outputKey.set(Integer.toString(i/s) + "," + Integer.toString(j/t) + "," + Int
outputValue.set("A," + Integer.toString(i%s) + "," + Integer.toString(j%t) +
context.write(outputKey, outputValue);
} else {
int j = Integer.parseInt(indicesAndValue[1]);
int k = Integer.parseInt(indicesAndValue[2]);
for (int iPerS = 0; iPerS < mPerS; iPerS++) {
outputKey.set(Integer.toString(iPerS) + "," + Integer.toString(j/t) + "," + I
outputValue.set("B," + Integer.toString(j%t) + "," + Integer.toString(k%v) +
context.write(outputKey, outputValue);
Outline
matrixmultiply
MatrixMultiplication
Map
map(LongWritable, Text, Context) : void
Reduce
main(String[]) : void
30°C
Mostly clear
ENG
IN
21:03
27-04-2022


eclipse-workspace - matrixmultiply/matrixmultiply/MatrixMultiplication.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
Package Explorer
matrixmultiply
MatrixMultiplication.java
New Java Project
Create a Java Project
Create a Java project in the workspace or in an external location.
Project name: MatrixMultiplication
Use default location
Location: C:\Users\Dhivya Akoramurthy\eclipse-workspace\MatrixMultiplication
Browse...
JRE
Use an execution environment JRE:
JavaSE-1.8
Use a project specific JRE:
jre
Use default JRE 'jre' and workspace compiler preferences
Configure JREs...
Project layout
Use project folder as root for sources and class files
Create separate folders for sources and class files
Configure default...
Working sets
Add project to working sets
New...
Working sets:
Select...
Module
Create module-info.java file
The default compiler compliance level for the current workspace is 17. The new project will use a project specific compiler
< Back
Next >
Finish
Cancel
Outline
matrixmultiply
MatrixMultiplication
Map
map(LongWritable, Text, Context) : void
Reduce
main(String[]) : void
30°C
Mostly clear
ENG
IN
21:03
27-04-2022



We have to save java file in below location
C:\Users\Dhivya Akoramurthy\eclipse-workspace\matrixmultiply\matrixmultiply\ MatrixMultiplication.java (example)

MatrixMultiplication.java
NOTE: class name and file name of java should be same

```
package matrixmultiply;

import java.io.IOException;
import java.util.*;
import java.util.AbstractMap.SimpleEntry;
import java.util.Map.Entry;

import org.apache.hadoop.fs.Path;
import org.apache.hadoop.conf.*;
import org.apache.hadoop.io.*;
import org.apache.hadoop.mapreduce.*;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.input.TextInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
import org.apache.hadoop.mapreduce.lib.output.TextOutputFormat;
```

```
public class MatrixMultiplication {

   public static class Map extends Mapper<LongWritable, Text, Text, Text> {
      public void map(LongWritable key, Text value, Context context) throws IOException,
InterruptedException {
         Configuration conf = context.getConfiguration();
         /*
          * Row column count
          */
         int m = Integer.parseInt(conf.get("m"));
         int p = Integer.parseInt(conf.get("p"));
         int s = Integer.parseInt(conf.get("s"));
         int t = Integer.parseInt(conf.get("t"));
         int v = Integer.parseInt(conf.get("v"));

         int mPerS = m/s; // Number of blocks in each column of A.
         int pPerV = p/v; // Number of blocks in each row of B.

         String line = value.toString();
         String[] indicesAndValue = line.split(",");
         Text outputKey = new Text();
         Text outputValue = new Text();

         if (indicesAndValue[0].equals("A")) {
            int i = Integer.parseInt(indicesAndValue[1]);
            int j = Integer.parseInt(indicesAndValue[2]);
            for (int kPerV = 0; kPerV < pPerV; kPerV++) {
               outputKey.set(Integer.toString(i/s) + "," + Integer.toString(j/t) + "," +
Integer.toString(kPerV));
               outputValue.set("A," + Integer.toString(i%s) + "," + Integer.toString(j%t) + "," +
indicesAndValue[3]);
               context.write(outputKey, outputValue);
            }
         } else {
            int j = Integer.parseInt(indicesAndValue[1]);
            int k = Integer.parseInt(indicesAndValue[2]);
            for (int iPerS = 0; iPerS < mPerS; iPerS++) {
               outputKey.set(Integer.toString(iPerS) + "," + Integer.toString(j/t) + "," +
Integer.toString(k/v));
```

```
                outputValue.set("B," + Integer.toString(j%t) + "," + Integer.toString(k%v) + "," +
indicesAndValue[3]);
                context.write(outputKey, outputValue);
            }
        }
    }
  }

  public static class Reduce extends Reducer<Text, Text, Text, Text> {
    public void reduce(Text key, Iterable<Text> values, Context context) throws IOException,
InterruptedException {
        String[] value;
        ArrayList<Entry<String, Float>> listA = new ArrayList<Entry<String, Float>>();
        ArrayList<Entry<String, Float>> listB = new ArrayList<Entry<String, Float>>();
        for (Text val : values) {
            value = val.toString().split(",");
            if (value[0].equals("A")) {
                listA.add(new SimpleEntry<String, Float>(value[1] + "," + value[2],
Float.parseFloat(value[3])));
            } else {
                listB.add(new SimpleEntry<String, Float>(value[1] + "," + value[2],
Float.parseFloat(value[3])));
            }
        }
        String[] iModSAndJModT;
        String[] jModTAndKModV;
        float a_ij;
        float b_jk;
        String hashKey;
        HashMap<String, Float> hash = new HashMap<String, Float>();
        for (Entry<String, Float> a : listA) {
            iModSAndJModT = a.getKey().split(",");
            a_ij = a.getValue();
            for (Entry<String, Float> b : listB) {
                jModTAndKModV = b.getKey().split(",");
                b_jk = b.getValue();
                if (iModSAndJModT[1].equals(jModTAndKModV[0])) {
                    hashKey = iModSAndJModT[0] + "," + jModTAndKModV[1];
                    if (hash.containsKey(hashKey)) {
                        hash.put(hashKey, hash.get(hashKey) + a_ij*b_jk);
```

```
                } else {
                    hash.put(hashKey, a_ij*b_jk);
                }
            }
        }
        String[] blockIndices = key.toString().split(",");
        String[] indices;
        String i;
        String k;
        Configuration conf = context.getConfiguration();
        int s = Integer.parseInt(conf.get("s"));
        int v = Integer.parseInt(conf.get("v"));
        Text outputValue = new Text();
        for (Entry<String, Float> entry : hash.entrySet()) {
            indices = entry.getKey().split(",");
            i = Integer.toString(Integer.parseInt(blockIndices[0])*s + Integer.parseInt(indices[0]));
            k = Integer.toString(Integer.parseInt(blockIndices[2])*v +
Integer.parseInt(indices[1]));
            outputValue.set(i + "," + k + "," + Float.toString(entry.getValue()));
            context.write(null, outputValue);
        }
    }
  }

  public static void main(String[] args) throws Exception {
    Configuration conf = new Configuration();
    // A is an m-by-n matrix; B is an n-by-p matrix.
    conf.set("m", "2");
    conf.set("n", "5");
    conf.set("p", "3");
    conf.set("s", "2"); // Number of rows in a block in A.
    conf.set("t", "5"); // Number of columns in a block in A = number of rows in a block in B.
    conf.set("v", "3"); // Number of columns in a block in B.

    Job job = new Job(conf, "Multiplication");
    job.setJarByClass(MatrixMultiplication.class);
    job.setOutputKeyClass(Text.class);
    job.setOutputValueClass(Text.class);
```

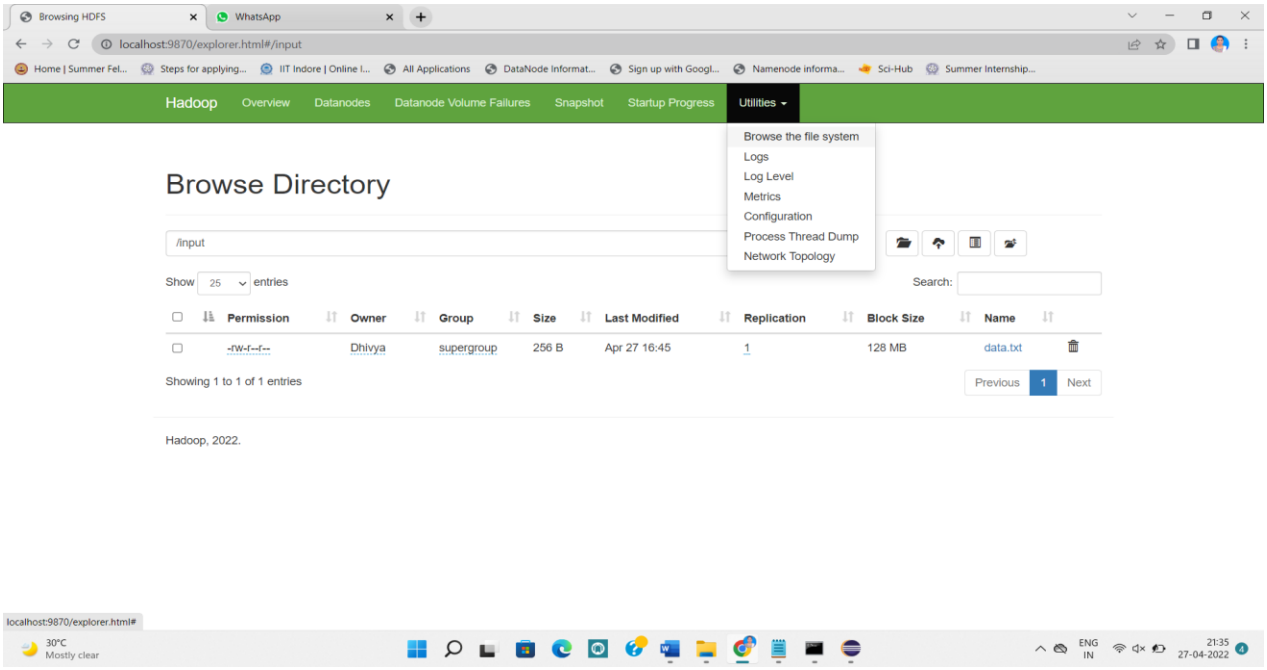
```
        job.setMapperClass(Map.class);
        job.setReducerClass(Reduce.class);

        job.setInputFormatClass(TextInputFormat.class);
        job.setOutputFormatClass(TextOutputFormat.class);

        FileInputFormat.addInputPath(job, new Path(args[0]));
        FileOutputFormat.setOutputPath(job, new Path(args[1]));

        job.waitForCompletion(true);
    }
}
```

data.txt

```
A,0,1,1.0
A,0,2,2.0
A,0,3,3.0
A,0,4,4.0
B,3,1,10.0
B,3,2,11.0
A,1,0,5.0
A,1,1,6.0
A,1,2,7.0
A,1,3,8.0
A,1,4,9.0
B,0,1,1.0
B,0,2,2.0
B,1,0,3.0
B,1,1,4.0
B,1,2,5.0
B,2,0,6.0
B,2,1,7.0
B,2,2,8.0
B,3,0,9.0
B,4,0,12.0
B,4,1,13.0
B,4,2,14.0
```

In Browser:

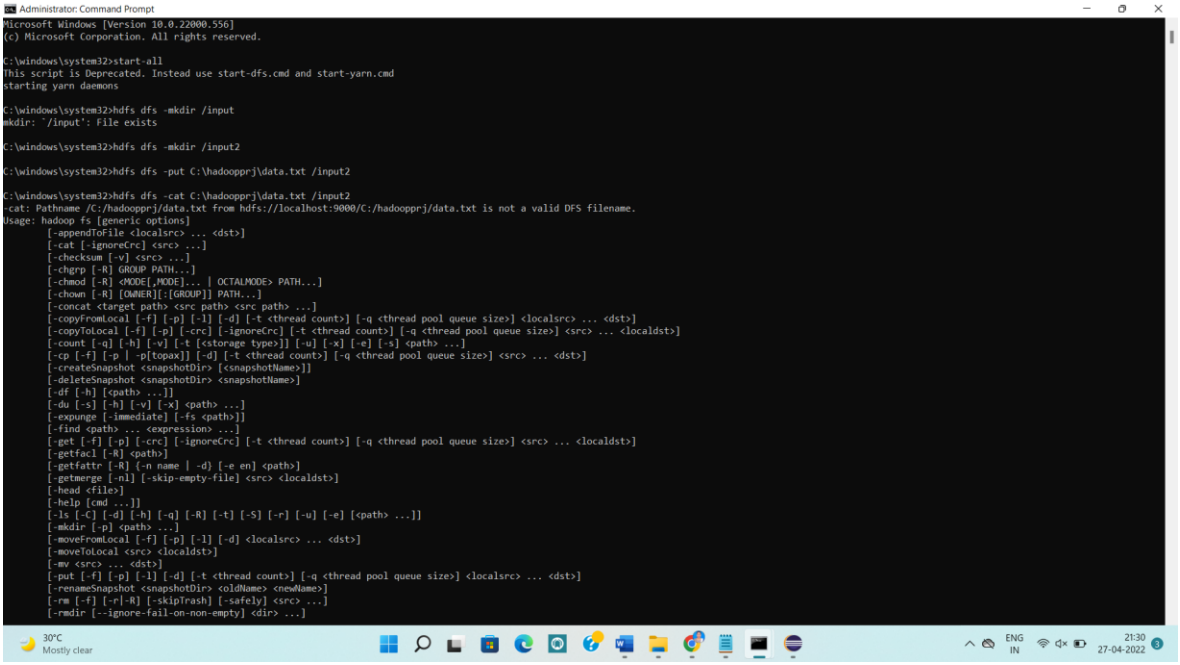
Name node: Port number – 9870
Check the file is in Hadoop or not

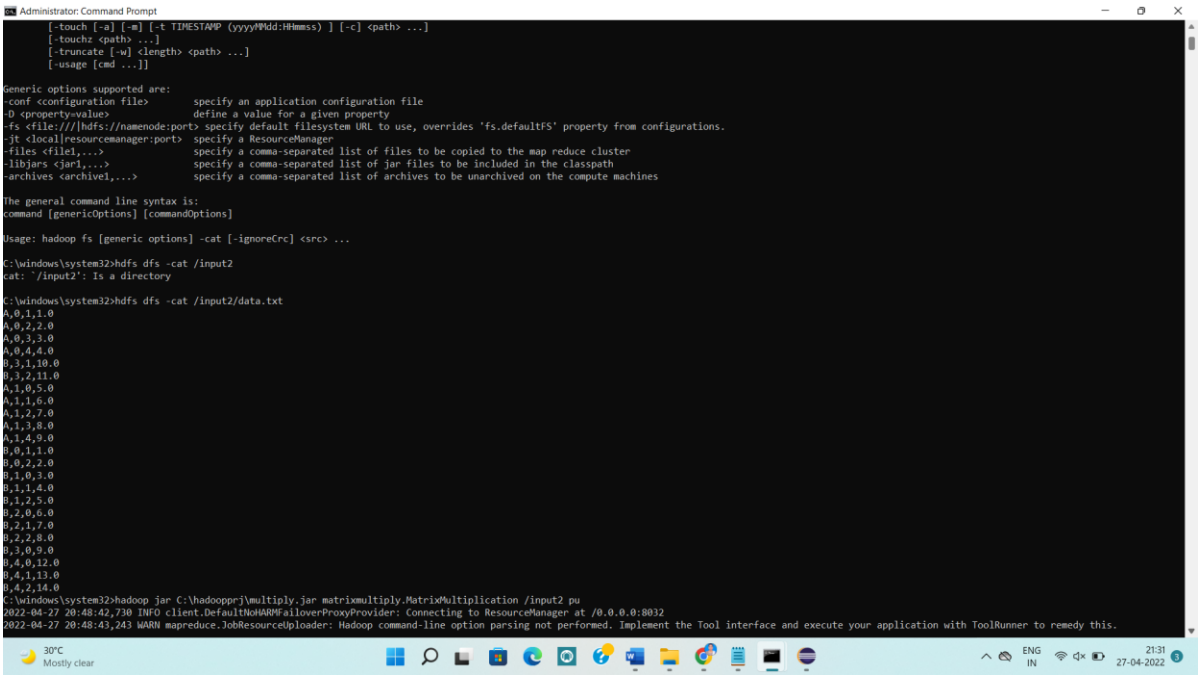


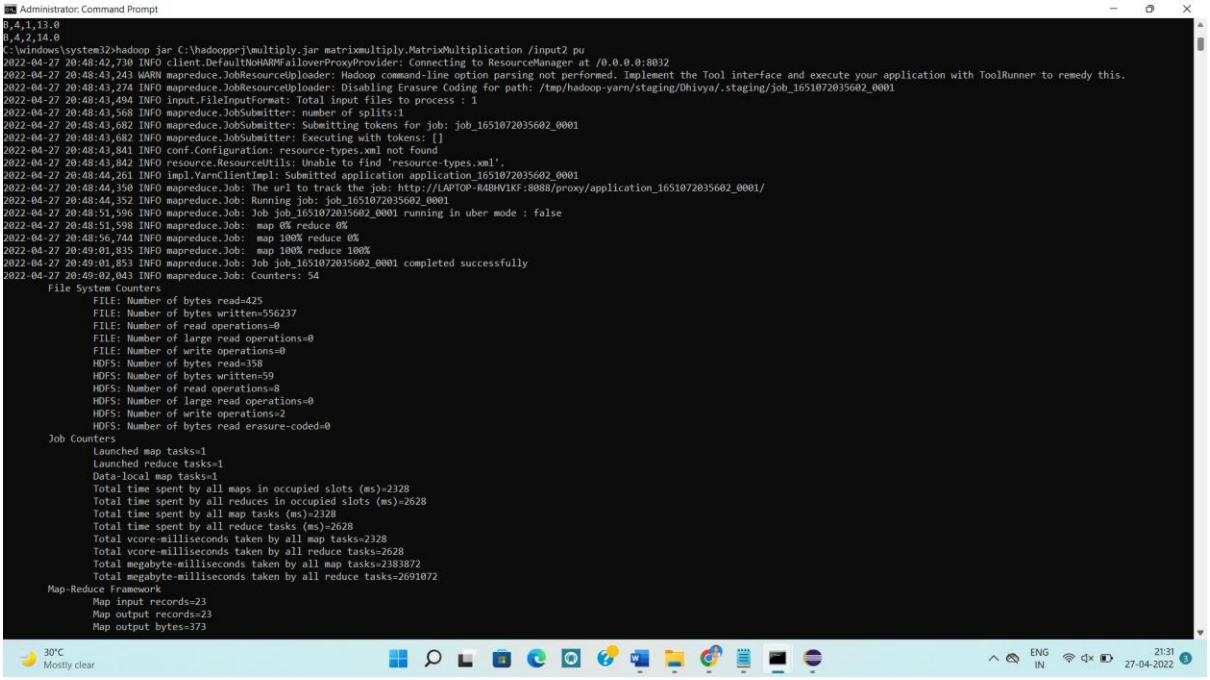
In Command Prompt, open cmd as administrator

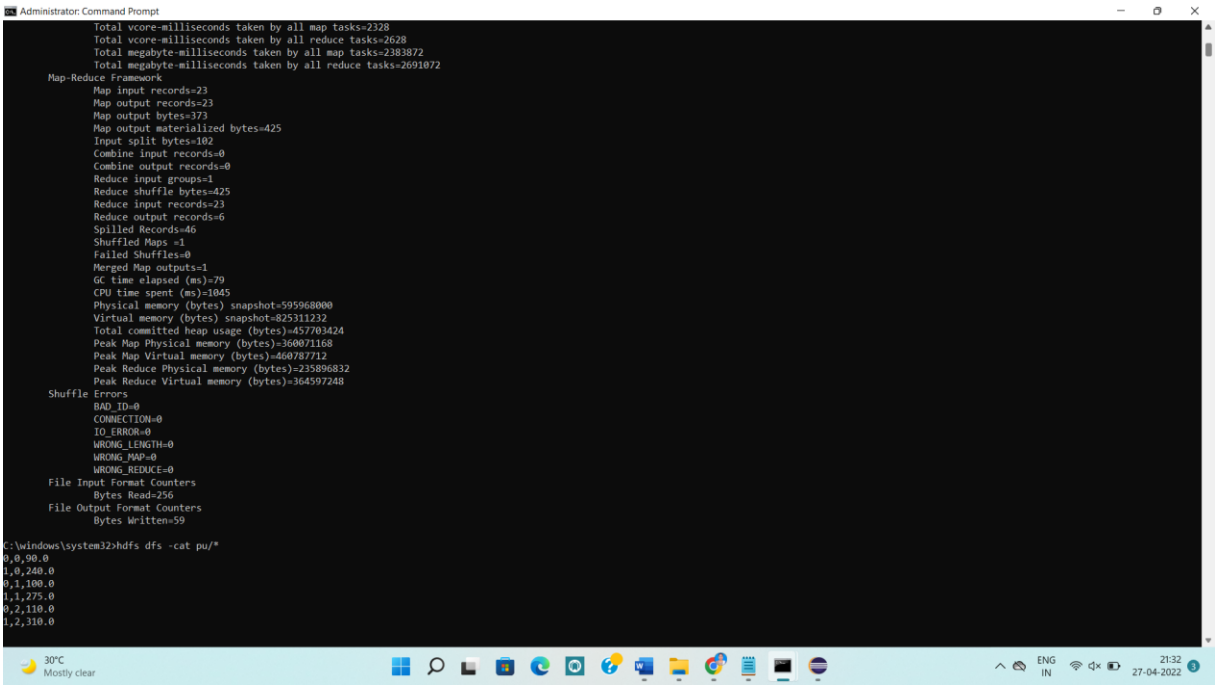
>Start-all
>hdfs dfs -mkdir /input2
>hdfs dfs -put C:\hadoopprj\data.txt /input2
>hdfs dfs -cat C:\hadoopprj\data.txt /input2
>hdfs dfs -cat /input2/data.txt
A,0,1,1.0
A,0,2,2.0
A,0,3,3.0
A,0,4,4.0
B,3,1,10.0
B,3,2,11.0
A,1,0,5.0
A,1,1,6.0
A,1,2,7.0
A,1,3,8.0
A,1,4,9.0
B,0,1,1.0
B,0,2,2.0
B,1,0,3.0
B,1,1,4.0
B,1,2,5.0
B,2,0,6.0
B,2,1,7.0
B,2,2,8.0
B,3,0,9.0
B,4,0,12.0
B,4,1,13.0
B,4,2,14.0
> hadoop jar C:\hadoopprj\multiply.jar matrixmultiply.MatrixMultiplication /input2 put23
> hdfs dfs -cat put23/*
0,0,90.0
1,0,240.0
0,1,100.0
1,1,275.0
0,2,110.0
1,2,310.0
>stop-all (after completing we need to close hadoop)

OUTPUT SCREENSHOT:









RESULT:

Thus, the implementation of Matrix multiplication using Hadoop is shown above.

4. APRIORI IN R:

AIM:

To implement Apriori algorithm in R.

PROCEDURE:

Step 1: The first part of any analysis is to bring in the dataset. We will be using an inbuilt dataset “Groceries” from the ‘arules’ package to simplify our analysis.

Step 2: All stores and retailers store their information of transactions in a specific type of dataset called the “Transaction” type dataset.

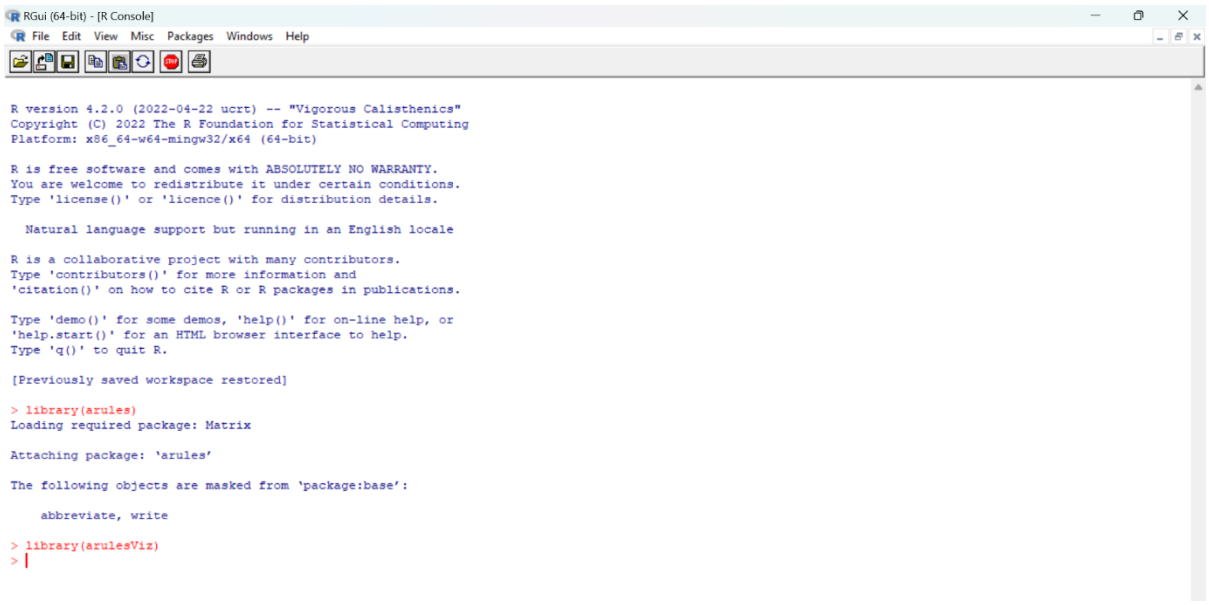
Step 3: The ‘pacman’ package is an assistor to help load and install the packages. we will be using pacman to load the arules package.

Step 4: The p_load() function from “pacman” takes names of packages as arguments.

Step 5: If your system has those packages, it will load them and if not, it will install and load them.

PROGRAM AND OUTPUT SCREENSHOT:

```
library(arules)
library(arulesViz)
```




```
data(Groceries)

data <- list(c("a","b","c"),
c("a","b"),
c("a","b","d"),
c("b","e"),
c("b","c","e"),
c("a","d","e"),
c("a","c"),
c("a","b","d"),
c("c","e"),
c("a","b","d","e"),
c("a",'b','e','c')
)
data <- as(data, "transactions")
inspect(data)
tl <- as(data, "tidLists")
inspect(tl)
```

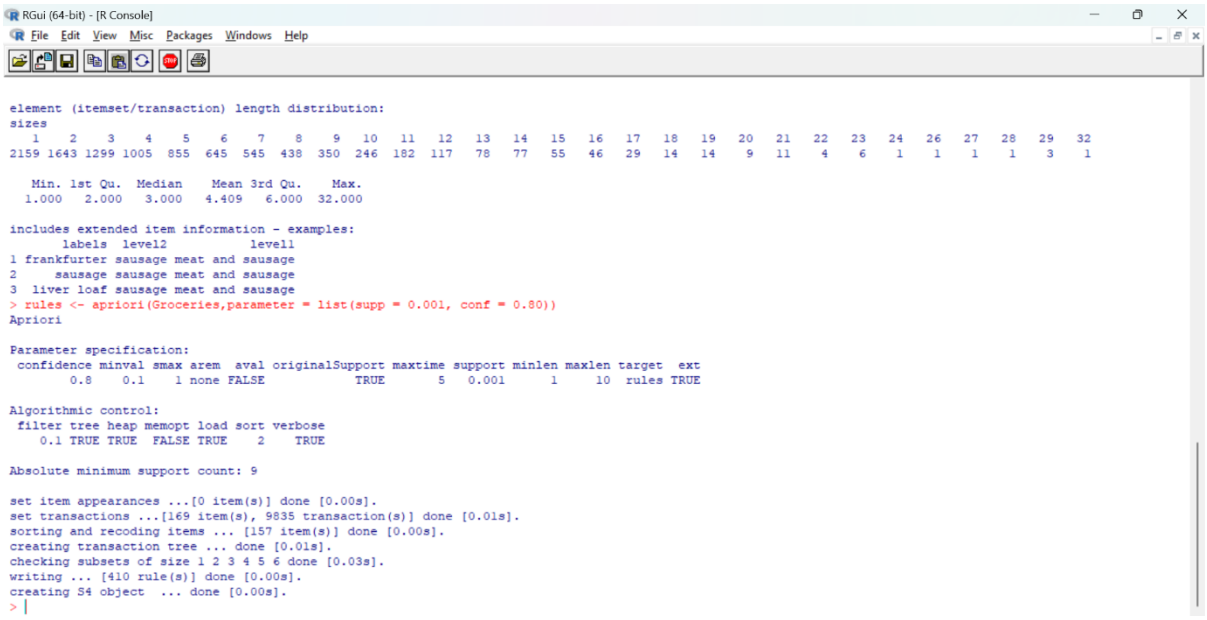
```
RGui (64-bit) - [R Console]
File Edit View Misc Packages Windows Help

Attaching package: 'arules'

The following objects are masked from 'package:base':

    abbreviate, write

> library(arulesViz)
> data(Groceries)
> data <- list(c("a","b","c"),
+ c("a","b"),
+ c("a","b","d"),
+ c("b","e"),
+ c("b","c","e"),
+ c("a","d","e"),
+ c("a","c"),
+ c("a","b","d"),
+ c("c","e"),
+ c("a","b","d","e"),
+ c("a",'b','e','c')
+ )
> data <- as(data, "transactions")
> inspect(data)
     items
[1]  {a, b, c}
[2]  {a, b}
[3]  {a, b, d}
[4]  {b, e}
[5]  {b, c, e}
[6]  {a, d, e}
[7]  {a, c}
[8]  {a, b, d}
[9]  {c, e}
[10] {a, b, d, e}
[11] {a, b, c, e}
>
```

```
RGui (64-bit) - [R Console]
File Edit View Misc Packages Windows Help

> data <- list(c("a","b","c"),
+ c("a","b"),
+ c("a","b","d"),
+ c("b","e"),
+ c("b","c","e"),
+ c("a","d","e"),
+ c("a","c"),
+ c("a","b","d"),
+ c("c","e"),
+ c("a","b","d","e"),
+ c("a",'b','e','c')
+ )
> data <- as(data, "transactions")
> inspect(data)
     items
[1]  {a, b, c}
[2]  {a, b}
[3]  {a, b, d}
[4]  {b, e}
[5]  {b, c, e}
[6]  {a, d, e}
[7]  {a, c}
[8]  {a, b, d}
[9]  {c, e}
[10] {a, b, d, e}
[11] {a, b, c, e}
> tl <- as(data, "tidLists")
> inspect(tl)
  items transactionIDs
1 a     {1,2,3,6,7,8,10,11}
2 b     {1,2,3,4,5,8,10,11}
3 c     {1,5,7,9,11}
4 d     {3,6,8,10}
5 e     {4,5,6,9,10,11}
>
```

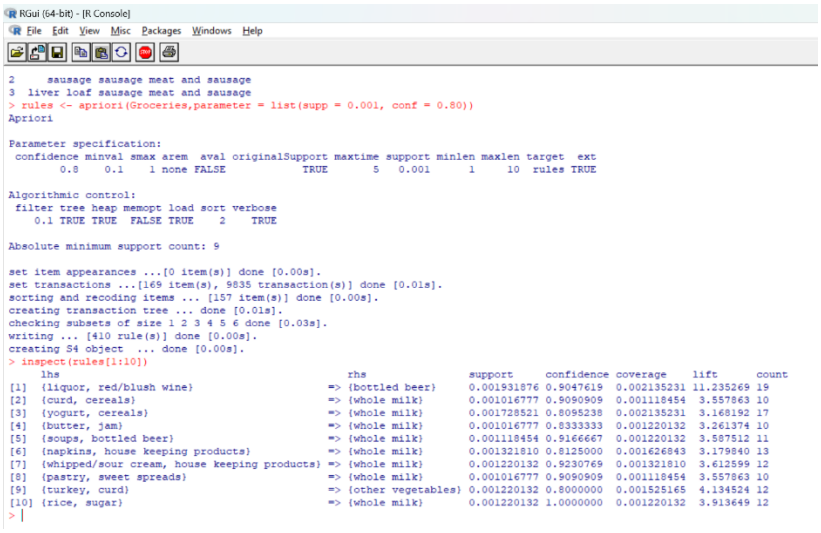
summary(Groceries)

```
RGui (64-bit) - [R Console]
File Edit View Misc Packages Windows Help

[8]  {a, b, d}
[9]  {c, e}
[10] {a, b, d, e}
[11] {a, b, c, e}
> tl <- as(data, "tidLists")
> inspect(tl)
  items transactionIDs
1 a     {1,2,3,6,7,8,10,11}
2 b     {1,2,3,4,5,8,10,11}
3 c     {1,5,7,9,11}
4 d     {3,6,8,10}
5 e     {4,5,6,9,10,11}
> summary(Groceries)
transactions as itemMatrix in sparse format with
 9835 rows (elements/itemsets/transactions) and
 169 columns (items) and a density of 0.02609146

most frequent items:
      whole milk other vegetables       rolls/buns             soda           yogurt          (Other)
            2513             1903             1809             1715             1372            34055

element (itemset/transaction) length distribution:
sizes
   1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20   21   22   23   24   26   27   28   29   32
2159 1643 1299 1005  855  645  545  438  350  246  182  117   78   77   55   46   29   14   14    9   11    4    6    1    1    1    1    3    1

   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  1.000   2.000   3.000   4.409   6.000  32.000

includes extended item information - examples:
        labels  level2           level1
1 frankfurter sausage meat and sausage
2     sausage sausage meat and sausage
3  liver loaf sausage meat and sausage
>
```

rules <- apriori(Groceries,parameter = list(supp = 0.001, conf = 0.80))

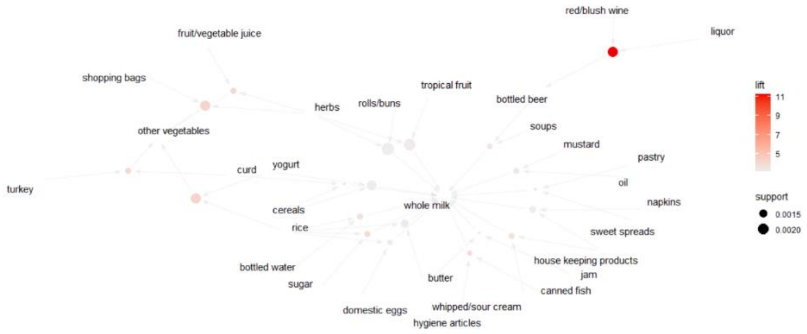


inspect(rules[1:10])



plot(rules[1:20], method = "graph", control = list(type = "items"))

```
RGui (64-bit) - [R Console]
File  Edit  View  Misc  Packages  Windows  Help

set item appearances ...[0 item(s)] done [0.00s].
set transactions ...[169 item(s), 9835 transaction(s)] done [0.01s].
sorting and recoding items ... [157 item(s)] done [0.00s].
creating transaction tree ... done [0.01s].
checking subsets of size 1 2 3 4 5 6 done [0.03s].
writing ... [410 rule(s)] done [0.00s].
creating S4 object  ... done [0.00s].
> inspect(rules[1:10])
     lhs                                                rhs                support     confidence coverage    lift      count
[1]  {liquor, red/blush wine}                        => {bottled beer}     0.001931876 0.9047619  0.002135231 11.235269 19
[2]  {curd, cereals}                                 => {whole milk}       0.001016777 0.9090909  0.001118454  3.557863 10
[3]  {yogurt, cereals}                               => {whole milk}       0.001728521 0.8095238  0.002135231  3.168192 17
[4]  {butter, jam}                                   => {whole milk}       0.001016777 0.8333333  0.001220132  3.261374 10
[5]  {soups, bottled beer}                           => {whole milk}       0.001118454 0.9166667  0.001220132  3.587512 11
[6]  {napkins, house keeping products}               => {whole milk}       0.001321810 0.8125000  0.001626843  3.179840 13
[7]  {whipped/sour cream, house keeping products}    => {whole milk}       0.001220132 0.9230769  0.001321810  3.612599 12
[8]  {pastry, sweet spreads}                         => {whole milk}       0.001016777 0.9090909  0.001118454  3.557863 10
[9]  {turkey, curd}                                  => {other vegetables} 0.001220132 0.8000000  0.001525165  4.134524 12
[10] {rice, sugar}                                   => {whole milk}       0.001220132 1.0000000  0.001220132  3.913649 12
> plot(rules[1:20],
+ method = "graph",
+ control = list(type = "items"))
Warning: Unknown control parameters: type
Available control parameters (with default values):
layout   =  stress
circular         =  FALSE
ggraphdots       =  NULL
edges    =  <environment>
nodes    =  <environment>
nodetext         =  <environment>
colors   =  c("#EE0000FF", "#EEEEEEFF")
engine   =  ggplot2
max      =  100
verbose  =  FALSE
>
```



RESULT:

Thus, the Apriori Algorithm is successfully executed in R language.

5. APRIORI IN WEKA

AIM

To implement apriori algorithm in weka.

PROCEDURE

Step 1: The first part of analysis is to bring in the dataset. We will be using a dataset weather.numeric.arff to simplify our analysis.
Step 2: Opening ARFF file in WEKA explorer.
Step 3: Apply the apriori algorithm

Figure 1. Opening ARFF file in WEKA explorer

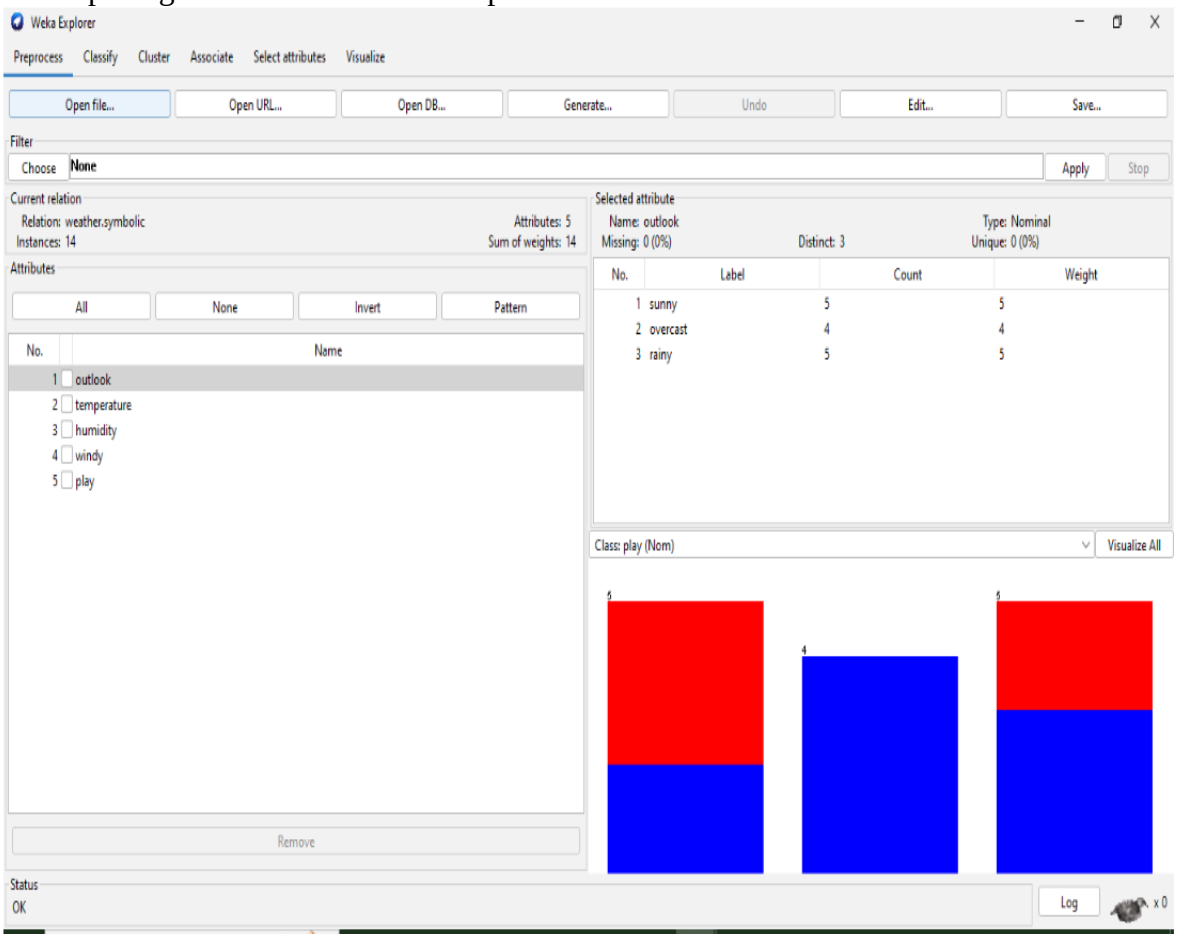


Figure 2 Apply the apriori algorithm

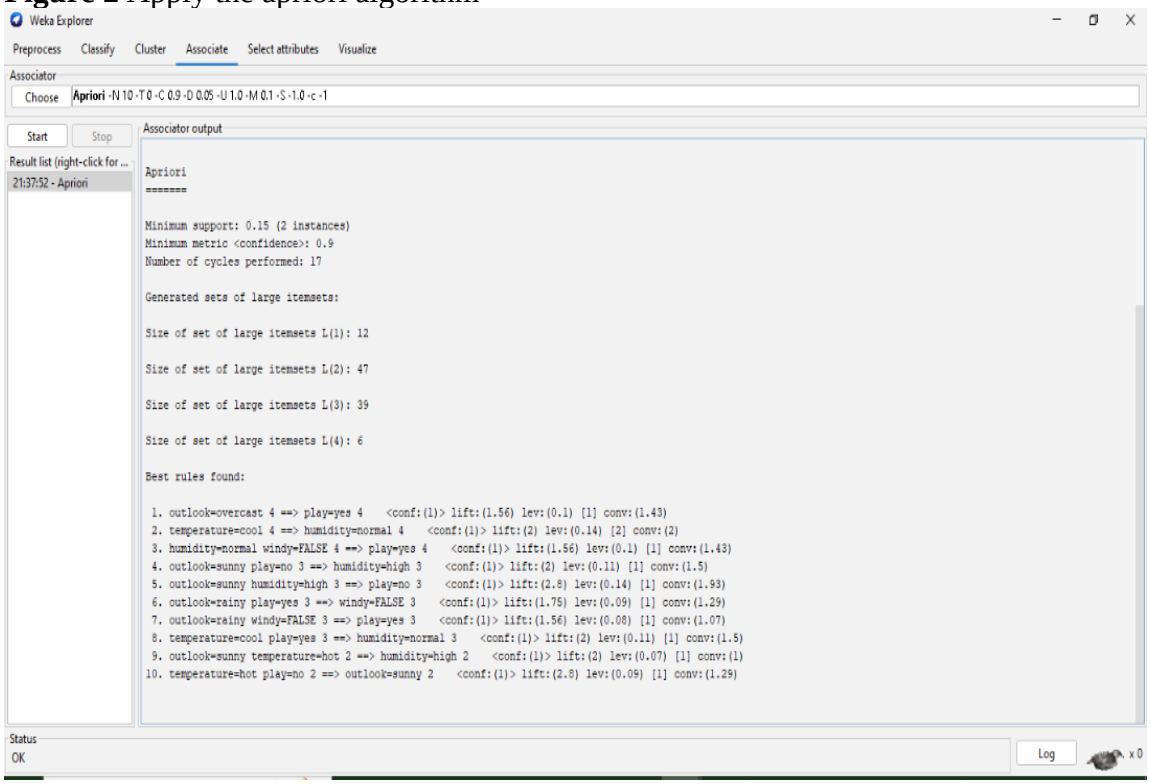
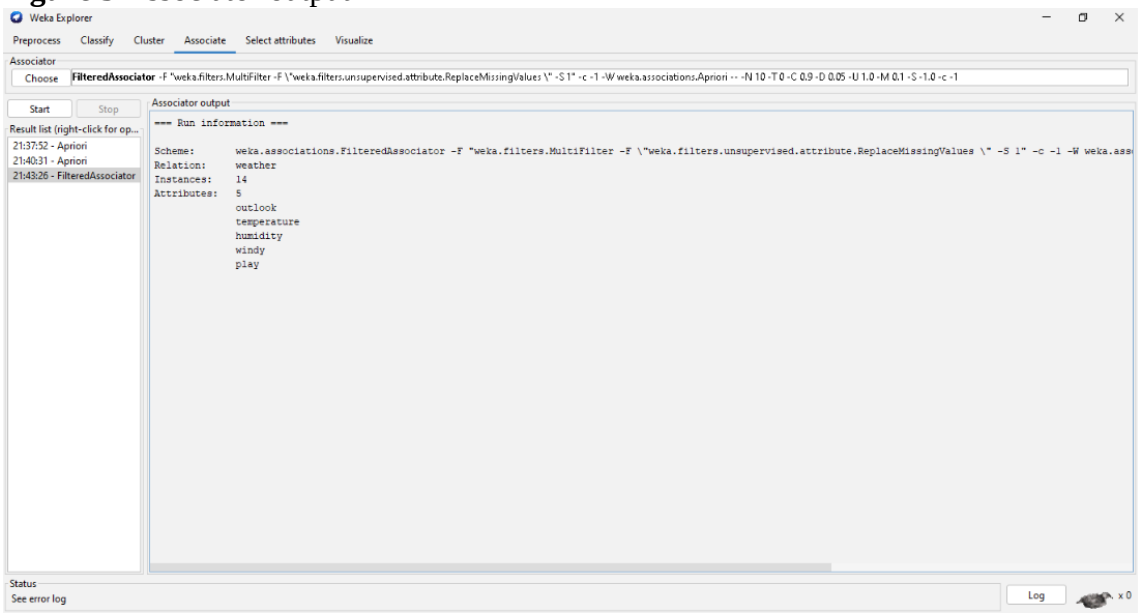


Figure 3 Associator output



RESULT:

Thus, the Apriori Algorithm is successfully executed in Weka.

6. APRIORI IN PYTHON

AIM:

To implement apriori algorithm in python.

PROCEDURE:

Step 1: Importing Libraries
Step 2: Importing the Dataset
Step 3: Data Preprocessing
Step 4: Using Apriori algorithm.

OUTPUT:

```
[1]
import numpy as np
import plotly.express as px
import pandas as pd
from apyori import apriori
```

```
[2]
data = pd.read_csv('D:\\DM LAB_APRIORI\\Groceries_dataset.csv')
print("Data Dimension:", data.shape)
data.head()
```

```
Data Dimension: (38765, 3)
```

	Member_number	Date	itemDescription
0	1808	21-07-2015	tropical fruit
1	2552	05-01-2015	whole milk
2	2300	19-09-2015	pip fruit
3	1187	12-12-2015	other vegetables
4	3037	01-02-2015	whole milk

```
[3]
data.isnull().any()
```

```
Member_number      False
Date               False
itemDescription    False
dtype: bool
```

```
[4]
print("Total number of unique products are:", len(data['itemDescription'].unique()))
```

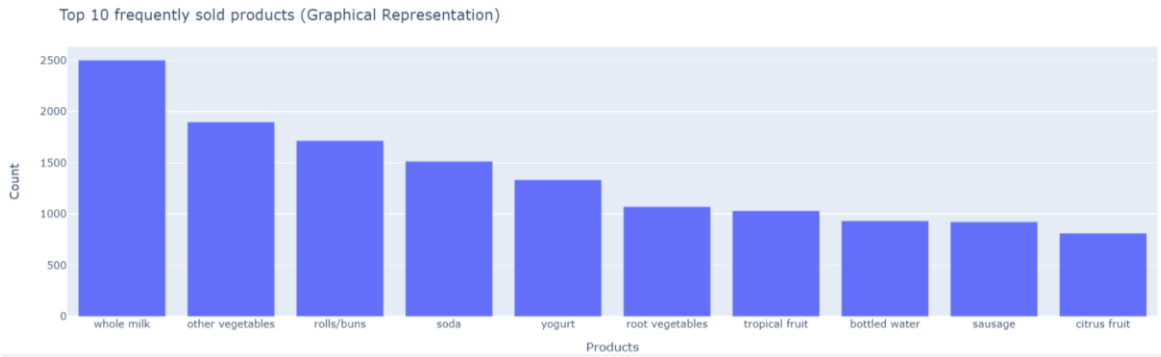
```
Total number of unique products are: 167
```

```
[5]
print("Top 10 frequently sold products(Tabular Representation)")
x = data['itemDescription'].value_counts().sort_values(ascending=False)[:10]
x
```

```
Top 10 frequently sold products(Tabular Representation)

whole milk          2502
other vegetables    1898
rolls/buns          1716
soda                1514
yogurt              1334
root vegetables     1071
tropical fruit      1032
bottled water        933
sausage              924
citrus fruit         812
Name: itemDescription, dtype: int64
```

```
fig = px.bar(x= x.index, y= x.values)
fig.update_layout(title_text= "Top 10 frequently sold products (Graphical Representation)", xaxis_title= "Products", yaxis_title="Count")
fig.show()
```

[6]



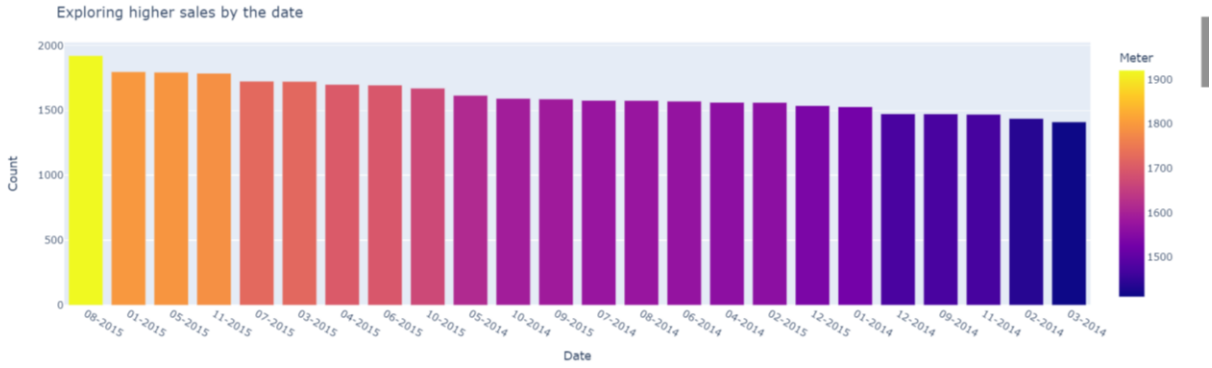

```
data["Year"] = data['Date'].str.split("-").str[-1]
data["Month-Year"] = data['Date'].str.split("-").str[1] + "-" + data['Date'].str.split("-").str[-1]
data.head()
```

[7]

	Member_number	Date	itemDescription	Year	Month-Year
0	1808	21-07-2015	tropical fruit	2015	07-2015
1	2552	05-01-2015	whole milk	2015	01-2015
2	2300	19-09-2015	pip fruit	2015	09-2015
3	1187	12-12-2015	other vegetables	2015	12-2015
4	3037	01-02-2015	whole milk	2015	02-2015

```
fig1 = px.bar(data["Month-Year"].value_counts(ascending=False),
              orientation= "v",
              color = data["Month-Year"].value_counts(ascending=False),
               labels={'value':'Count', 'index':'Date','color':'Meter'})

fig1.update_layout(title_text="Exploring higher sales by the date")

fig1.show()
```

[8] Python



```
products = data['itemDescription'].unique()
```
[9] Python

```
dummy = pd.get_dummies(data['itemDescription'])
data.drop(['itemDescription'], inplace =True, axis=1)

data = data.join(dummy)

data.head()
```
[10] Python

	Member_number	Date	Year	Month-Year	Instant food products	UHT-milk	abrasive cleaner	artif. sweetener	baby cosmetics	bags	...	turkey	vinegar	waffles	whipped/sour cream	whisky	white bread	white wine	whole milk	yogurt	zwieback
0	1808	21-07-2015	2015	07-2015	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
1	2552	05-01-2015	2015	01-2015	0	0	0	0	0	0	...	0	0	0	0	0	0	0	1	0	0
2	2300	19-09-2015	2015	09-2015	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
3	1187	12-12-2015	2015	12-2015	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
4	3037	01-02-2015	2015	02-2015	0	0	0	0	0	0	...	0	0	0	0	0	0	0	1	0	0

5 rows × 171 columns

```
data1 = data.groupby(['Member_number', 'Date'])[products[:]].sum()
data1 = data1.reset_index()[products]

print("New Dimension", data1.shape)
data1.head()
```
[11] Python

```
New Dimension (14963, 167)
```

	tropical fruit	whole milk	pip fruit	other vegetables	rolls/buns	pot plants	citrus fruit	beef	frankfurter	chicken	...	flower (seeds)	rice	tea	salad dressing	specialty vegetables	pudding powder	ready soups	make up remover	toilet cleaner	preservation products
0	0	1	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
1	0	1	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0

5 rows × 167 columns

```
def product_names(x):
    for product in products:
        if x[product] >0:
            x[product] = product
    return x

data1 = data1.apply(product_names, axis=1)
data1.head()
```
[12] Python

	tropical fruit	whole milk	pip fruit	other vegetables	rolls/buns	pot plants	citrus fruit	beef	frankfurter	chicken	...	flower (seeds)	rice	tea	salad dressing	specialty vegetables	pudding powder	ready soups	make up remover	toilet cleaner	preservation products
0	0	whole milk	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
1	0	whole milk	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0

5 rows × 167 columns

```
print("Total Number of Transactions:", len(data1))
```
[13] Python

```
Total Number of Transactions: 14963
```

```
x = data1.values
x = [sub[~(sub==0)].tolist() for sub in x if sub [sub != 0].tolist()]
transactions = x
transactions[0:10]
```

[14] Python

```
[['whole milk', 'yogurt', 'sausage', 'semi-finished bread'],
 ['whole milk', 'pastry', 'salty snack'],
 ['canned beer', 'misc. beverages'],
 ['sausage', 'hygiene articles'],
 ['soda', 'pickled vegetables'],
 ['frankfurter', 'curd'],
 ['whole milk', 'rolls/buns', 'sausage'],
 ['whole milk', 'soda'],
 ['beef', 'white bread'],
 ['frankfurter', 'soda', 'whipped/sour cream']]
```

```
rules = apriori(transactions, min_support = 0.00030, min_confidence = 0.05, min_lift = 3, max_length = 2, target = "rules")
association_results = list(rules)
print(association_results[0])
```

[15] Python

```
RelationRecord(items=frozenset({'liver loaf', 'fruit/vegetable juice'}), support=0.0004009891064626077 5, ordered_statistics=[OrderedStatistic(items_base=frozenset({'liver loaf'}),
items_add=frozenset({'fruit/vegetable juice'}), confidence=0.12, lift=3.5276227897838903)])
```

```
for item in association_results:

    pair = item[0]
    items = [x for x in pair]

    print("Rule : ", items[0], " -> " + items[1])
    print("Support : ", str(item[1]))
    print("Confidence : ",str(item[2][0][2]))
    print("Lift : ", str(item[2][0][3]))

    print("==============================")
```

[16]

```
Rule :  liver loaf  -> fruit/vegetable juice
Support :  0.0004009891064626077 5
Confidence :  0.12
Lift :  3.5276227897838903
============================
Rule :  pickled vegetables  -> ham
Support :  0.0005346521419501437
Confidence :  0.05970149253731344
Lift :  3.489505597014925 4
============================
Rule :  roll products   -> meat
Support :  0.0003341575887188398
Confidence :  0.06097560975609757
Lift :  3.620547812620984
============================
Rule :  misc. beverages  -> salt
Support :  0.0003341575887188398
Confidence :  0.05617977528089888
Lift :  3.5619405827461437
============================
Rule :  misc. beverages  -> spread cheese
Support :  0.0003341575887188398
Confidence :  0.05
Lift :  3.170127118644068
============================
Rule :  soups  -> seasonal products
Support :  0.0003341575887188398
Confidence :  0.10416666666666667
Lift :  14.704205974842768
============================
Rule :  sugar  -> spread cheese
Support :  0.0004009891064626077 5
Confidence :  0.06
Lift :  3.3878490566037733
============================
```

RESULT:

Thus, Apriori algorithm is successfully executed using Python.

7. BAYES IN WEKA

AIM:

To implement Bayes classifier in Weka.

PROCEDURE:

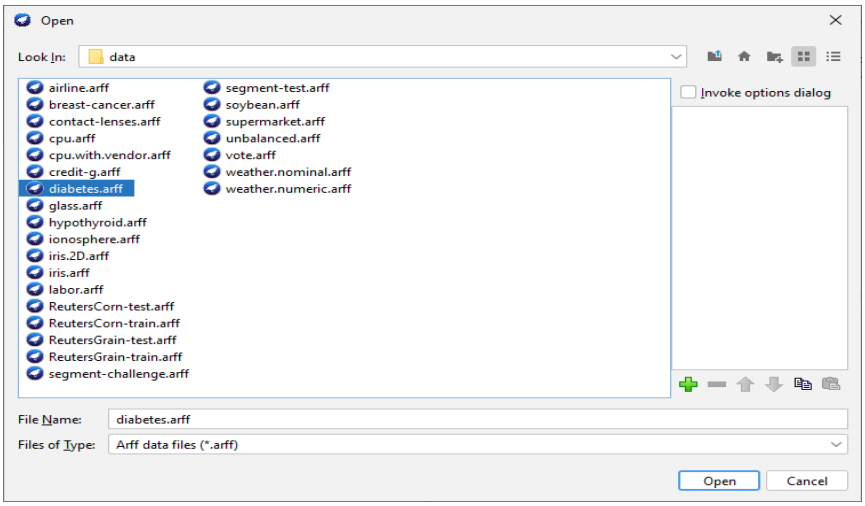
The following is how to apply simple classifier and visualization with Weka to a Naive Bayes classifier.

Loading the Diabetes Data

Step 1: Start Weka

Step 2: Press the Explorer Button:

Step 3: Download the diabetes data file, e.g. from Weka folder.
Step 4: In the "Preprocess" tab of the Weka Explorer window, click the "Open file…" button, and select the diabetes data file from your download location. The window should then look like this:

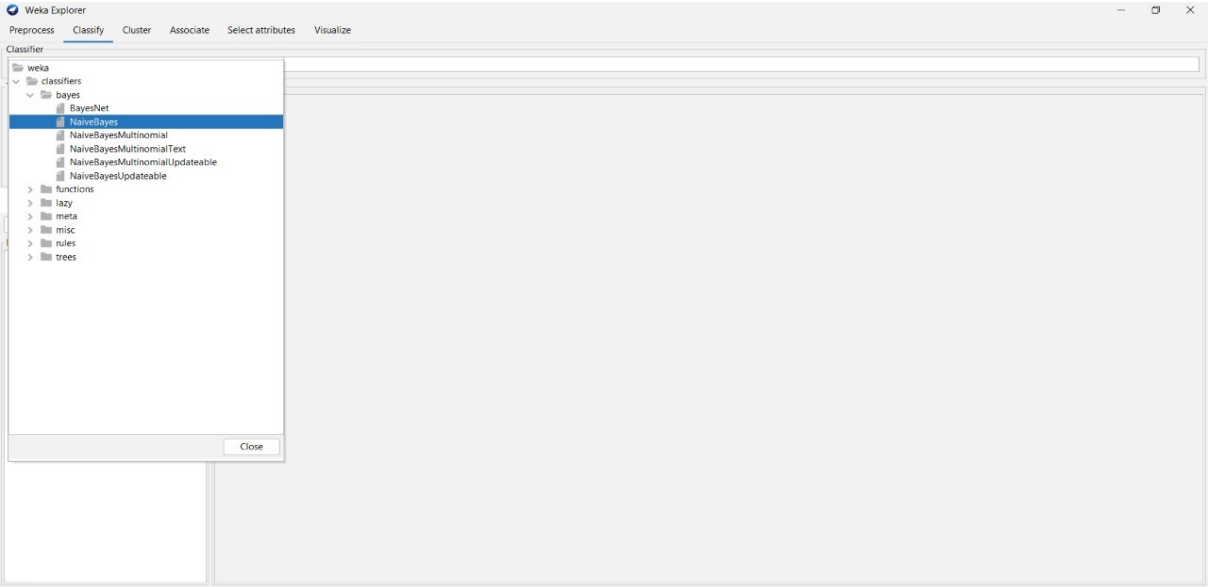


Naive Bayes classifier:

We will experiment here to see how well the **Naive Bayes classifier** algorithm classifies the data according to the original class labels.

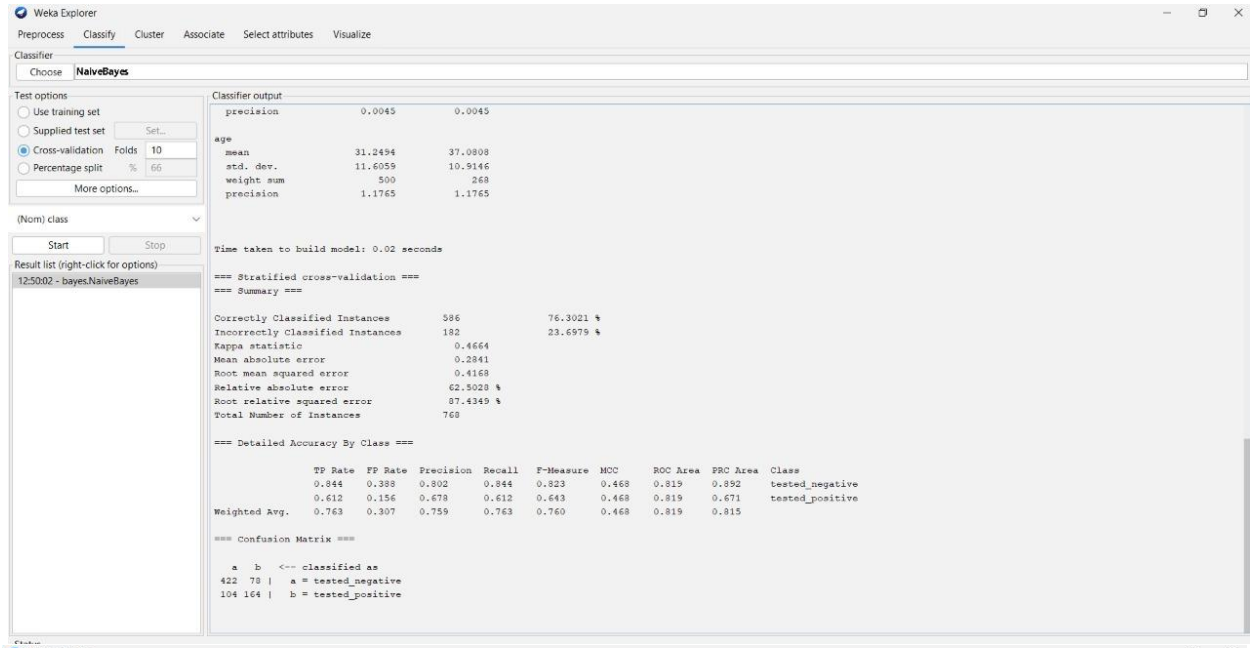
Step 1: Click the “Classify” tab at the top of the Weka Explorer.

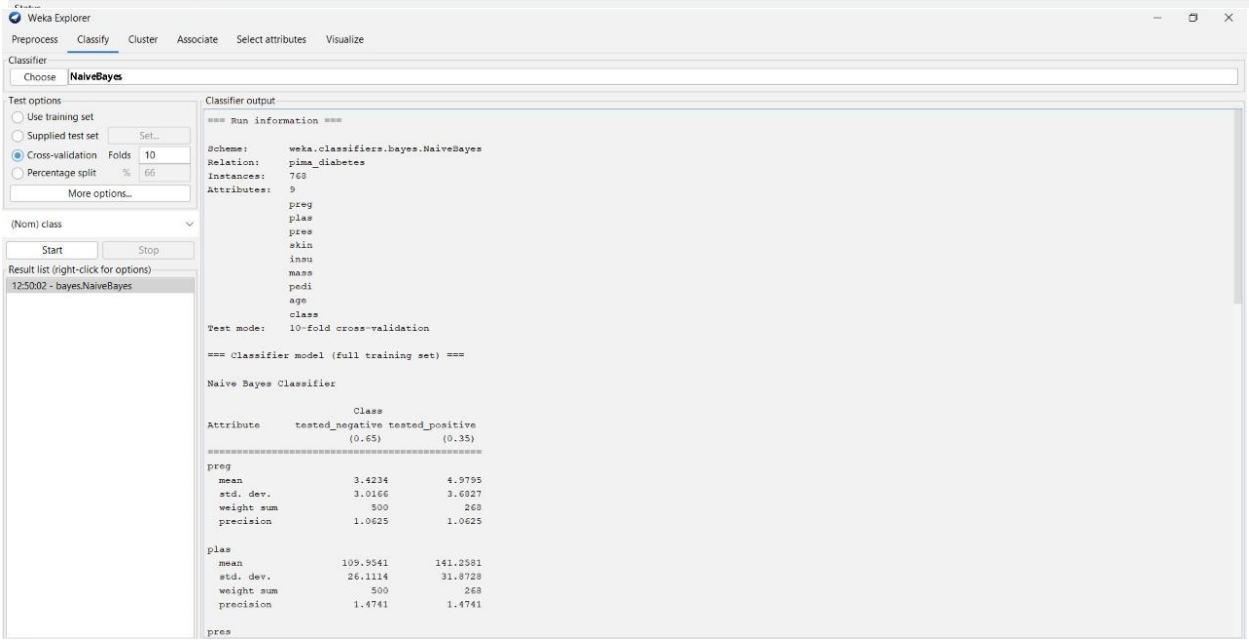
Step 2: Click the Classify “Choose” button and select “Naive Bayes”.

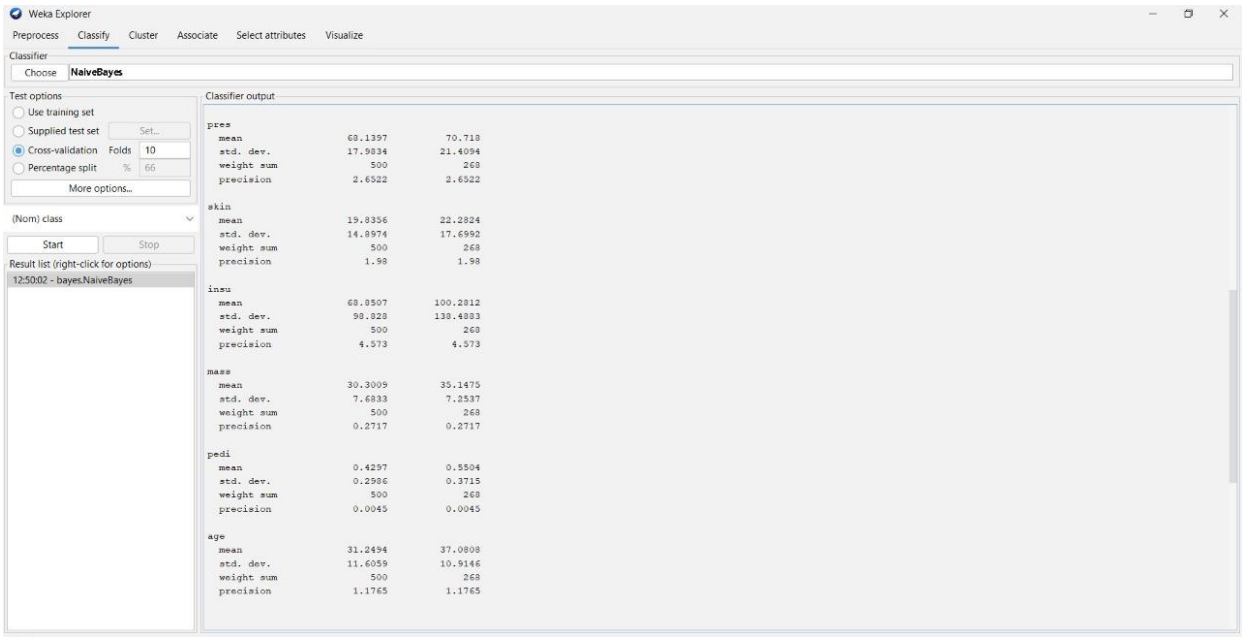


Step 3: Click “Cross-validation” in “Test options” and set “folds as 10”.

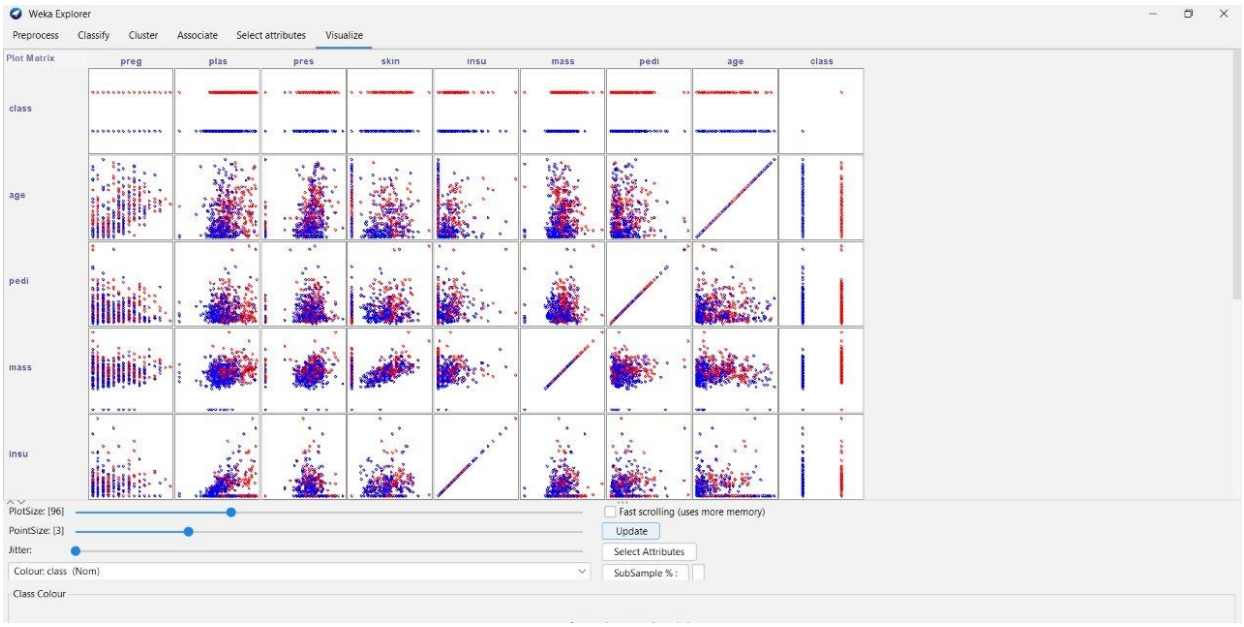
Step 4: Press Start to begin Naive Bayes classifier and evaluation.


Weka Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
NaiveBayes
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
(Nom) class
Start
Stop
Result list (right-click for options)
12:50:02 - bayes.NaiveBayes
Classifier output
precision 0.0045 0.0045
age
mean 31.2494 37.0808
std. dev. 11.6059 10.9146
weight sum 500 268
precision 1.1765 1.1765
Time taken to build model: 0.02 seconds
=== Stratified cross-validation ===
=== Summary ===
Correctly Classified Instances 586 76.3021 %
Incorrectly Classified Instances 182 23.6979 %
Kappa statistic 0.4664
Mean absolute error 0.2841
Root mean squared error 0.4168
Relative absolute error 62.5028 %
Root relative squared error 87.4349 %
Total Number of Instances 768
=== Detailed Accuracy By Class ===
TP Rate FP Rate Precision Recall F-Measure MCC ROC Area PRC Area Class
0.844 0.388 0.802 0.844 0.823 0.468 0.819 0.892 tested_negative
0.612 0.156 0.678 0.612 0.643 0.468 0.819 0.671 tested_positive
Weighted Avg. 0.763 0.307 0.759 0.763 0.760 0.468 0.819 0.815
=== Confusion Matrix ===
a b <-- classified as
422 78 | a = tested_negative
104 164 | b = tested_positive


Weka Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
NaiveBayes
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
(Nom) class
Start
Stop
Result list (right-click for options)
12:50:02 - bayes.NaiveBayes
Classifier output
=== Run information ===
Scheme: weka.classifiers.bayes.NaiveBayes
Relation: pima_diabetes
Instances: 768
Attributes: 9
preg
plas
pres
skin
insu
mass
pedi
age
class
Test mode: 10-fold cross-validation
=== Classifier model (full training set) ===
Naive Bayes Classifier
Class
Attribute tested_negative tested_positive
(0.65) (0.35)
preg
mean 3.4234 4.9795
std. dev. 3.0166 3.6827
weight sum 500 268
precision 1.0625 1.0625
plas
mean 109.9541 141.2581
std. dev. 26.1114 31.8728
weight sum 500 268
precision 1.4741 1.4741
pres



Step 5: Click on the "Visualize" tab.



RESULT:

Thus, Bayes classifier is successfully executed using Weka.

8. BAYES CLASSIFIER USING R

AIM:

To implement Bayes classifier using R.

PROCEDURE:

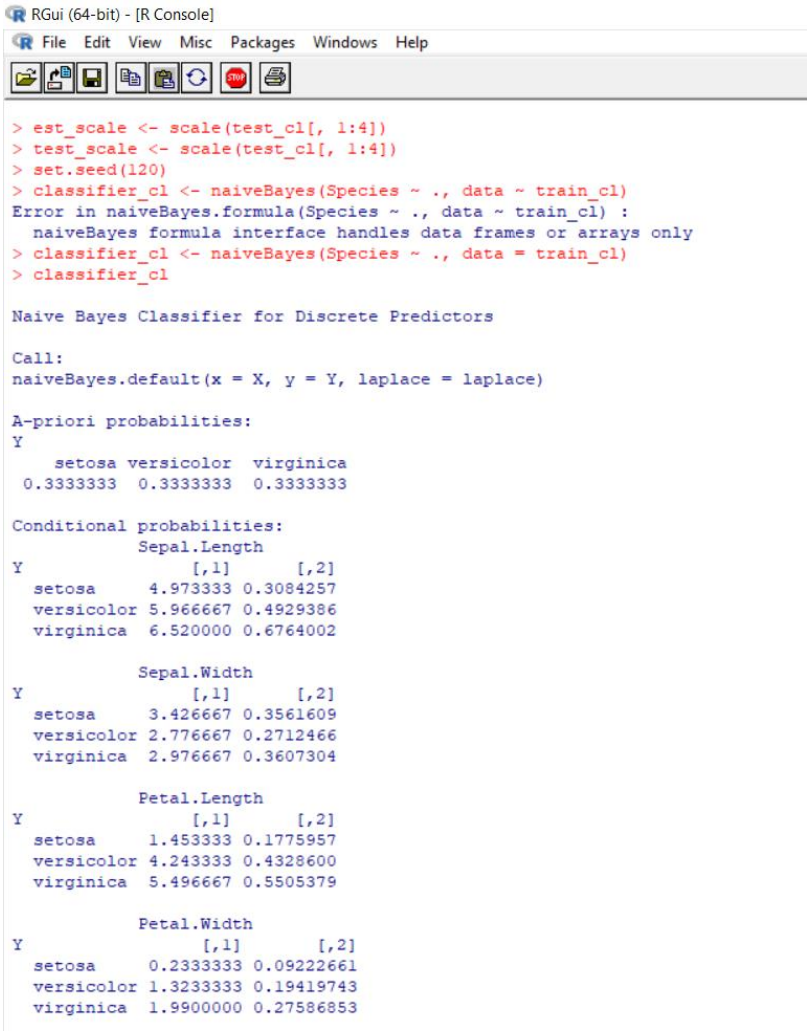
- **Step 1**: The first part of any analysis is to bring in the dataset. We will be using an inbuilt dataset "Iris", caTools, caret and e1071 packages are loaded for our analysis.
- **Step 2**: The iris data are now trained and tested by using the below commands.
  > data(iris)
  > str(iris)
  >library(caTools)
  > library(caret)
  > library(e1071)
  > split <- sample.split(iris, SplitRatio=0.7)
  > train_cl <- subset(iris, split=="TRUE")
  > test_cl <- subset(iris, split=="FALSE")
  > train_scale <- scale(train_cl[, 1:4])
  > est_scale <- scale(test_cl[, 1:4])
  > test_scale <- scale(test_cl[, 1:4])
  > set.seed(120)

```
> utils:::menuInstallPkgs()
--- Please select a CRAN mirror for use in this session ---
Error in contrib.url(repos, type) :
  trying to use CRAN without setting a mirror
> data(iris)
> str(iris)
'data.frame':   150 obs. of  5 variables:
 $ Sepal.Length: num  5.1 4.9 4.7 4.6 5 5.4 4.6 5 4.4 4.9 ...
 $ Sepal.Width : num  3.5 3 3.2 3.1 3.6 3.9 3.4 3.4 2.9 3.1 ...
 $ Petal.Length: num  1.4 1.4 1.3 1.5 1.4 1.7 1.4 1.5 1.4 1.5 ...
 $ Petal.Width : num  0.2 0.2 0.2 0.2 0.2 0.4 0.3 0.2 0.2 0.1 ...
 $ Species     : Factor w/ 3 levels "setosa","versicolor",..: 1 1 1 1 1 1 1 1 1 1 ...
> library(caTools)
> library(caret)
Loading required package: ggplot2
Loading required package: lattice
> library(e1071)
>
>
> library(caTools)
> split <- sample.split(iris, SplitRatio=0.7)
> train_cl <- subset(iris, split=="TRUE")
> test_cl <- subset(iris, split=="FALSE")
> train_scale <- scale(train_cl[, 1:4])
> est_scale <- scale(test_cl[, 1:4])
> test_scale <- scale(test_cl[, 1:4])
> set.seed(120)
```

Step 3: Now Bayes classifier is implemented.

> classifier_cl <- naiveBayes(Species ~ ., data = train_cl)

> classifier_cl




```
> est_scale <- scale(test_cl[, 1:4])
> test_scale <- scale(test_cl[, 1:4])
> set.seed(120)
> classifier_cl <- naiveBayes(Species ~ ., data ~ train_cl)
Error in naiveBayes.formula(Species ~ ., data ~ train_cl) :
  naiveBayes formula interface handles data frames or arrays only
> classifier_cl <- naiveBayes(Species ~ ., data = train_cl)
> classifier_cl

Naive Bayes Classifier for Discrete Predictors

Call:
naiveBayes.default(x = X, y = Y, laplace = laplace)

A-priori probabilities:
Y
    setosa versicolor  virginica
 0.3333333  0.3333333  0.3333333

Conditional probabilities:
            Sepal.Length
Y               [,1]      [,2]
  setosa     4.973333 0.3084257
  versicolor 5.966667 0.4929386
  virginica  6.520000 0.6764002

            Sepal.Width
Y               [,1]      [,2]
  setosa     3.426667 0.3561609
  versicolor 2.776667 0.2712466
  virginica  2.976667 0.3607304

            Petal.Length
Y               [,1]      [,2]
  setosa     1.453333 0.1775957
  versicolor 4.243333 0.4328600
  virginica  5.496667 0.5505379

            Petal.Width
Y               [,1]       [,2]
  setosa     0.2333333 0.09222661
  versicolor 1.3233333 0.19419743
  virginica  1.9900000 0.27586853
```

RESULT:

Thus, Bayes classifier is successfully executed in R.

9. BAYESIAN IN PYTHON

AIM:

Implementing Naive Bayes algorithm using Python.

PROCEDURE:

Naive Bayes algorithm:

Step 1: Data Pre-processing step
Step 2: Fitting Naive Bayes to the Training Set
Step 3: Prediction of the test set result
Step 4: Creating Confusion Matrix

OUTPUT:

In [1]:
```
import numpy as np
```

In [2]:
```
def fit(X_train,Y_train):
    result = {}
    class_values = set(Y_train)
    for curr_value in class_values:
        result[curr_value] = {}
        result["total_data"] = len(Y_train)
        curr_class_rows = (Y_train == curr_value)
        X_train_curr = X_train[curr_class_rows]
        Y_train_curr = Y_train[curr_class_rows]
        num_features = X_train.shape[1]
        result[curr_value]["total_count"] = len(Y_train_curr)
        for j in range(1,num_features+1):
            result[curr_value][j] = {}
            all_possible_values = set(X_train[:,j-1])
            for this_value in all_possible_values:
                result[curr_value][j][this_value] = (X_train_curr[:,j-1]==this_value).sum()
    return result
```

In [3]:
```
def probablity(dictionary,x,current_class):
    output= np.log(dictionary[current_class]["total_count"])-np.log(dictionary["total_data"])
    num_features = len(dictionary[current_class].keys())-1;
    for j in range(1,num_features+1):
        xj = x[j-1]
        count_current_class_with_value_xj = dictionary[current_class][j][xj] + 1
        count_current_class = dictionary[current_class]["total_count"] + len(dictionary[current_class][j].keys())
        current_xj_prob = np.log(count_current_class_with_value_xj) -np.log(count_current_class)
        output = output + current_xj_prob
    return output
```

In [4]:
```
def predictSinglePoint(dictionary,x):
    classes = dictionary.keys()
    best_p = -1000
    best_class = -1
    first_run = True
    for current_class in classes:
        if(current_class == "total_data"):
            continue
        p_curr_class = probablity(dictionary,x,current_class)
        if(first_run or p_curr_class > best_p):
            best_p = p_curr_class
            best_class = current_class
        first_run = False
    return best_class
```

In [5]:
```
def predict(dictionary,X_test):
    Y_pred = []
    for x in X_test:
        x_class = predictSinglePoint(dictionary,x)
        Y_pred.append(x_class)
    return Y_pred
```

In [6]:
```
def makelabelled(column):
    second_limit = column.mean()
    first_limit = 0.5 * second_limit
    third_limit = 1.5 * second_limit
    for i in range(0,len(column)):
        if(column[i]<first_limit):
            column[i] = 0
        elif(column[i] < second_limit):
            column[i] = 1
        elif(column[i]<third_limit):
            column[i] = 2
        else:
            column[i] = 3
    return column
```

In [7]:
```
from sklearn import datasets
iris = datasets.load_iris()
x = iris.data
y = iris.target
```

In [8]:
```
for i in range(0,x.shape[-1]):
    x[:,i] = makelabelled(x[:,i])
```

In [9]:
```
from sklearn import model_selection
X_train,X_test,Y_train,Y_test = model_selection.train_test_split(x,y,test_size=0.25,random_state=0)
```

In [10]:
```
dictionary = fit(X_train,Y_train)
```

```
In [10]: dictionary = fit(X_train,Y_train)

In [11]: Y_pred = predict(dictionary,X_test)

In [12]: from sklearn.metrics import classification_report,confusion_matrix
         print(classification_report(Y_test,Y_pred))
         print(confusion_matrix(Y_test,Y_pred))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        13
           1       0.94      1.00      0.97        16
           2       1.00      0.89      0.94         9

    accuracy                           0.97        38
   macro avg       0.98      0.96      0.97        38
weighted avg       0.98      0.97      0.97        38

[[13  0  0]
 [ 0 16  0]
 [ 0  1  8]]
```

RESULT:

Thus, Bayes classifier is successfully executed using Python.

INTERNAL – 1

10. Demonstration of Association rule process on dataset contactlenses using apriori algorithm in WEKA

AIM:

To find Association rule process on dataset contactlenses using apriori algorithm in Weka

PROCEDURE:

Step1: Open the data file in Weka Explorer. It is presumed that the required data fields have been discretized. In this example it is age attribute

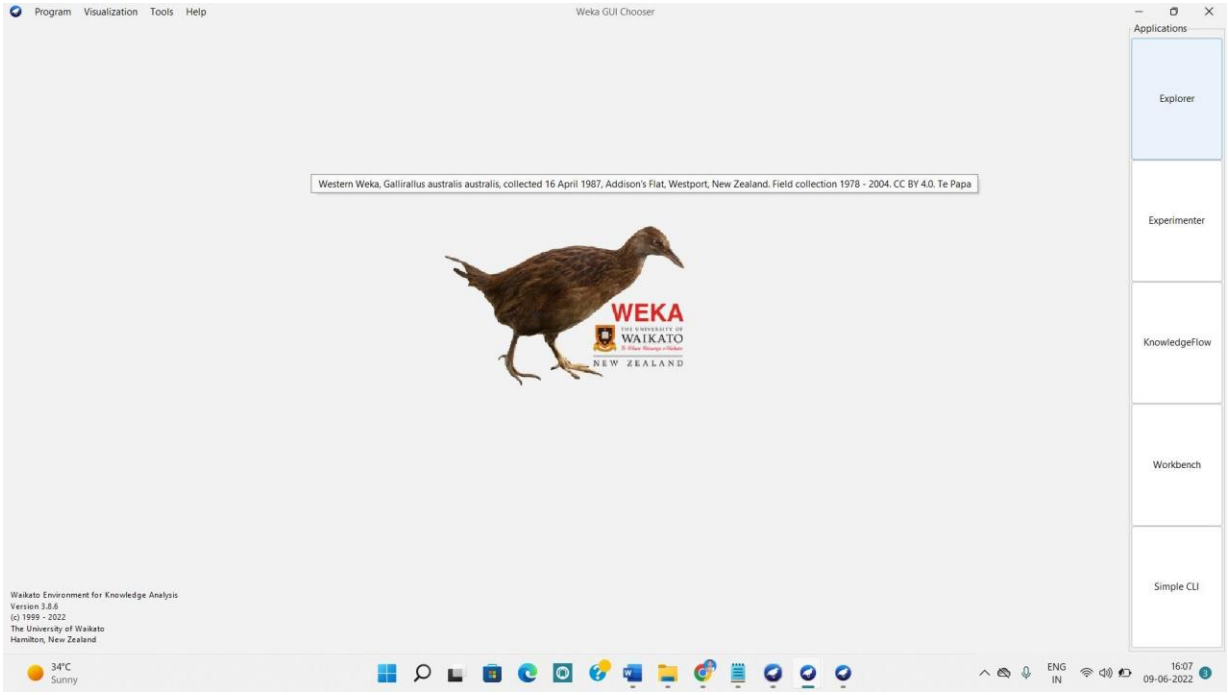
Step2: Clicking on the associate tab will bring up the interface for association rule algorithm

Step3: We will use apriori algorithm. This is the default algorithm

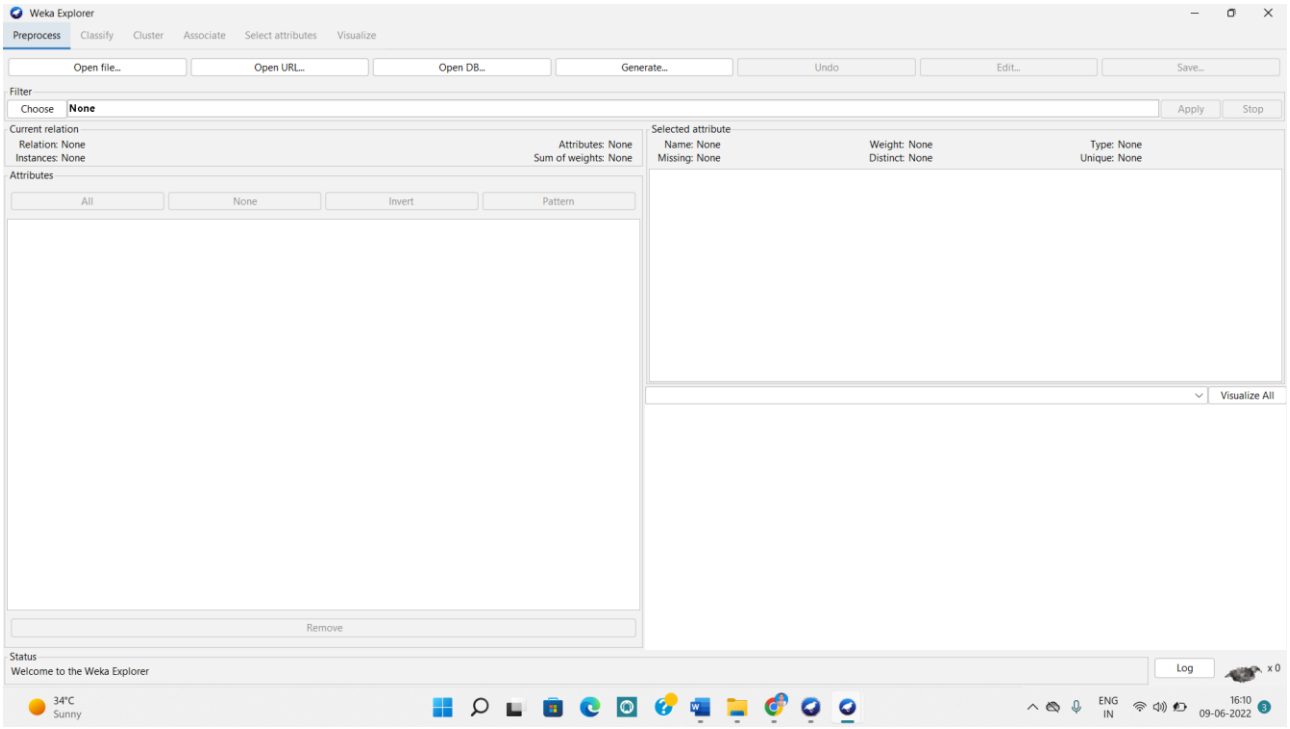
Step4: In order to change the parameters for the run (example support, confidence etc) we click on the text box immediately to the right of the choose button

OUTPUT SCREENSHOT:

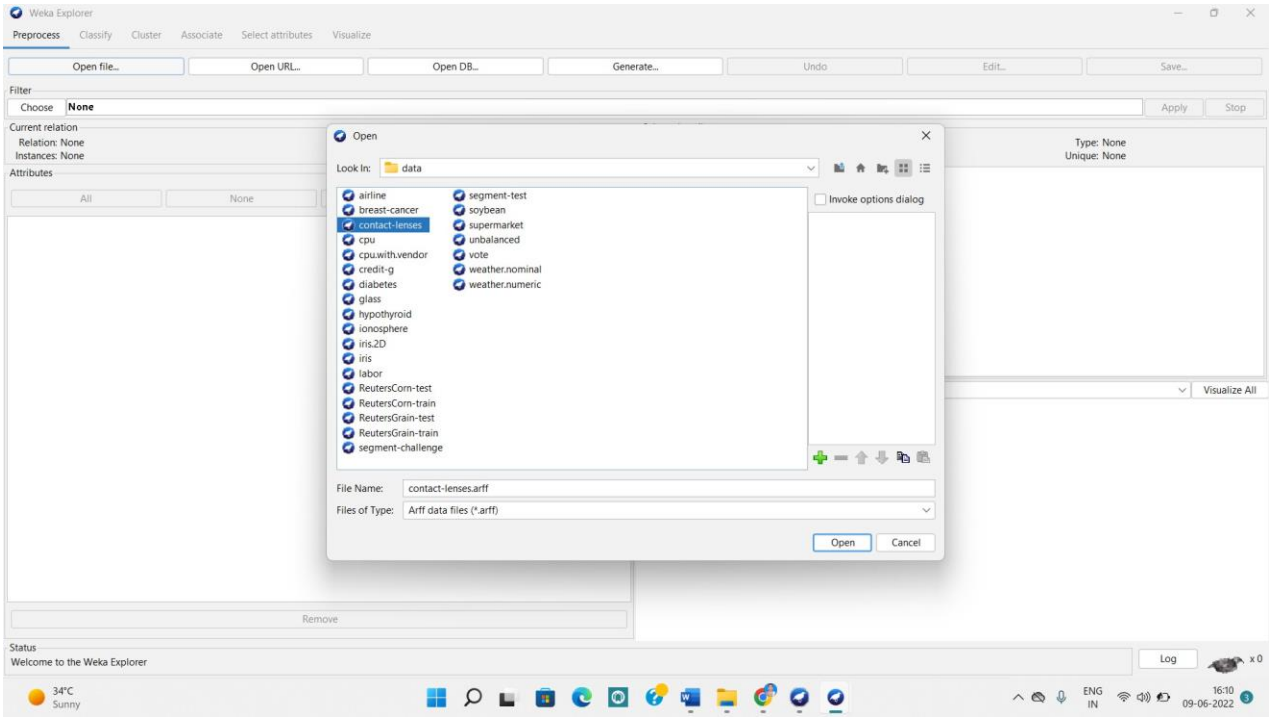
Open Weka →Click Explore



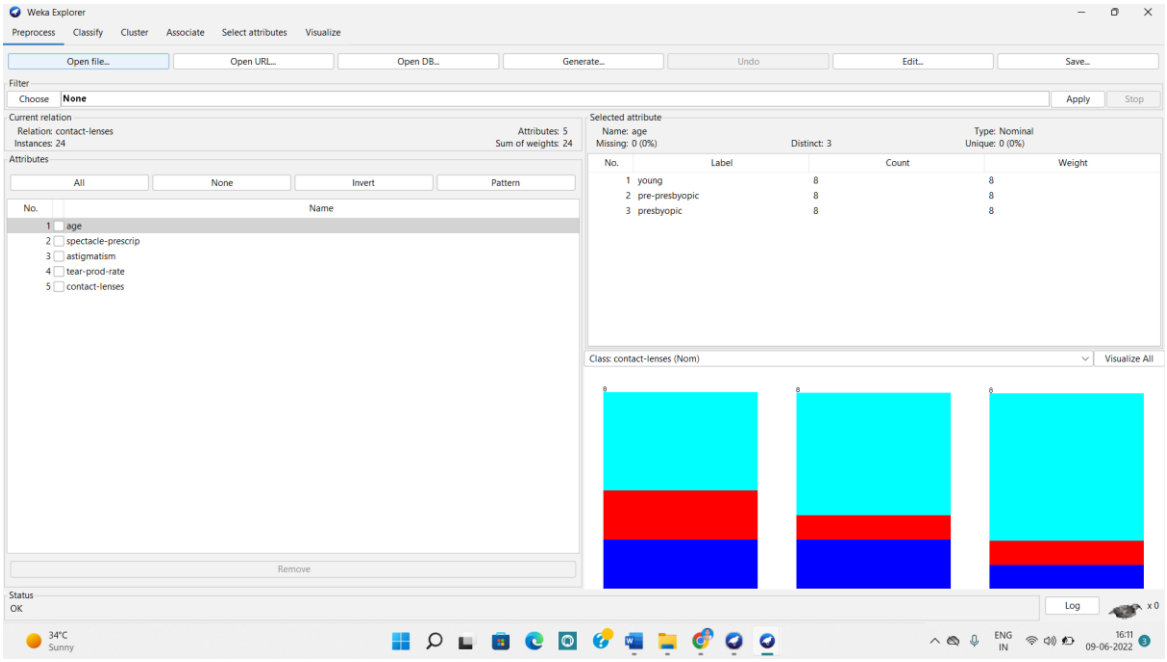
In preprocess → Click open file

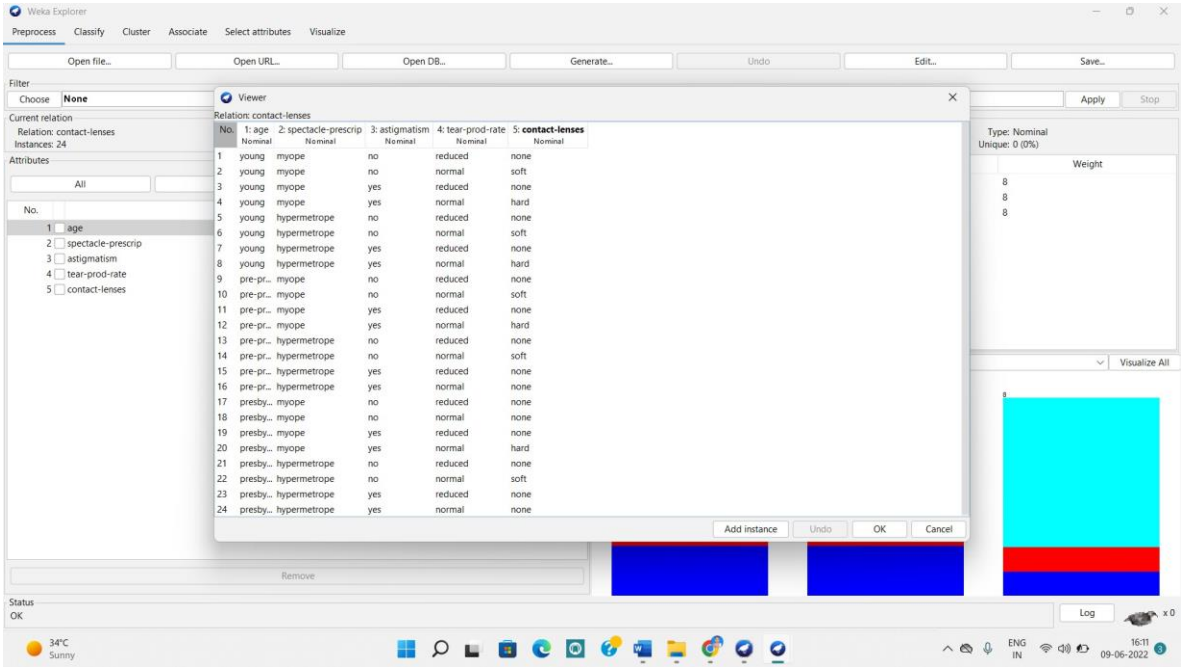


Select weka → data → (Dataset)contactlenses → click open

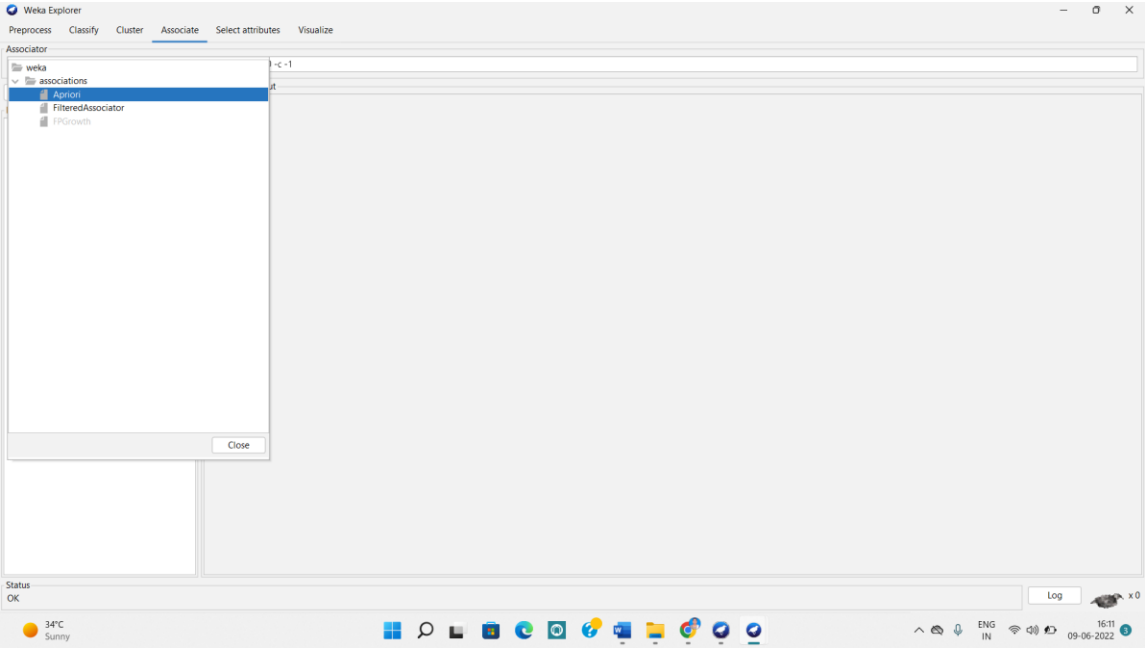


It will show the pre-processed data of contact lens

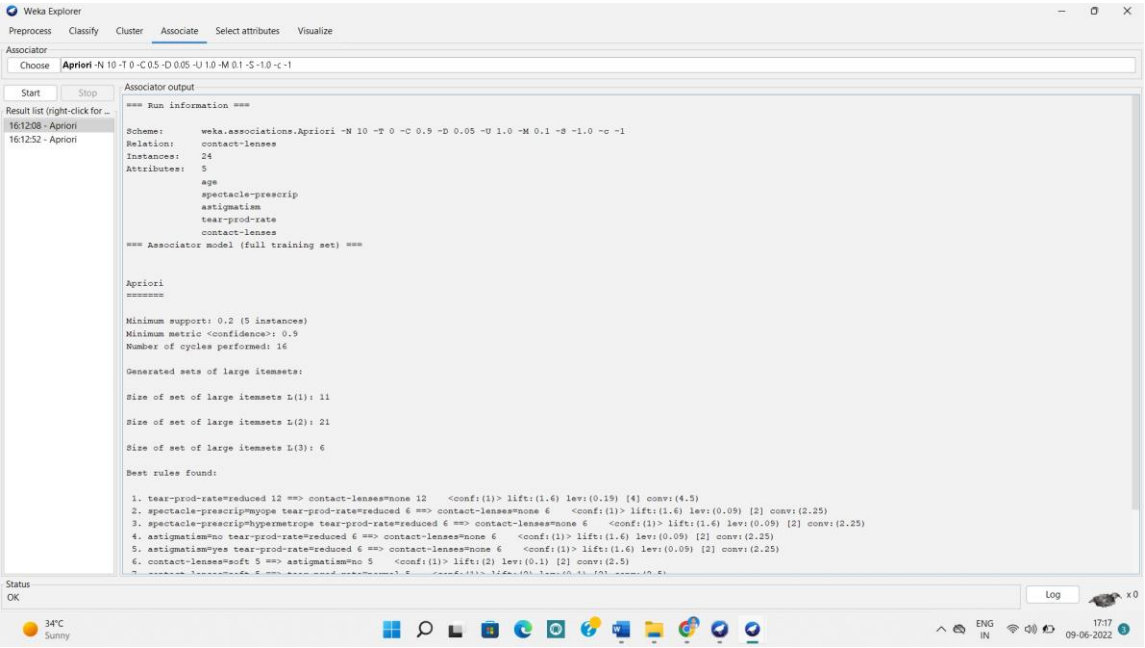




Select Associate → Select Apriori



It will show minimum support, minimum matrix, no. of cycles in this figure



RESULT:

Thus, the Association rule process on dataset contactlenses using apriori algorithm in WEKA is shown.

11. Create a dataset in .arff file format. Demonstration of preprocessing using weka dataset

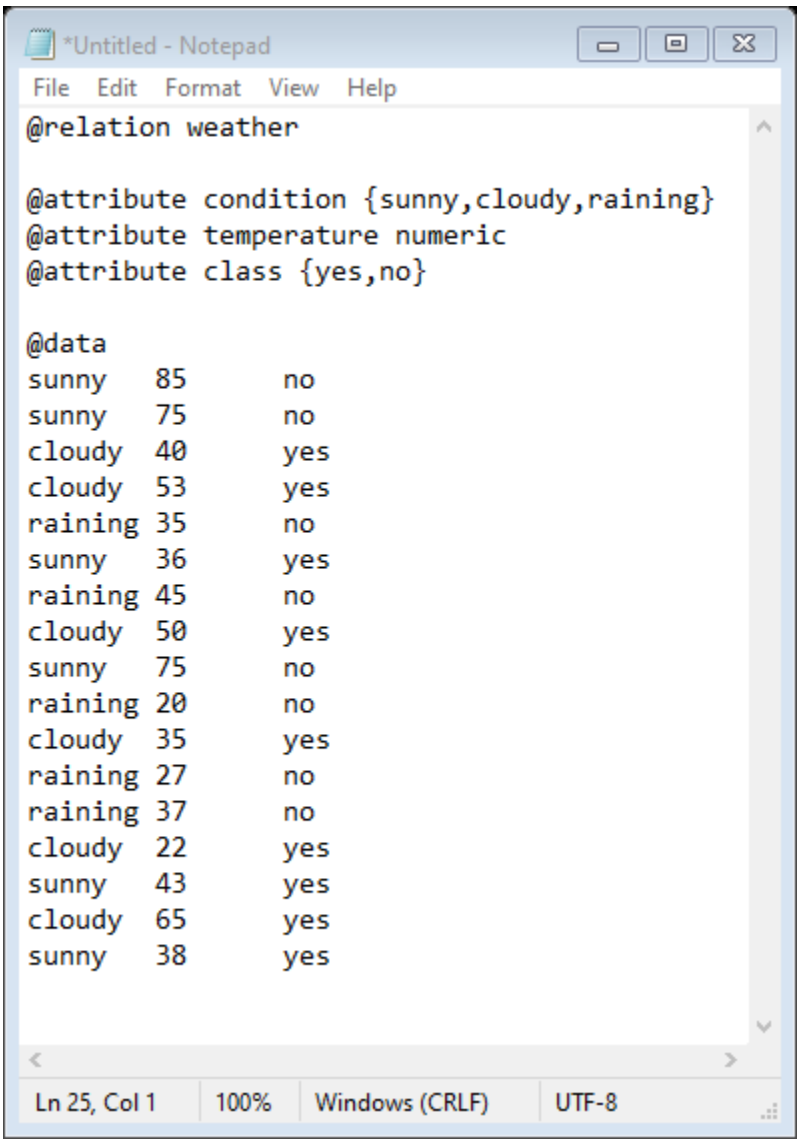
AIM:

To create a dataset in .arff file format and demonstrate preprocessing using WEKA dataset.

PROCEDURE:

STEP-1: Open NOTEPAD.

STEP-2: Type your dataset.



Here,

Firstly, we need to say type of relation/name as follows

"@relation weather"

Secondly, we have to define the attributes as follows,

"@attribute attribute_name type/type of arguments it has"

In our dataset we are taking three attribute namely –

condition, temperature and class

In our dataset,

condition has three arguments – sunny, raining and cloudy.

Temperature is taking numbers so it is a numeric type

Class having – yes, no arguments in the dataset

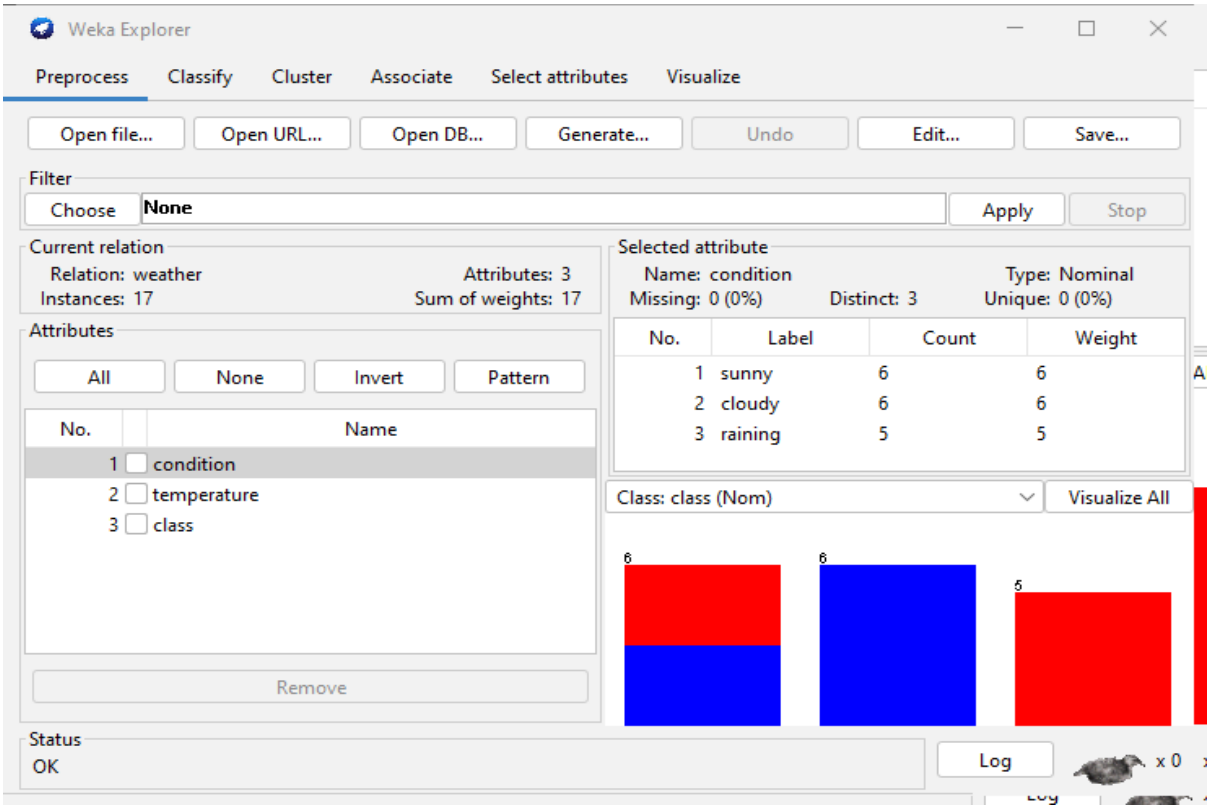
Finally, we enter our dataset data by following "@data"

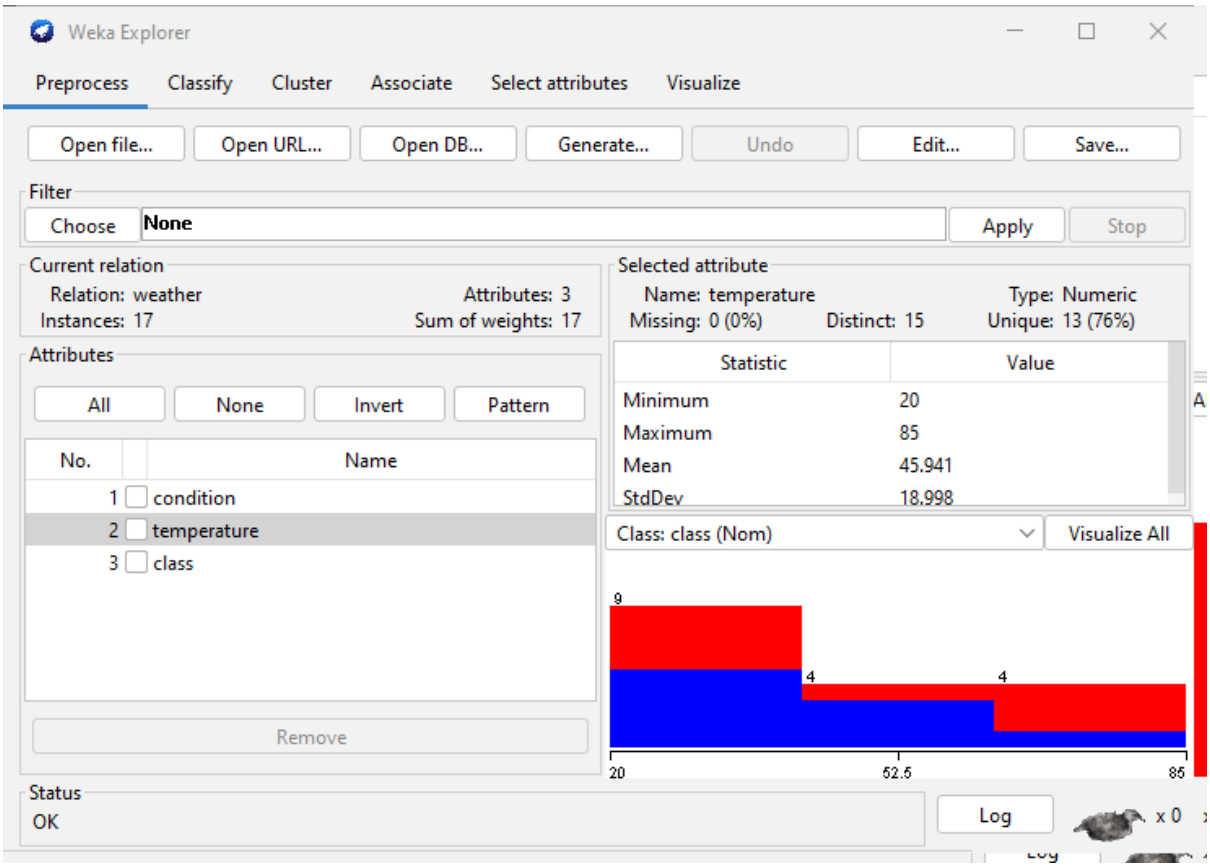
These are the requirements then only .arff file can be read by weka. Otherwise, it will throw an error.

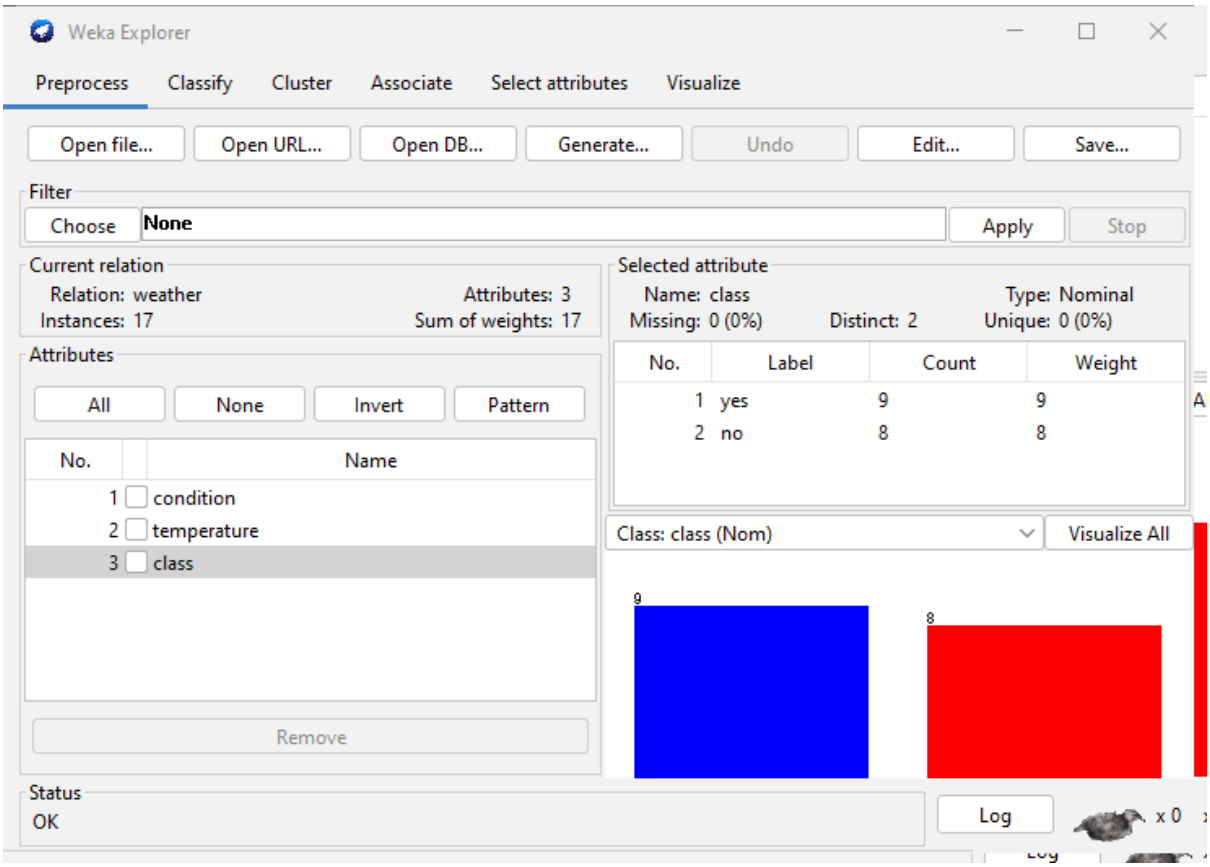
STEP-3: Finally we SAVE our dataset file as file_name.arff i.e.; with .arff file extention. In our case we saved as weather.arff

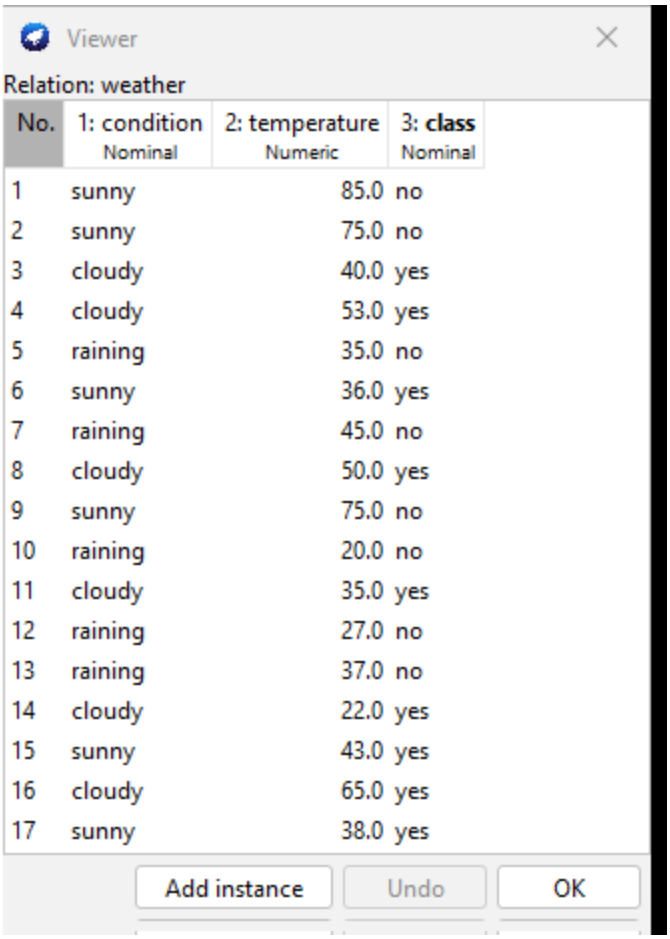
Demonstration of preprocessing on dataset using weka

STEP-1: Open weather.arff file in weka tool in PREPROCESS.




Weka Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Generate...
Undo
Edit...
Save...
Filter
Choose
None
Apply
Stop
Current relation
Relation: weather
Instances: 17
Attributes: 3
Sum of weights: 17
Selected attribute
Name: temperature
Missing: 0 (0%)
Distinct: 15
Type: Numeric
Unique: 13 (76%)
Attributes
All
None
Invert
Pattern
No.
Name
1 condition
2 temperature
3 class
Statistic
Value
Minimum 20
Maximum 85
Mean 45.941
StdDev 18.998
Class: class (Nom)
Visualize All
Remove
9
4
4
20
52.5
85
Status
OK
Log
x 0

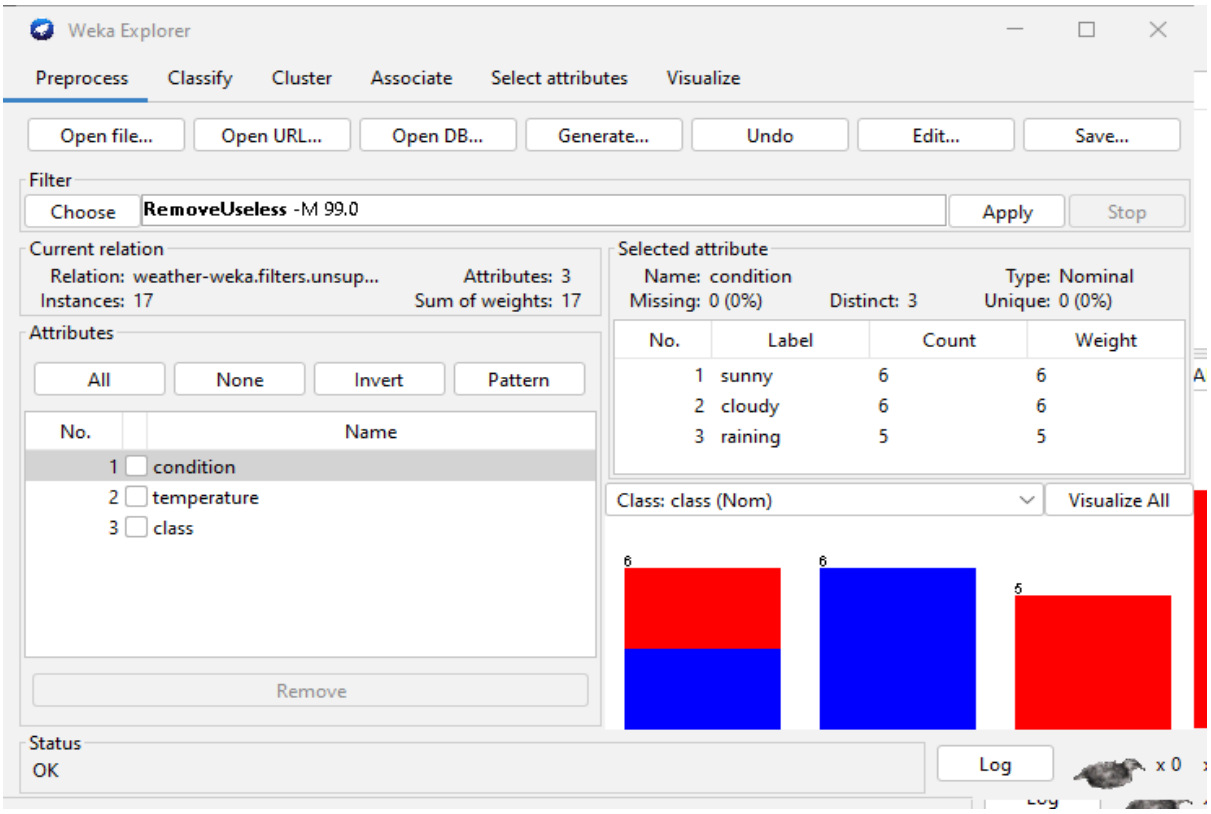

Weka Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Generate...
Undo
Edit...
Save...
Filter
Choose
None
Apply
Stop
Current relation
Relation: weather
Instances: 17
Attributes: 3
Sum of weights: 17
Selected attribute
Name: class
Missing: 0 (0%)
Distinct: 2
Type: Nominal
Unique: 0 (0%)
No.
Label
Count
Weight
1 yes 9 9
2 no 8 8
Attributes
All
None
Invert
Pattern
No.
Name
1 condition
2 temperature
3 class
Remove
Class: class (Nom)
Visualize All
9
8
Status
OK
Log
x 0

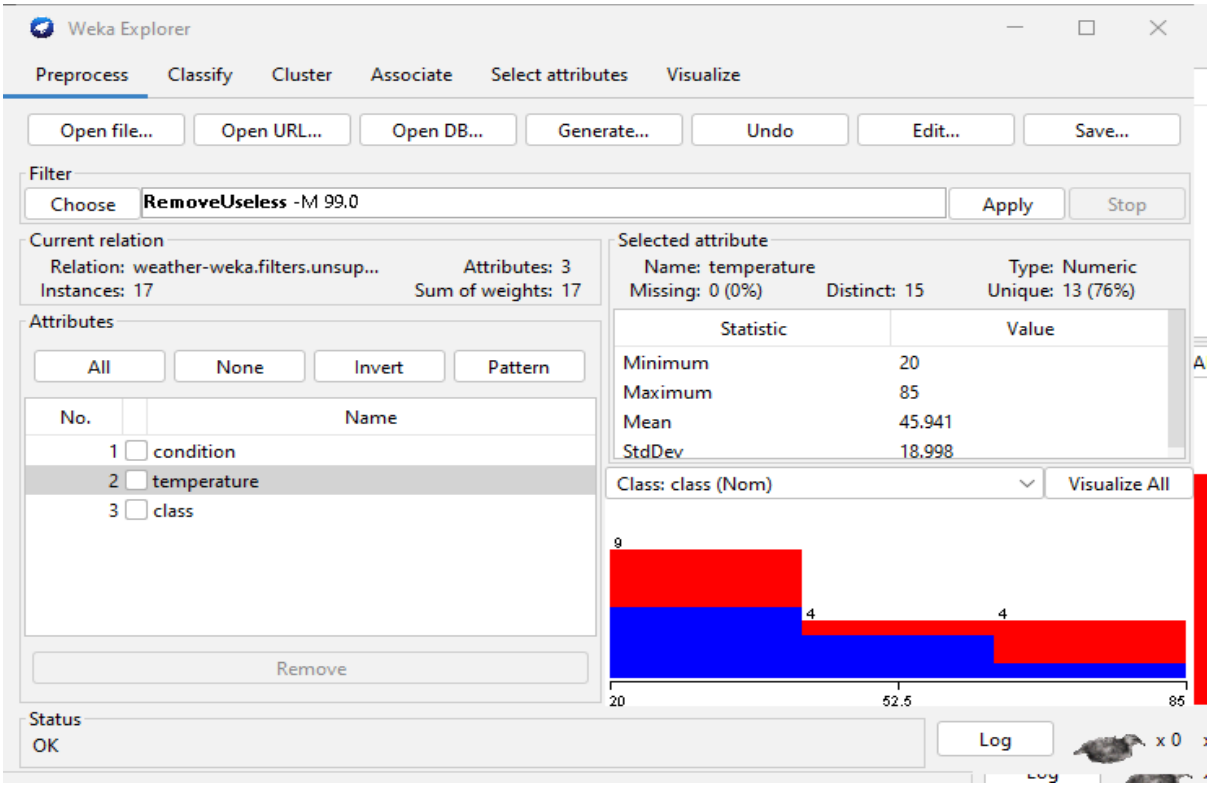


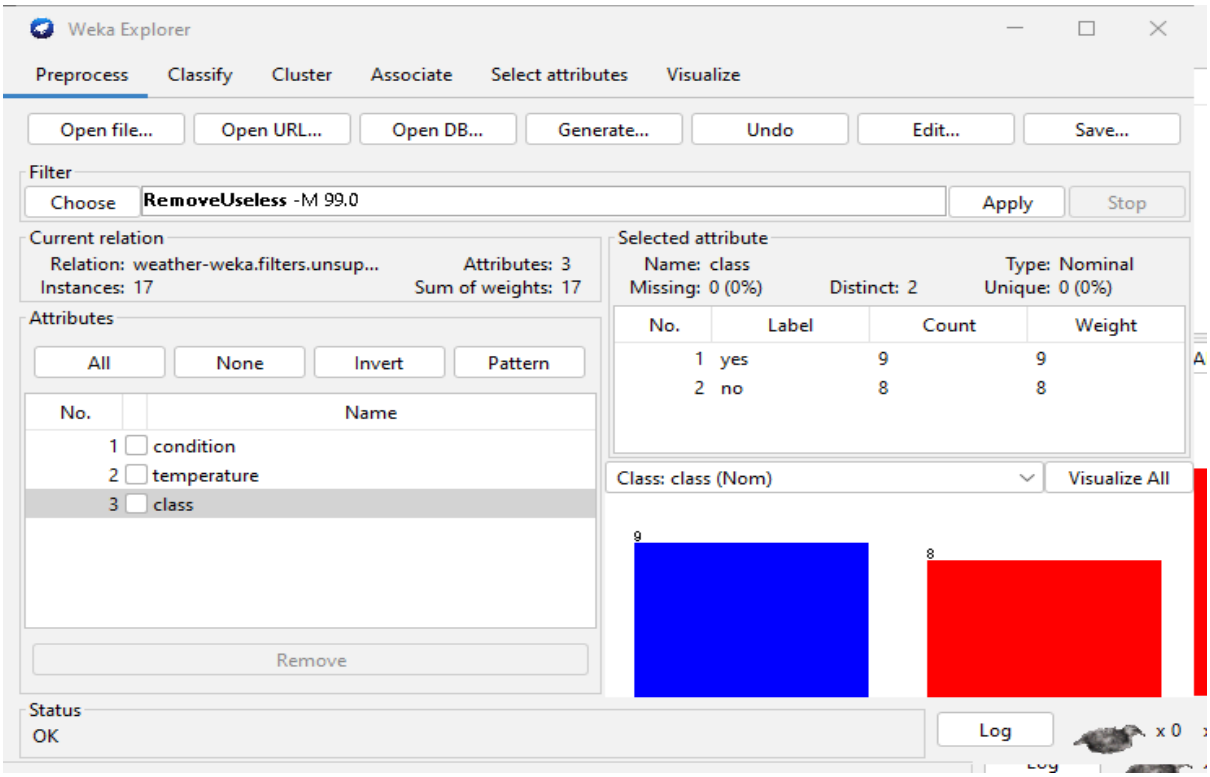
STEP-2: Apply any preprocessing methods by clicking on “CHOOSE” option.

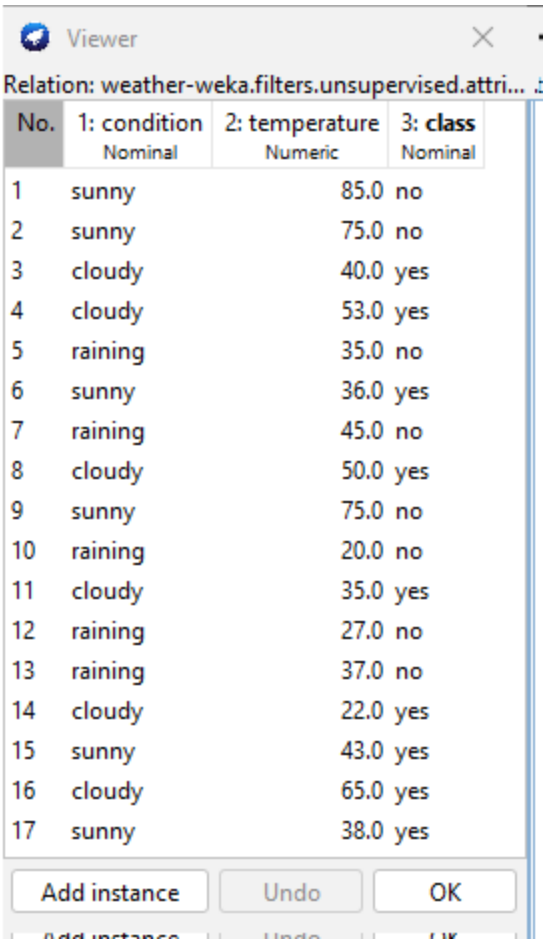
Here we will apply any two preprocessing techniques.

By applying “RemoveUseless” in unsupervised attributes.


Weka Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Generate...
Undo
Edit...
Save...
Filter
Choose
RemoveUseless -M 99.0
Apply
Stop
Current relation
Relation: weather-weka.filters.unsup...
Attributes: 3
Instances: 17
Sum of weights: 17
Selected attribute
Name: condition
Type: Nominal
Missing: 0 (0%)
Distinct: 3
Unique: 0 (0%)
No.
Label
Count
Weight
1 sunny 6 6
2 cloudy 6 6
3 raining 5 5
Attributes
All
None
Invert
Pattern
No.
Name
1 condition
2 temperature
3 class
Remove
Class: class (Nom)
Visualize All
6
6
5
Status
OK
Log
x 0

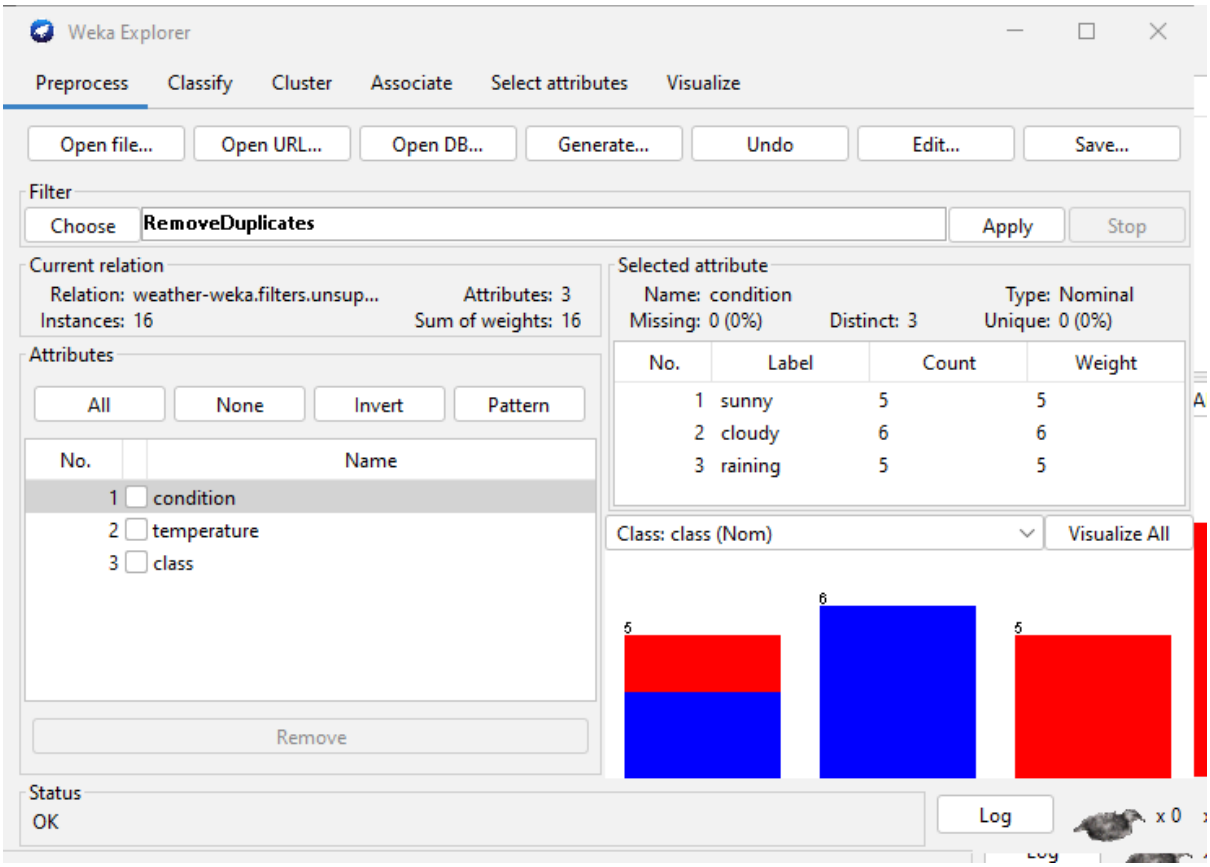

Weka Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Generate...
Undo
Edit...
Save...
Filter
Choose
RemoveUseless -M 99.0
Apply
Stop
Current relation
Relation: weather-weka.filters.unsup...
Attributes: 3
Instances: 17
Sum of weights: 17
Selected attribute
Name: temperature
Type: Numeric
Missing: 0 (0%)
Distinct: 15
Unique: 13 (76%)
Statistic
Value
Minimum 20
Maximum 85
Mean 45.941
StdDev 18.998
Attributes
All
None
Invert
Pattern
No.
Name
1 condition
2 temperature
3 class
Remove
Class: class (Nom)
Visualize All
9
4
4
20
52.5
85
Status
OK
Log
x 0

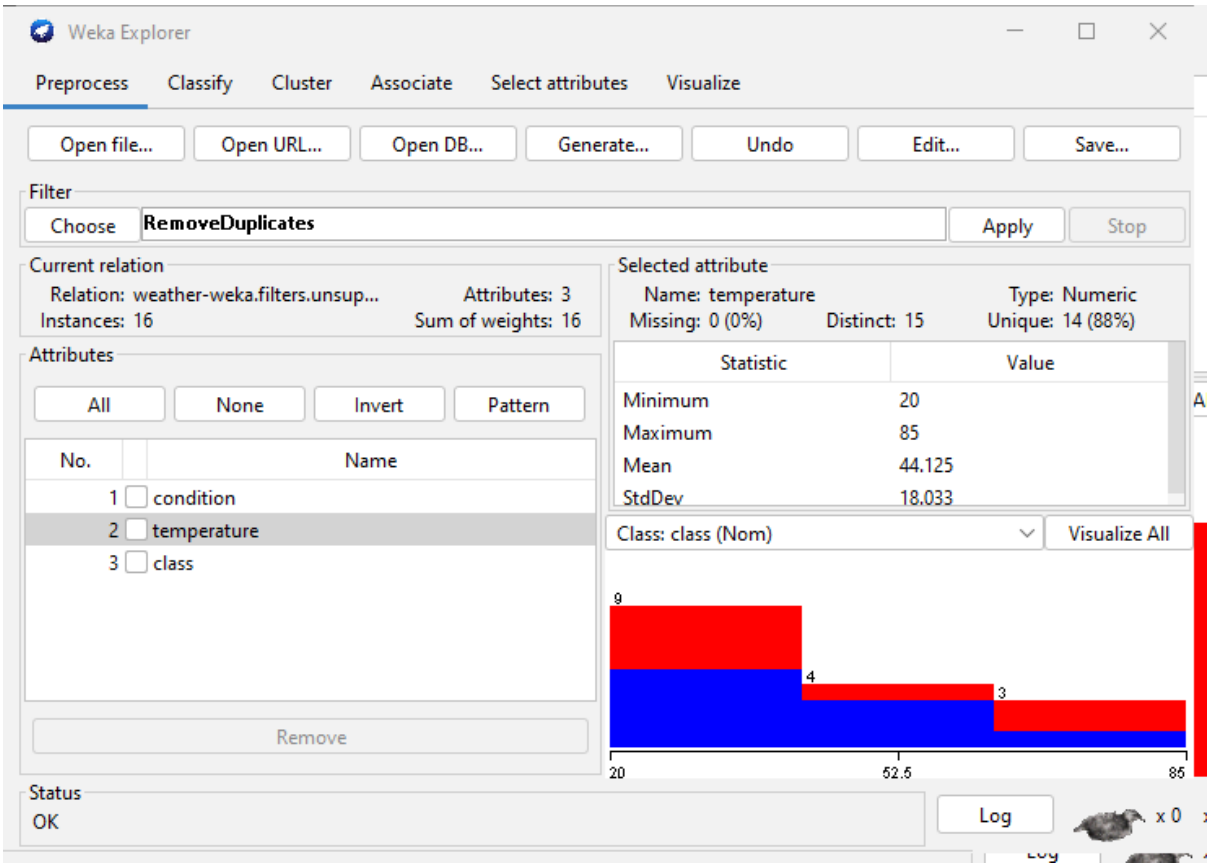

Weka Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Generate...
Undo
Edit...
Save...
Filter
Choose
RemoveUseless -M 99.0
Apply
Stop
Current relation
Relation: weather-weka.filters.unsup...
Attributes: 3
Instances: 17
Sum of weights: 17
Selected attribute
Name: class
Type: Nominal
Missing: 0 (0%)
Distinct: 2
Unique: 0 (0%)
No.
Label
Count
Weight
1 yes 9 9
2 no 8 8
Attributes
All
None
Invert
Pattern
No.
Name
1 condition
2 temperature
3 class
Remove
Class: class (Nom)
Visualize All
9
8
Status
OK
Log
x 0

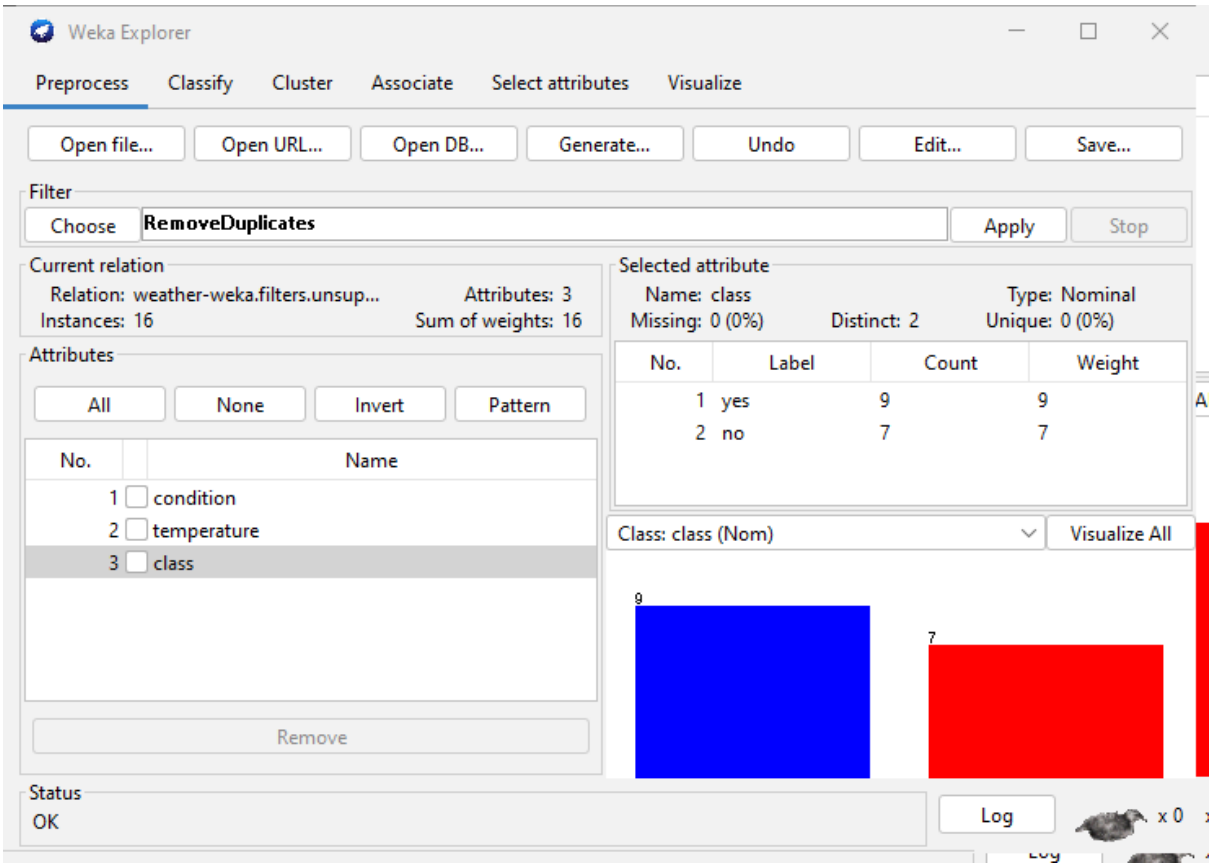


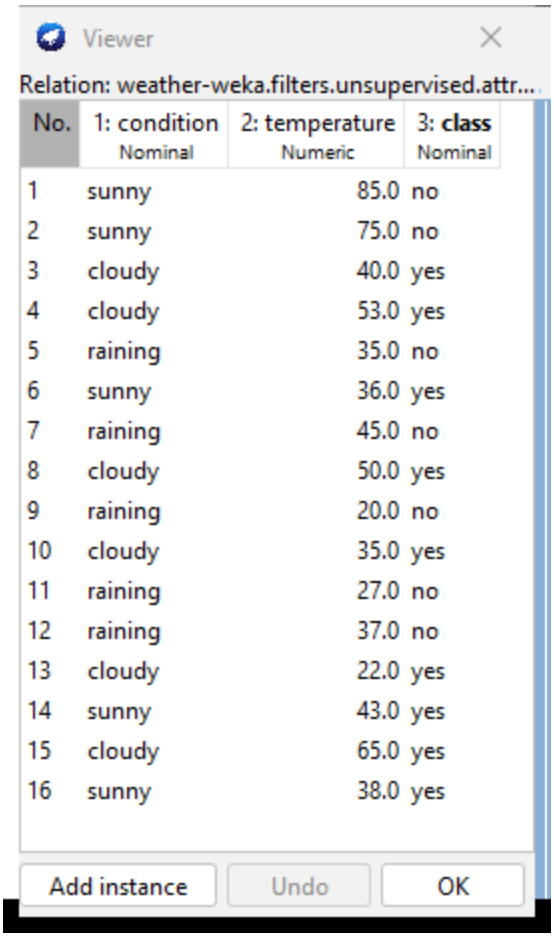
After applying “RemoveUseless” no change occured

By applying “RemoveDuplicates” in unsupervised instance.


Weka Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Generate...
Undo
Edit...
Save...
Filter
Choose
RemoveDuplicates
Apply
Stop
Current relation
Relation: weather-weka.filters.unsup...
Attributes: 3
Instances: 16
Sum of weights: 16
Selected attribute
Name: condition
Type: Nominal
Missing: 0 (0%)
Distinct: 3
Unique: 0 (0%)
No. Label Count Weight
1 sunny 5 5
2 cloudy 6 6
3 raining 5 5
Attributes
All
None
Invert
Pattern
No. Name
1 condition
2 temperature
3 class
Remove
Class: class (Nom)
Visualize All
5
6
5
Status
OK
Log
x 0


Weka Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Generate...
Undo
Edit...
Save...
Filter
Choose
RemoveDuplicates
Apply
Stop
Current relation
Relation: weather-weka.filters.unsup...
Attributes: 3
Instances: 16
Sum of weights: 16
Selected attribute
Name: temperature
Type: Numeric
Missing: 0 (0%)
Distinct: 15
Unique: 14 (88%)
Statistic
Value
Minimum
20
Maximum
85
Mean
44.125
StdDev
18.033
Attributes
All
None
Invert
Pattern
No.
Name
1 condition
2 temperature
3 class
Remove
Class: class (Nom)
Visualize All
9
4
3
20
52.5
85
Status
OK
Log
x 0


Weka Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Generate...
Undo
Edit...
Save...
Filter
Choose
RemoveDuplicates
Apply
Stop
Current relation
Relation: weather-weka.filters.unsup...
Attributes: 3
Instances: 16
Sum of weights: 16
Selected attribute
Name: class
Type: Nominal
Missing: 0 (0%)
Distinct: 2
Unique: 0 (0%)
No.
Label
Count
Weight
1 yes 9 9
2 no 7 7
Attributes
All
None
Invert
Pattern
No.
Name
1 condition
2 temperature
3 class
Remove
Class: class (Nom)
Visualize All
9
7
Status
OK
Log
x 0



After applying “RemoveDuplicates” one duplicate found and removed.

i.e.; “sunny 75.0 no”

So our data entries reduced to 16 from 17.

RESULT:

Thus, the dataset in .arff file format is created and Demonstration of preprocessing using weka dataset is shown.

12. Demonstration of Association rule process on any supermarket dataset using Apriori algorithm using R.

AIM:

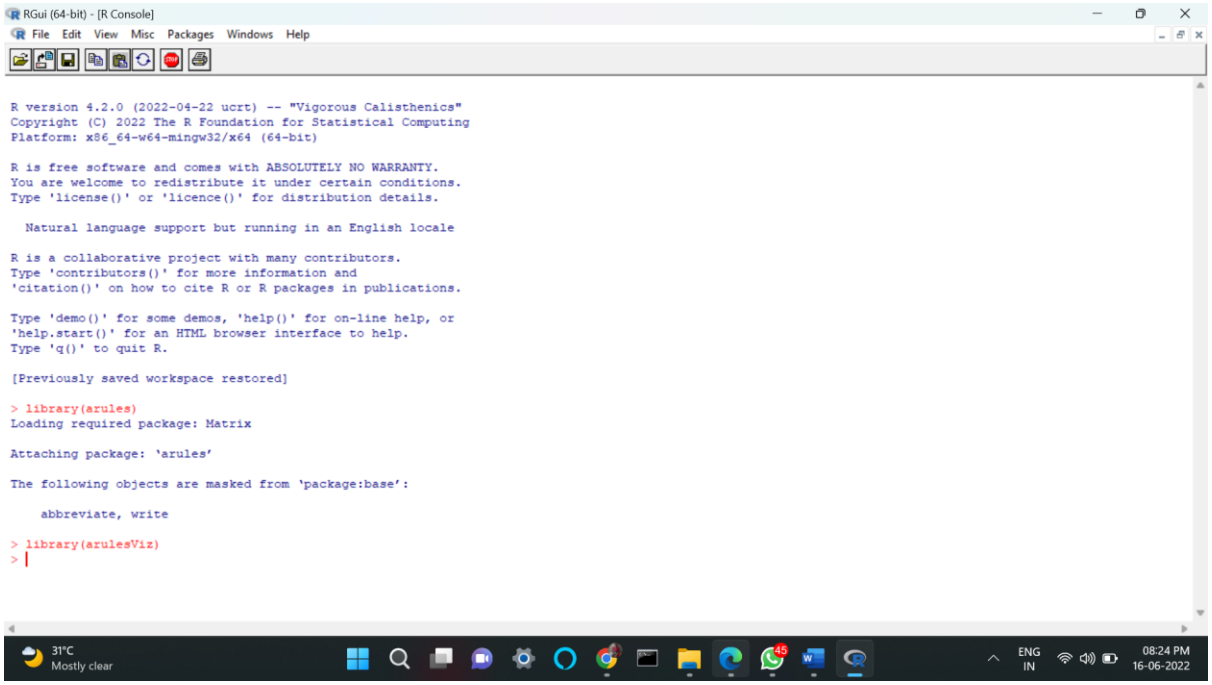
To demonstration of Association rule process on any supermarket dataset using Apriori algorithm using R.

PROCEDURE:

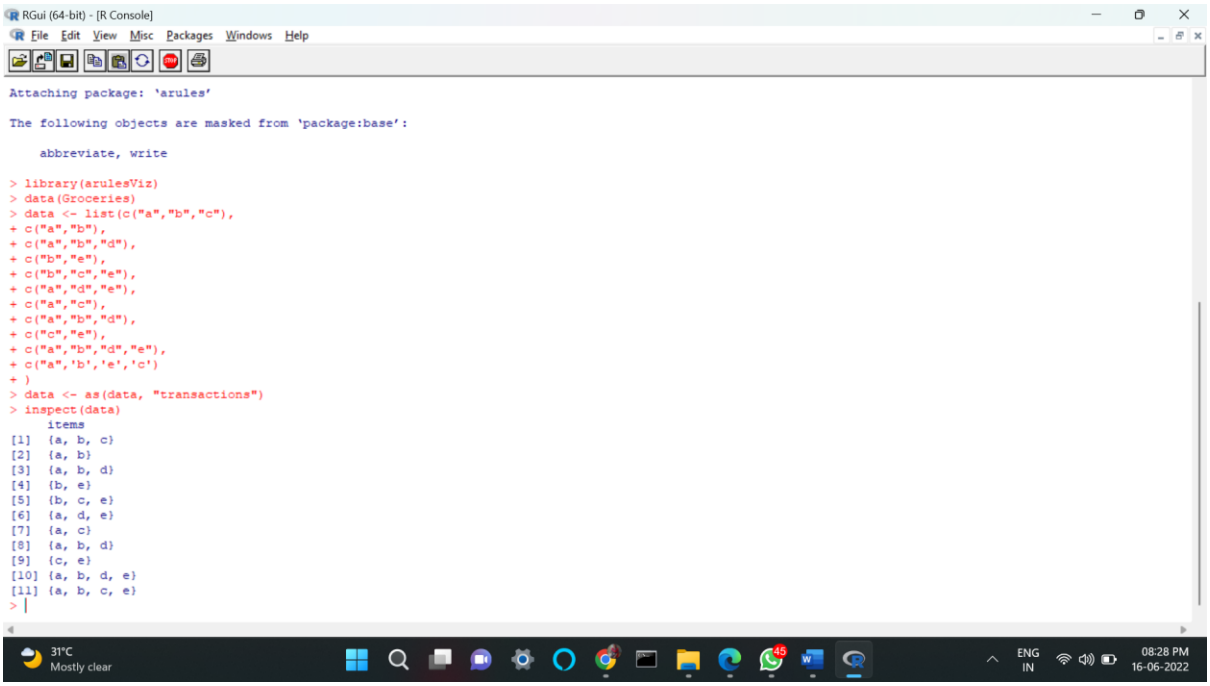
- **Step 1**: The first part of any analysis is to bring in the dataset. We will be using an inbuilt dataset “Groceries” from the ‘arules’ package to simplify our analysis.
- **Step 2**: All stores and retailers store their information of transactions in a specific type of dataset called the “Transaction” type dataset.
- **Step 3**: The ‘pacman’ package is an assistor to help load and install the packages. we will be using pacman to load the arules package.
- **Step 4**: The p_load() function from “pacman” takes names of packages as arguments.
- **Step 5**: If your system has those packages, it will load them and if not, it will install and load them.

CODE IN R:

```
library(arules)
library(arulesViz)
```

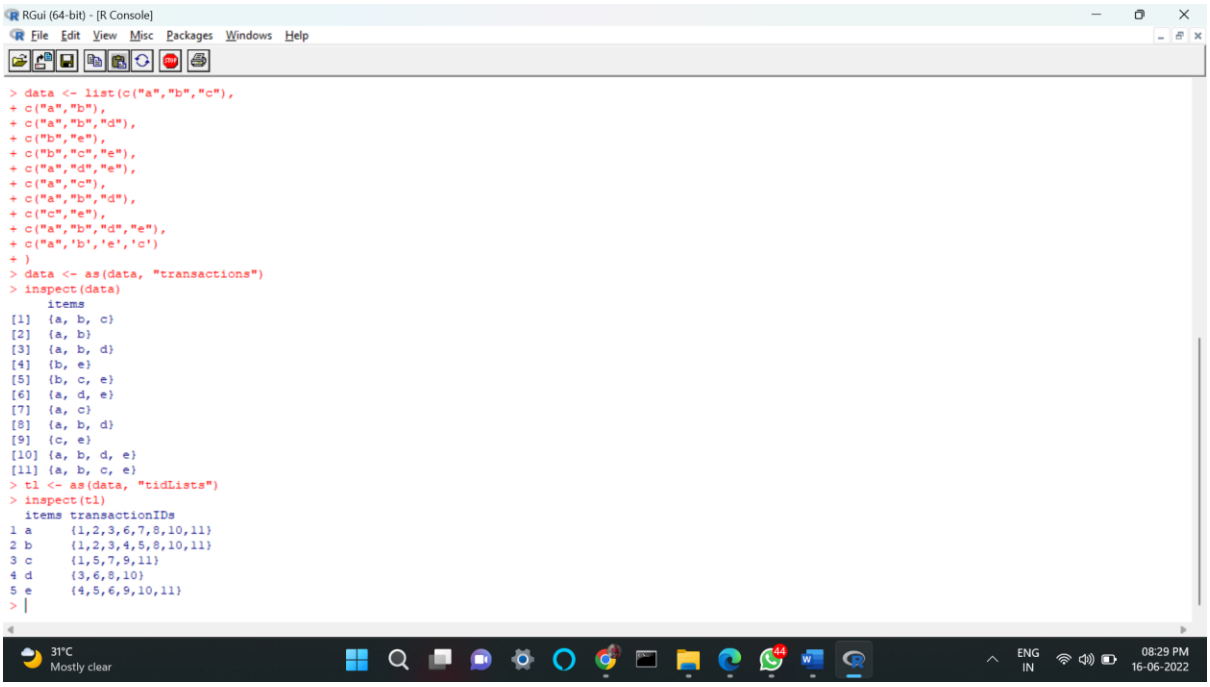


```
data(Groceries)

data <- list(c("a","b","c"),

c("a","b"),

c("a","b","d"),

c("b","e"),

c("b","c","e"),

c("a","d","e"),

c("a","c"),

c("a","b","d"),

c("c","e"),

c("a","b","d","e"),

c("a",'b','e','c')

)

data <- as(data, "transactions")

inspect(data)
```

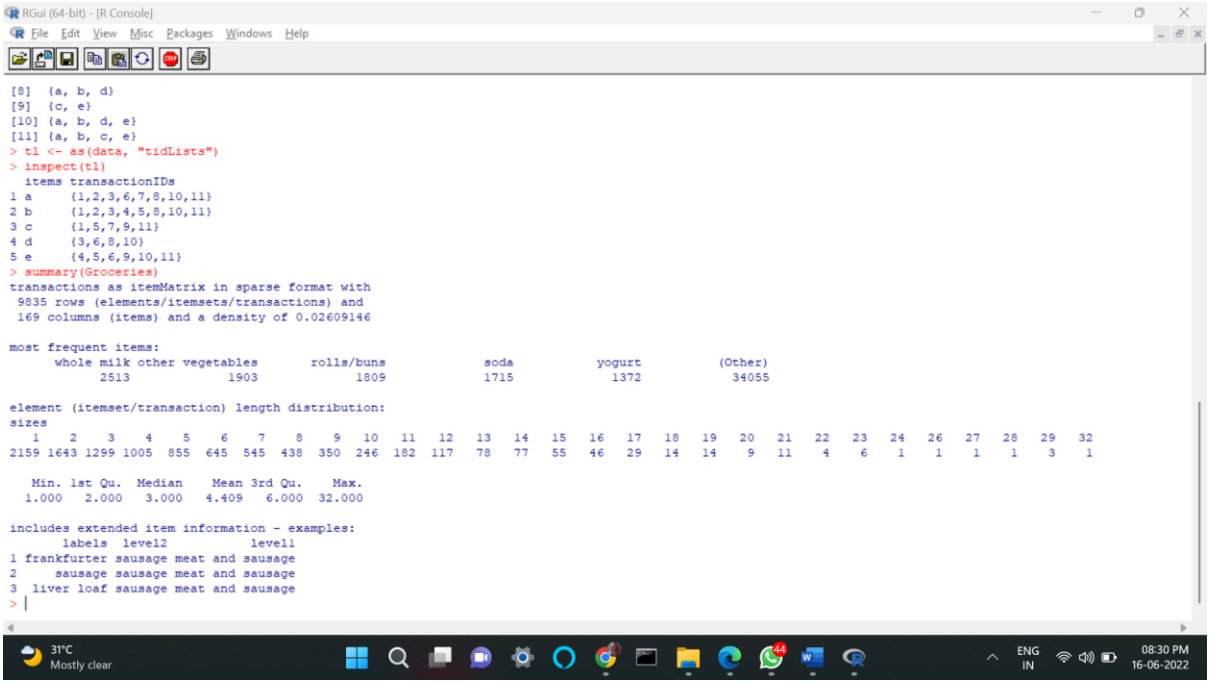


tl <- as(data, "tidLists")

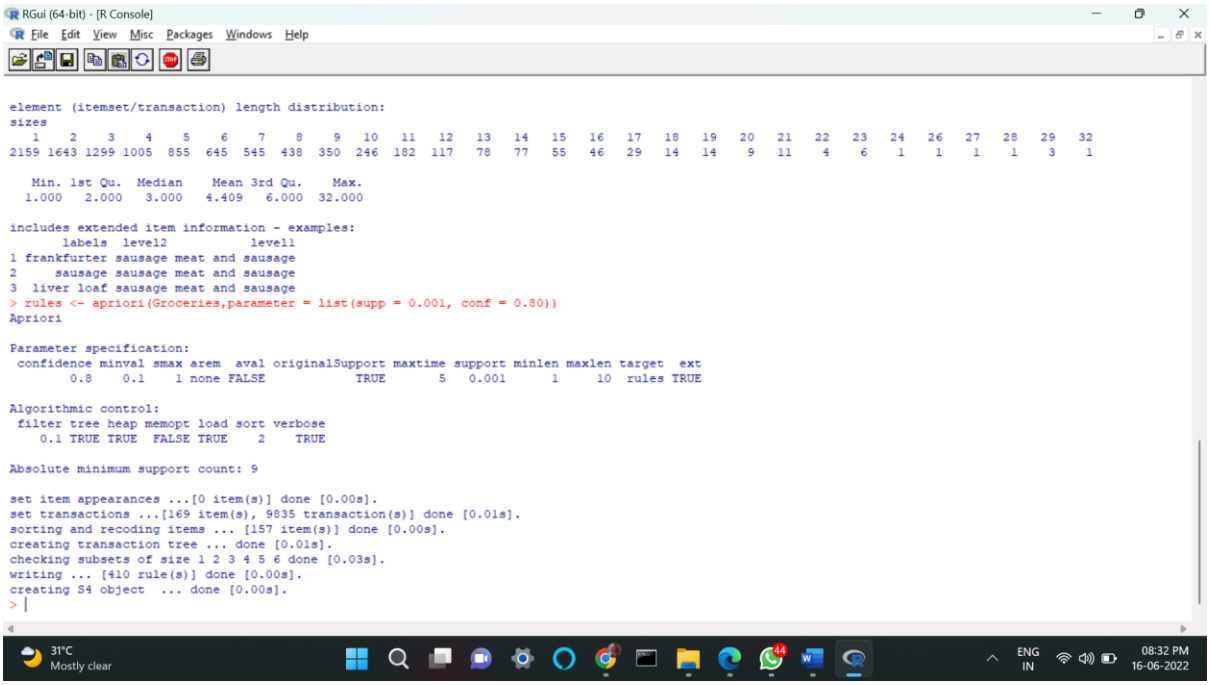
inspect(tl)



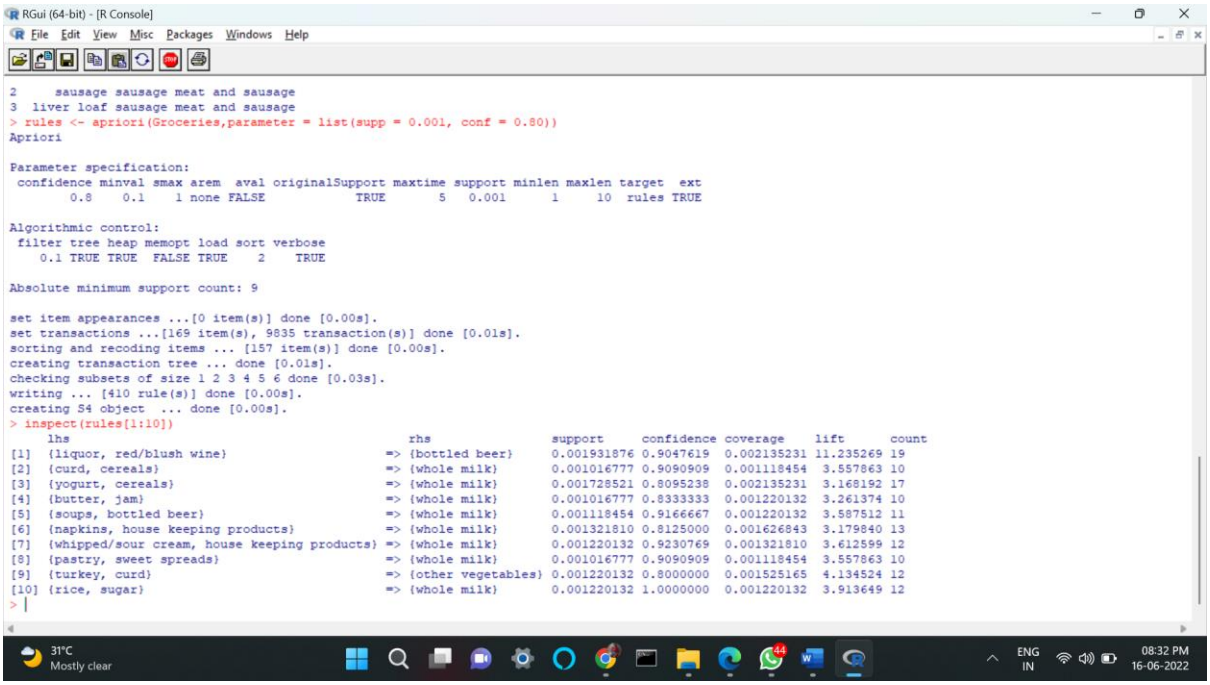
summary(Groceries)



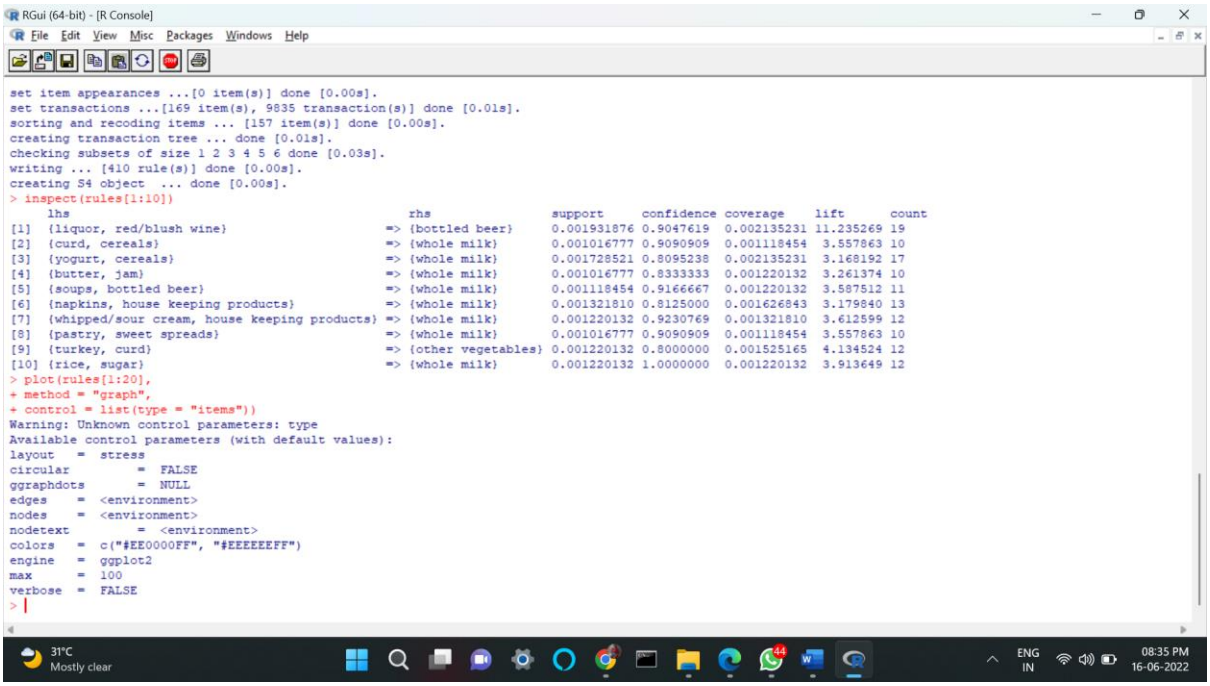
rules <- apriori(Groceries,parameter = list(supp = 0.001, conf = 0.80))

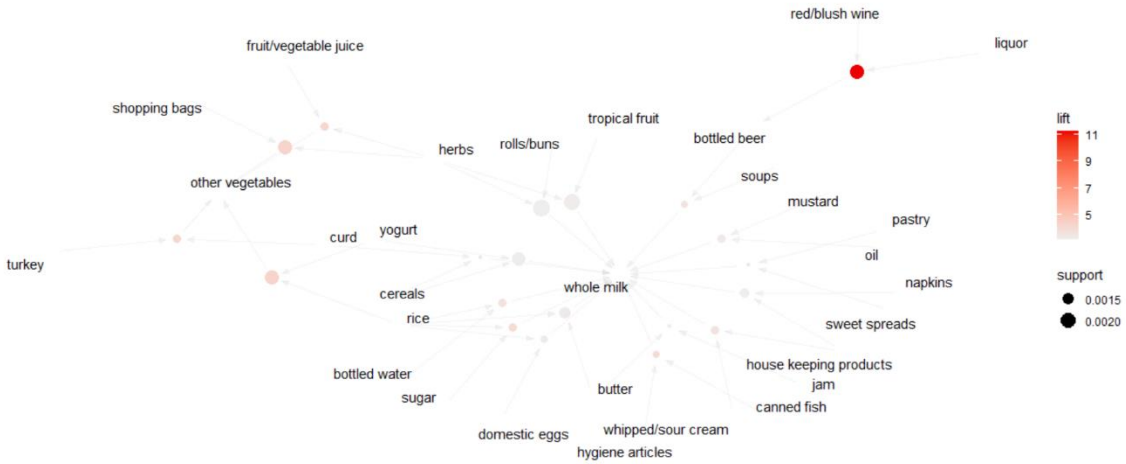


inspect(rules[1:10])



plot(rules[1:20], method = "graph", control = list(type = "items"))





RESULT:

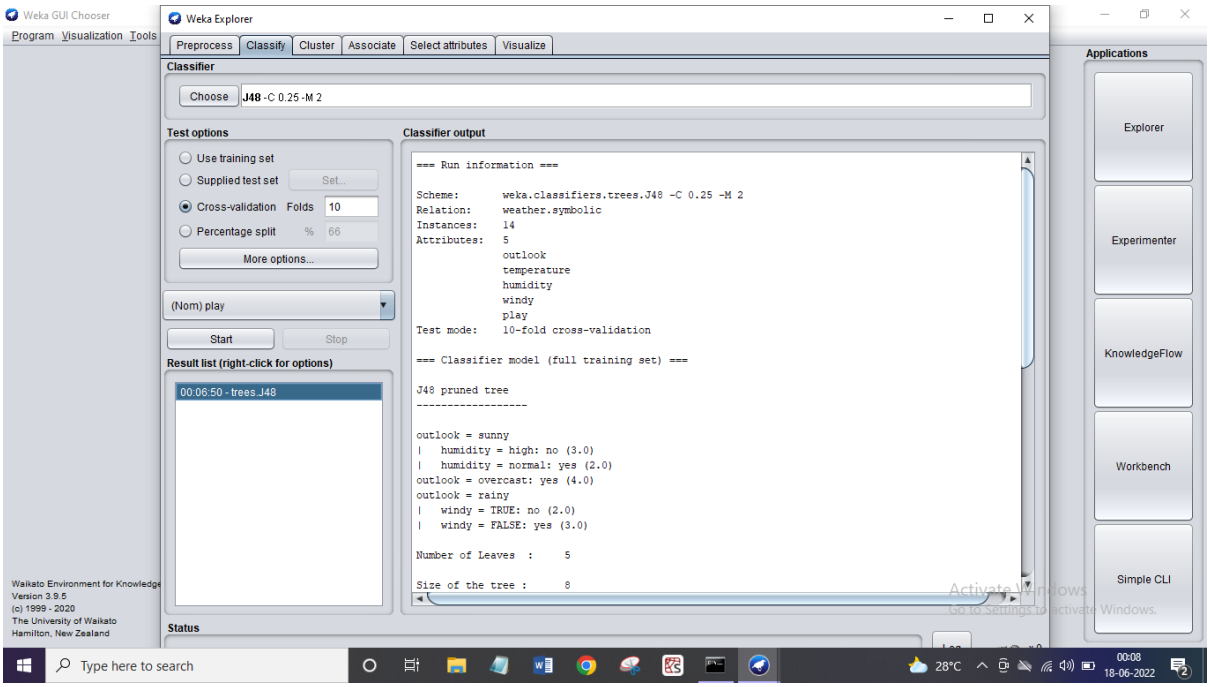
Thus, the implementation of Apriori Algorithm is executed in R language is shown.

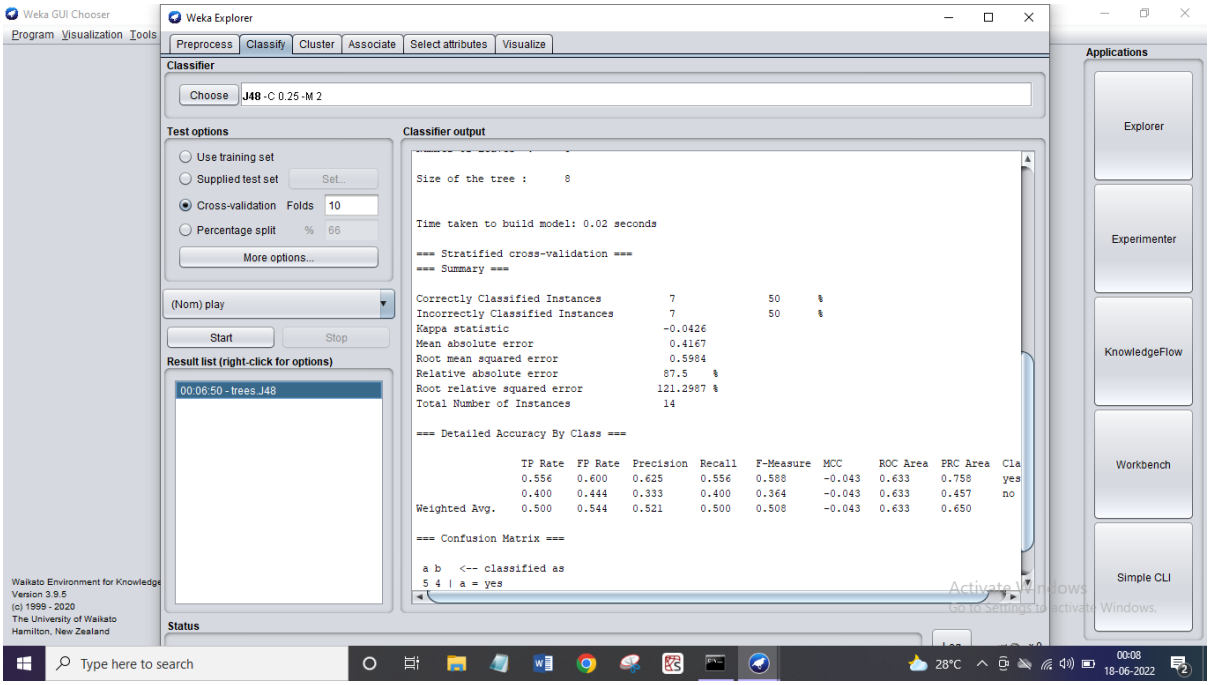
13. Demonstration of classification ruleprocess on WEKA dataset using j48 algorithm

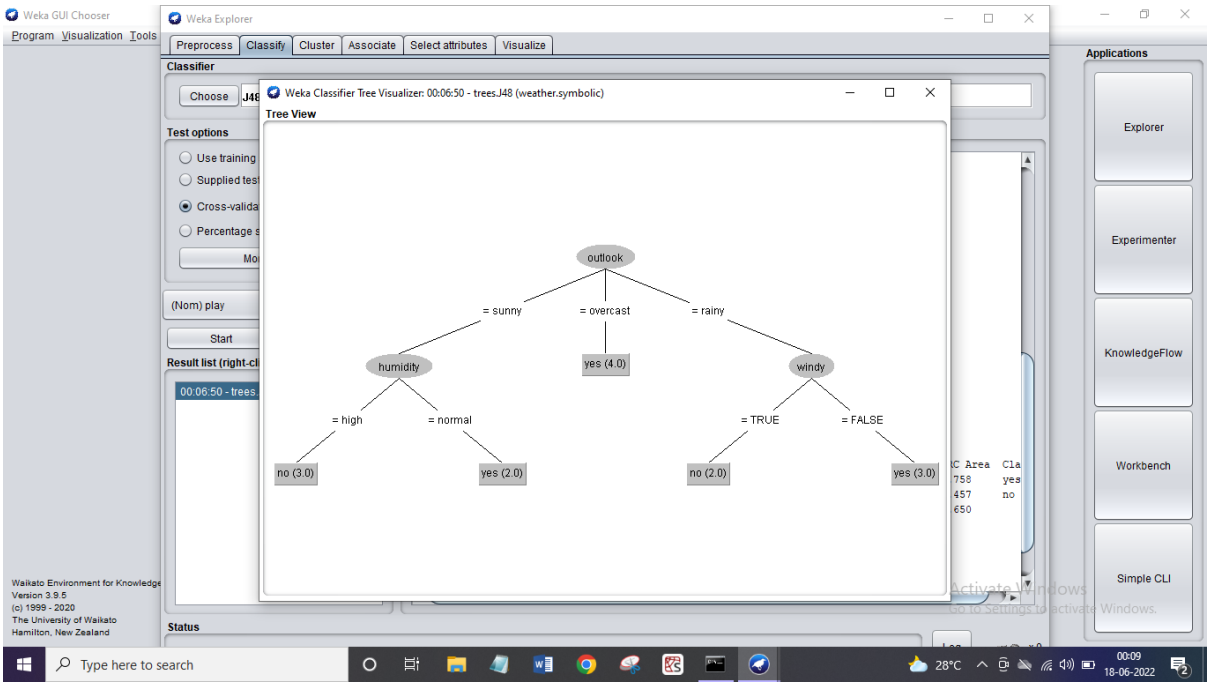
AIM:

To demonstrate the classification ruleprocess on WEKA dataset using j48 algorithm in WEKA

PROGRAM AND OUTPUT SCREENSHOT:







RESULT:

Thus, the demonstrate the classification ruleprocess on WEKA dataset using j48 algorithm in WEKA is shown.

14. Demonstration of classification rule process on WEKA dataset using naïve bayes algorithm. Compute the accuracy of the classifier, precision, and recall.

Aim: This experiment illustrates the use of naïve bayes classifier in WEKA. The sample data set used in this experiment is “iris”data available at arff format. This document assumes that appropriate data pre-processing has been performed.

PROCEDURE:

Step-1: We begin the experiment by loading the data (iris.arff) into WEKA.

Step-2: Next we select the “classify” tab and click “choose” button to select the “naïve bayes” classifier.

Step-3: Now we specify the various parameters. These can be specified by clicking in the text box to the right of the chose button. In this example, we accept the default values his default version does perform some pruning but does not perform error pruning.

Step-4: Under the “text “options in the main panel. We select the 10-fold cross validation as our evaluation approach. Since we don’t have separate evaluation data set, this is necessary to get a reasonable idea of accuracy of generated model.

Step-5: We now click ”start” to generate the model. The ASCII version of the tree as well as evaluation statistic will appear in the right panel when the model construction is complete.

Step-6: Note that the classification accuracy of model is about 96%. This indicates that we may find more work. (Either in pre-processing or in selecting current parameters for the classification)

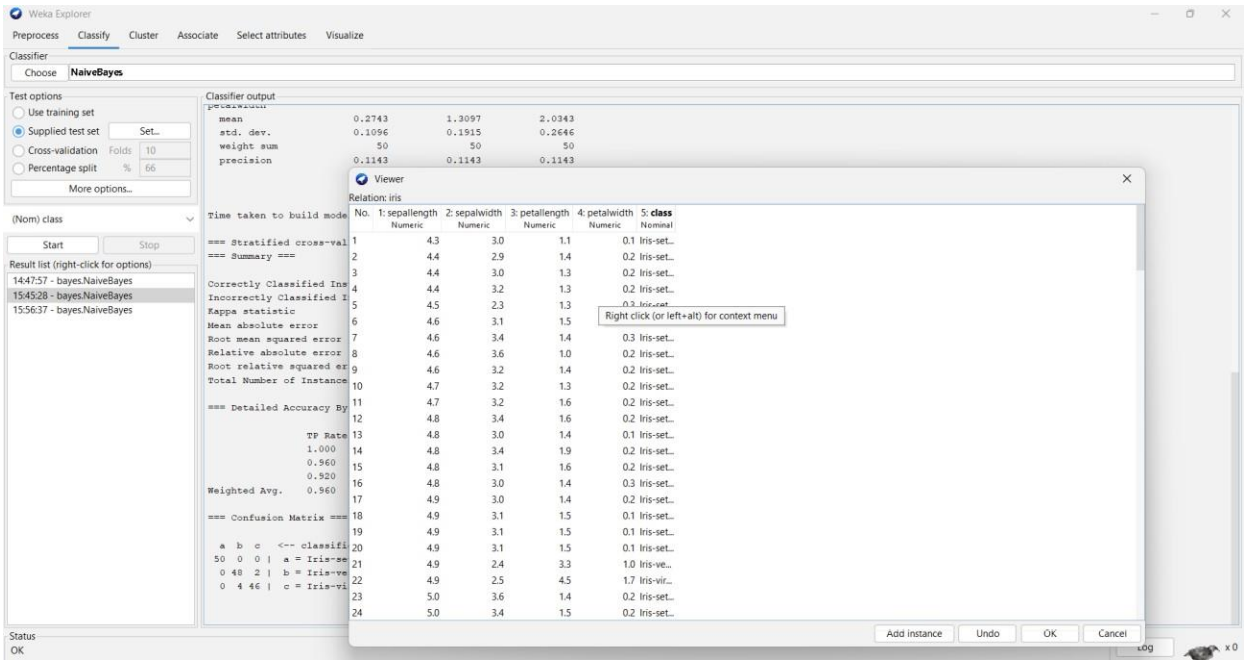
Step-7: Now WEKA also lets us a view a graphical version of the classification. This can be done by right clicking the last result set and selecting “visualize” from the pop-up menu.

Step-8: We will use our model to classify the new instances.

Step-9: In the main panel under “text “options click the “supplied test set” radio button and then click the “set” button. This will show pop-up window which will allow you to open the file containing test instances.

The following screenshot shows the classification rules that were generated when naive bayes algorithm is applied on the given dataset.

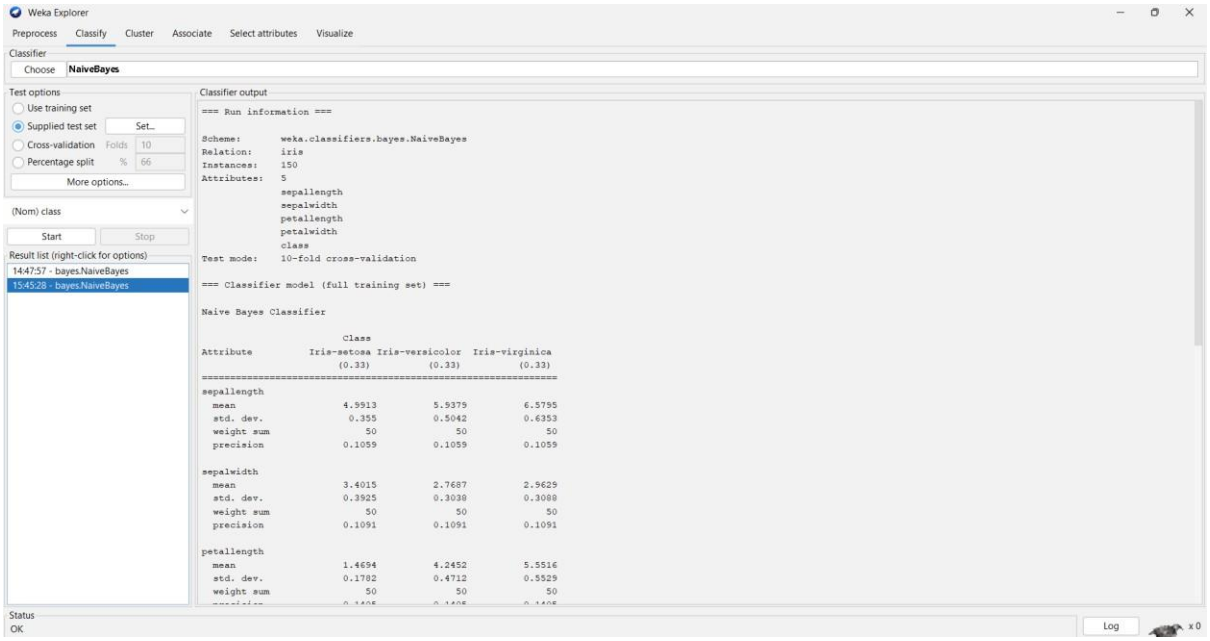
Dataset – Iris Dataset in WEKA

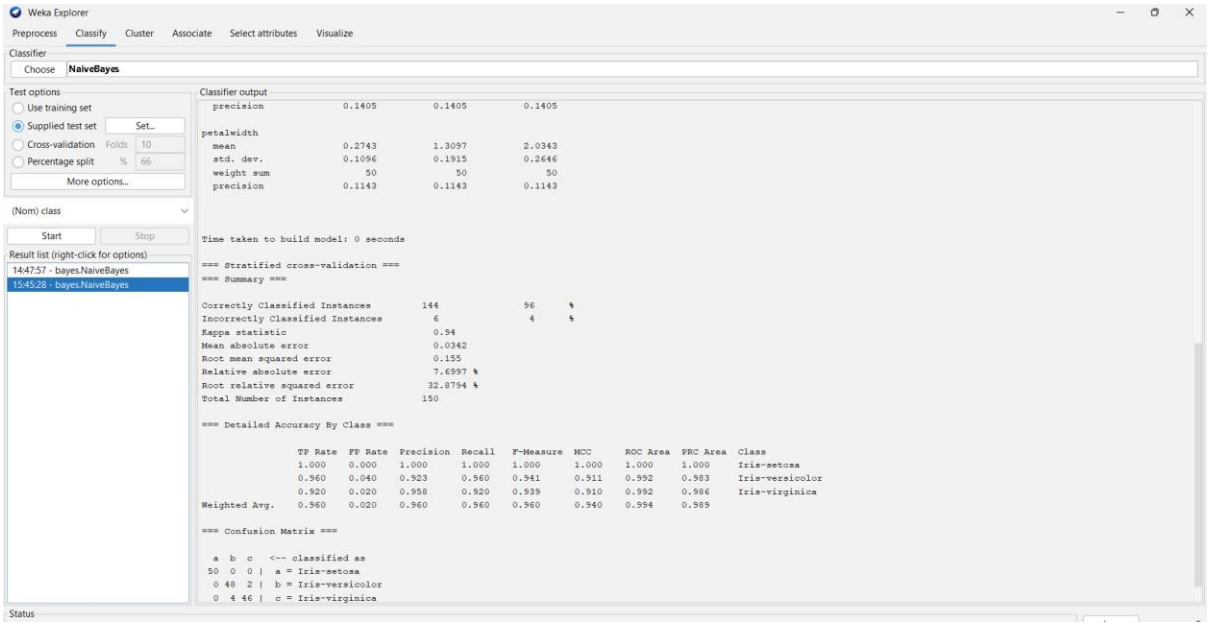


Using Naïve Bayes Classifier

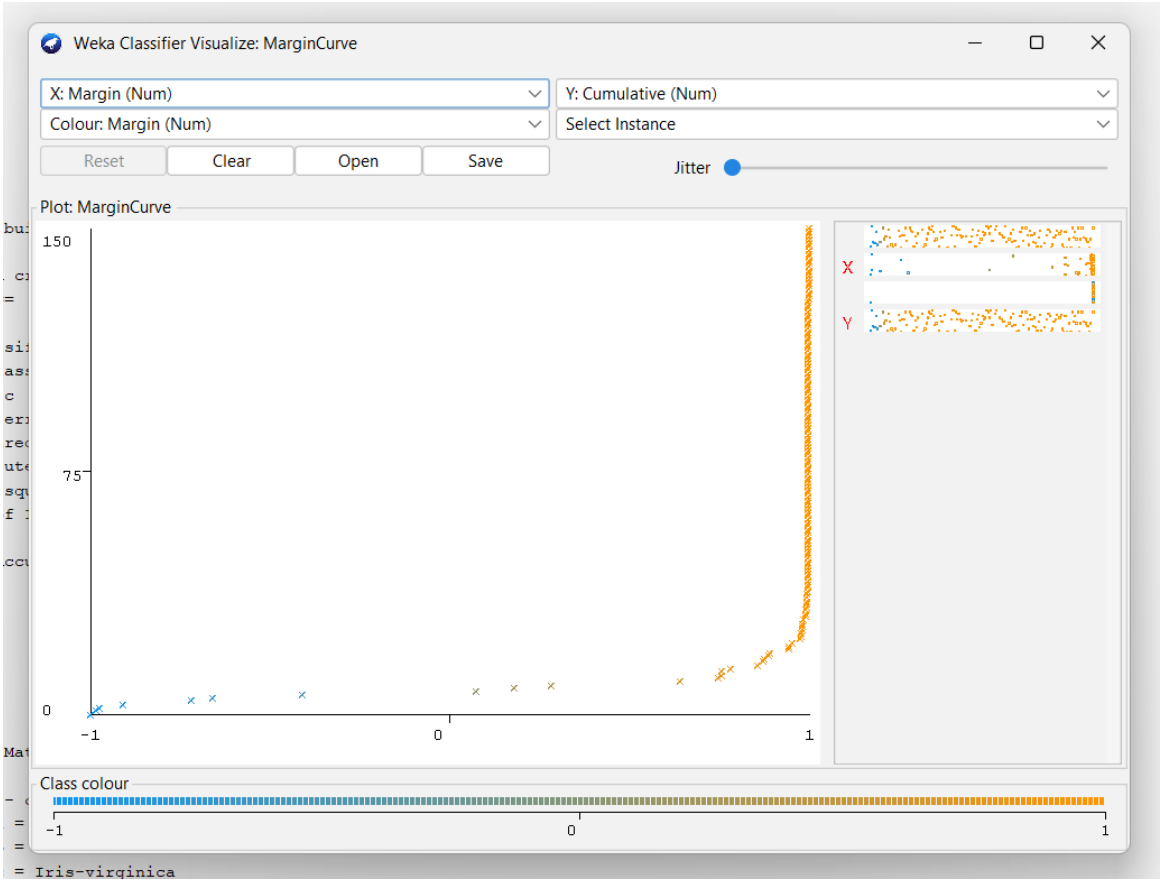
No of instances = 150

Output:


Weka Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
NaiveBayes
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
(Nom) class
Start
Stop
Result list (right-click for options)
14:47:57 - bayes.NaiveBayes
15:45:28 - bayes.NaiveBayes
Classifier output
=== Run information ===
Scheme: weka.classifiers.bayes.NaiveBayes
Relation: iris
Instances: 150
Attributes: 5
sepallength
sepalwidth
petallength
petalwidth
class
Test mode: 10-fold cross-validation
=== Classifier model (full training set) ===
Naive Bayes Classifier
Class
Attribute Iris-setosa Iris-versicolor Iris-virginica
(0.33) (0.33) (0.33)
sepallength
mean 4.9913 5.9379 6.5795
std. dev. 0.355 0.5042 0.6353
weight sum 50 50 50
precision 0.1059 0.1059 0.1059
sepalwidth
mean 3.4015 2.7687 2.9629
std. dev. 0.3925 0.3038 0.3088
weight sum 50 50 50
precision 0.1091 0.1091 0.1091
petallength
mean 1.4694 4.2452 5.5516
std. dev. 0.1782 0.4712 0.5529
weight sum 50 50 50
Status
OK
Log
x 0


Weka Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
NaiveBayes
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
(Nom) class
Start
Stop
Result list (right-click for options)
14:47:57 - bayes.NaiveBayes
15:45:28 - bayes.NaiveBayes
Classifier output
precision 0.1405 0.1405 0.1405
petalwidth
mean 0.2743 1.3097 2.0343
std. dev. 0.1096 0.1915 0.2646
weight sum 50 50 50
precision 0.1143 0.1143 0.1143
Time taken to build model: 0 seconds
=== Stratified cross-validation ===
=== Summary ===
Correctly Classified Instances 144 96 %
Incorrectly Classified Instances 6 4 %
Kappa statistic 0.94
Mean absolute error 0.0342
Root mean squared error 0.155
Relative absolute error 7.6997 %
Root relative squared error 32.8794 %
Total Number of Instances 150
=== Detailed Accuracy By Class ===
TP Rate FP Rate Precision Recall F-Measure MCC ROC Area PRC Area Class
1.000 0.000 1.000 1.000 1.000 1.000 1.000 1.000 Iris-setosa
0.960 0.040 0.923 0.960 0.941 0.911 0.992 0.983 Iris-versicolor
0.920 0.020 0.958 0.920 0.939 0.910 0.992 0.986 Iris-virginica
Weighted Avg. 0.960 0.020 0.960 0.960 0.960 0.940 0.994 0.989
=== Confusion Matrix ===
a b c <-- classified as
50 0 0 | a = Iris-setosa
0 48 2 | b = Iris-versicolor
0 4 46 | c = Iris-virginica
Status

Margin Curve Output:



RESULT:

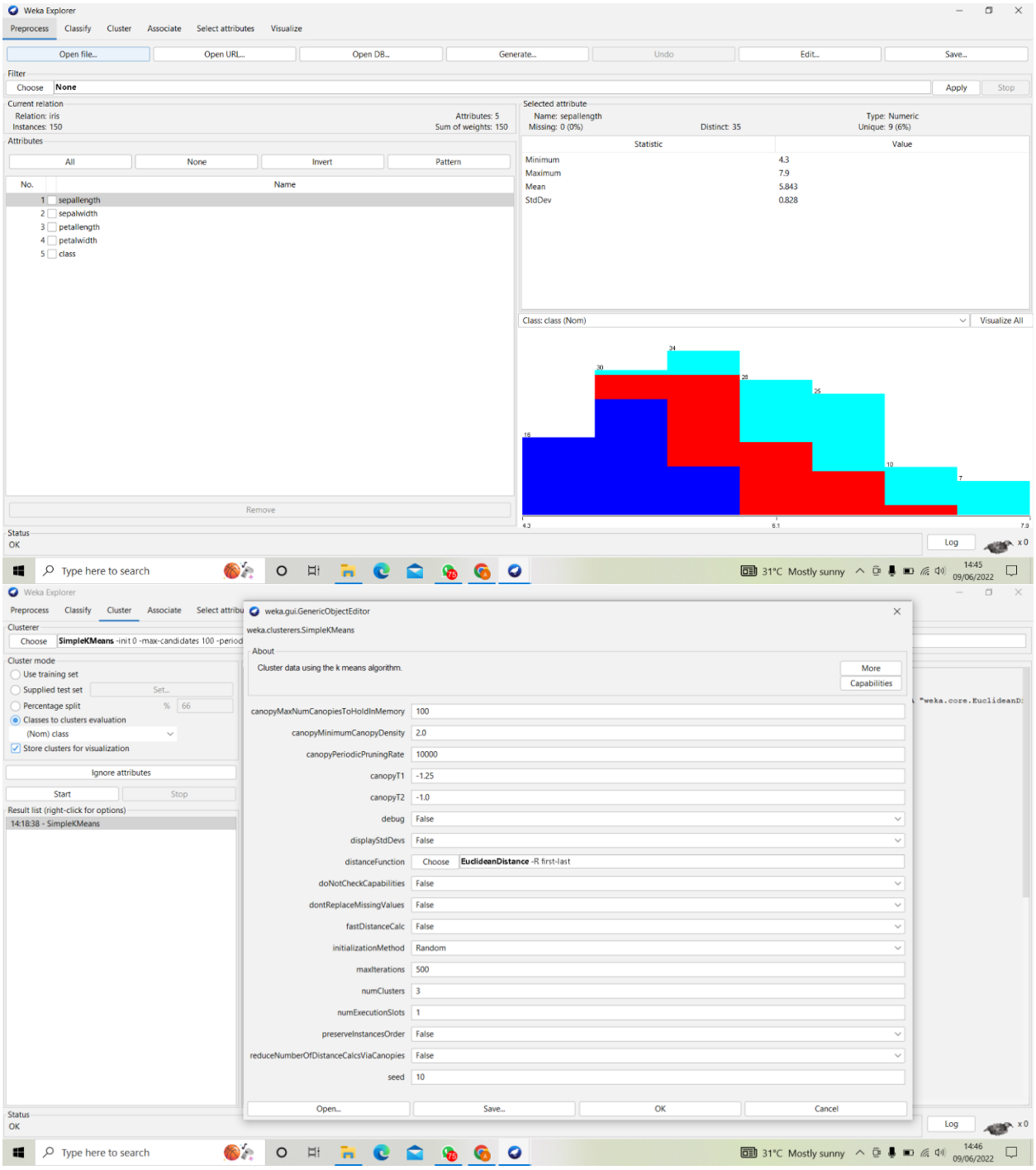
Thus, the Demonstration of classification rule process on WEKA dataset using naïve bayes algorithm and Compute the accuracy of the classifier, precision, and recall shown.

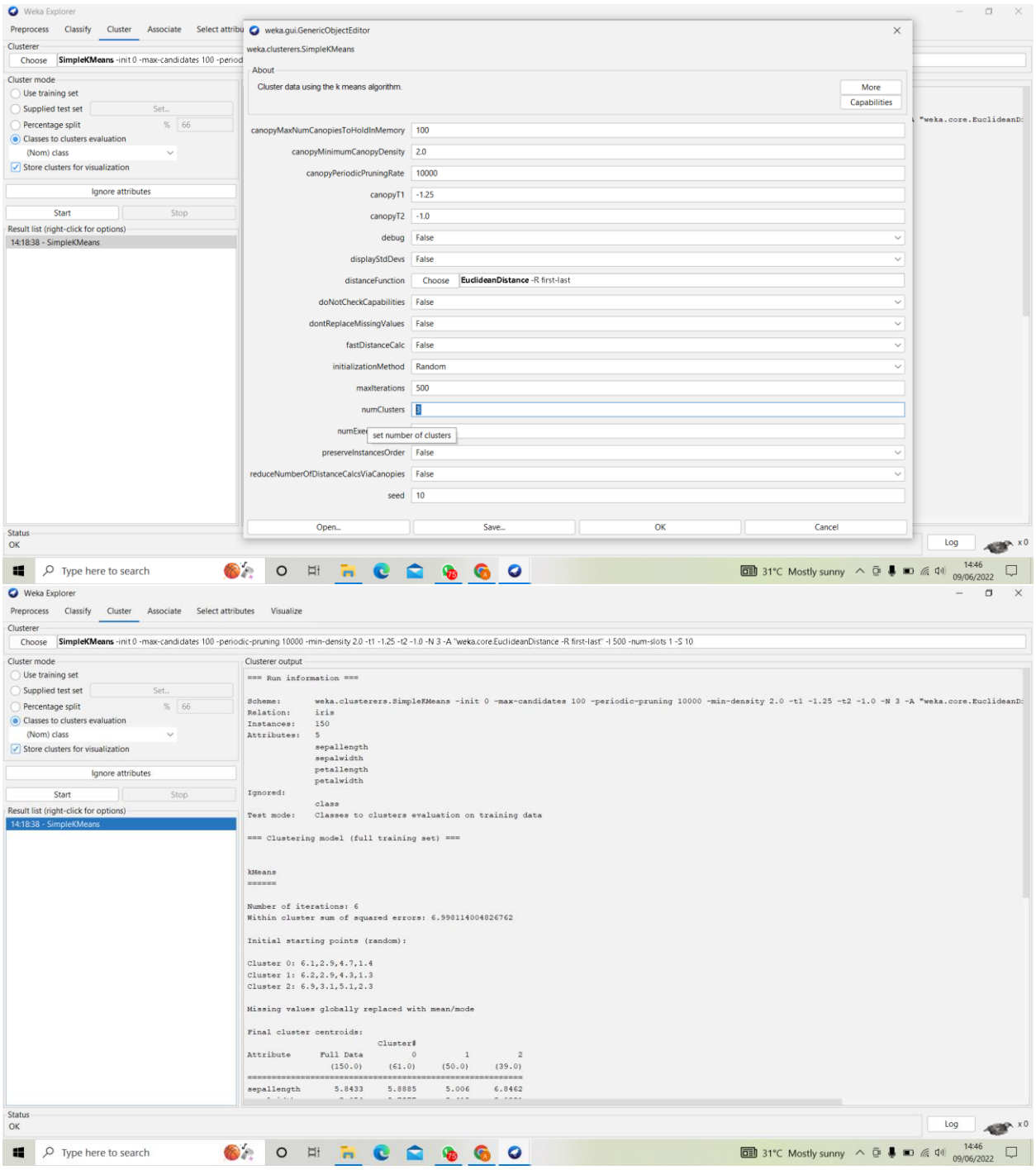
15. Demonstration of clustering rule process on data set iris.arff using simple K.Means

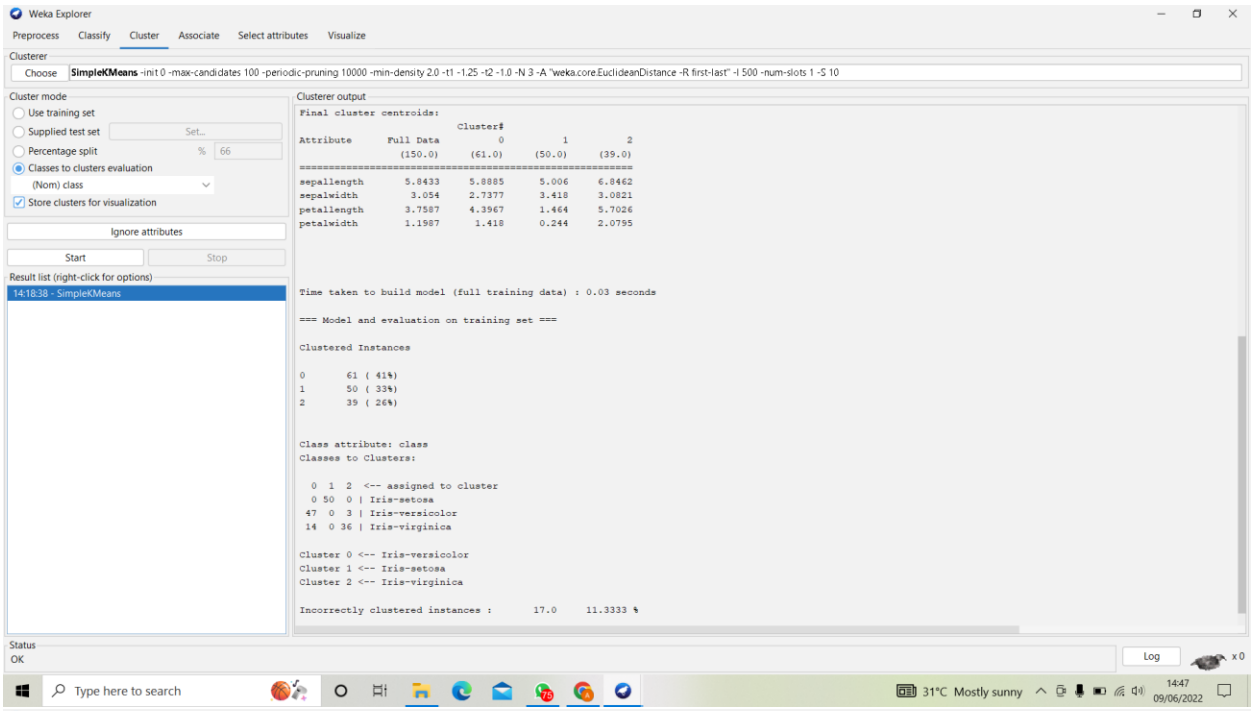
AIM:

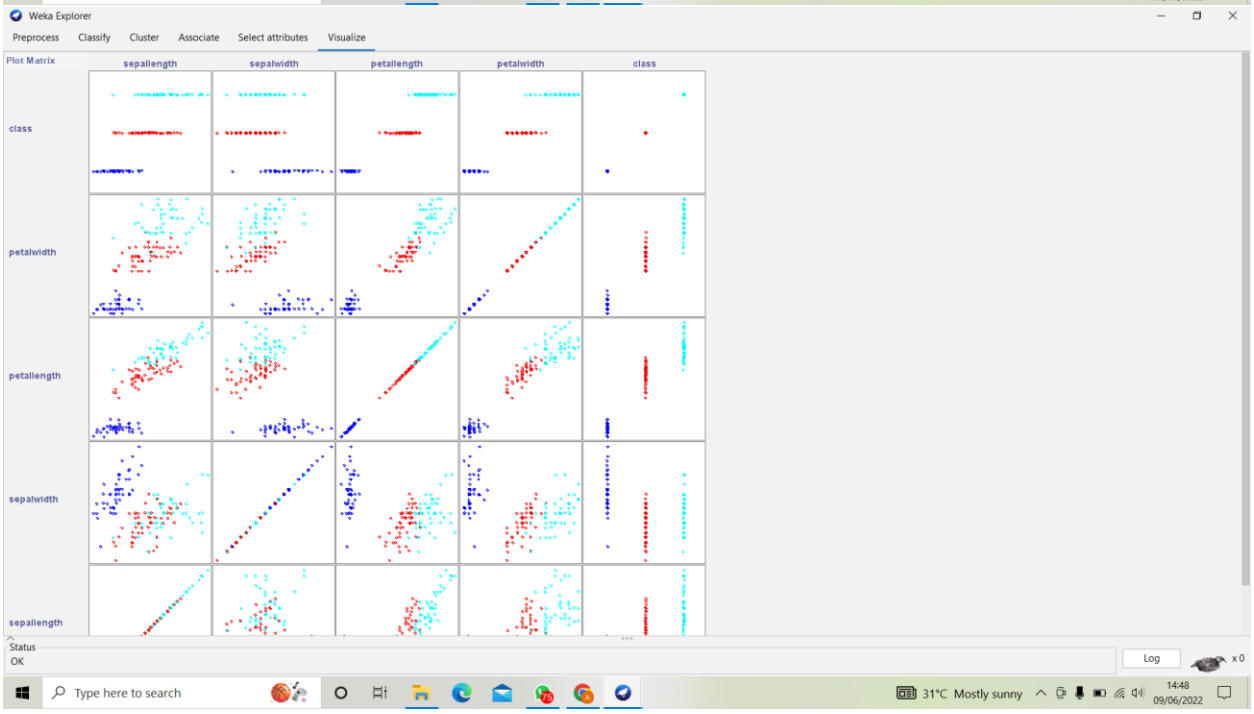
To find demonstration of clustering rule process on data set iris.arff using simple K-Means in WEKA

PROCEDURE AND OUTPUT SCREENSHOT:




Weka Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Clusterer
Choose
SimpleKMeans -init 0 -max-candidates 100 -periodic-pruning 10000 -min-density 2.0 -t1 -1.25 -t2 -1.0 -N 3 -A "weka.core.EuclideanDistance -R first-last" -I 500 -num-slots 1 -S 10
Cluster mode
Use training set
Supplied test set
Set...
Percentage split
%
66
Classes to clusters evaluation
(Nom) class
Store clusters for visualization
Ignore attributes
Start
Stop
Result list (right-click for options)
14:18:38 - SimpleKMeans
Clusterer output
=== Run information ===
Scheme: weka.clusterers.SimpleKMeans -init 0 -max-candidates 100 -periodic-pruning 10000 -min-density 2.0 -t1 -1.25 -t2 -1.0 -N 3 -A "weka.core.EuclideanD
Relation: iris
Instances: 150
Attributes: 5
sepallength
sepalwidth
petallength
petalwidth
Ignored:
class
Test mode: Classes to clusters evaluation on training data
=== Clustering model (full training set) ===
kMeans
======
Number of iterations: 6
Within cluster sum of squared errors: 6.998114004826762
Initial starting points (random):
Cluster 0: 6.1,2.9,4.7,1.4
Cluster 1: 6.2,2.9,4.3,1.3
Cluster 2: 6.9,3.1,5.1,2.3
Missing values globally replaced with mean/mode
Final cluster centroids:
Cluster#
Attribute Full Data 0 1 2
(150.0) (61.0) (50.0) (39.0)
sepallength 5.8433 5.8885 5.006 6.8462
Status
OK
Log
x 0
Type here to search
31°C Mostly sunny
14:46
09/06/2022
weka.gui.GenericObjectEditor
weka.clusterers.SimpleKMeans
About
Cluster data using the k means algorithm.
More
Capabilities
canopyMaxNumCanopiesToHoldInMemory 100
canopyMinimumCanopyDensity 2.0
canopyPeriodicPruningRate 10000
canopyT1 -1.25
canopyT2 -1.0
debug False
displayStdDevs False
distanceFunction Choose EuclideanDistance -R first-last
doNotCheckCapabilities False
dontReplaceMissingValues False
fastDistanceCalc False
initializationMethod Random
maxIterations 500
numClusters 3
set number of clusters
numExe
preserveInstancesOrder False
reduceNumberOfDistanceCalcsViaCanopies False
seed 10
Open...
Save...
OK
Cancel





RESULT:

Thus, the demonstration of clustering rule process on data set iris.arff using simple K-Means in WEKA is shown.

16. Demonstration of classification rule a process on student dataset using KNN algorithm in Python.

AIM:

To find Demonstration of classification rule a process on student dataset using KNN algorithm in Python.

PROGRAM CODE AND OUTPUT SCREENSHOT:

In [81]:
```
#Load the necessary python libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
plt.style.use('ggplot')
```

In [82]:
```
#Load the dataset
df = pd.read_csv('Data.csv')

#Print the first 5 rows of the dataframe.
df.head()
```

Out[82]:

	gender	NationalITy	PlaceofBirth	StageID	GradeID	SectionID	Topic	Semester	Relation	raisedhands	VisITedResources	AnnouncementsView	Discussion
0	M	KW	KuwaIT	lowerlevel	G-04	A	IT	F	Father	15	16	2	20
1	M	KW	KuwaIT	lowerlevel	G-04	A	IT	F	Father	20	20	3	25
2	M	KW	KuwaIT	lowerlevel	G-04	A	IT	F	Father	10	7	0	30
3	M	KW	KuwaIT	lowerlevel	G-04	A	IT	F	Father	30	25	5	35
4	M	KW	KuwaIT	lowerlevel	G-04	A	IT	F	Father	40	50	12	50

In [83]:
```
#Let's observe the shape of the dataframe.
df.shape
```

Out[83]:
```
(480, 17)
```

In [84]:
```
x = df[['Discussion','raisedhands']]
y = df['VisITedResources']
```

In [85]:
```
x
```

Out[85]:

	Discussion	raisedhands
0	20	15
1	25	20
2	30	10
3	35	30
4	50	40
...	...	...
475	8	5
476	28	50
477	29	55
478	57	30
479	62	35

480 rows × 2 columns

In [86]:
```
y
```

Out[86]:
```
0      16
1      20
2       7
3      25
4      50
       ..
475     4
476    77
477    74
478    17
479    14
Name: VisITedResources, Length: 480, dtype: int64
```

In [87]:
```
#importing train_test_split
from sklearn.model_selection import train_test_split
```

In [88]:
```
X_train, X_test, y_train, y_test = train_test_split(x,y,test_size=0.2,random_state=10)
```

In [89]:
```
len(X_train)
```

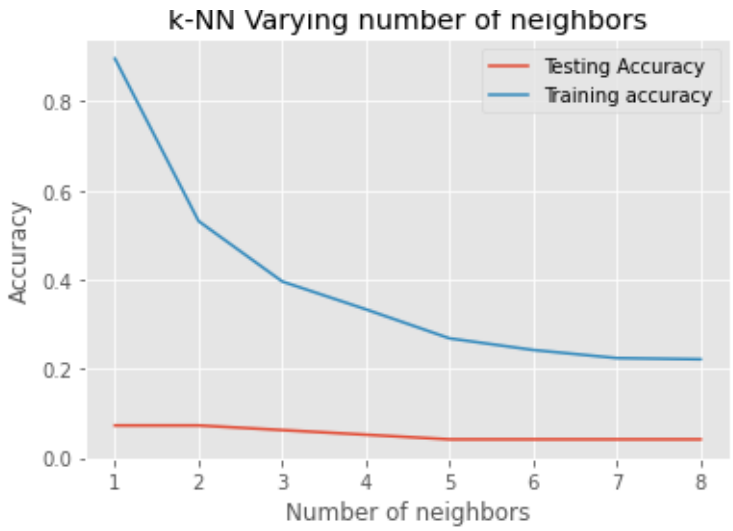
Out[89]:
```
384
```

In [90]:
```
len(y_test)
```

Out[90]:
```
96
```

In [91]:
```
#import KNeighborsClassifier
from sklearn.neighbors import KNeighborsClassifier

#Setup arrays to store training and test accuracies
neighbors = np.arange(1,9)
train_accuracy =np.empty(len(neighbors))
test_accuracy = np.empty(len(neighbors))

for i,k in enumerate(neighbors):
    #Setup a knn classifier with k neighbors
    knn = KNeighborsClassifier(n_neighbors=k)

    #Fit the model
    knn.fit(X_train, y_train)

    #Compute accuracy on the training set
    train_accuracy[i] = knn.score(X_train, y_train)

    #Compute accuracy on the test set
    test_accuracy[i] = knn.score(X_test, y_test)
```

In [92]:
```
#Generate plot
plt.title('k-NN Varying number of neighbors')
plt.plot(neighbors, test_accuracy, label='Testing Accuracy')
plt.plot(neighbors, train_accuracy, label='Training accuracy')
plt.legend()
plt.xlabel('Number of neighbors')
plt.ylabel('Accuracy')
plt.show()
```



In [93]:
```
knn = KNeighborsClassifier(n_neighbors=7)
```

In [94]:
```
knn.fit(X_train,y_train)
```

Out[94]:
```
KNeighborsClassifier(n_neighbors=7)
```

In [95]:
```
knn.score(X_test,y_test)
```

Out[95]:
```
0.041666666666666664
```

```
In [96]: from sklearn.metrics import confusion_matrix

In [97]: y_pred = knn.predict(X_test)

In [80]: confusion_matrix(y_test,y_pred)

Out[80]: array([[0, 0, 0, ..., 0, 0, 0],
                [0, 0, 0, ..., 0, 0, 0],
                [0, 1, 0, ..., 0, 0, 0],
                ...,
                [0, 1, 0, ..., 0, 0, 0],
                [1, 0, 1, ..., 0, 0, 0],
                [0, 0, 0, ..., 0, 0, 0]], dtype=int64)
```

RESULT:

Thus, the demonstration of classification rule a process on student dataset using KNN algorithm in Python is shown.

17. Demonstrate Decision tree ID3 algorithm for any dataset using PYTHON

AIM:

To implement the Navie Bayes algorithm using python

PROCEDURE:

Step 1: Data Pre-processing step
Step 2: Fitting Naive Bayes to the Training Set
Step 3: Prediction of the test set result
Step 4: Creating Confusion Matrix

PROGRAM CODE AND OUTPUT SCREENSHOT:

In [1]:
```
import numpy as np
```

In [2]:
```
def fit(X_train,Y_train):
    result = {}
    class_values = set(Y_train)
    for curr_value in class_values:
        result[curr_value] = {}
        result["total_data"] = len(Y_train)
        curr_class_rows = (Y_train == curr_value)
        X_train_curr = X_train[curr_class_rows]
        Y_train_curr = Y_train[curr_class_rows]
        num_features = X_train.shape[1]
        result[curr_value]["total_count"] = len(Y_train_curr)
        for j in range(1,num_features+1):
            result[curr_value][j] = {}
            all_possible_values = set(X_train[:,j-1])
            for this_value in all_possible_values:
                result[curr_value][j][this_value] = (X_train_curr[:,j-1]==this_value).sum()
    return result
```

In [3]:
```
def probablity(dictionary,x,current_class):
    output= np.log(dictionary[current_class]["total_count"])-np.log(dictionary["total_data"])
    num_features = len(dictionary[current_class].keys())-1;
    for j in range(1,num_features+1):
        xj = x[j-1]
        count_current_class_with_value_xj = dictionary[current_class][j][xj] + 1
        count_current_class = dictionary[current_class]["total_count"] + len(dictionary[current_class][j].keys())
        current_xj_prob = np.log(count_current_class_with_value_xj) -np.log(count_current_class)
        output = output + current_xj_prob
    return output
```

In [4]:
```
def predictSinglePoint(dictionary,x):
    classes = dictionary.keys()
    best_p = -1000
    best_class = -1
    first_run = True
    for current_class in classes:
        if(current_class == "total_data"):
            continue
        p_curr_class = probablity(dictionary,x,current_class)
        if(first_run or p_curr_class > best_p):
            best_p = p_curr_class
            best_class = current_class
        first_run = False
    return best_class
```

In [5]:
```
def predict(dictionary,X_test):
    Y_pred = []
    for x in X_test:
        x_class = predictSinglePoint(dictionary,x)
        Y_pred.append(x_class)
    return Y_pred
```

In [6]:
```
def makelabelled(column):
    second_limit = column.mean()
    first_limit = 0.5 * second_limit
    third_limit = 1.5 * second_limit
    for i in range(0,len(column)):
        if(column[i]<first_limit):
            column[i] = 0
        elif(column[i] < second_limit):
            column[i] = 1
        elif(column[i]<third_limit):
            column[i] = 2
        else:
            column[i] = 3
    return column
```

In [7]:
```
from sklearn import datasets
iris = datasets.load_iris()
x = iris.data
y = iris.target
```

In [8]:
```
for i in range(0,x.shape[-1]):
    x[:,i] = makelabelled(x[:,i])
```

In [9]:
```
from sklearn import model_selection
X_train,X_test,Y_train,Y_test = model_selection.train_test_split(x,y,test_size=0.25,random_state=0)
```

In [10]:
```
dictionary = fit(X_train,Y_train)
```

```
In [10]: dictionary = fit(X_train,Y_train)

In [11]: Y_pred = predict(dictionary,X_test)

In [12]: from sklearn.metrics import classification_report,confusion_matrix
         print(classification_report(Y_test,Y_pred))
         print(confusion_matrix(Y_test,Y_pred))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        13
           1       0.94      1.00      0.97        16
           2       1.00      0.89      0.94         9

    accuracy                           0.97        38
   macro avg       0.98      0.96      0.97        38
weighted avg       0.98      0.97      0.97        38

[[13  0  0]
 [ 0 16  0]
 [ 0  1  8]]
```

RESULT:

Thus, the implement the Navie Bayes algorithm using python

18. Write a Program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/ Python ML library classes can be used for this problem.

AIM:

To implement k-Nearest Neighbour algorithm to classify the iris data set and print both correct and wrong predictions.

PROCEDURE:

STEP1: The data is imported and then it goes through splitting process.

STEP2: Then by using the KNN classifier the model is trained and value of k is taken as 3.

STEP3: The distance is calculated with all the training points to test the point and then select the three lowest distance points.

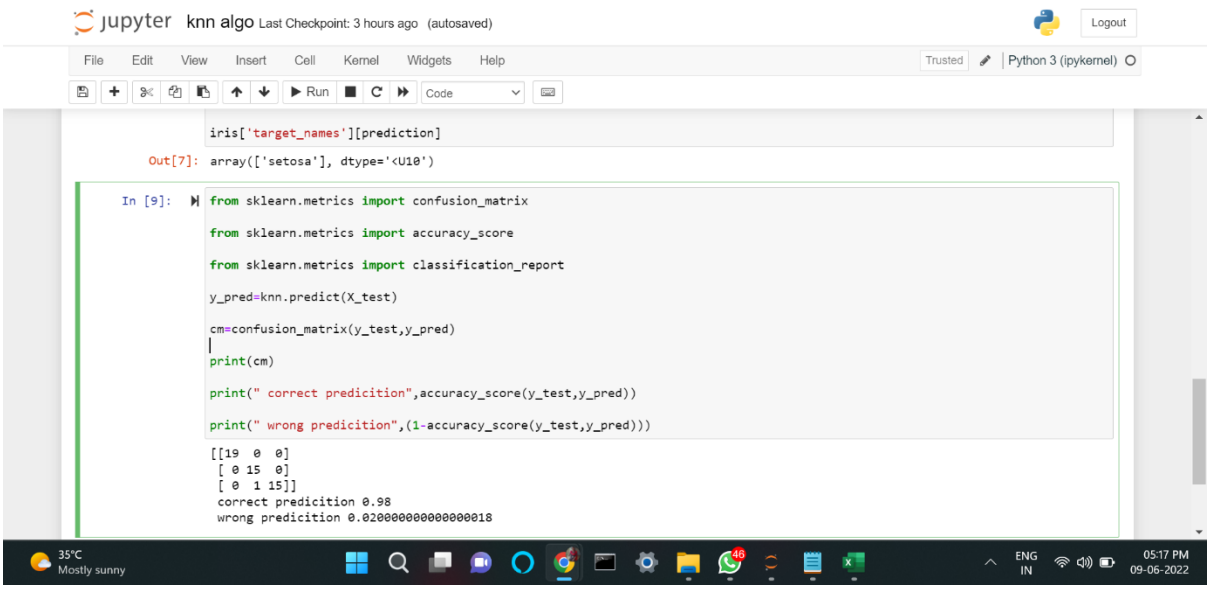
STEP4: After that the prediction process is done for getting the result.

PROGRAM CODING IN PYTHON:

```
import sklearn

import pandas as pd

from sklearn.datasets import load_iris

iris=load_iris()

iris.keys()

df=pd.DataFrame(iris['data'])

print(df)

print(iris['target_names'])

iris['feature_names']

X=df

y=iris['target']

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33, random_state=42)
```

```
from sklearn.neighbors import KNeighborsClassifier
knn=KNeighborsClassifier(n_neighbors=3)


knn.fit(X_train,y_train)


import numpy as np
x_new=np.array([[5,2.9,1,0.2]])
prediction=knn.predict(x_new)
iris['target_names'][prediction]
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score
from sklearn.metrics import classification_report
y_pred=knn.predict(X_test)
cm=confusion_matrix(y_test,y_pred)
print(cm)
print(" correct predicition",accuracy_score(y_test,y_pred))
print(" worng predicition",(1-accuracy_score(y_test,y_pred)))
```

OUTPUT SCREENSHOT:



RESULT:

Thus, the implement k-Nearest Neighbour algorithm to classify the iris data set and print both correct and wrong predictions.

INTERNAL - 2

19. KMEANS CLUSTERING FOR IRIS DATASET USING R

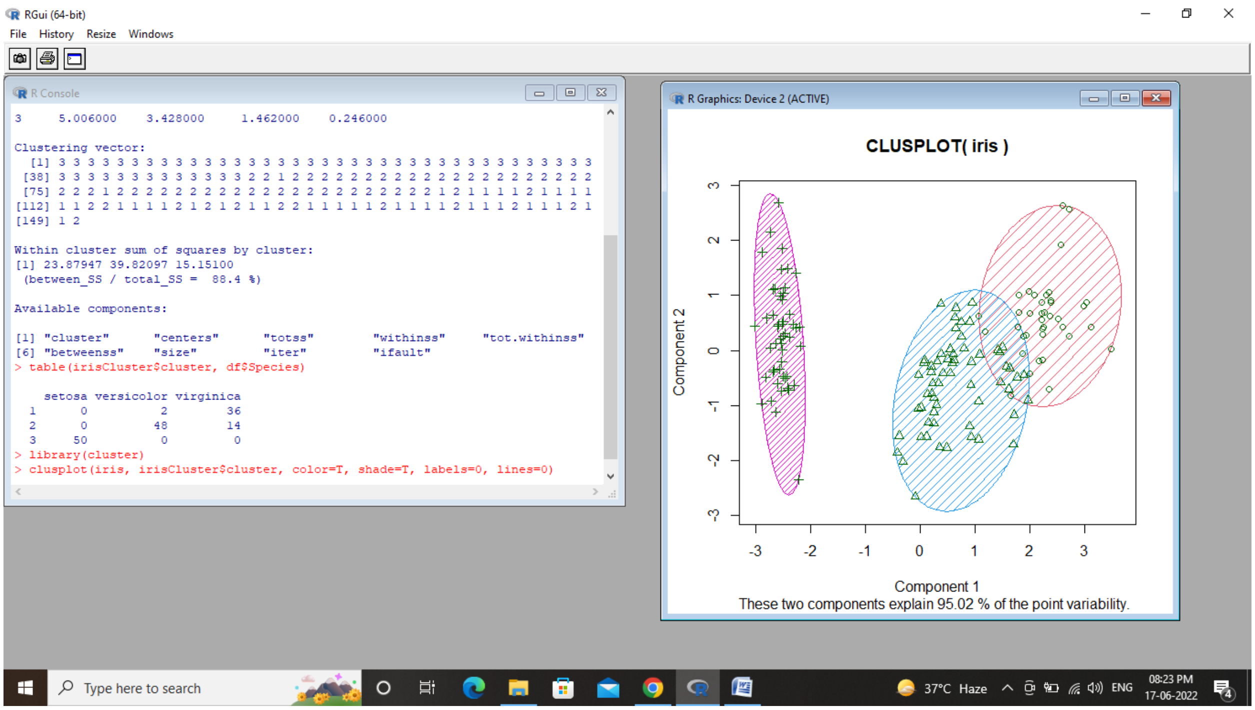
AIM:

To find KMEANS Clustering for IRIS dataset using R

PROCEDURE:

```
library(ggplot2)
df <- iris
head(iris)
ggplot(df, aes(Petal.Length, Petal.Width)) + geom_point(aes(col=Species), size=4)
set.seed(101)
irisCluster <- kmeans(df[,1:4], center=3, nstart=20)
irisCluster
table(irisCluster$cluster, df$Species)
library(cluster)
clusplot(iris, irisCluster$cluster, color=T, shade=T, labels=0, lines=0)
```

OUTPUT SCREENSHOT:



RESULT:

Thus, the implementation of KMEANS Clustering for IRIS dataset is shown.

20. Outliner Detection using K Means Classification algorithm on IRIS dataset using R

AIM:

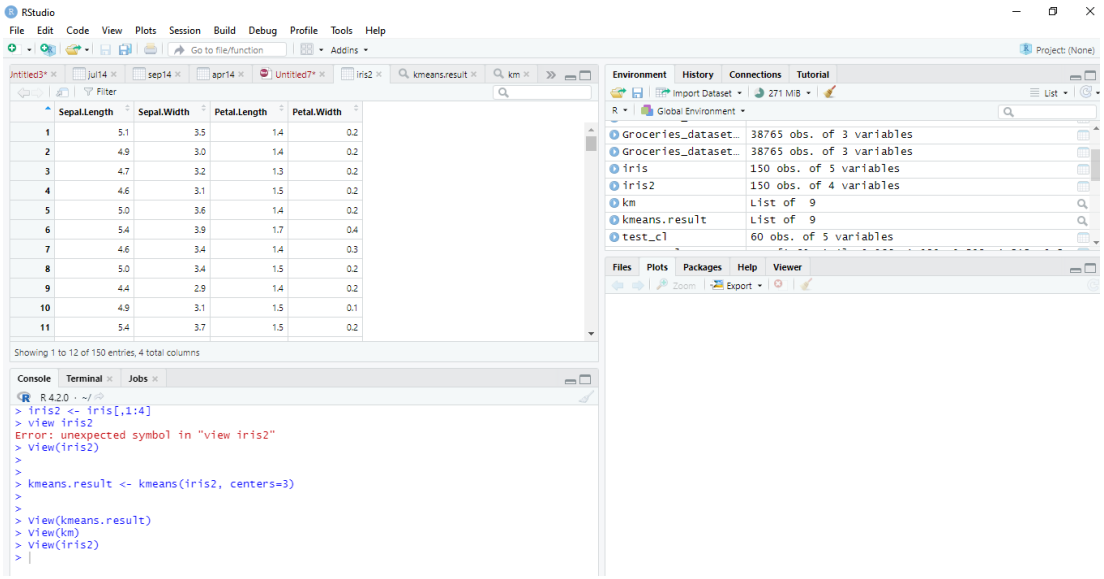
To apply Outliner Detection using K Means Classification algorithm on IRIS dataset using R

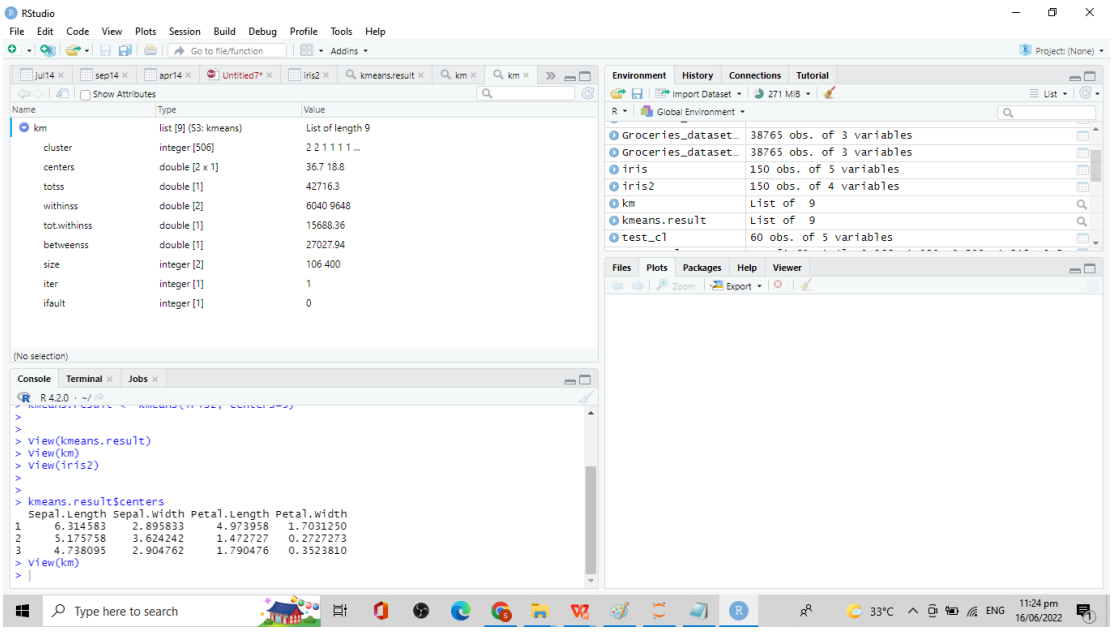
Procedure:

iris2 <- iris[,1:4]

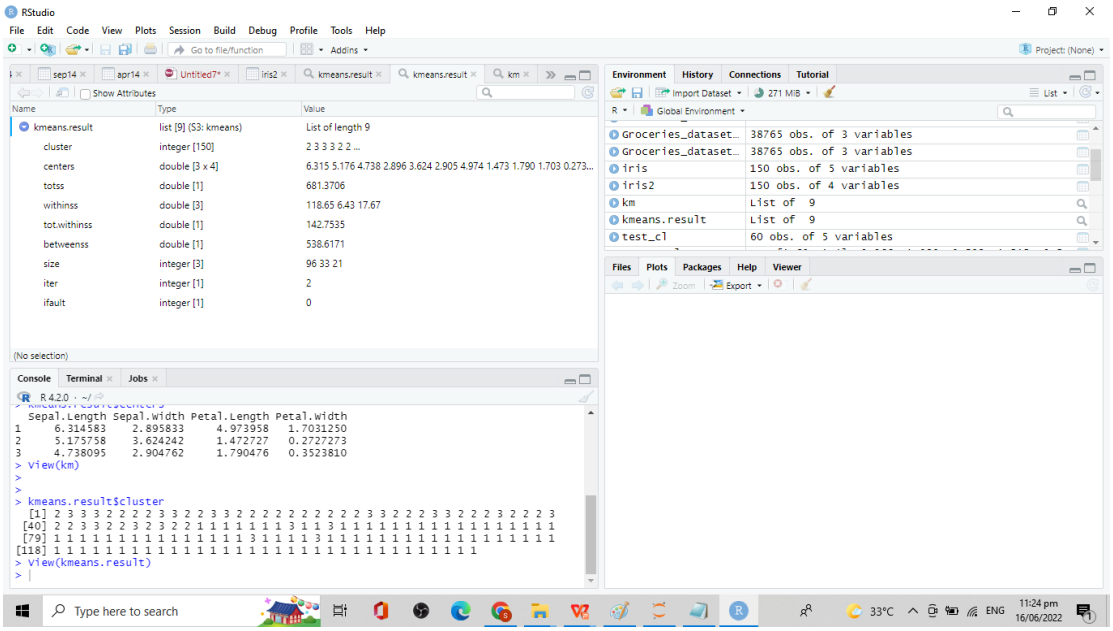
kmeans.result <- kmeans(iris2, centers=3)

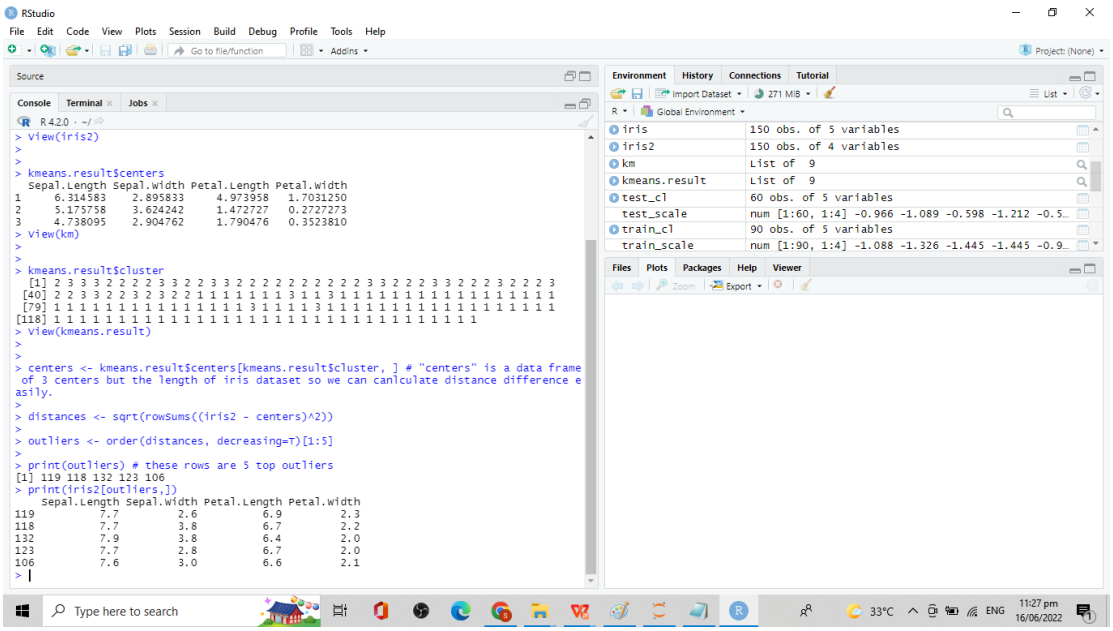
kmeans.result$centers





kmeans.result$cluster

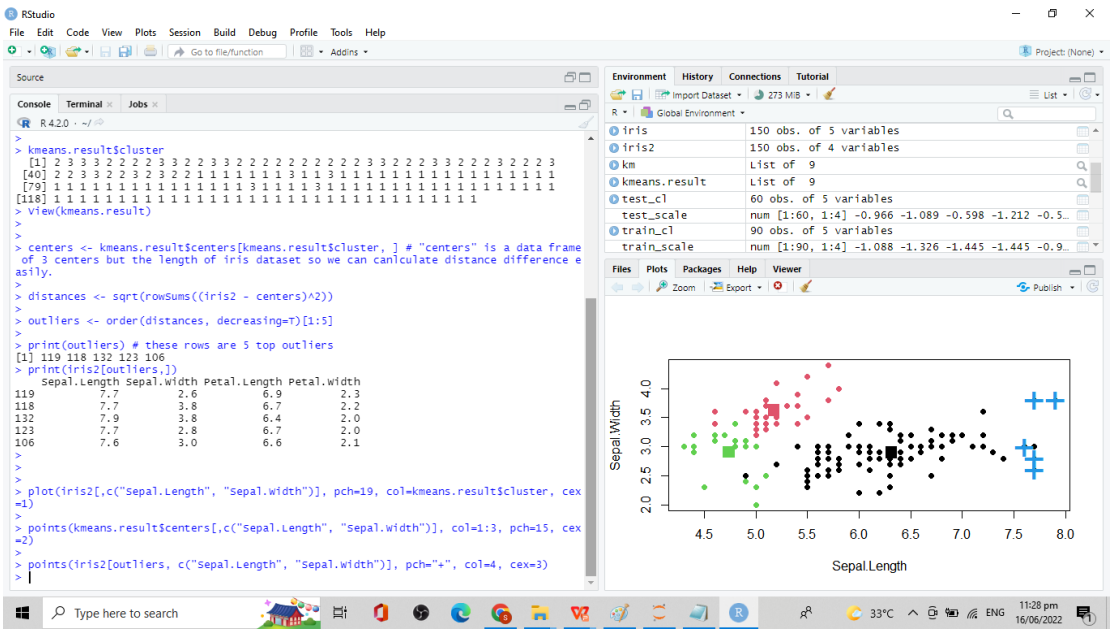




plot(iris2[,c("Sepal.Length", "Sepal.Width")], pch=19, col=kmeans.result$cluster, cex=1)

points(kmeans.result$centers[,c("Sepal.Length", "Sepal.Width")], col=1:3, pch=15, cex=2)

points(iris2[outliers, c("Sepal.Length", "Sepal.Width")], pch="+", col=4, cex=3)



RESULT:

Thus the implementation of KMeans Classification algorithm for IRIS dataset using R

21. KNN Algorithm in BodyFat dataset using R.

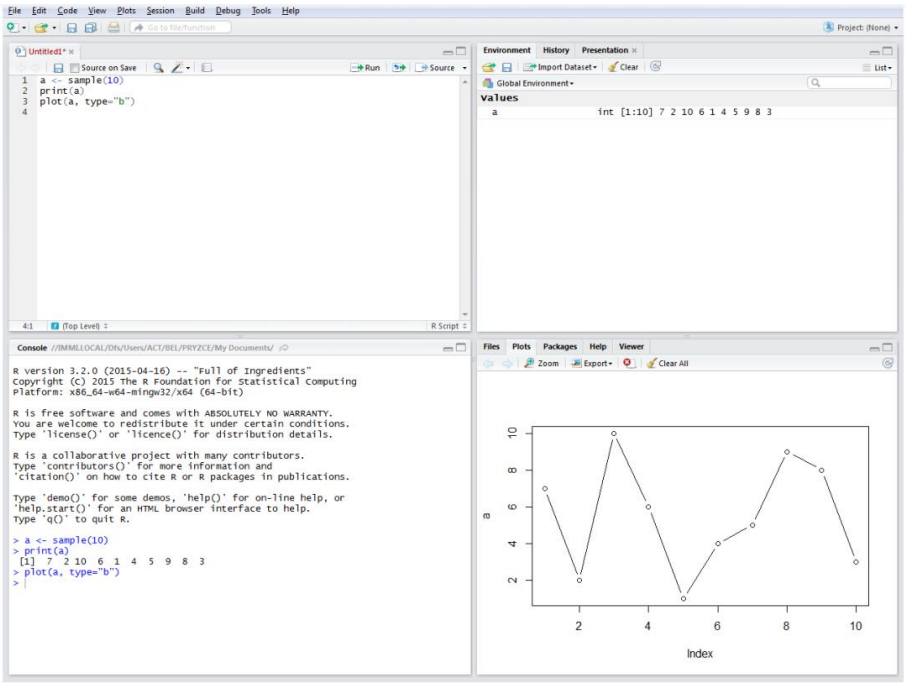
Solution:

Introduction to RStudio

RStudio 10 is an integrated development environment (IDE) for R and can run on various operating systems like Windows, Mac OS X and Linux. It is a very useful and powerful tool for R programming, and therefore, readers are suggested to use RStudio when learning from this book or doing their projects, although all the provided code can run without it. What you normally need is RStudio Desktop open-source edition, which is free of charge.

There are four panels:

- Source panel (top left), which shows your R source code. If you cannot see the source panel, you can find it by clicking menu “File”, “New File” and then “R Script”. You can run a line or a selection of R code by clicking the “Run” bottom on top of source panel, or pressing “Ctrl + Enter”.
- Console panel (bottom left), which shows outputs and system messages displayed in a normal R console;
- Environment/History/Presentation panel (top right), whose three tabs show respectively all objects and function loaded in R, a history of submitted R code, and Presentations generated with R;



It is always a good practice to begin R programming with an RStudio project, which is a folder where to put your R code, data files and figures. To create a new project, click the

"Project" button at the top-right corner and then choose "New Project". After that, select "create project from new directory" and then "Empty Project". After typing a directory name, which will also be your project name, click "Create Project" to create your project folder and files. If you open an existing project, RStudio will automatically set the working directory to the project directory, which is very convenient. After that, create three folders as below:

- code, where to put your R source code;
- data, where to put your datasets; and
- figures, where to put produced diagrams.

In addition to above three folders which are useful to most projects, depending on your project and preference, you may create additional folders below:

- rawdata, where to put all raw data,
- models, where to put all produced analytics models, and
- reports, where to put your analysis reports.

Dataset

The BodyFat data is used in this practical for demonstration of KNN Algorithm with R.

	Density	BodyFat	Age	Weight	Height	Neck	Chest	Abdomen	Hip	Thigh	Knee	Ankle	Biceps	Forearm	Wrist
1	1.0708	12.3	23	154.25	67.75	36.2	93.1	85.2	94.5	59.0	37.3	21.9	32.0	27.4	17.1
2	1.0853	6.1	22	173.25	72.25	38.5	93.6	83.0	98.7	58.7	37.3	23.4	30.5	28.9	18.2
3	1.0414	25.3	22	154.00	66.25	34.0	95.8	87.9	99.2	59.6	38.9	24.0	28.8	25.2	16.6
4	1.0751	10.4	26	184.75	72.25	37.4	101.8	86.4	101.2	60.1	37.3	22.8	32.4	29.4	18.2
5	1.0340	28.7	24	184.25	71.25	34.4	97.3	100.0	101.9	63.2	42.2	24.0	32.2	27.7	17.7
6	1.0502	20.9	24	210.25	74.75	39.0	104.5	94.4	107.8	66.0	42.0	25.6	35.7	30.6	18.8
7	1.0549	19.2	26	181.00	69.75	36.4	105.1	90.7	100.3	58.4	38.3	22.9	31.9	27.8	17.7
8	1.0704	12.4	25	176.00	72.50	37.8	99.6	88.5	97.1	60.0	39.4	23.2	30.5	29.0	18.8
9	1.0900	4.1	25	191.00	74.00	38.1	100.9	82.5	99.9	62.9	38.3	23.8	35.9	31.1	18.2
10	1.0722	11.7	23	198.25	73.50	42.1	99.6	88.6	104.1	63.1	41.7	25.0	35.6	30.0	19.2
11	1.0830	7.1	26	186.25	74.50	38.5	101.5	83.6	98.2	59.7	39.7	25.2	32.8	29.4	18.5
12	1.0812	7.8	27	216.00	76.00	39.4	103.6	90.9	107.7	66.2	39.2	25.9	37.2	30.2	19.0
13	1.0513	20.8	32	180.50	69.50	38.4	102.0	91.6	103.9	63.4	38.3	21.5	32.5	28.6	17.7
14	1.0505	21.2	30	205.25	71.25	39.4	104.1	101.8	108.6	66.0	41.5	23.7	36.9	31.6	18.8
15	1.0484	22.1	35	187.75	69.50	40.5	101.3	96.4	100.1	69.0	39.0	23.1	36.1	30.5	18.2
16	1.0512	20.9	35	162.75	66.00	36.4	99.1	92.8	99.2	63.1	38.7	21.7	31.1	26.4	16.9
17	1.0333	29.0	34	195.75	71.00	38.9	101.9	96.4	105.2	64.8	40.8	23.1	36.2	30.8	17.3
18	1.0468	22.9	32	209.25	71.00	42.1	107.6	97.5	107.0	66.9	40.0	24.4	38.2	31.6	19.3
19	1.0622	16.0	28	183.75	67.75	38.0	106.8	89.6	102.4	64.2	38.7	22.9	37.2	30.5	18.5
20	1.0610	16.5	33	211.75	73.50	40.0	106.2	100.5	109.0	65.8	40.6	24.0	37.1	30.1	18.2
21	1.0551	19.1	28	179.00	68.00	39.1	103.3	95.9	104.9	63.5	38.0	22.1	32.5	30.3	18.4
22	1.0640	15.2	28	200.50	69.75	41.3	111.4	98.8	104.8	63.4	40.6	24.6	33.0	32.8	19.9
23	1.0631	15.6	31	140.25	68.25	33.9	86.0	76.4	94.6	57.4	35.3	22.2	27.9	25.9	16.7
24	1.0584	17.7	32	148.75	70.00	35.5	86.7	80.0	93.4	54.9	36.2	22.1	29.8	26.7	17.1
25	1.0668	14.0	28	151.25	67.75	34.5	90.2	76.3	95.8	58.4	35.5	22.9	31.1	28.0	17.6
26	1.0911	3.7	27	159.25	71.50	35.7	89.6	79.7	96.5	55.0	36.7	22.5	29.9	28.2	17.7
27	1.0811	7.9	34	131.50	67.50	36.2	88.6	74.6	85.3	51.7	34.7	21.4	28.7	27.0	16.5
28	1.0468	22.9	31	148.00	67.50	38.8	97.4	88.7	94.7	57.5	36.0	21.0	29.2	26.6	17.0
29	1.0910	3.7	27	133.25	64.75	36.4	93.5	73.9	88.5	50.1	34.5	21.3	30.5	27.9	17.2
30	1.0790	8.8	29	160.75	69.00	36.7	97.4	83.5	98.7	58.9	35.3	22.6	30.1	26.7	17.6
31	1.0716	11.9	32	182.00	73.75	38.7	100.5	88.7	99.8	57.5	38.7	33.9	32.5	27.7	18.4
32	1.0862	5.7	29	160.25	71.25	37.3	93.5	84.5	100.6	58.5	38.8	21.5	30.1	26.4	17.9
33	1.0719	11.8	27	168.00	71.25	38.1	93.0	79.1	94.5	57.3	36.2	24.5	29.0	30.0	18.8

Showing 1 to 34 of 252 entries, 15 total columns

PROGRAM & OUTPUT SCREENSHOT

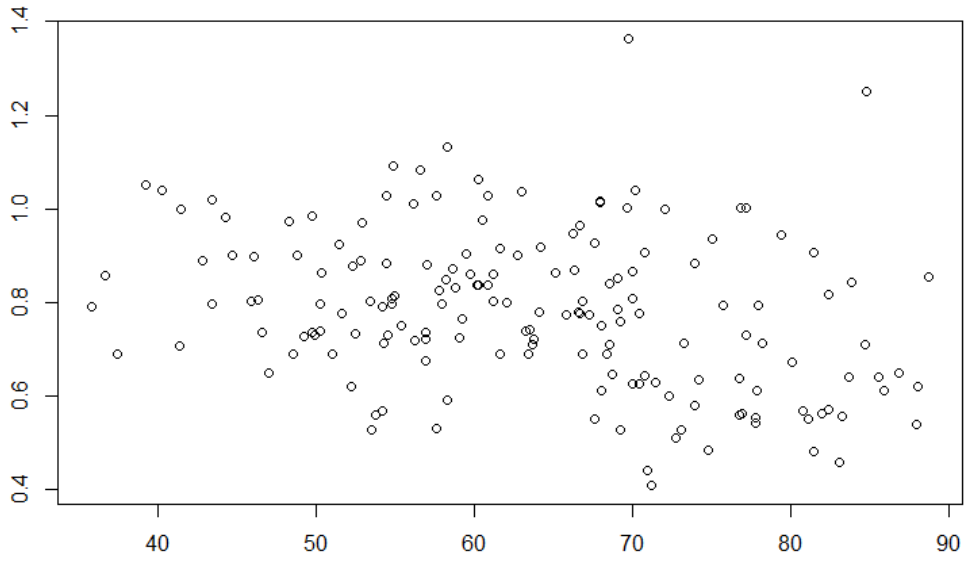
```
library(caret)
library(e1071)
library(caTools)
library(class)
data <-read.csv("C:/Users/sunil/Desktop/DM Lab/bodyfat.csv")
split <- sample.split(data, SplitRatio = 0.7)
train_cl <- subset(data, split =="TRUE")
test_cl <- subset(data, split =="FALSE")
train_scale <- scale(train_cl[, 1:4])
test_scale <- scale(test_cl[, 1:4])
classifier_knn <- knn(train = train_scale,

                      test = test_scale,

                      cl = train_cl$BodyFat,

                      k = 1)
classifier_knn
cm <- table(test_cl$BodyFat, classifier_knn)
cm
classifier_knn <- knn(train = train_scale,

                      test = test_scale,

                      cl = train_cl$BodyFat,

                      k = 7)

accuracy<- mean(classifier_knn != test_cl$BodyFat)
print(paste('Accuracy =', accuracy))
```

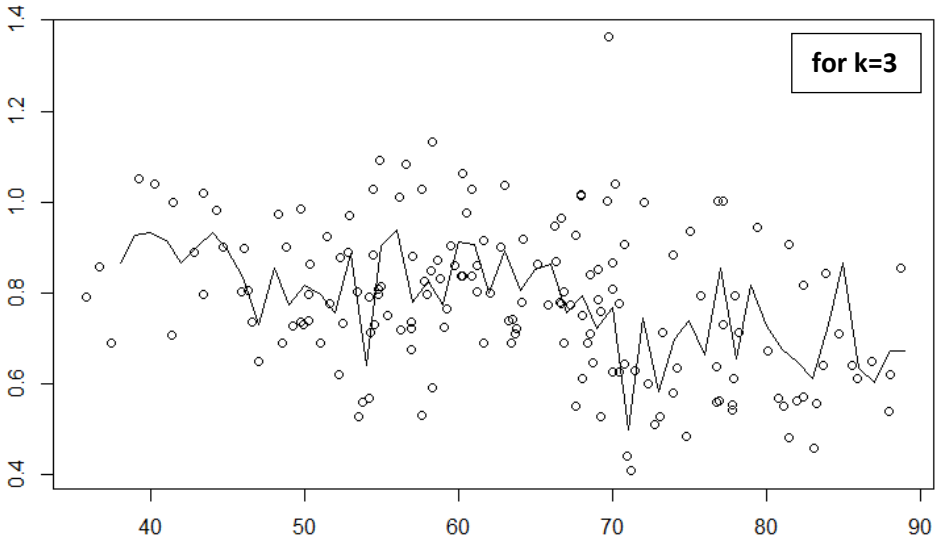
```
> data <-read.csv("C:/Users/sunil/Desktop/DM Lab/bodyfat.csv")
> split <- sample.split(data, SplitRatio = 0.7)
> train_cl <- subset(data, split =="TRUE")
> test_cl <- subset(data, split =="FALSE")
> train_scale <- scale(train_cl[, 1:4])
> test_scale <- scale(test_cl[, 1:4])
> classifier_knn <- knn(train = train_scale,
+
+                       test = test_scale,
+
+                       cl = train_cl$BodyFat,
+
+                       k = 1)
> classifier_knn
 [1] 21.8 19.1 10.4 20.5 21   19.2 14.6 12.5 20.9 3    8.8  20.5 32.3 27.2 32.9 9.9  7.7  4    29   32.3 30   23.3 12.4 8.8  12.5
[26] 18.8 26.6 27   24.3 6    7.5  6    21.2 19.7 21.2 18.7 27.1 25.4 10.9 25.3 12.1 25.4 13.9 21.2 23.3 27.1 17.5 10.4 25.2 3.7
[51] 9.4  29   20.5 11.9 15.6 19.2 0    26.6 32.3 20.8 10.8 21.3 25.3 17.3 21.3 18   22   32.9 32.9 7.5  18.1 12.4 13.8 8.8  6.3
[76] 22.6 15.4 24.3 26.1 11.8 32.6 31.9 26
132 Levels: 0 3 3.7 4 4.1 5.7 6 6.1 6.3 6.6 7.1 7.5 7.7 7.8 7.9 8 8.6 8.8 9 9.4 9.9 10 10.2 10.4 10.6 10.8 10.9 11 11.3 ... 47.5
>
```

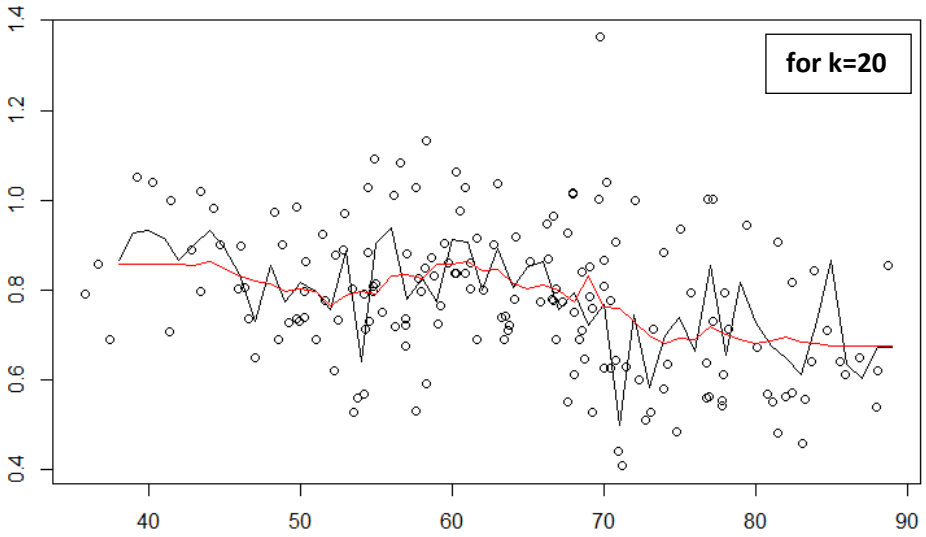
```
    classifier_knn
     0 3 3.7 4 4.1 5.7 6 6.1 6.3 6.6 7.1 7.5 7.7 7.8 7.9 8 8.6 8.8 9 9.4 9.9 10 10.2 10.4 10.6 10.8 10.9 11 11.3 11.4 11.8 11.9
0.7  1 0   0 0   0   0 0   0   0   0   0   0   0   0   0 0   0   0 0   0   0  0   0    0    0    0    0  0   0    0    0    0
3.7  0 1   0 0   0   0 0   0   0   0   0   0   0   0   0 0   0   0 0   0   0  0   0    0    0    0    0  0   0    0    0    0
3.9  0 0   0 1   0   0 0   0   0   0   0   0   0   0   0 0   0   0 0   0   0  0   0    0    0    0    0  0   0    0    0    0
5.2  0 0   0 0   0   0 0   0   1   0   0   0   0   0   0 0   0   0 0   0   0  0   0    0    0    0    0  0   0    0    0    0
5.3  0 0   1 0   0   0 0   0   0   0   0   0   0   0   0 0   0   0 0   0   0  0   0    0    0    0    0  0   0    0    0    0
5.6  0 0   0 0   0   0 0   0   0   0   0   0   0   0   0 0   0   0 0   0   1  0   0    0    0    0    0  0   0    0    0    0
6.6  0 0   0 0   0   0 0   0   0   0   0   1   0   0   0 0   0   0 0   0   0  0   0    0    0    0    0  0   0    0    0    0
    classifier_knn
     12.1 12.2 12.3 12.4 12.5 13.1 13.6 13.8 13.9 14.1 14.2 14.6 14.8 14.9 15.2 15.4 15.6 16 16.5 16.6 16.7 16.9 17 17.3 17.4
0.7     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0    0    0  0    0    0
3.7     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0    0    0  0    0    0
3.9     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0    0    0  0    0    0
5.2     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0    0    0  0    0    0
5.3     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0    0    0  0    0    0
5.6     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0    0    0  0    0    0
6.6     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0    0    0  0    0    0
    classifier_knn
     17.5 17.7 17.8 18 18.1 18.2 18.4 18.5 18.6 18.7 18.8 19.1 19.2 19.3 19.5 19.6 19.7 20.1 20.4 20.5 20.8 20.9 21 21.2 21.3
0.7     0    0    0  0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0
3.7     0    0    0  0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0
3.9     0    0    0  0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0
5.2     0    0    0  0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0
5.3     0    0    0  0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0
5.6     0    0    0  0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0
6.6     0    0    0  0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0
    classifier_knn
     21.4 21.5 21.8 22 22.1 22.4 22.6 22.7 22.8 23.3 23.6 24.3 24.4 24.5 24.6 24.8 24.9 25.2 25.3 25.4 25.5 25.8 26 26.1 26.6
0.7     0    0    0  0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0
3.7     0    0    0  0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0
3.9     0    0    0  0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0
5.2     0    0    0  0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0
5.3     0    0    0  0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0
5.6     0    0    0  0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0
6.6     0    0    0  0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0  0    0    0
    classifier_knn
     26.7 27 27.1 27.2 27.3 27.9 28.4 28.7 29 29.8 29.9 30 31.4 31.9 32.3 32.6 32.9 33.6 34.3 34.5 35 35.2 38.1 40.1 47.5
0.7     0  0    0    0    0    0    0    0  0    0    0  0    0    0    0    0    0    0    0    0  0    0    0    0    0
3.7     0  0    0    0    0    0    0    0  0    0    0  0    0    0    0    0    0    0    0    0  0    0    0    0    0
3.9     0  0    0    0    0    0    0    0  0    0    0  0    0    0    0    0    0    0    0    0  0    0    0    0    0
5.2     0  0    0    0    0    0    0    0  0    0    0  0    0    0    0    0    0    0    0    0  0    0    0    0    0
5.3     0  0    0    0    0    0    0    0  0    0    0  0    0    0    0    0    0    0    0    0  0    0    0    0    0
5.6     0  0    0    0    0    0    0    0  0    0    0  0    0    0    0    0    0    0    0    0  0    0    0    0    0
6.6     0  0    0    0    0    0    0    0  0    0    0  0    0    0    0    0    0    0    0    0  0    0    0    0    0
[ reached getOption("max.print") -- omitted 65 rows ]
```

```
      classifier_knn
       26.7 27 27.1 27.2 27.3 27.9 28.4 28.7 29 29.8 29.9 30 31.4 31.9 32.3 32.6 32.9 33.6 34.3 34.5 35 35.2 38.1 40.1 47.5
  0.7     0  0    0    0    0    0    0    0  0    0    0  0    0    0    0    0    0    0    0    0  0    0    0    0    0
  3.7     0  0    0    0    0    0    0    0  0    0    0  0    0    0    0    0    0    0    0    0  0    0    0    0    0
  3.9     0  0    0    0    0    0    0    0  0    0    0  0    0    0    0    0    0    0    0    0  0    0    0    0    0
  5.2     0  0    0    0    0    0    0    0  0    0    0  0    0    0    0    0    0    0    0    0  0    0    0    0    0
  5.3     0  0    0    0    0    0    0    0  0    0    0  0    0    0    0    0    0    0    0    0  0    0    0    0    0
  5.6     0  0    0    0    0    0    0    0  0    0    0  0    0    0    0    0    0    0    0    0  0    0    0    0    0
  6.6     0  0    0    0    0    0    0    0  0    0    0  0    0    0    0    0    0    0    0    0  0    0    0    0    0
 [ reached getOption("max.print") -- omitted 65 rows ]
> classifier_knn <- knn(train = train_scale,
+
+                       test = test_scale,
+
+                       cl = train_cl$BodyFat,
+
+                       k = 7)
> accuracy<- mean(classifier_knn != test_cl$BodyFat)
> print(paste('Accuracy =', accuracy))
[1] "Accuracy = 0.987951807228916"
>
```

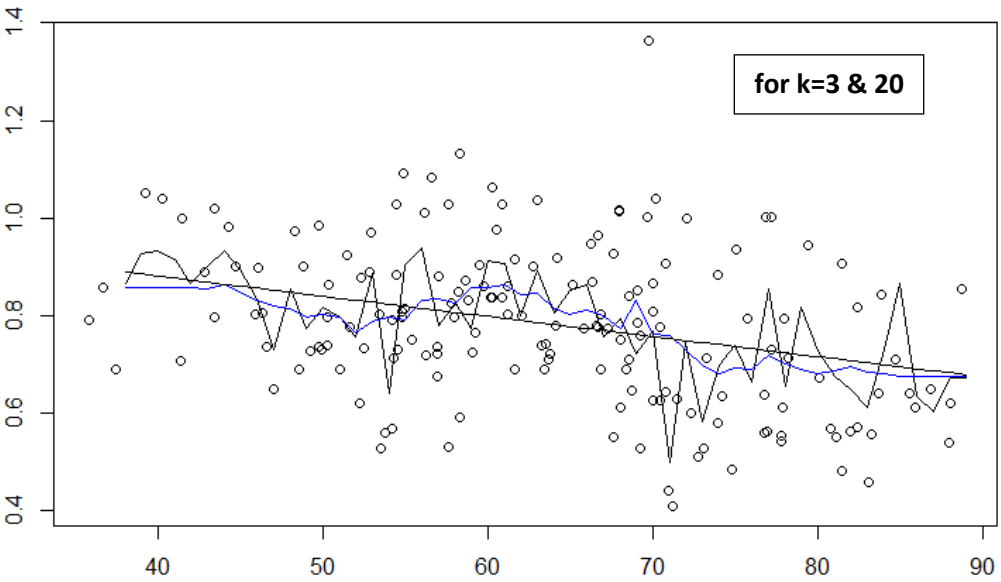
Graph plot: for k = 3 & 20







Linear Prediction:



RESULT:

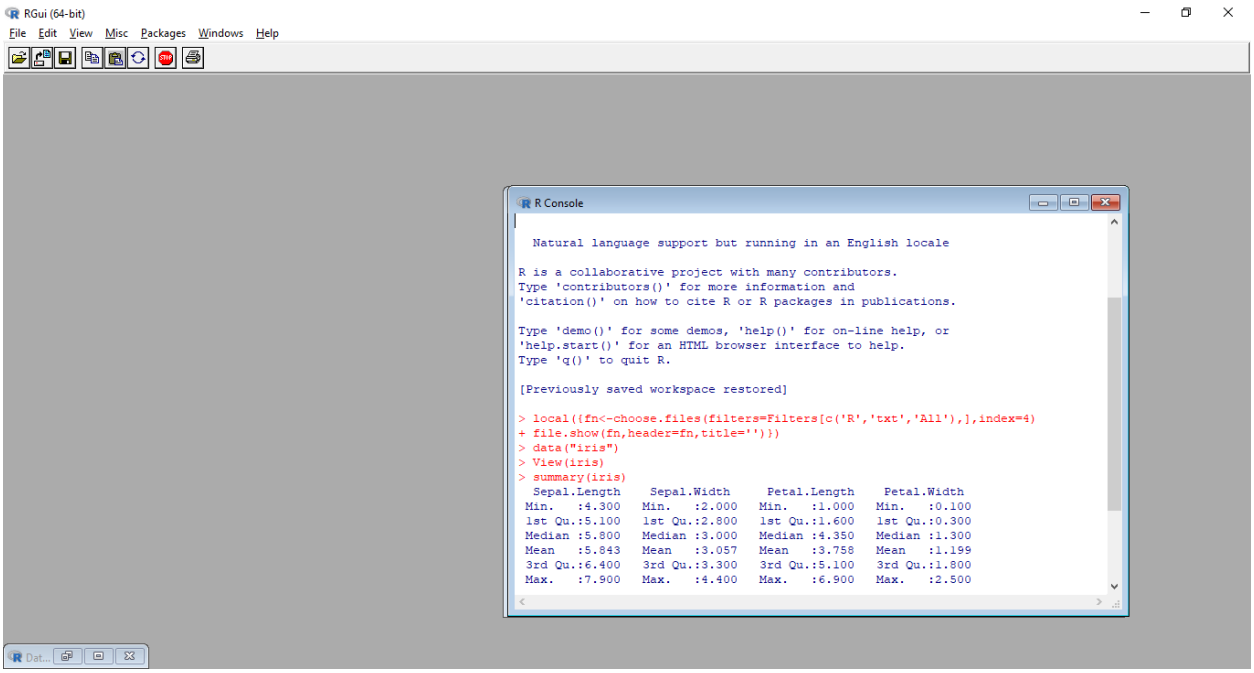
Thus, the implementation of KNN algorithm for bodyfat dataset using R is shown.

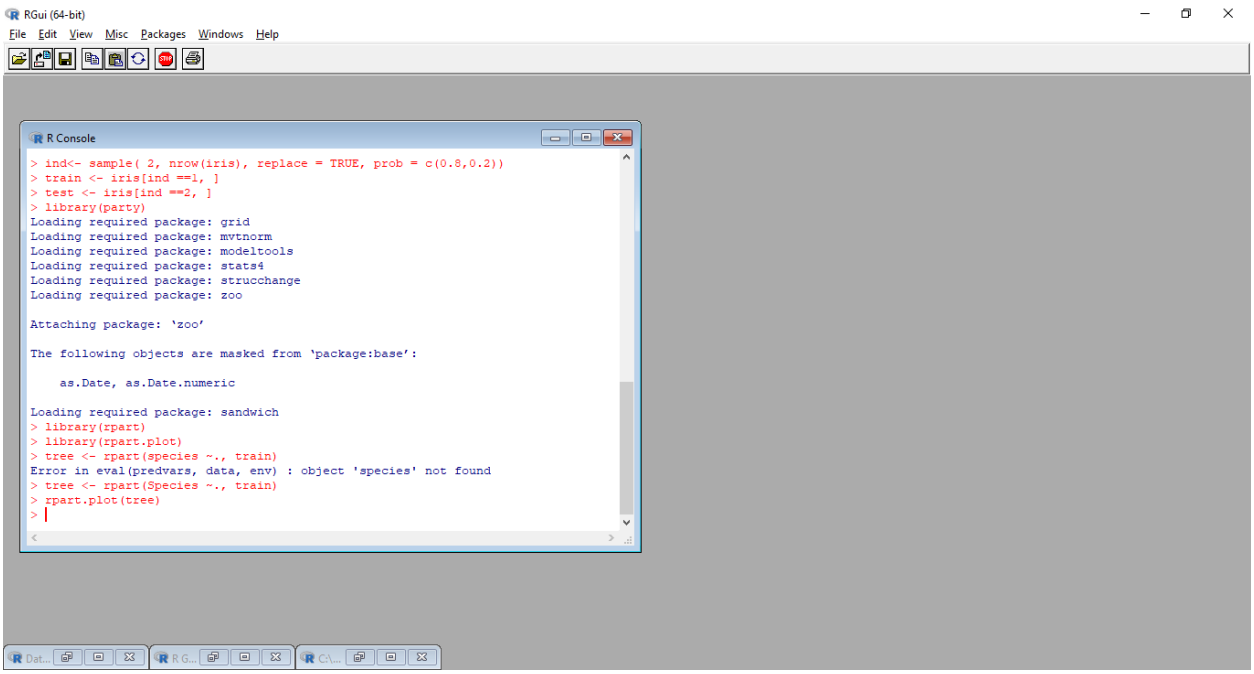
22. Generate a decision tree using ID3 algorithm for iris dataset using R studio

AIM:

To find a decision tree using ID3 algorithm for iris dataset using R studio

PROGRAM CODE AND OUTPUT SCREENSHOT:





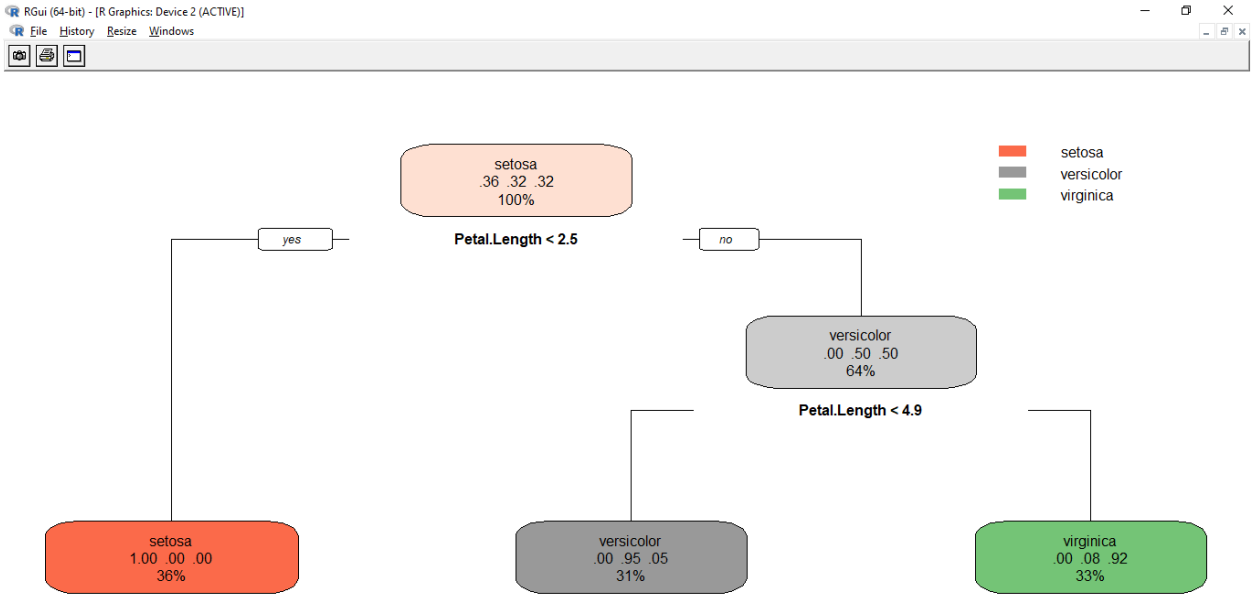
Iris Dataset:

RGui (64-bit) - [Data: iris]

File

	Sepal.Length	Sepal.Width	Petal.Length	Petal.Width	Species
1	5.1	3.5	1.4	0.2	setosa
2	4.9	3.0	1.4	0.2	setosa
3	4.7	3.2	1.3	0.2	setosa
4	4.6	3.1	1.5	0.2	setosa
5	5.0	3.6	1.4	0.2	setosa
6	5.4	3.9	1.7	0.4	setosa
7	4.6	3.4	1.4	0.3	setosa
8	5.0	3.4	1.5	0.2	setosa
9	4.4	2.9	1.4	0.2	setosa
10	4.9	3.1	1.5	0.1	setosa
11	5.4	3.7	1.5	0.2	setosa
12	4.8	3.4	1.6	0.2	setosa
13	4.8	3.0	1.4	0.1	setosa
14	4.3	3.0	1.1	0.1	setosa
15	5.8	4.0	1.2	0.2	setosa
16	5.7	4.4	1.5	0.4	setosa
17	5.4	3.9	1.3	0.4	setosa
18	5.1	3.5	1.4	0.3	setosa
19	5.7	3.8	1.7	0.3	setosa
20	5.1	3.8	1.5	0.3	setosa
21	5.4	3.4	1.7	0.2	setosa
22	5.1	3.7	1.5	0.4	setosa
23	4.6	3.6	1.0	0.2	setosa
24	5.1	3.3	1.7	0.5	setosa
25	4.8	3.4	1.9	0.2	setosa
26	5.0	3.0	1.6	0.2	setosa
27	5.0	3.4	1.6	0.4	setosa
28	5.2	3.5	1.5	0.2	setosa
29	5.2	3.4	1.4	0.2	setosa
30	4.7	3.2	1.6	0.2	setosa
31	4.8	3.1	1.6	0.2	setosa

Graphical representation of decision tree model:



RESULT:

Thus, the implementation of decision tree using ID3 algorithm for iris dataset using R is shown.

23. Apply random forest algorithm for bodyfat dataset using R

AIM:

To find random forest algorithm for bodyfat dataset using R studio

PROCEDURE AND OUTPUT SCREENSHOT:

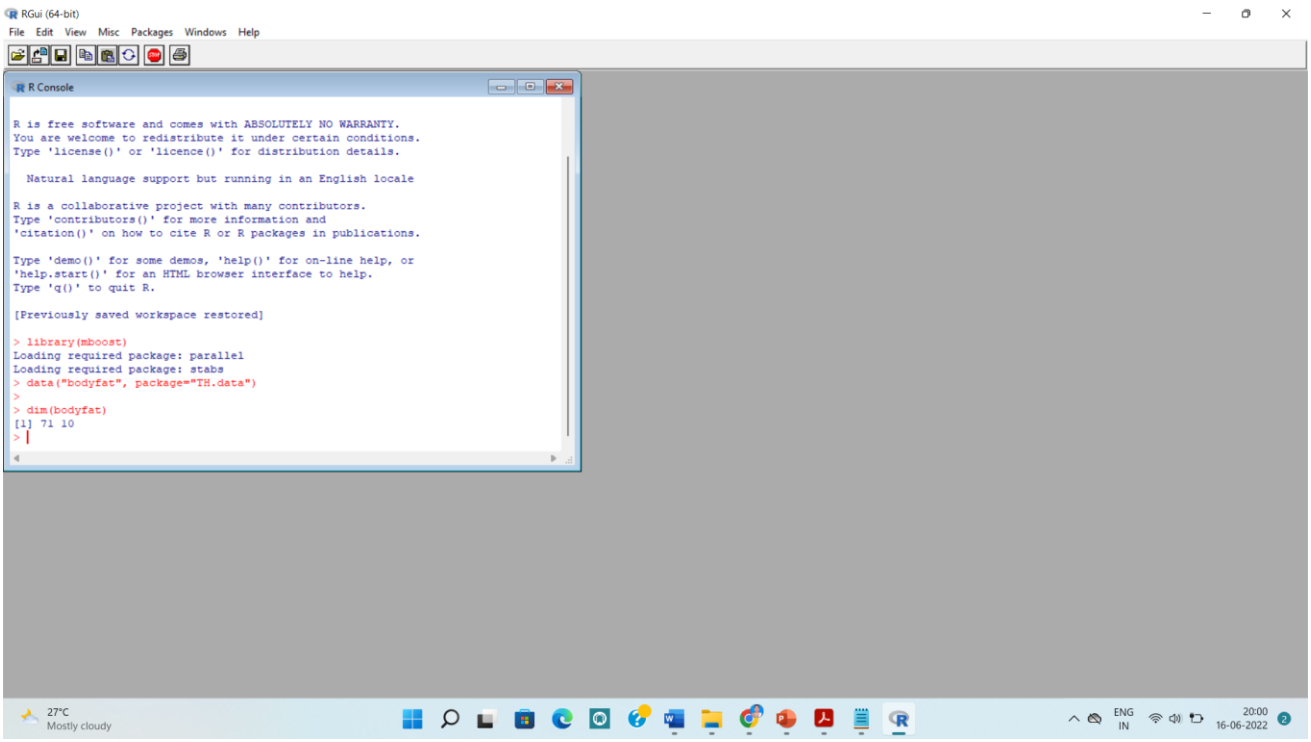
STEP 1: Open R and take new R Console

STEP 2: Type the following steps in R Console

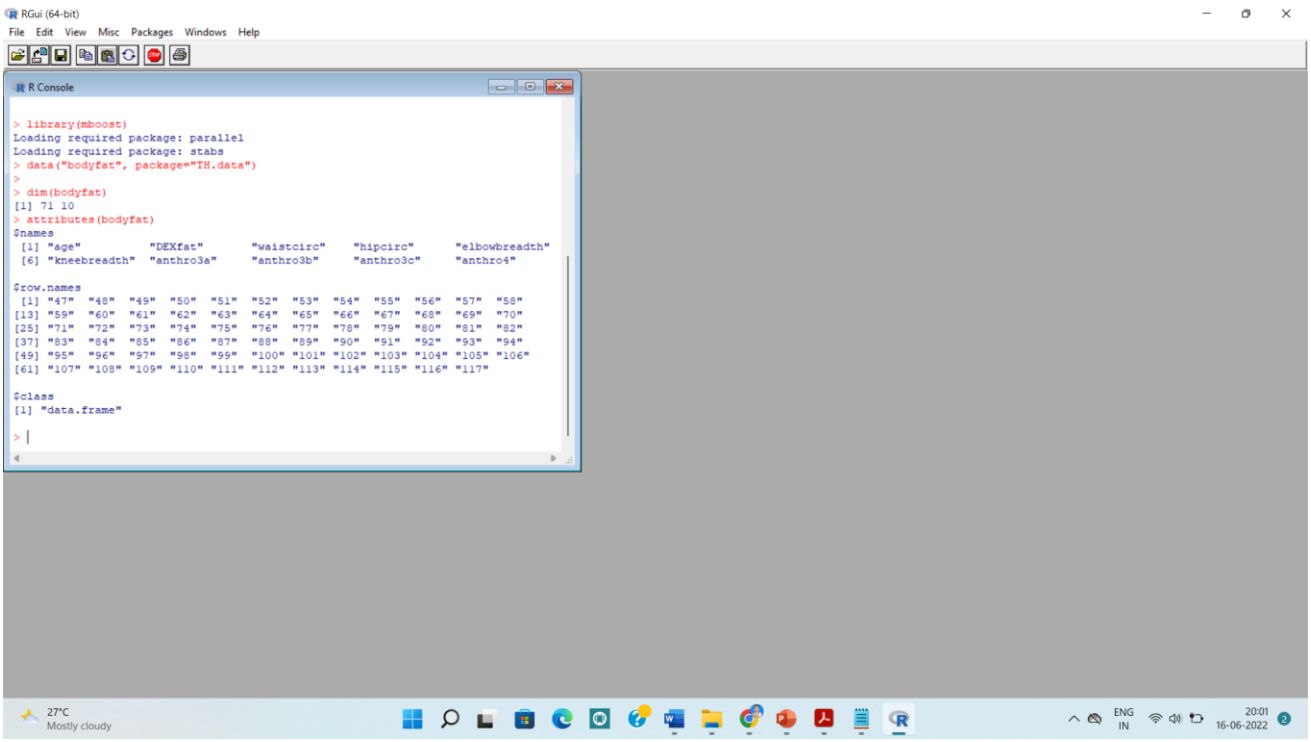
library(mboost)

data("bodyfat", package="TH.data")

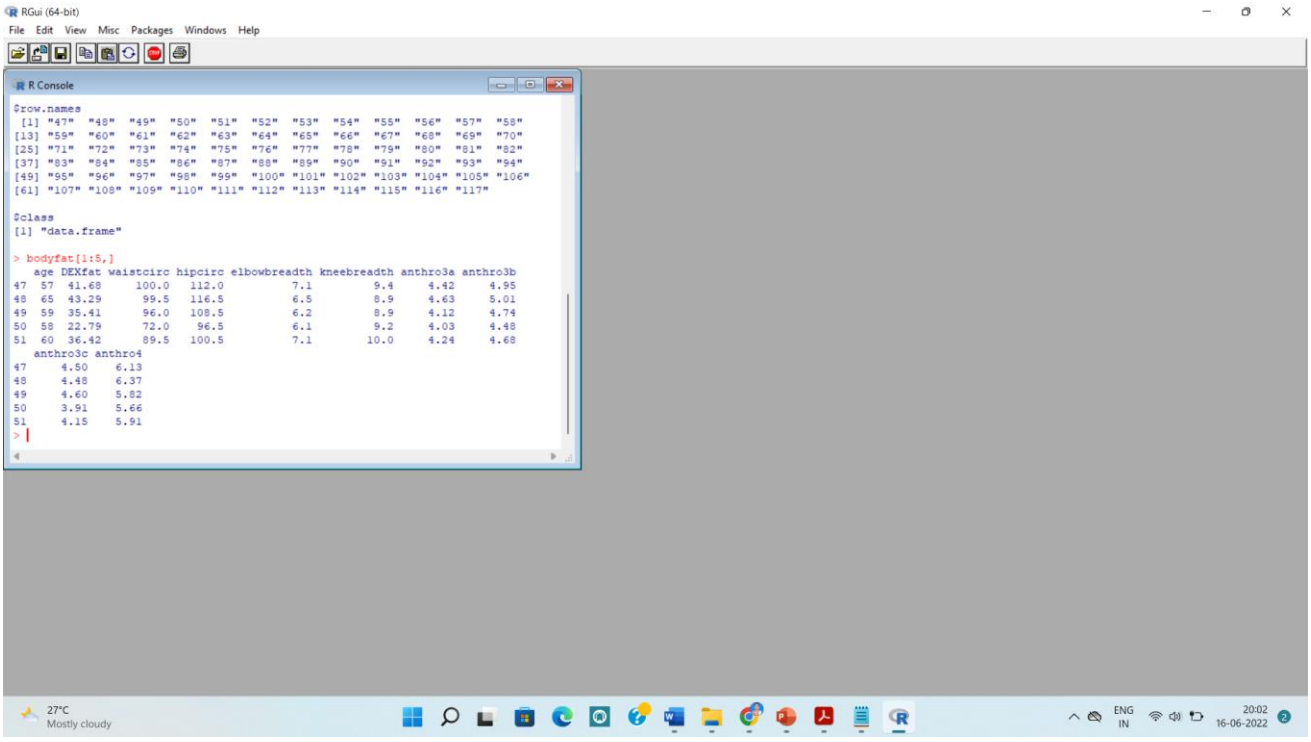
dim(bodyfat)



attributes(bodyfat)



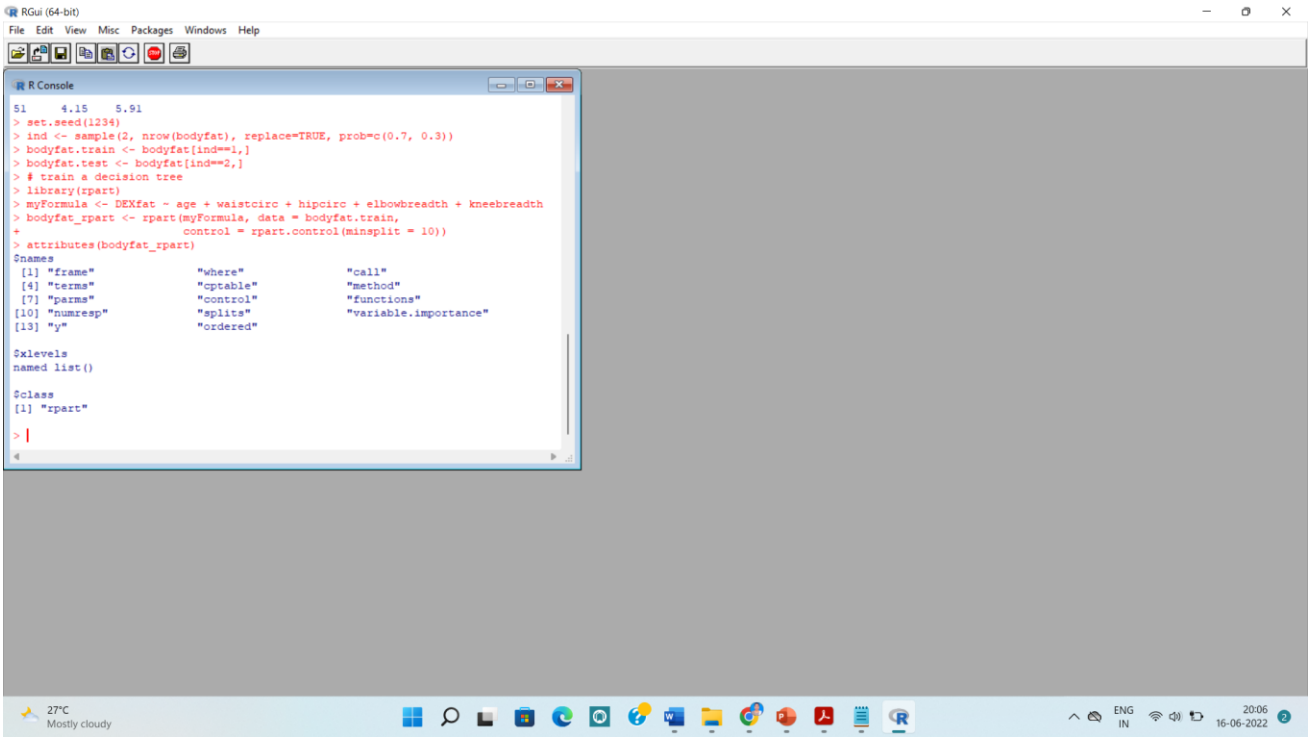
bodyfat[1:5,]



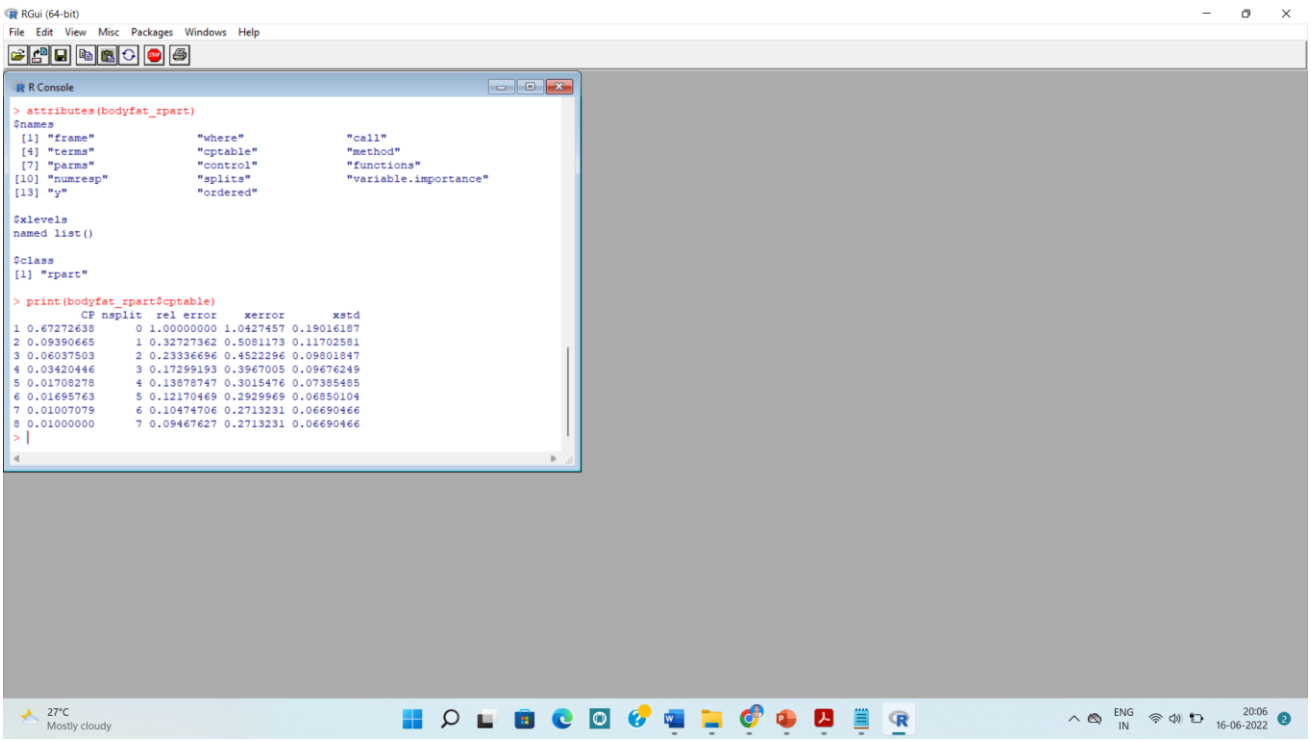
set.seed(1234)

ind <- sample(2, nrow(bodyfat), replace=TRUE, prob=c(0.7, 0.3))

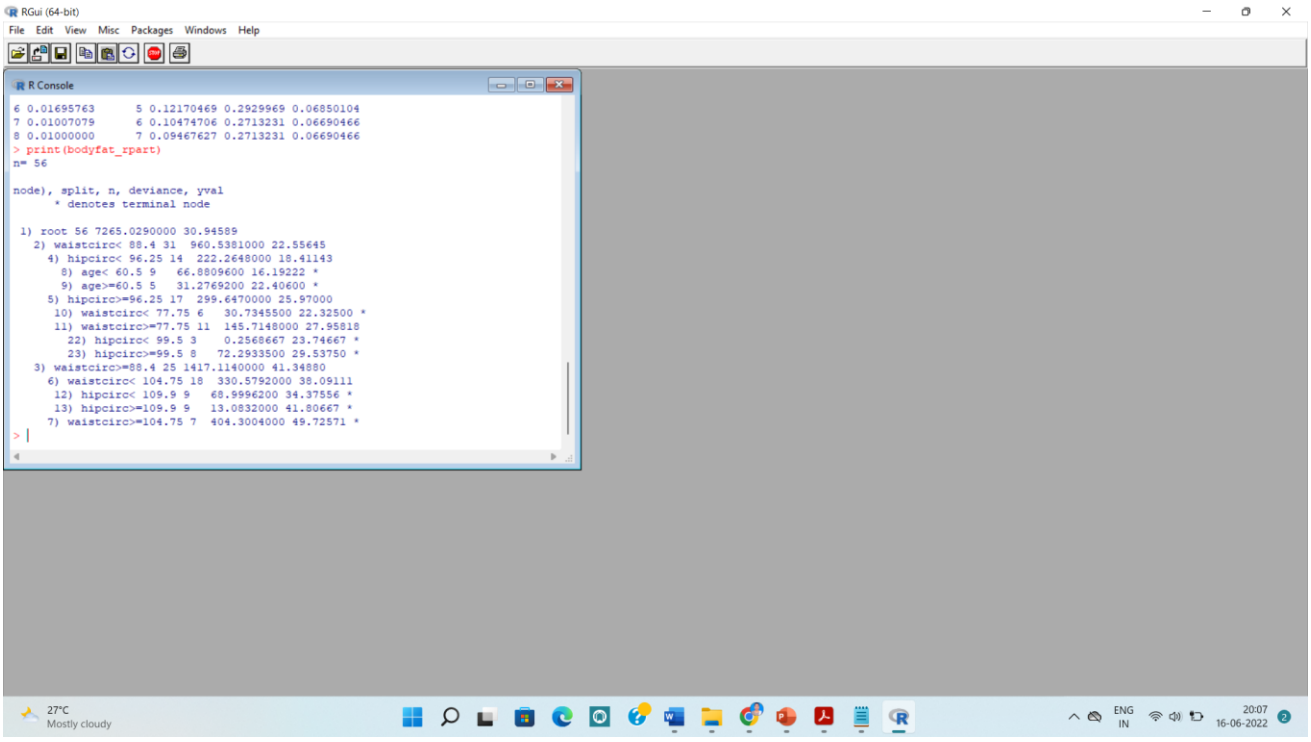
```
bodyfat.train <- bodyfat[ind==1,]

bodyfat.test <- bodyfat[ind==2,]

# train a decision tree

library(rpart)

myFormula <- DEXfat ~ age + waistcirc + hipcirc + elbowbreadth + kneebreadth

bodyfat_rpart <- rpart(myFormula, data = bodyfat.train,

                       control = rpart.control(minsplit = 10))

attributes(bodyfat_rpart)
```




```
print(bodyfat_rpart$cptable)
```

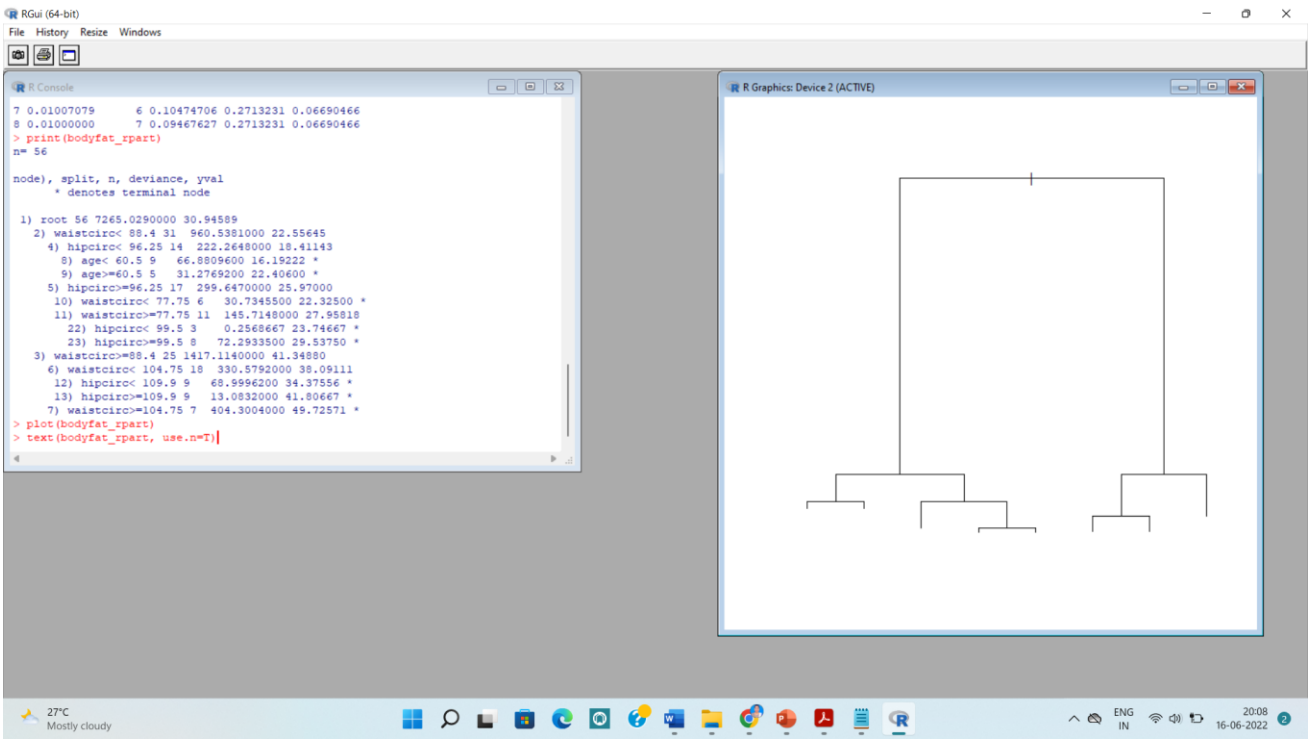


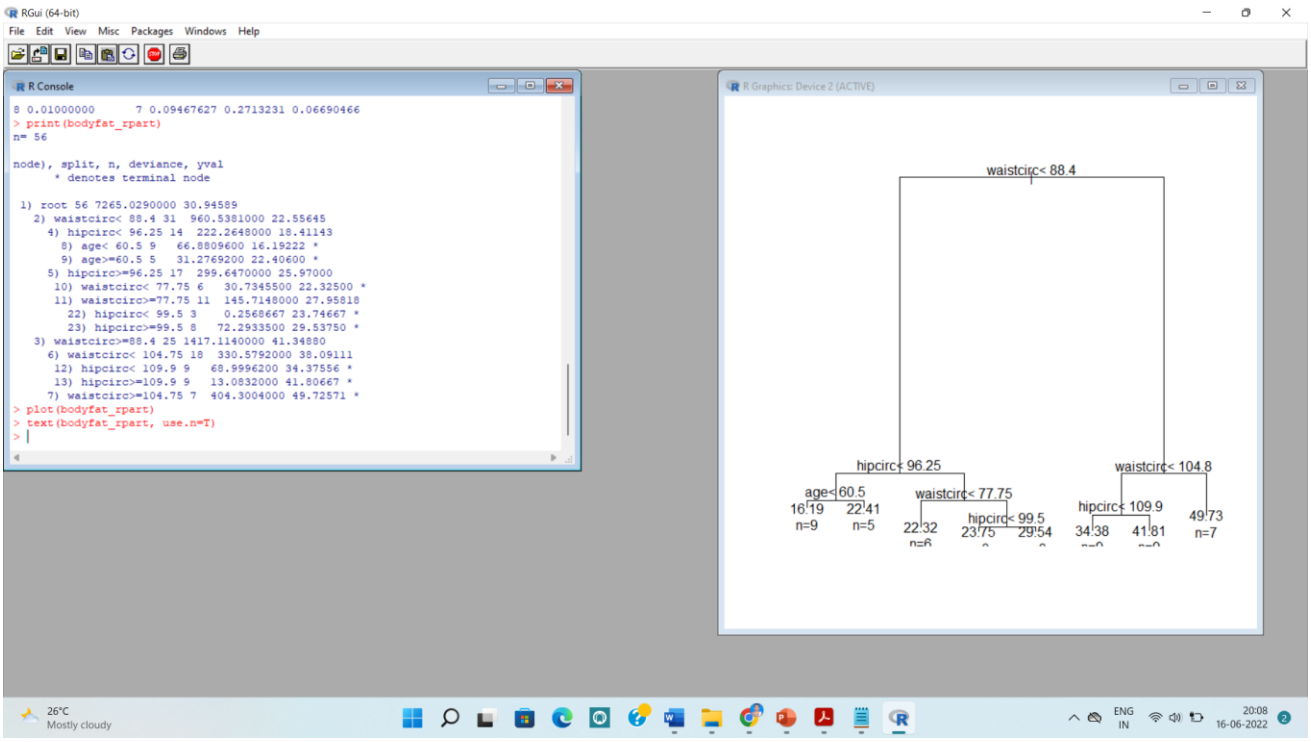
print(bodyfat_rpart)



plot(bodyfat_rpart)

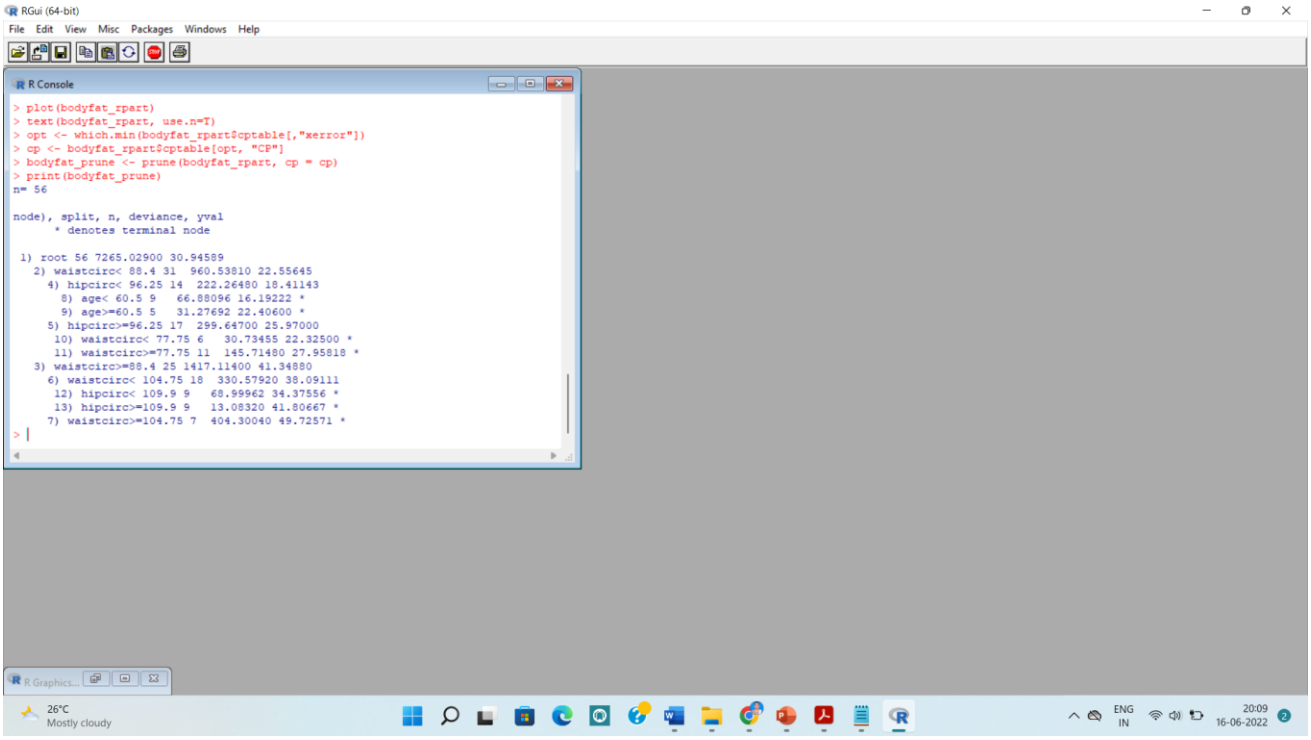
text(bodyfat_rpart, use.n=T)





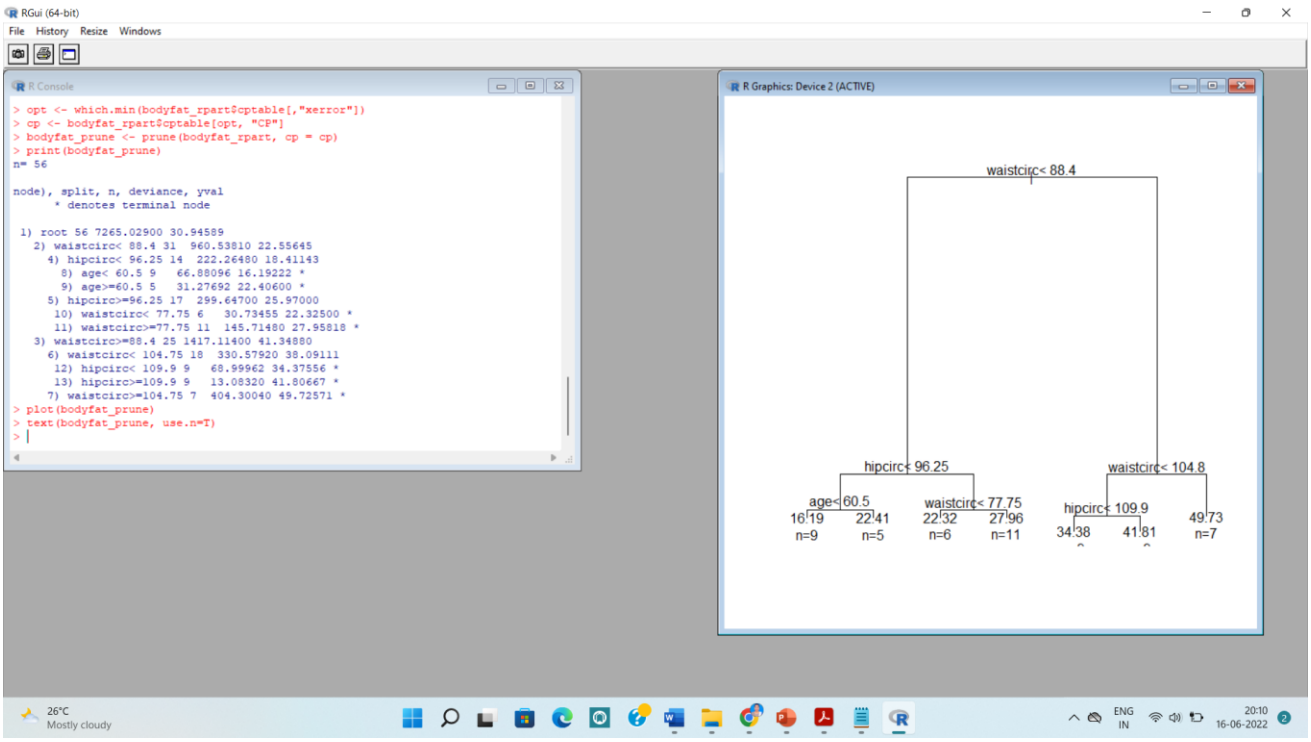

```
opt <- which.min(bodyfat_rpart$cptable[,"xerror"])

cp <- bodyfat_rpart$cptable[opt, "CP"]

bodyfat_prune <- prune(bodyfat_rpart, cp = cp)
```

print(bodyfat_prune)

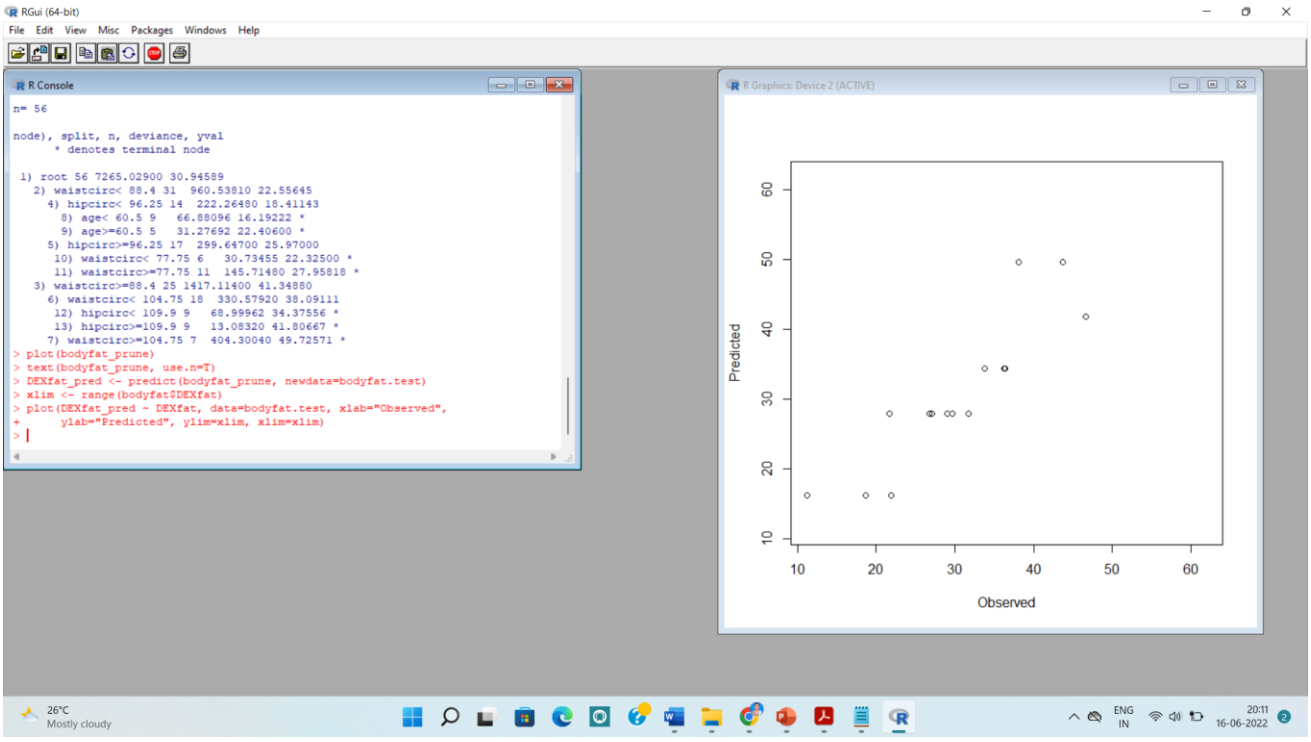


plot(bodyfat_prune)

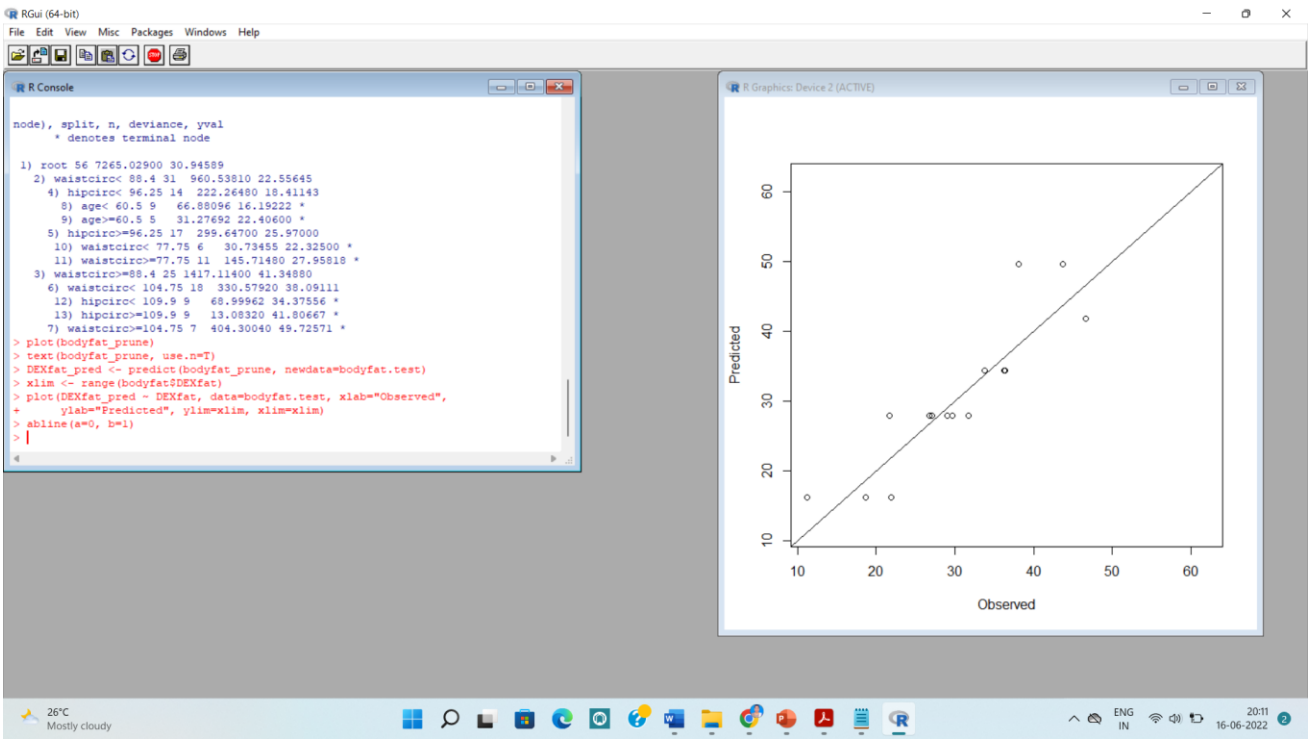
text(bodyfat_prune, use.n=T)



```
DEXfat_pred <- predict(bodyfat_prune, newdata=bodyfat.test)

xlim <- range(bodyfat$DEXfat)

plot(DEXfat_pred ~ DEXfat, data=bodyfat.test, xlab="Observed",

    ylab="Predicted", ylim=xlim, xlim=xlim)
```




```
abline(a=0, b=1)
```



RESULT:

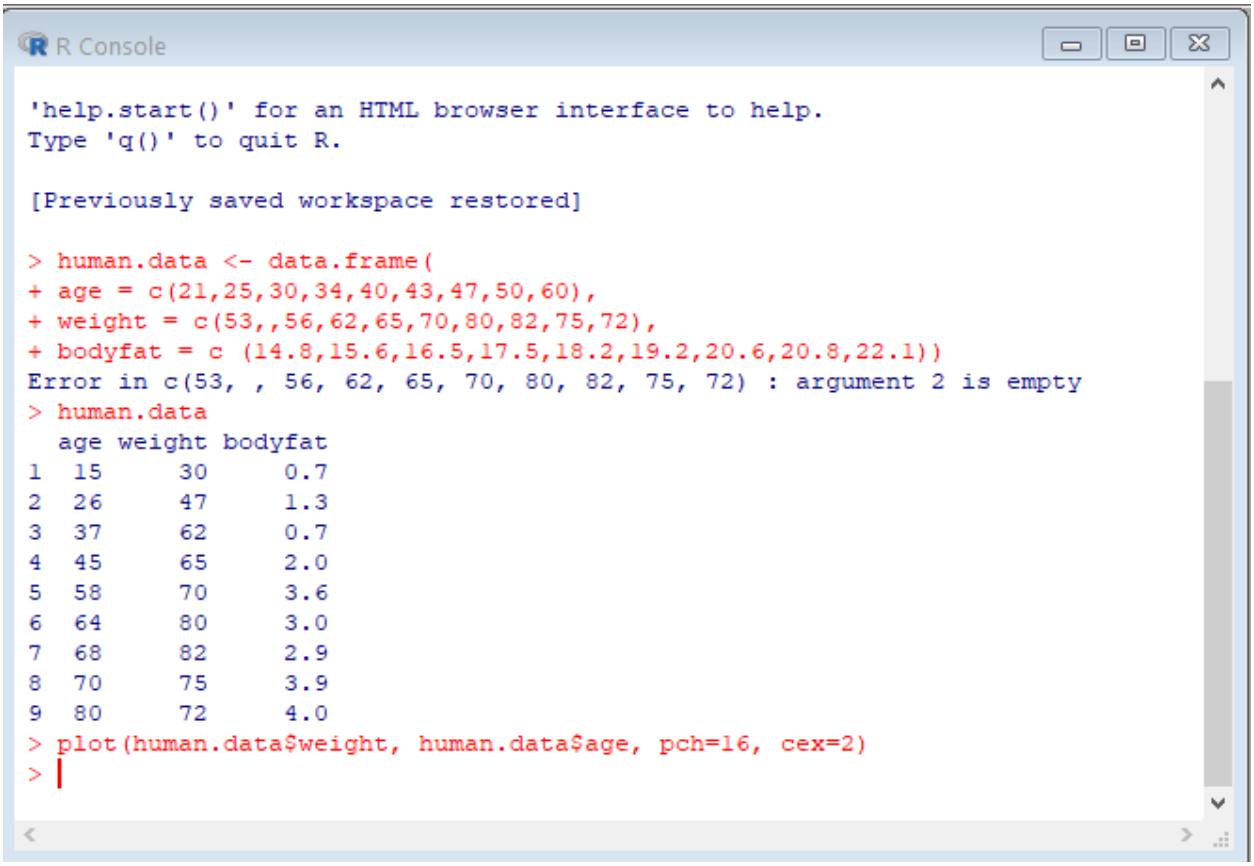
Thus, the implementation of random forest algorithm for bodyfat dataset using R

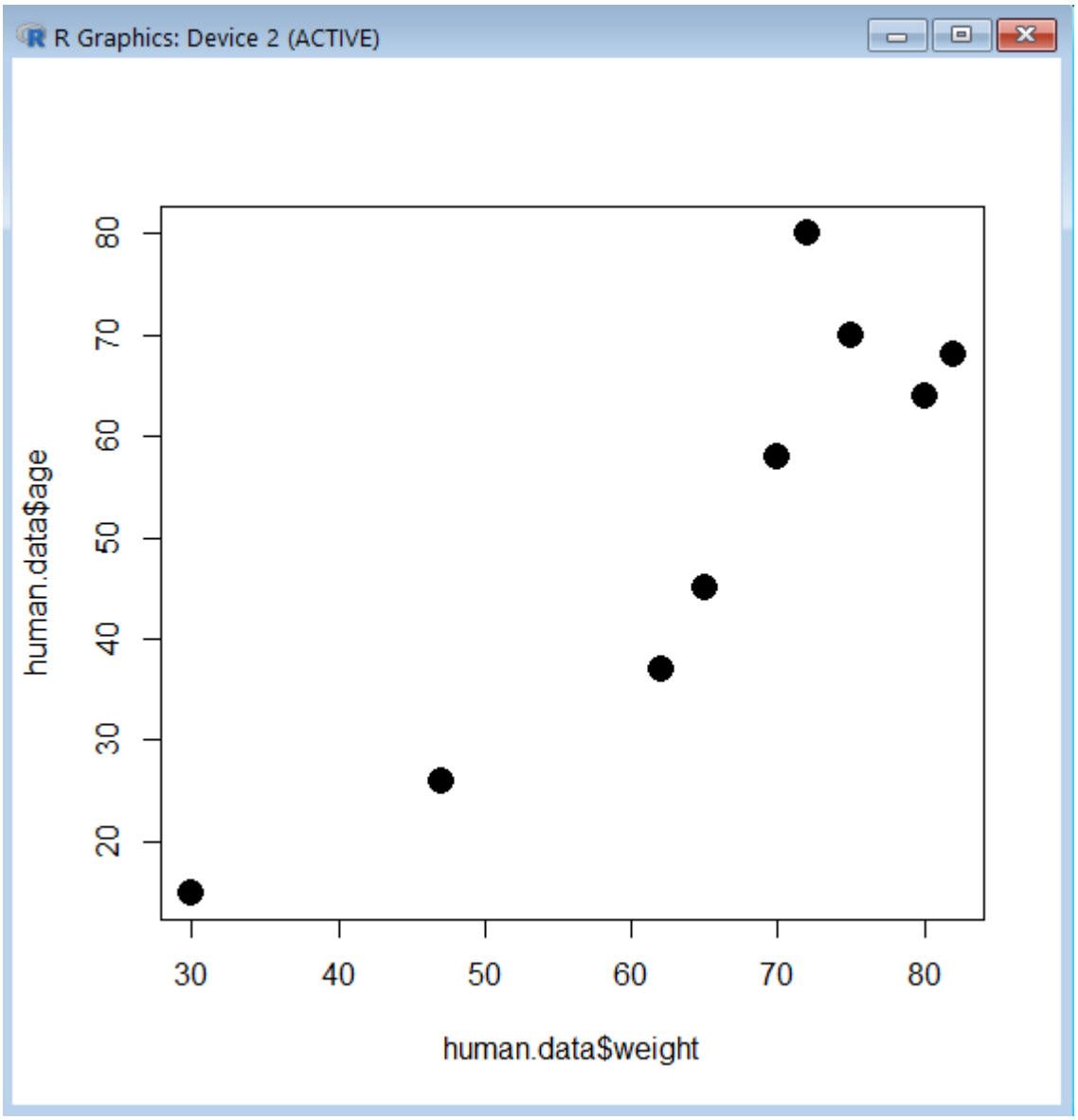
24. Multiple Linear Regression using bodyfat dataset

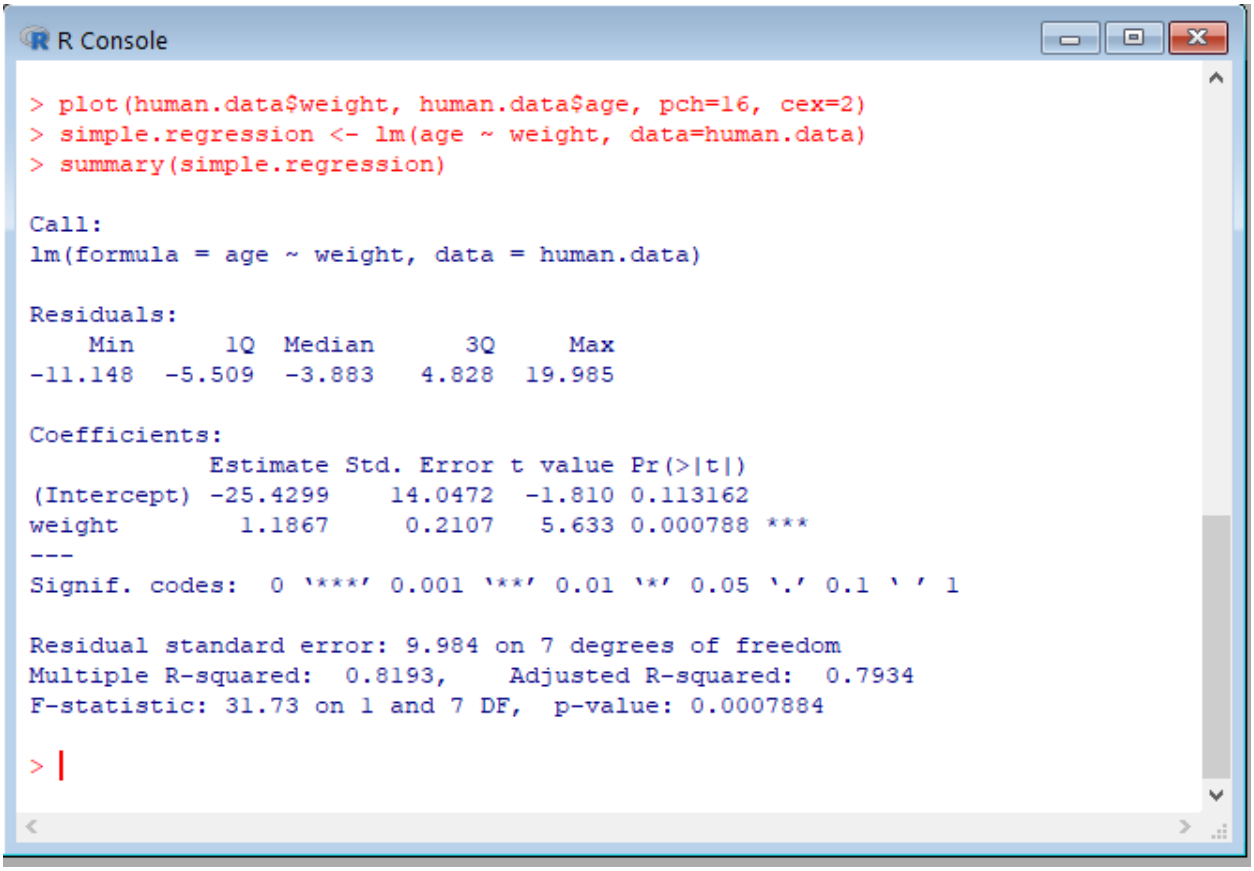
AIM:

To apply the Multiple Linear Regression algorithm on Bodyfat dataset using R studio.

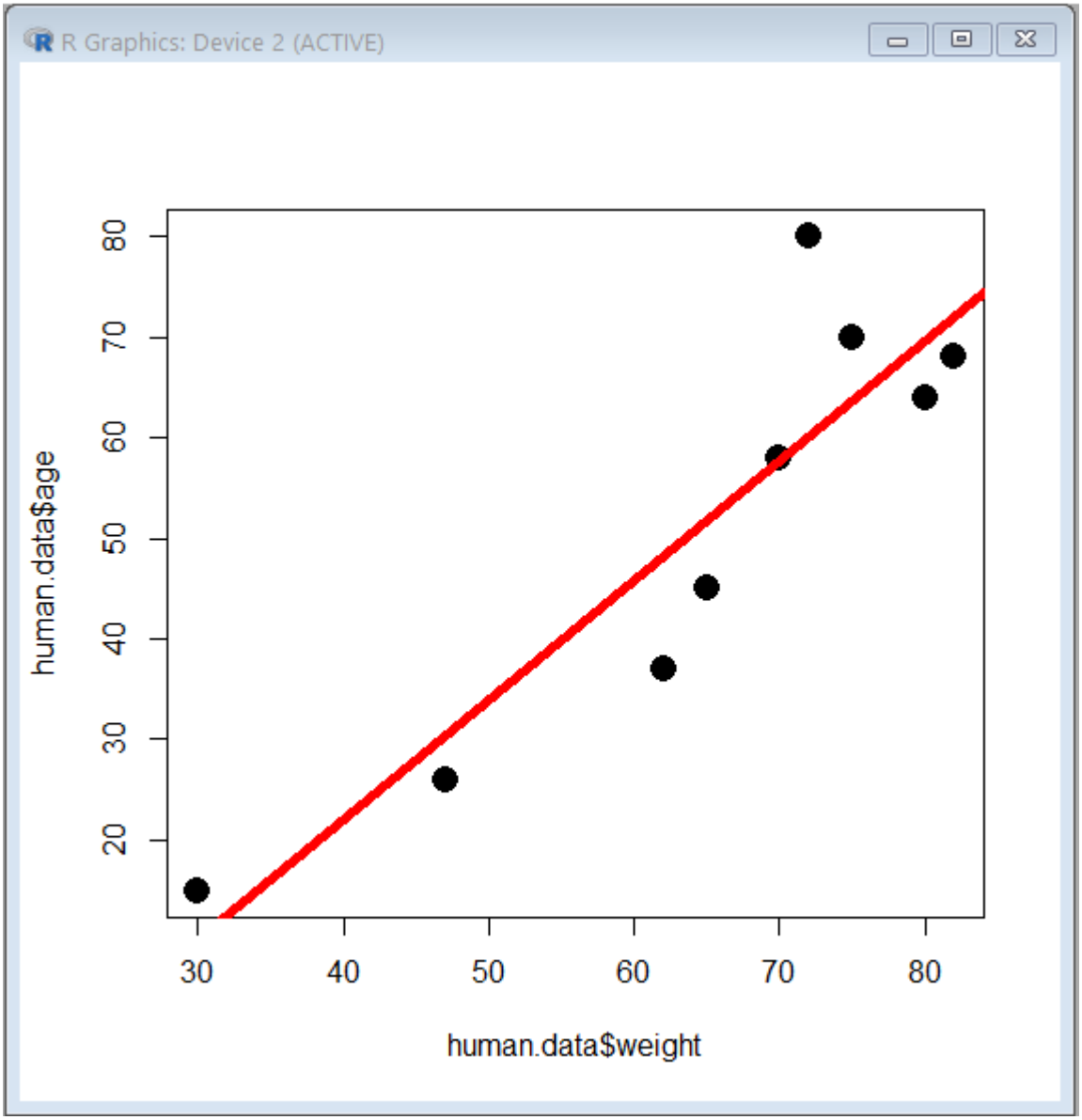
PROGRAM AND OUTPUT SCREENSHOT:

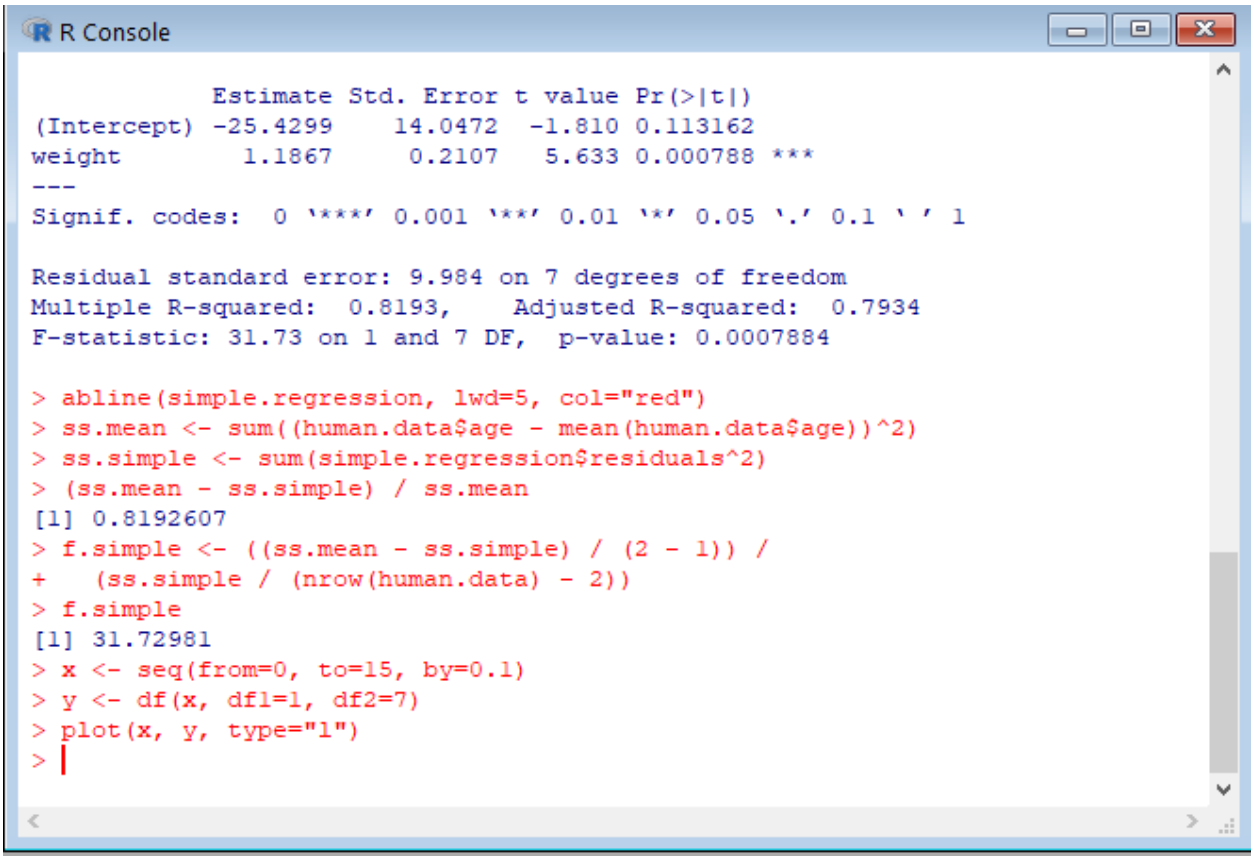



R Graphics: Device 2 (ACTIVE)
human.data$age
20
30
40
50
60
70
80
30
40
50
60
70
80
human.data$weight

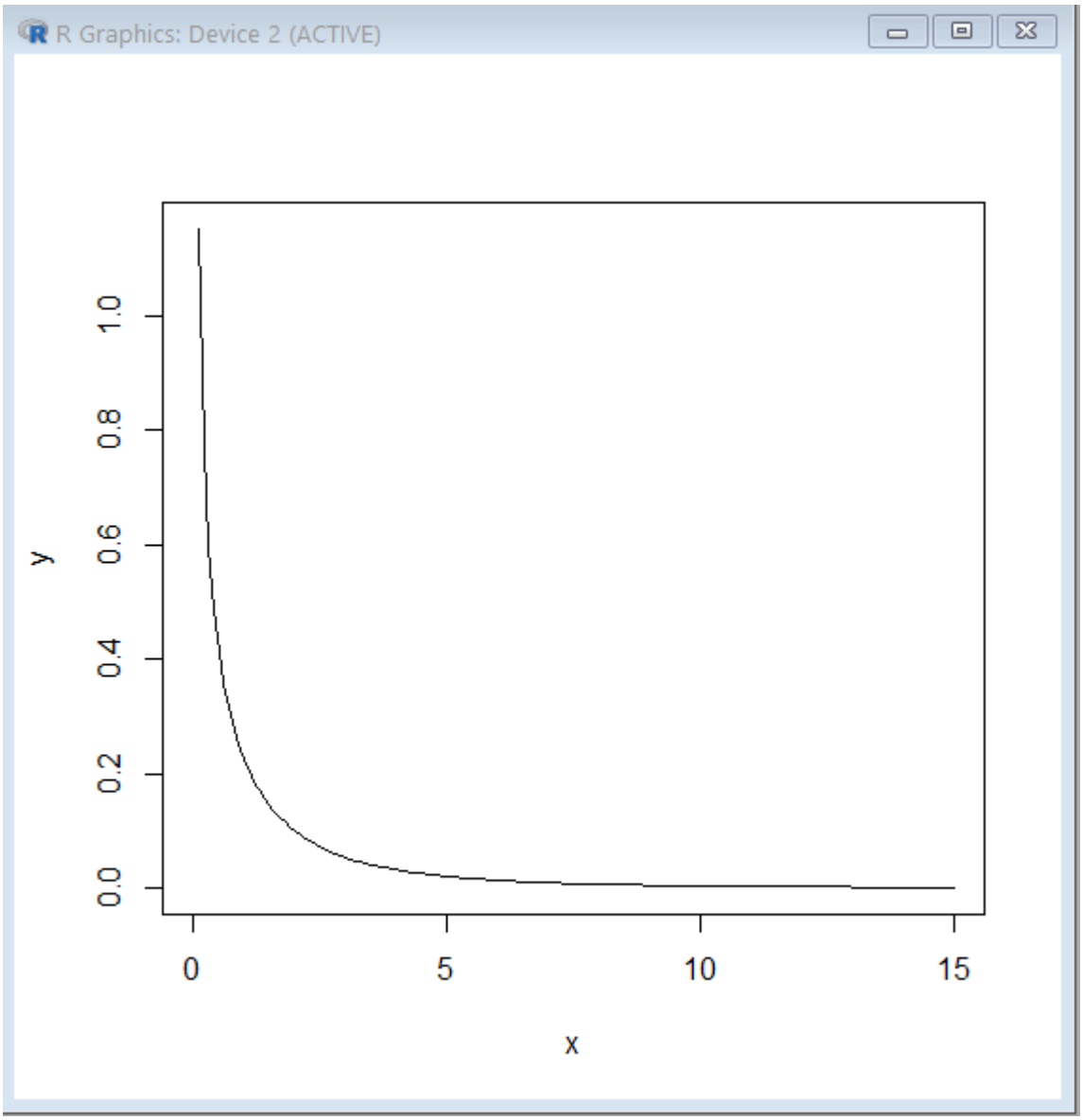

R Console
> plot(human.data$weight, human.data$age, pch=16, cex=2)
> simple.regression <- lm(age ~ weight, data=human.data)
> summary(simple.regression)
Call:
lm(formula = age ~ weight, data = human.data)
Residuals:
Min 1Q Median 3Q Max
-11.148 -5.509 -3.883 4.828 19.985
Coefficients:
Estimate Std. Error t value Pr(>|t|)
(Intercept) -25.4299 14.0472 -1.810 0.113162
weight 1.1867 0.2107 5.633 0.000788 ***

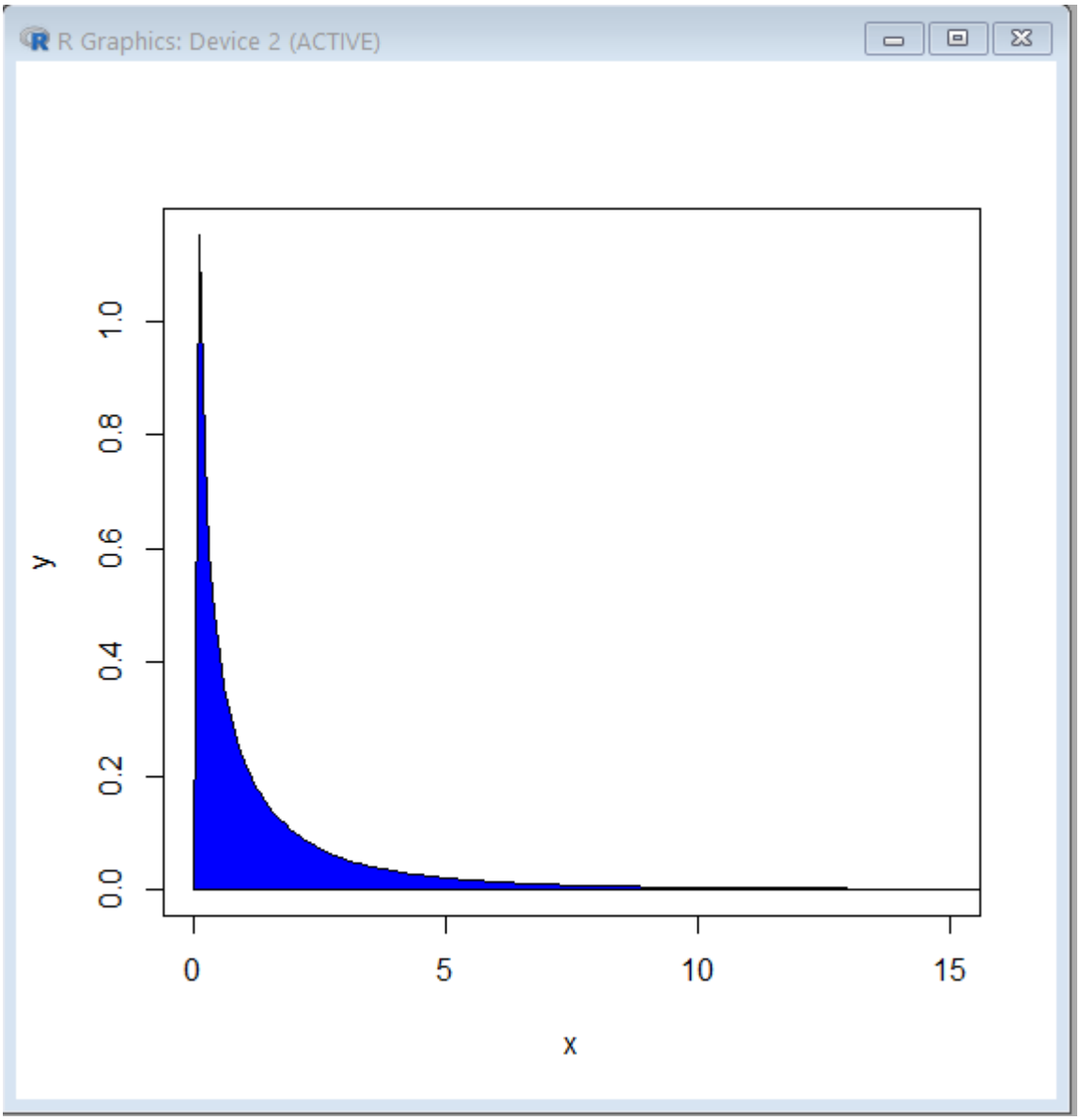
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 9.984 on 7 degrees of freedom
Multiple R-squared: 0.8193, Adjusted R-squared: 0.7934
F-statistic: 31.73 on 1 and 7 DF, p-value: 0.0007884
>

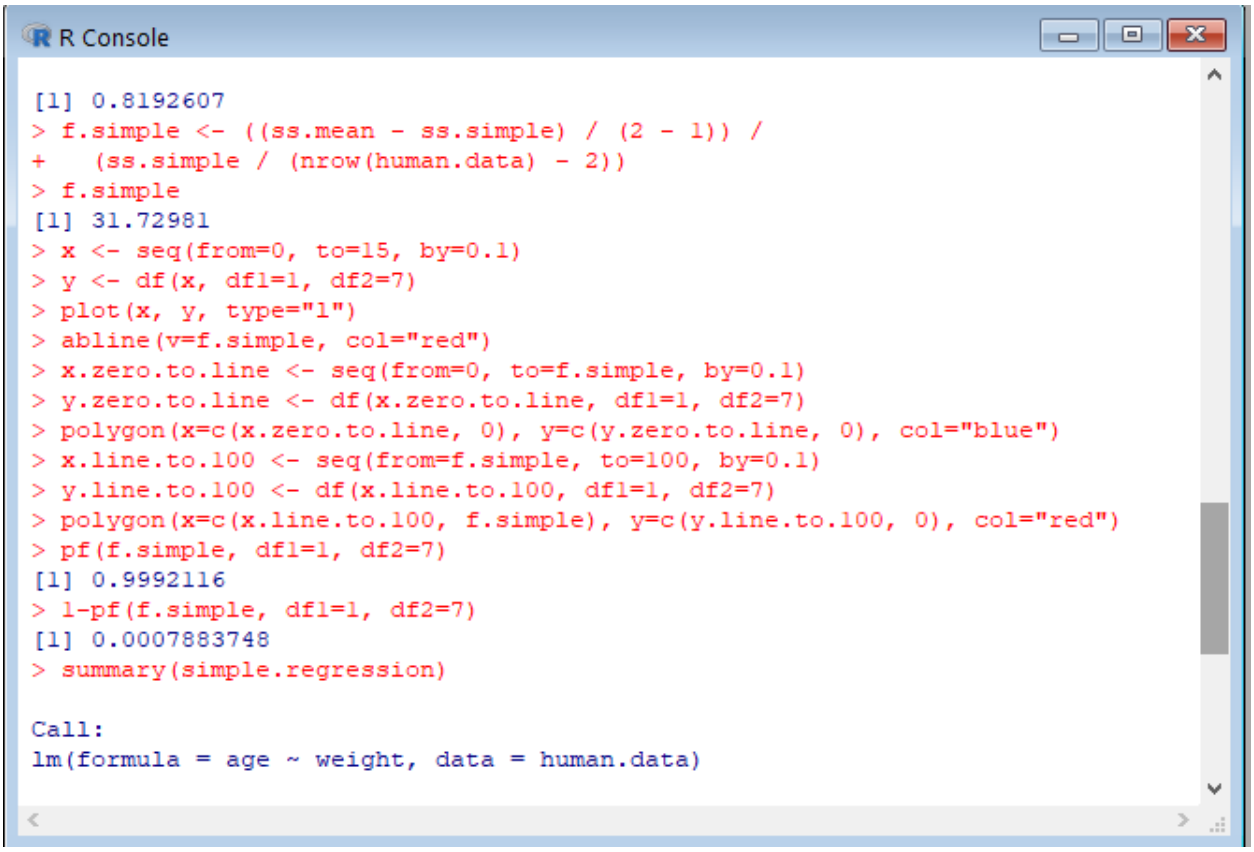

R Graphics: Device 2 (ACTIVE)
human.data$age
20
30
40
50
60
70
80
human.data$weight
30
40
50
60
70
80

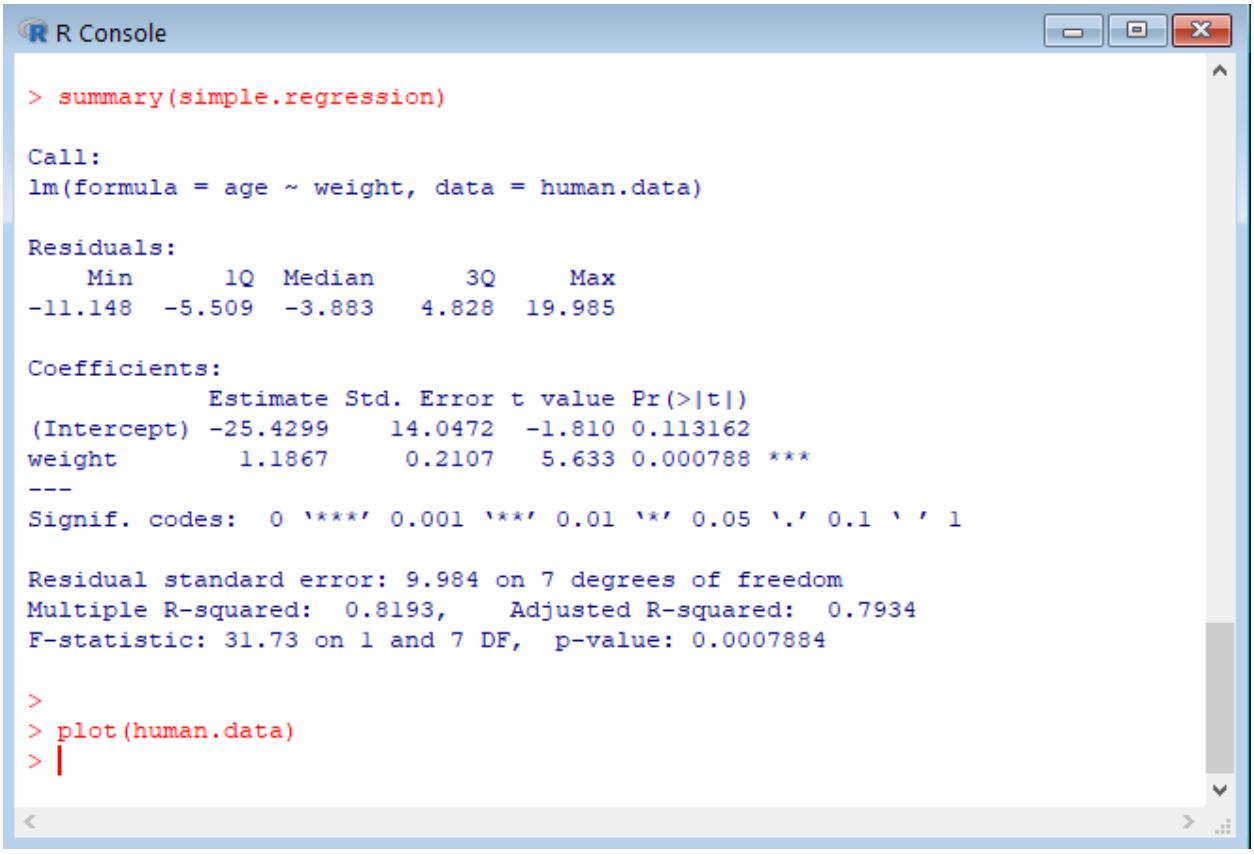

R Console
Estimate Std. Error t value Pr(>|t|)
(Intercept) -25.4299 14.0472 -1.810 0.113162
weight 1.1867 0.2107 5.633 0.000788 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 9.984 on 7 degrees of freedom
Multiple R-squared: 0.8193, Adjusted R-squared: 0.7934
F-statistic: 31.73 on 1 and 7 DF, p-value: 0.0007884
> abline(simple.regression, lwd=5, col="red")
> ss.mean <- sum((human.data$age - mean(human.data$age))^2)
> ss.simple <- sum(simple.regression$residuals^2)
> (ss.mean - ss.simple) / ss.mean
[1] 0.8192607
> f.simple <- ((ss.mean - ss.simple) / (2 - 1)) /
+ (ss.simple / (nrow(human.data) - 2))
> f.simple
[1] 31.72981
> x <- seq(from=0, to=15, by=0.1)
> y <- df(x, df1=1, df2=7)
> plot(x, y, type="l")
>

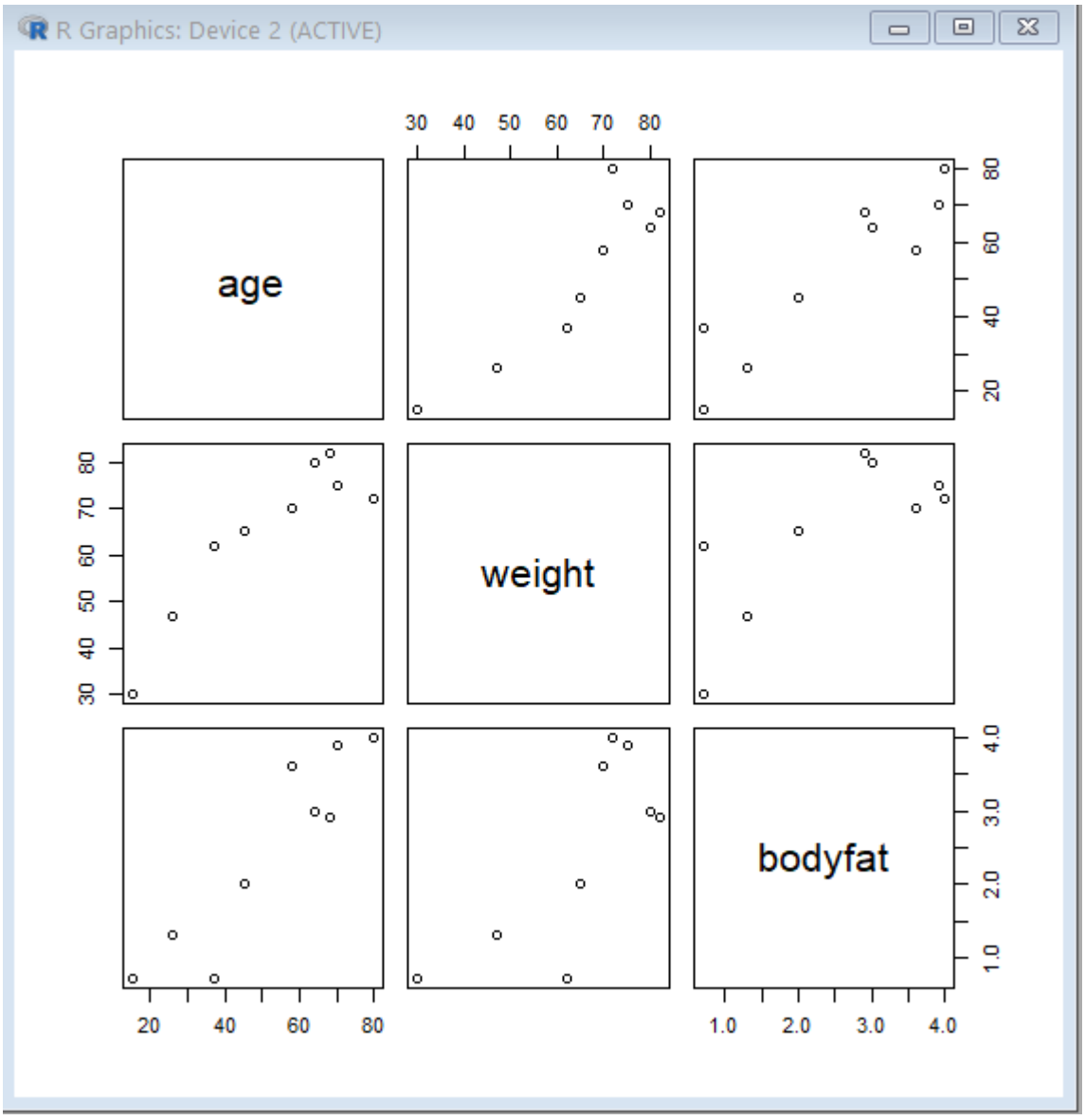

R Graphics: Device 2 (ACTIVE)
y
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
x

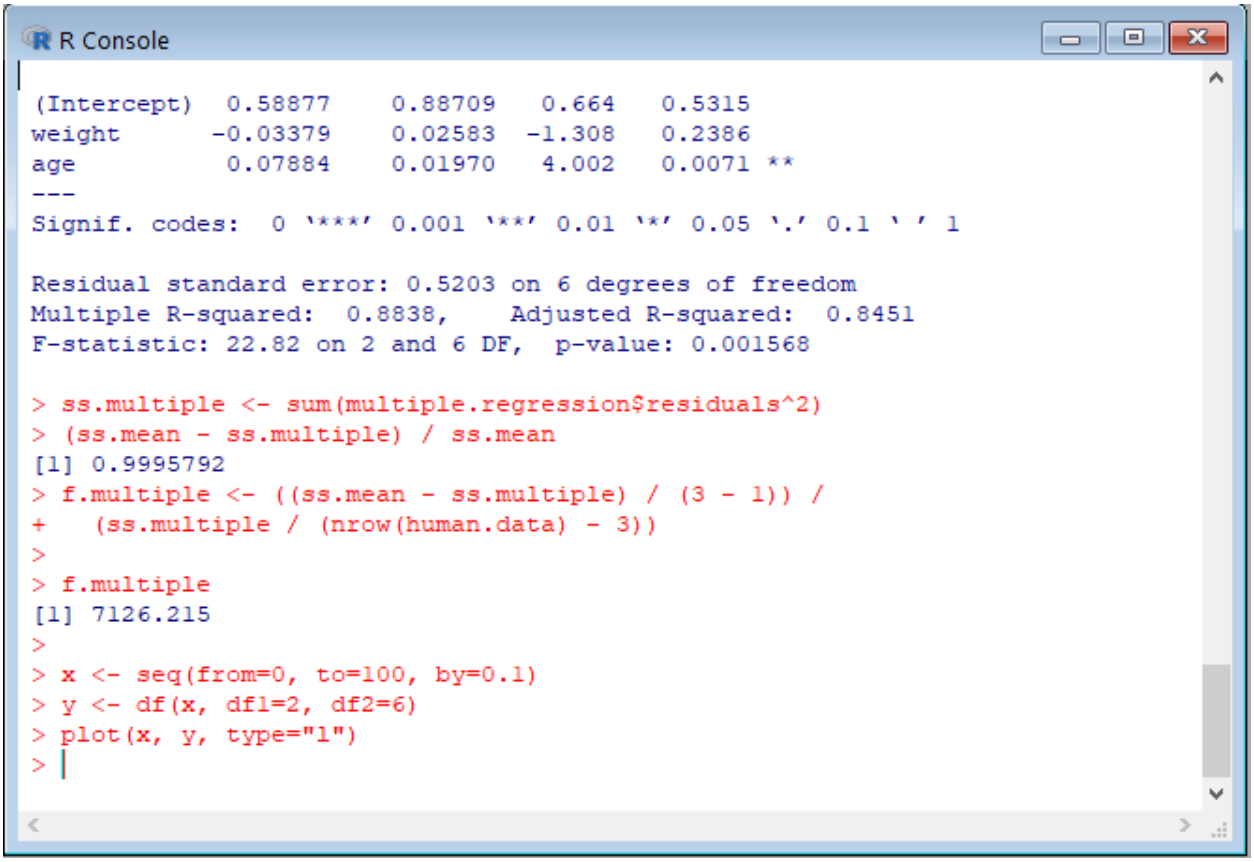

R Graphics: Device 2 (ACTIVE)
y
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
x


R Console
[1] 0.8192607
> f.simple <- ((ss.mean - ss.simple) / (2 - 1)) /
+ (ss.simple / (nrow(human.data) - 2))
> f.simple
[1] 31.72981
> x <- seq(from=0, to=15, by=0.1)
> y <- df(x, df1=1, df2=7)
> plot(x, y, type="l")
> abline(v=f.simple, col="red")
> x.zero.to.line <- seq(from=0, to=f.simple, by=0.1)
> y.zero.to.line <- df(x.zero.to.line, df1=1, df2=7)
> polygon(x=c(x.zero.to.line, 0), y=c(y.zero.to.line, 0), col="blue")
> x.line.to.100 <- seq(from=f.simple, to=100, by=0.1)
> y.line.to.100 <- df(x.line.to.100, df1=1, df2=7)
> polygon(x=c(x.line.to.100, f.simple), y=c(y.line.to.100, 0), col="red")
> pf(f.simple, df1=1, df2=7)
[1] 0.9992116
> 1-pf(f.simple, df1=1, df2=7)
[1] 0.0007883748
> summary(simple.regression)
Call:
lm(formula = age ~ weight, data = human.data)

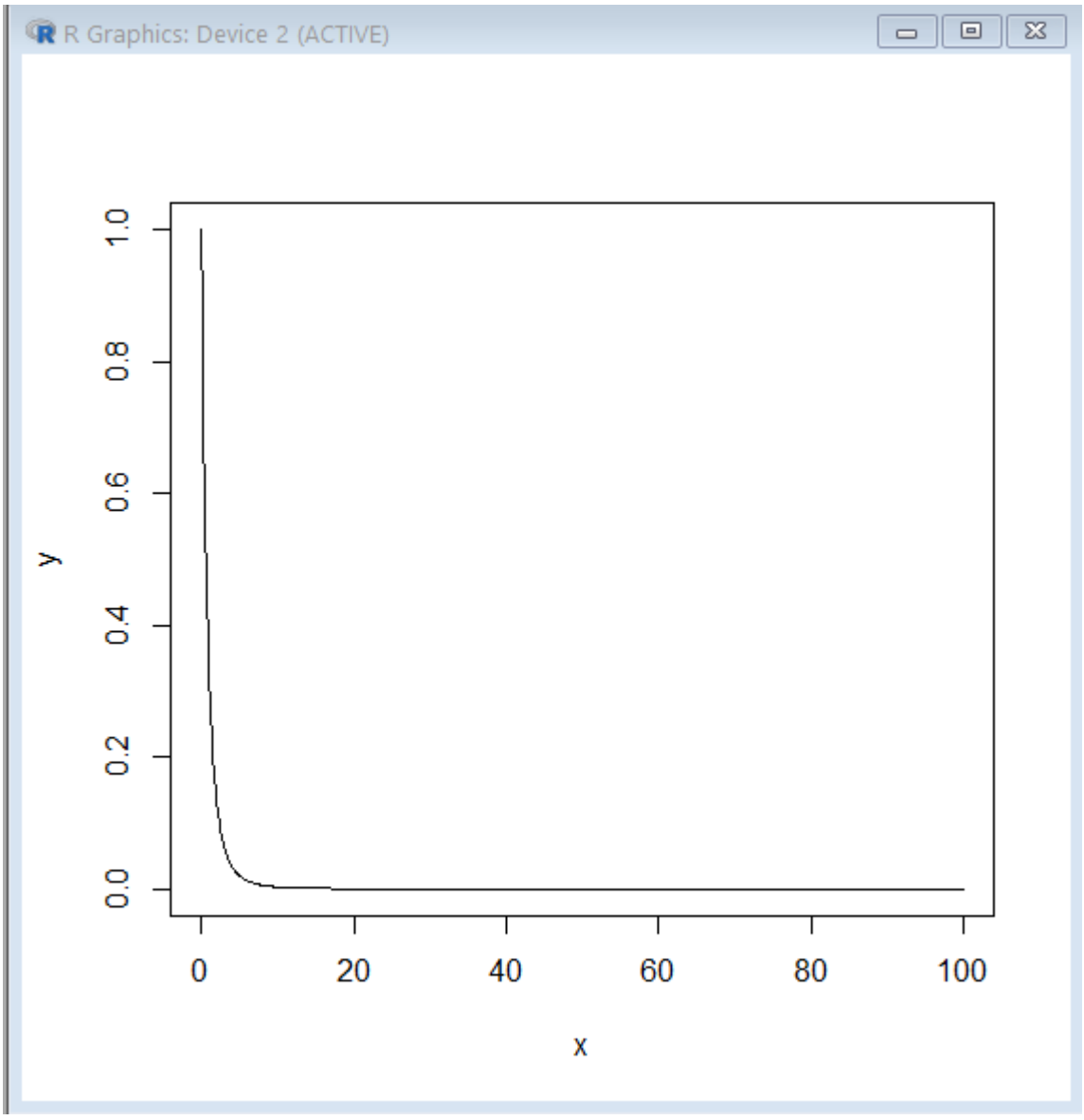

R Console
> summary(simple.regression)
Call:
lm(formula = age ~ weight, data = human.data)
Residuals:
Min 1Q Median 3Q Max
-11.148 -5.509 -3.883 4.828 19.985
Coefficients:
Estimate Std. Error t value Pr(>|t|)
(Intercept) -25.4299 14.0472 -1.810 0.113162
weight 1.1867 0.2107 5.633 0.000788 ***

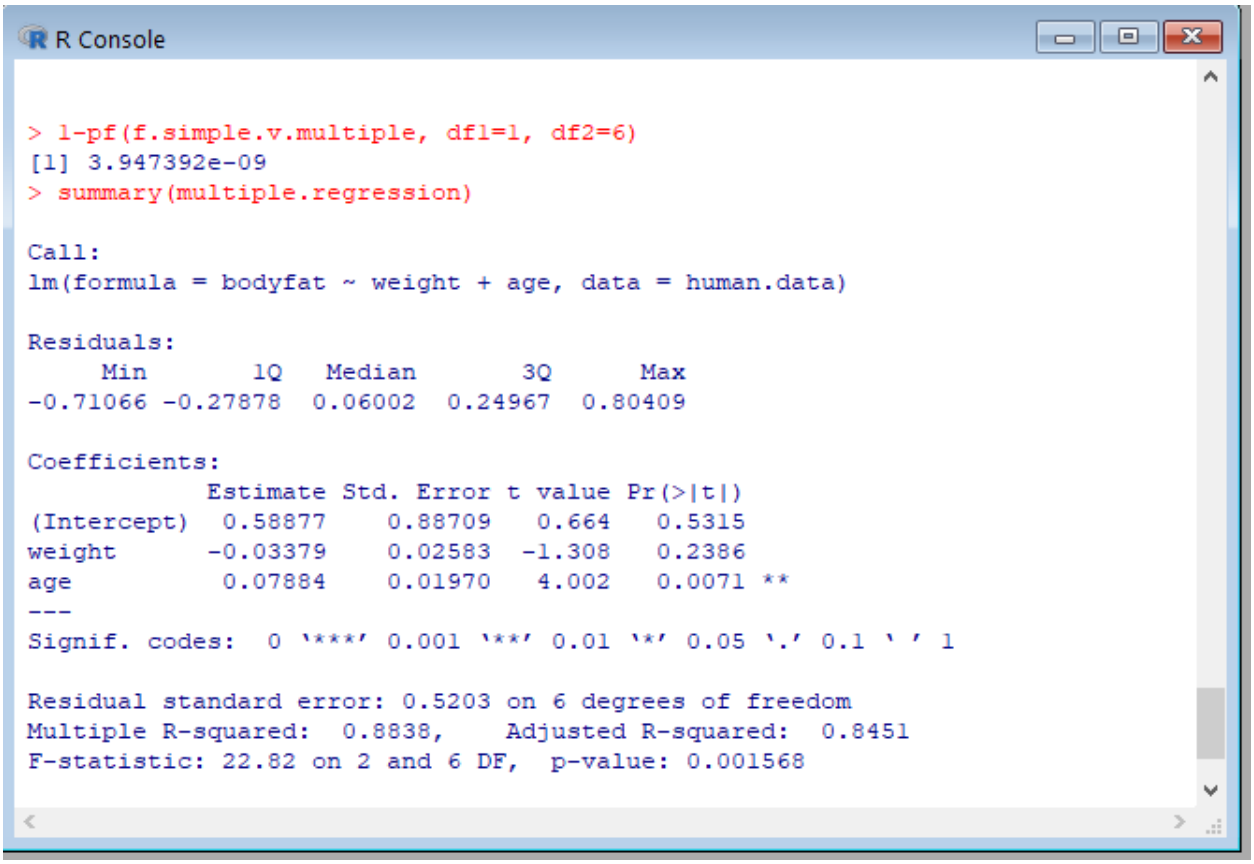
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 9.984 on 7 degrees of freedom
Multiple R-squared: 0.8193, Adjusted R-squared: 0.7934
F-statistic: 31.73 on 1 and 7 DF, p-value: 0.0007884
>
> plot(human.data)
>


R Graphics: Device 2 (ACTIVE)
age
weight
bodyfat
30 40 50 60 70 80
20 40 60 80
1.0 2.0 3.0 4.0

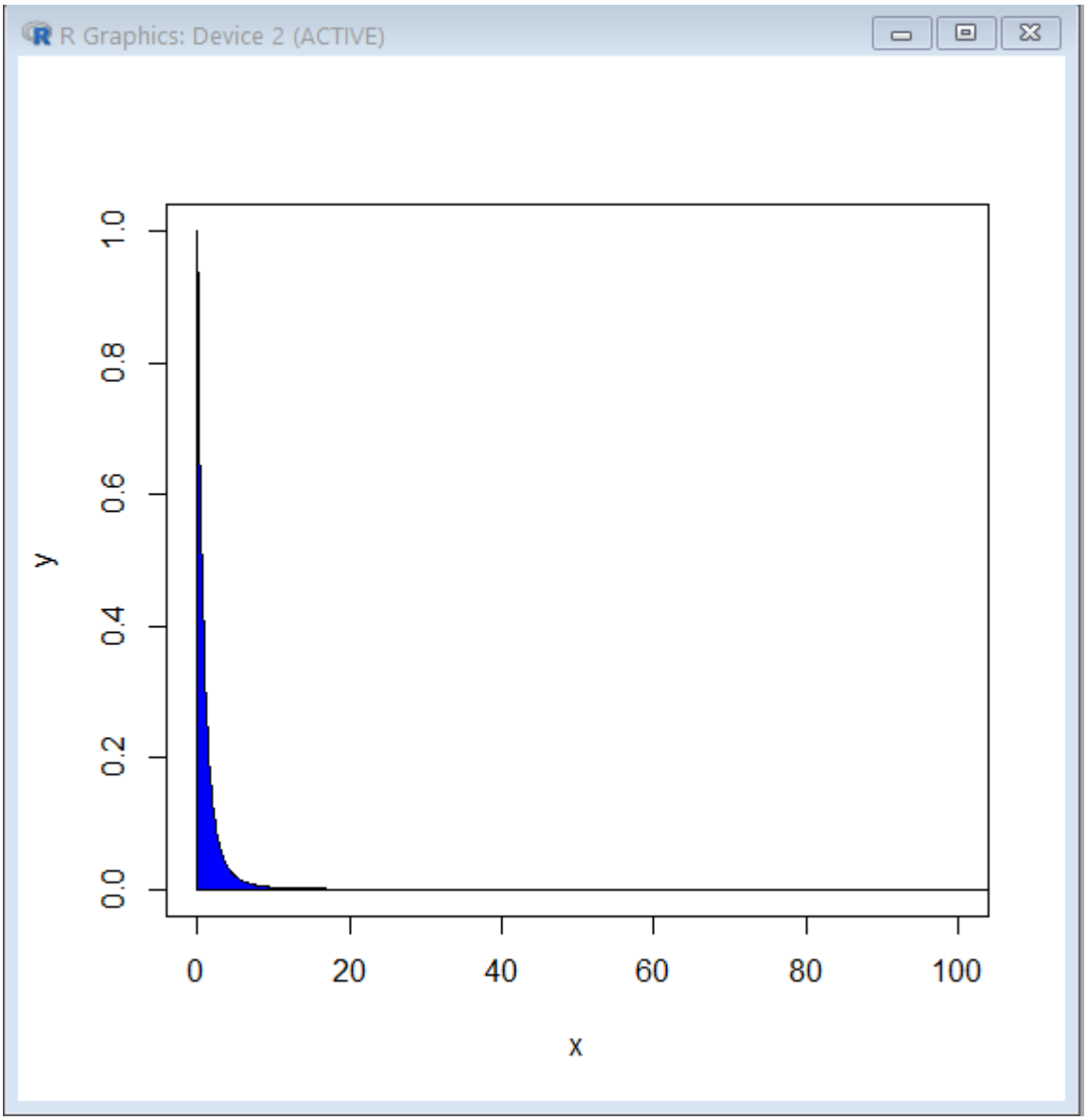

R Console
(Intercept) 0.58877 0.88709 0.664 0.5315
weight -0.03379 0.02583 -1.308 0.2386
age 0.07884 0.01970 4.002 0.0071 **

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.5203 on 6 degrees of freedom
Multiple R-squared: 0.8838, Adjusted R-squared: 0.8451
F-statistic: 22.82 on 2 and 6 DF, p-value: 0.001568
> ss.multiple <- sum(multiple.regression$residuals^2)
> (ss.mean - ss.multiple) / ss.mean
[1] 0.9995792
> f.multiple <- ((ss.mean - ss.multiple) / (3 - 1)) /
+ (ss.multiple / (nrow(human.data) - 3))
>
> f.multiple
[1] 7126.215
>
> x <- seq(from=0, to=100, by=0.1)
> y <- df(x, df1=2, df2=6)
> plot(x, y, type="l")
>


R Graphics: Device 2 (ACTIVE)
y
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
x


R Console
> 1-pf(f.simple.v.multiple, df1=1, df2=6)
[1] 3.947392e-09
> summary(multiple.regression)
Call:
lm(formula = bodyfat ~ weight + age, data = human.data)
Residuals:
Min 1Q Median 3Q Max
-0.71066 -0.27878 0.06002 0.24967 0.80409
Coefficients:
Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.58877 0.88709 0.664 0.5315
weight -0.03379 0.02583 -1.308 0.2386
age 0.07884 0.01970 4.002 0.0071 **

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.5203 on 6 degrees of freedom
Multiple R-squared: 0.8838, Adjusted R-squared: 0.8451
F-statistic: 22.82 on 2 and 6 DF, p-value: 0.001568



RESULT:

Thus, the implementation of Multiple Linear Regression algorithm for bodyfat dataset using R is shown.