UNIVERSITY SCHOOL OF INFORMATION COMMUNICATION AND TECHNOLOGY
GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY
2024

BIG DATA ANALYTICS
(ITE-403)
Lab File

Submitted to:
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S. No	List of Experiments	Date	Remarks
1	Install Apache Hadoop.		
2	Develop a map reduce program to calculate the frequency of a given word in a given file.		
3	Develop a map reduce program to find the maximum temperature in each year.		
4	Develop a map reduce program to find the grade of students.		
5	Develop a map reduce program to implement matrix multiplication.		
6	Develop a map reduce program to find the maximum electrical consumption in each year given electrical consumption for each month in each year.		
7	Develop a map reduce program to analyze weather data set and print whether the day is shiny or cool day.		
8	Develop a map reduce program to find the tags associated with each movie by analyzing movie lens data.		
9	Develop a map reduce program to analyze Uber data set to find the days on which each basement has more trips using the following data set. The uber data set consists of four columns they are: Dispatching, base, no. date active, vehicle trips.		
10	Develop a map reduce program to analyze titanic dataset to find the average age of the people (both male and female) who died in the tragedy. How many people survived in each class.		
11	Develop a program to calculate the maximum recorded temperature year wise for the weather data set in Pig Latin.		
12	Write queries to sort and aggregate the data in a table using HiveQL.		

EXPERIMENT 1

Aim: Install Apache Hadoop.

Theory:

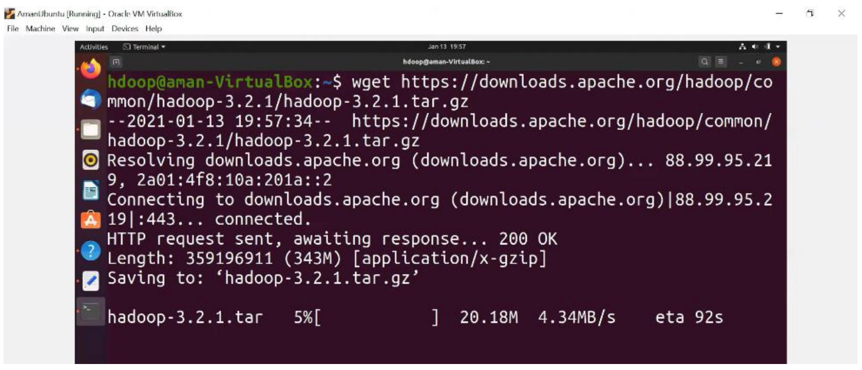
Apache Hadoop is a framework for distributed storage and processing of large datasets using a cluster of commodity hardware. Here's how it relates to Ubuntu:

1. Installation: You can install Apache Hadoop on Ubuntu by downloading the Hadoop binaries from the official Apache Hadoop website or by using package managers like apt. Ubuntu provides a convenient environment for setting up Hadoop clusters due to its ease of installation and robust package management system.
2. Compatibility: Hadoop is compatible with Ubuntu, meaning it can run smoothly on Ubuntu servers or desktops without major compatibility issues. This allows users to leverage the features of Ubuntu along with the capabilities of Hadoop for big data processing.
3. Resource Management: Ubuntu provides tools and utilities for managing system resources effectively, which can be beneficial when running Hadoop clusters. Resource management is crucial in Hadoop environments to ensure optimal performance and utilization of cluster resources.
4. Security: Ubuntu offers robust security features that can be leveraged to secure Hadoop clusters. This includes configuring firewalls, setting up user permissions, and enabling encryption to protect data stored and processed by Hadoop.
5. Maintenance: Ubuntu's regular updates and longterm support (LTS) releases make it suitable for maintaining Hadoop clusters over extended periods. Updates can be easily applied to both Ubuntu and Hadoop components to ensure stability, security, and compatibility.
6. Community Support: Both Apache Hadoop and Ubuntu have vibrant communities that provide support, documentation, and resources for users. This makes it easier for users to troubleshoot issues, seek advice, and stay updated with the latest developments in both technologies.

In summary, Ubuntu provides a reliable and flexible platform for deploying, managing, and maintaining Apache Hadoop clusters, making it a popular choice for organizations looking to harness the power of big data analytics.

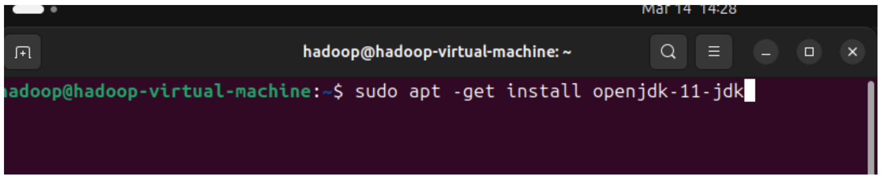
Steps:

1. Install Hadoop in the virtual machine.


AmanUbuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities
Terminal
Jan 13 19:57
hdoop@aman-VirtualBox: ~

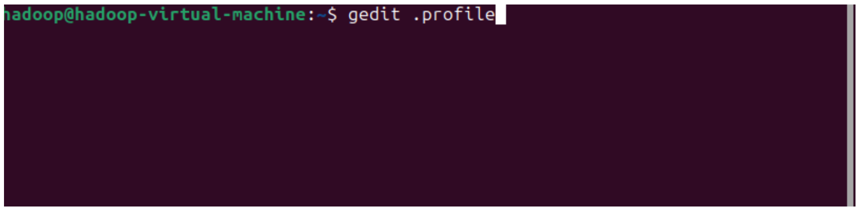
```
hdoop@aman-VirtualBox:~$ wget https://downloads.apache.org/hadoop/co
mmon/hadoop-3.2.1/hadoop-3.2.1.tar.gz
--2021-01-13 19:57:34--  https://downloads.apache.org/hadoop/common/
hadoop-3.2.1/hadoop-3.2.1.tar.gz
Resolving downloads.apache.org (downloads.apache.org)... 88.99.95.21
9, 2a01:4f8:10a:201a::2
Connecting to downloads.apache.org (downloads.apache.org)|88.99.95.2
19|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 359196911 (343M) [application/x-gzip]
Saving to: ‘hadoop-3.2.1.tar.gz’

hadoop-3.2.1.tar   5%[          ]  20.18M  4.34MB/s    eta 92s
```

2. Download Java SE Development Kit

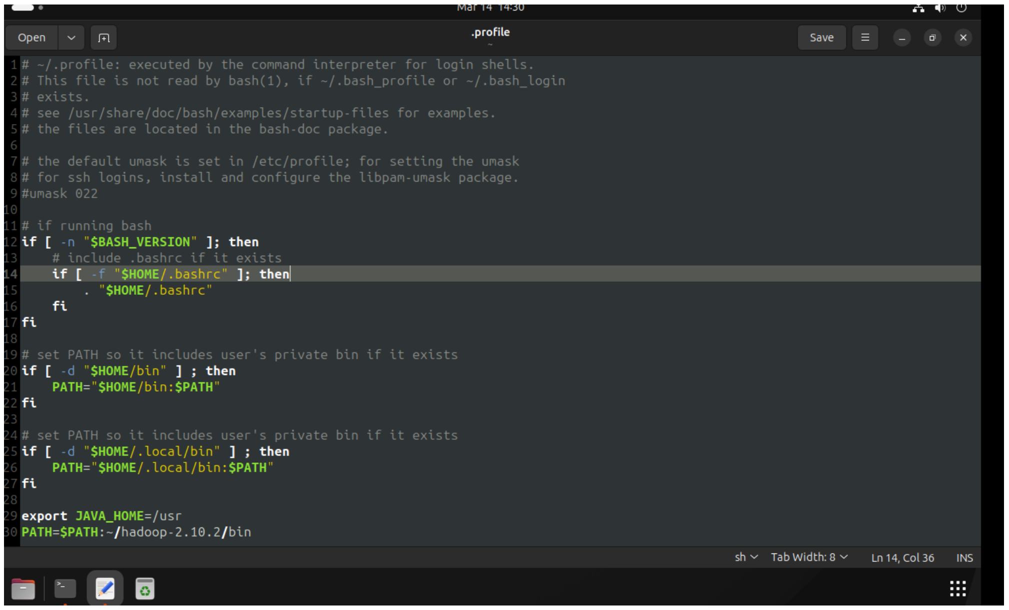


```
adoop@hadoop-virtual-machine:~$ sudo apt -get install openjdk-11-jdk
```

3. Set Environment Variable.

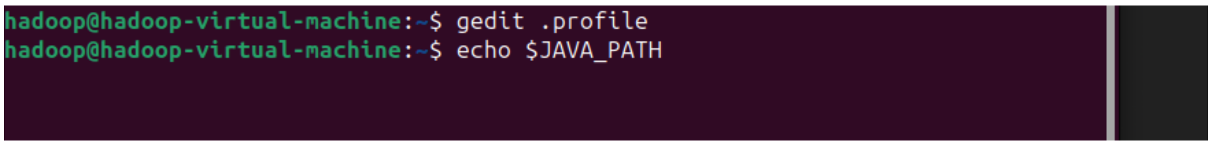


```
adoop@hadoop-virtual-machine:~$ gedit .profile
```



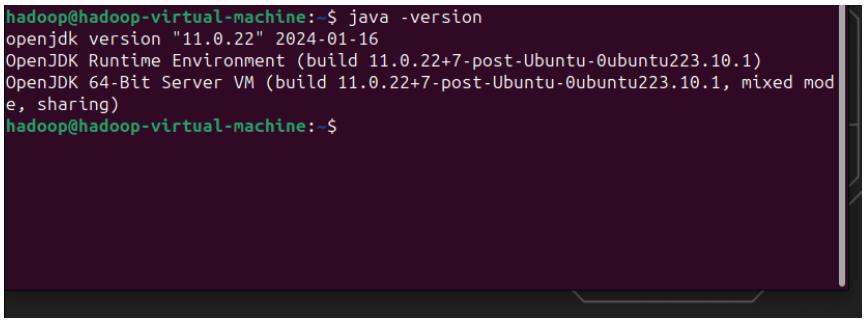
```
# ~/.profile: executed by the command interpreter for login shells.
# This file is not read by bash(1), if ~/.bash_profile or ~/.bash_login
# exists.
# see /usr/share/doc/bash/examples/startup-files for examples.
# the files are located in the bash-doc package.

# the default umask is set in /etc/profile; for setting the umask
# for ssh logins, install and configure the libpam-umask package.
#umask 022

# if running bash
if [ -n "$BASH_VERSION" ]; then
    # include .bashrc if it exists
    if [ -f "$HOME/.bashrc" ]; then
        . "$HOME/.bashrc"
    fi
fi

# set PATH so it includes user's private bin if it exists
if [ -d "$HOME/bin" ] ; then
    PATH="$HOME/bin:$PATH"
fi

# set PATH so it includes user's private bin if it exists
if [ -d "$HOME/.local/bin" ] ; then
    PATH="$HOME/.local/bin:$PATH"
fi

export JAVA_HOME=/usr
PATH=$PATH:~/hadoop-2.10.2/bin
```

4. Check Java Path



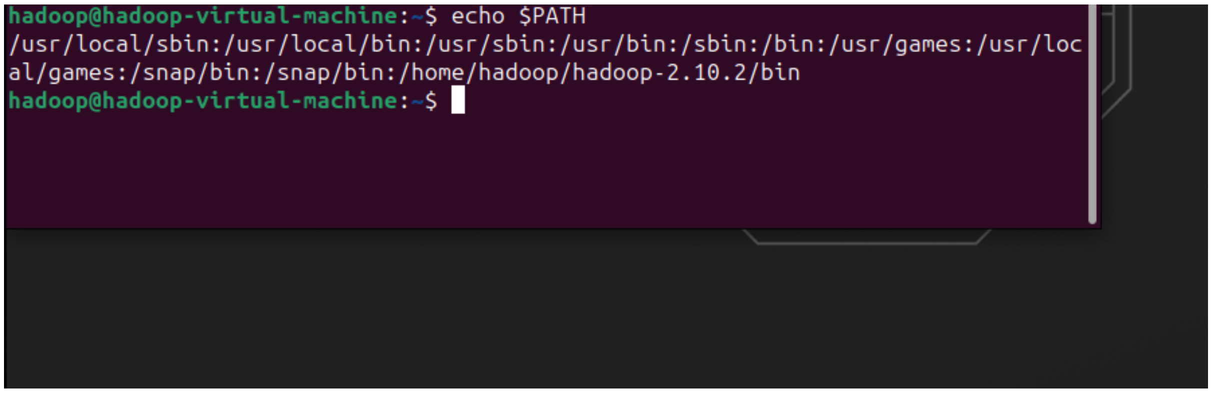
```
hadoop@hadoop-virtual-machine:~$ gedit .profile
hadoop@hadoop-virtual-machine:~$ echo $JAVA_PATH
```

5. Check the JAVA version installed.



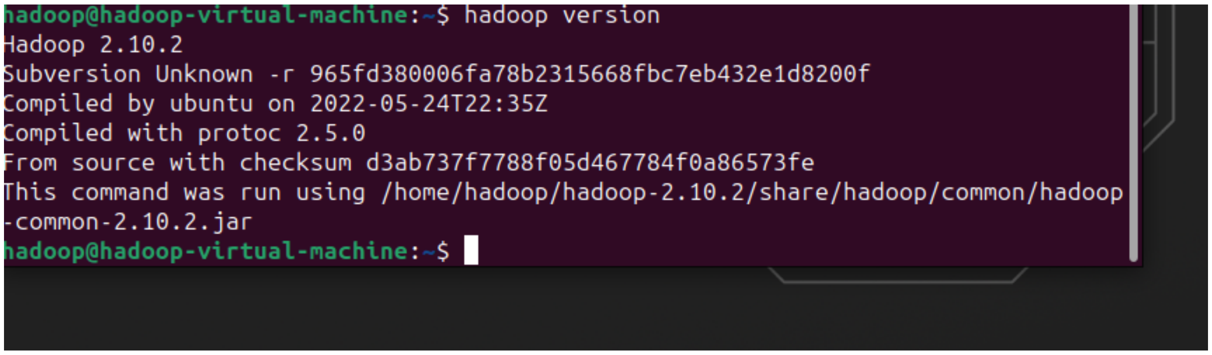
```
hadoop@hadoop-virtual-machine:~$ java -version
openjdk version "11.0.22" 2024-01-16
OpenJDK Runtime Environment (build 11.0.22+7-post-Ubuntu-0ubuntu223.10.1)
OpenJDK 64-Bit Server VM (build 11.0.22+7-post-Ubuntu-0ubuntu223.10.1, mixed mod
e, sharing)
hadoop@hadoop-virtual-machine:~$
```

6. Check the Path for Hadoop.



```
hadoop@hadoop-virtual-machine:~$ echo $PATH
/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/loc
al/games:/snap/bin:/snap/bin:/home/hadoop/hadoop-2.10.2/bin
hadoop@hadoop-virtual-machine:~$
```

7. Check Hadoop version.



```
hadoop@hadoop-virtual-machine:~$ hadoop version
Hadoop 2.10.2
Subversion Unknown -r 965fd380006fa78b2315668fbc7eb432e1d8200f
Compiled by ubuntu on 2022-05-24T22:35Z
Compiled with protoc 2.5.0
From source with checksum d3ab737f7788f05d467784f0a86573fe
This command was run using /home/hadoop/hadoop-2.10.2/share/hadoop/common/hadoop
-common-2.10.2.jar
hadoop@hadoop-virtual-machine:~$
```

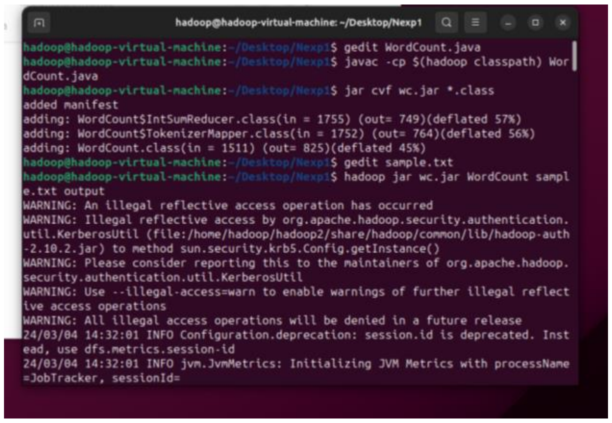
Experiment 2

Aim: Develop a mapreduce program to calculate the frequency of a given word in a given file.

Theory:

To develop a MapReduce program using Apache Hadoop to efficiently calculate the frequency of a given word within a specified file. MapReduce is a programming model specifically designed for processing large volumes of data in a distributed manner. By leveraging the parallel processing capabilities of Hadoop, this experiment seeks to demonstrate an effective approach to analyzing text data and derive useful insights regarding word frequency.
Word frequency analysis is a fundamental task in natural language processing, which involves paradigm to distribute the workload across multiple nodes in a Hadoop cluster, enabling faster processing and analysis of text data.
The primary objective of this experiment is to develop a MapReduce program using Apache Hadoop to calculate the frequency of a specified word within a given text file. By distributing the computation across multiple nodes in a Hadoop cluster, the experiment aims to demonstrate the scalability and efficiency of MapReduce in processing large volumes of text data.
The experiment demonstrates the effectiveness of using Apache Hadoop and the MapReduce paradigm for calculating word frequency in large text datasets. By distributing the computation across multiple nodes, Hadoop enables efficient processing of big data, making it suitable for a wide range of analytical tasks in various domains.

Steps:

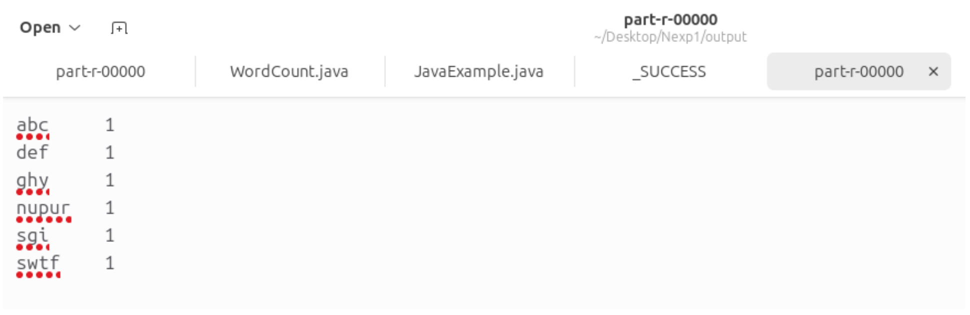


```
hadoop@hadoop-virtual-machine:~/Desktop/Nexp1$ gedit WordCount.java
hadoop@hadoop-virtual-machine:~/Desktop/Nexp1$ javac -cp $(hadoop classpath) Wor
dCount.java
hadoop@hadoop-virtual-machine:~/Desktop/Nexp1$ jar cvf wc.jar *.class
added manifest
adding: WordCount$IntSumReducer.class(in = 1755) (out= 749)(deflated 57%)
adding: WordCount$TokenizerMapper.class(in = 1752) (out= 764)(deflated 56%)
adding: WordCount.class(in = 1511) (out= 825)(deflated 45%)
hadoop@hadoop-virtual-machine:~/Desktop/Nexp1$ gedit sample.txt
hadoop@hadoop-virtual-machine:~/Desktop/Nexp1$ hadoop jar wc.jar WordCount sampl
e.txt output
WARNING: An illegal reflective access operation has occurred
WARNING: Illegal reflective access by org.apache.hadoop.security.authentication.
util.KerberosUtil (file:/home/hadoop/hadoop2/share/hadoop/common/lib/hadoop-auth
-2.10.2.jar) to method sun.security.krb5.Config.getInstance()
WARNING: Please consider reporting this to the maintainers of org.apache.hadoop.
security.authentication.util.KerberosUtil
WARNING: Use --illegal-access=warn to enable warnings of further illegal reflect
ive access operations
WARNING: All illegal access operations will be denied in a future release
24/03/04 14:32:01 INFO Configuration.deprecation: session.id is deprecated. Inst
ead, use dfs.metrics.session-id
24/03/04 14:32:01 INFO jvm.JvmMetrics: Initializing JVM Metrics with processName
=JobTracker, sessionId=
```

Code:

```
import java.io.IOException;
import java.util.StringTokenizer;
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Job;
import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
public class WordCount {
  public static class TokenizerMapper extends Mapper<Object, Text, Text, IntWritable> {
    private final static IntWritable one = new IntWritable(1);
    private Text word = new Text();

    public void map(Object key, Text value, Context context) throws IOException, InterruptedException {
      StringTokenizer itr = new StringTokenizer(value.toString());
      while (itr.hasMoreTokens()) {
        word.set(itr.nextToken());
        context.write(word, one);
      }
    }
  }
  public static class IntSumReducer extends Reducer<Text, IntWritable, Text, IntWritable> {
    private IntWritable result = new IntWritable();
    public void reduce(Text key, Iterable<IntWritable> values, Context context) throws IOException,
InterruptedException {
      int sum = 0;
      for (IntWritable val : values) {
        sum += val.get();
      }
      result.set(sum);
      context.write(key, result);
    }
  }
  public static void main(String[] args) throws Exception {
    Configuration conf = new Configuration();
    Job job = Job.getInstance(conf, "word count");
    job.setJarByClass(WordCount.class);
    job.setMapperClass(TokenizerMapper.class);
    job.setCombinerClass(IntSumReducer.class);
    job.setReducerClass(IntSumReducer.class);
    job.setOutputKeyClass(Text.class);
    job.setOutputValueClass(IntWritable.class);
    FileInputFormat.addInputPath(job, new Path(args[0]));
    FileOutputFormat.setOutputPath(job, new Path(args[1]));
    System.exit(job.waitForCompletion(true) ? 0 : 1);
  }
}
```

Output:



```
abc     1
def     1
ghy     1
nupur   1
sgi     1
swtf    1
```

Experiment 3

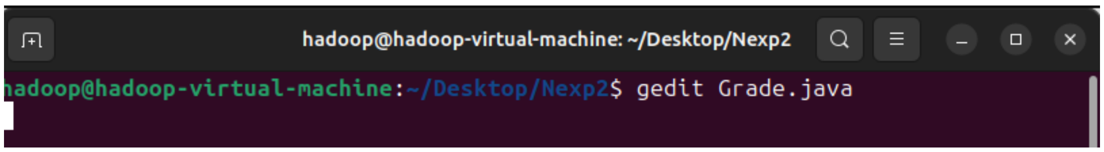
Aim: Develop a map reduction program to find the grades of students.

Theory:

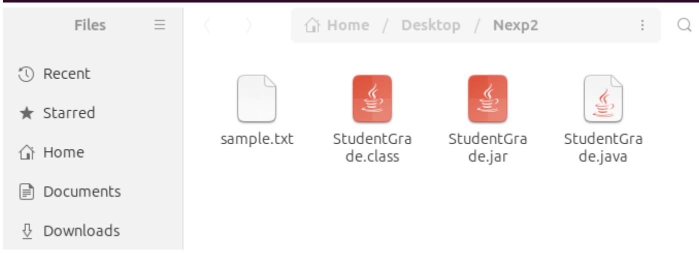
To develop a MapReduce program using Apache Hadoop to efficiently calculate the grades of students. MapReduce is a programming model and processing framework designed to handle largescale data processing tasks distributedly. The input data for our program will consist of records representing student information, such as student ID, name, scores in various subjects, and possibly other relevant details. The objective is to calculate the final grades for each student based on their scores and any predefined grading criteria.
The MapReduce program will consist of two main phases: the Map phase and the Reduce phase.

1. Map Phase: In the Map phase, each mapper task will process a portion of the input data independently.
   The mapper will parse the input records, extract the relevant information (such as student ID and scores), and perform any necessary calculations or transformations.
   For each input record, the mapper will output keyvalue pairs, where the key represents the student ID and the value includes relevant information for grade calculation (e.g., subject scores).
2. Reduce Phase: In the Reduce phase, the output of the Map phase will be aggregated and processed to calculate the final grades for each student. The reducer tasks will receive the keyvalue pairs generated by the mappers, grouped by student ID.
   For each student, the reducer will compute the final grade based on the provided scores and any predefined grading criteria.
   The final output of the Reduce phase will be keyvalue pairs containing the student ID and their corresponding final grade.

Steps:



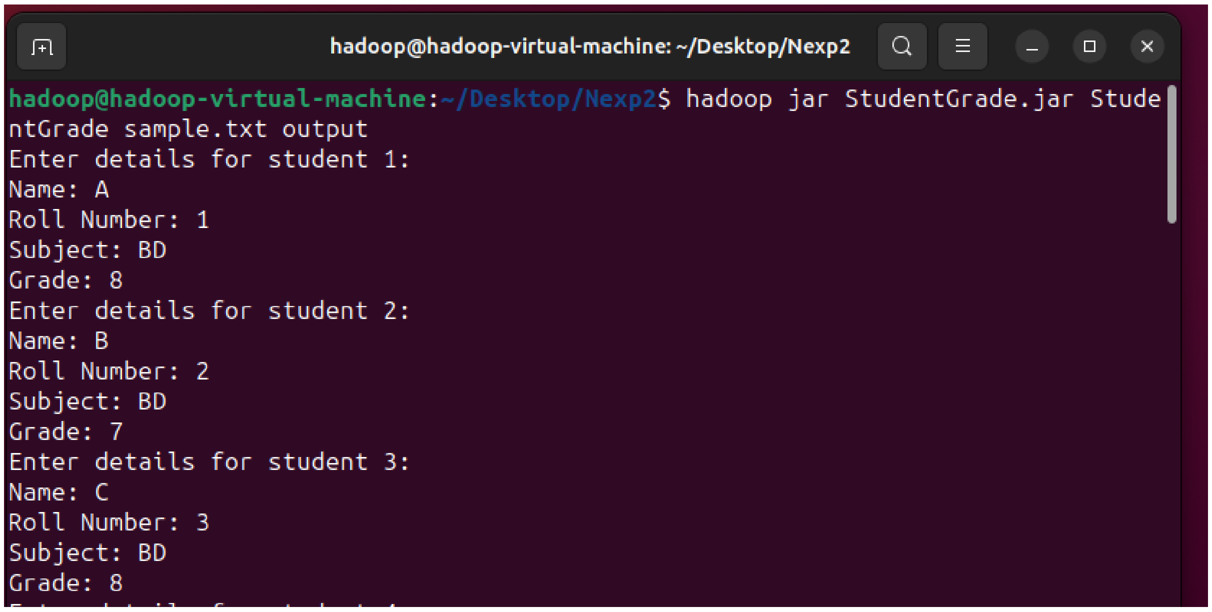
```
hadoop@hadoop-virtual-machine: ~/Desktop/Nexp2
hadoop@hadoop-virtual-machine:~/Desktop/Nexp2$ gedit Grade.java
```



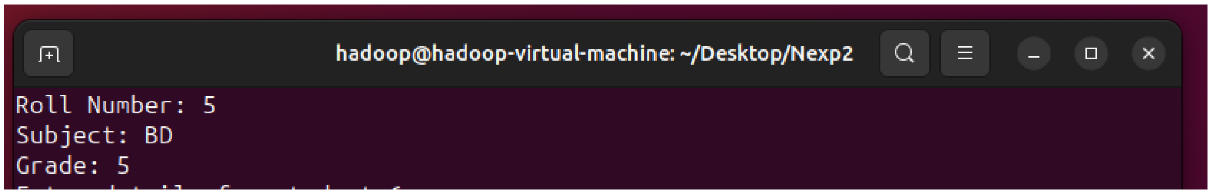
Code:

```
import java.util.Scanner;
public class StudentGrade {
    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
        System.out.print("Enter the number of students: ");
        int numStudents = scanner.nextInt();
        scanner.nextLine(); // Consume newline character
        String[] names = new String[numStudents];
        int[] rollNumbers = new int[numStudents];
        String[] subjects = new String[numStudents];
        char[] grades = new char[numStudents];
        for (int i = 0; i < numStudents; i++) {
            System.out.println("Enter details for student " + (i + 1) + ":");
            System.out.print("Name: ");
            names[i] = scanner.nextLine();
            System.out.print("Roll Number: ");
            rollNumbers[i] = scanner.nextInt();
            scanner.nextLine(); // Consume newline character
            System.out.print("Subject: ");
            subjects[i] = scanner.nextLine();
            System.out.print("Grade: ");
            grades[i] = scanner.nextLine().charAt(0);
        }
        // Print details for all students
        System.out.println("\nStudent Details:");
        for (int i = 0; i < numStudents; i++) {
            System.out.println("Student " + (i + 1) + ":");
            System.out.println("Name: " + names[i]);
            System.out.println("Roll Number: " + rollNumbers[i]);
            System.out.println("Subject: " + subjects[i]);
            System.out.println("Grade: " + grades[i]);
            System.out.println();
        }
        scanner.close();
    }
}
```

Output:



```
hadoop@hadoop-virtual-machine:~/Desktop/Nexp2$ hadoop jar StudentGrade.jar Stude
ntGrade sample.txt output
Enter details for student 1:
Name: A
Roll Number: 1
Subject: BD
Grade: 8
Enter details for student 2:
Name: B
Roll Number: 2
Subject: BD
Grade: 7
Enter details for student 3:
Name: C
Roll Number: 3
Subject: BD
Grade: 8
```



```
Roll Number: 5
Subject: BD
Grade: 5
```

Experiment 4

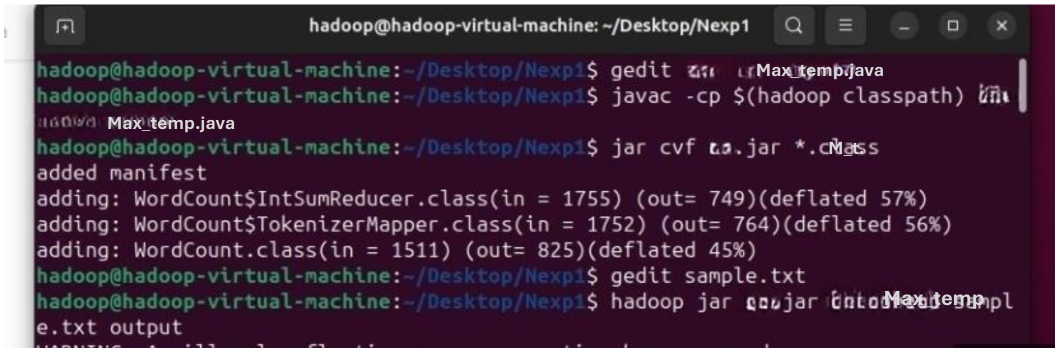
Aim: Develop a program to calculate the maximum recorded temperature yearwise for theweather data set in Pig Latin.

Theory:

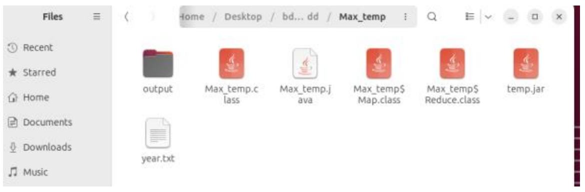
Apache Hadoop is a powerful framework for processing and analyzing large datasets in a distributed manner across clusters of computers using simple programming models. To calculate the maximum recorded temperature yearwise in a weather dataset using Hadoop, we can follow a MapReduce paradigm.

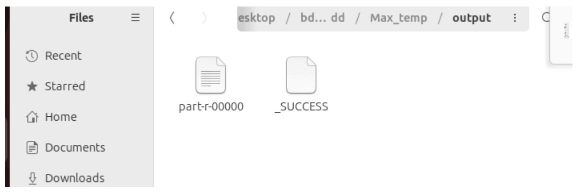
1. **Input Data Format:** The weather dataset should be stored in a format suitable for Hadoop, such as Hadoop Distributed File System (HDFS) or any other Hadoopcompatible file system. Each line in the dataset represents a weather record, typically containing fields like date, temperature, humidity, etc.
2. **Mapper Function**: The mapper function reads each weather record and extracts the year and temperature information. It emits keyvalue pairs where the key is the year and the value is the temperature.
3. **Reducer Function:** The reducer function receives keyvalue pairs grouped by year. For each year, it iterates through the temperature values and finds the maximum temperature. It emits the year along with the maximum temperature.
4. **Input Splitting**: Hadoop automatically divides the input data into manageable chunks called input splits, which are processed by individual mapper tasks.
5. **MapReduce Workflow:** Hadoop distributes the mapper tasks across the cluster, where each mapper processes a portion of the input data. The output of the mapper tasks is shuffled and sorted by key, then passed to the reducer tasks. Reducer tasks aggregate the intermediate results and compute the maximum temperature for each year. The final output is written to the output directory specified by the user.
6. **Handling Edge Cases**: Ensure handling of missing or invalid temperature values. Consider data skewness to optimize reducer performance.
7. **Output**: The final output will contain keyvalue pairs where the key is the year and the value is the maximum recorded temperature for that year.
8. **Execution:** The Hadoop job is submitted to the cluster using the appropriate commands or APIs provided by the Hadoop ecosystem.
9.

Steps:



```
hadoop@hadoop-virtual-machine: ~/Desktop/Nexp1
hadoop@hadoop-virtual-machine:~/Desktop/Nexp1$ gedit Max_temp.java
hadoop@hadoop-virtual-machine:~/Desktop/Nexp1$ javac -cp $(hadoop classpath)
Max_temp.java
hadoop@hadoop-virtual-machine:~/Desktop/Nexp1$ jar cvf [illegible].jar *.class
added manifest
adding: WordCount$IntSumReducer.class(in = 1755) (out= 749)(deflated 57%)
adding: WordCount$TokenizerMapper.class(in = 1752) (out= 764)(deflated 56%)
adding: WordCount.class(in = 1511) (out= 825)(deflated 45%)
hadoop@hadoop-virtual-machine:~/Desktop/Nexp1$ gedit sample.txt
hadoop@hadoop-virtual-machine:~/Desktop/Nexp1$ hadoop jar [illegible].jar Max_temp sampl
e.txt output
```

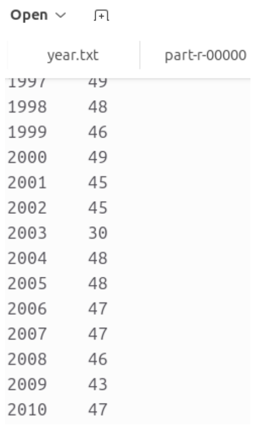




Code:

```
import java.io.IOException;
import java.util.StringTokenizer;
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.mapreduce.lib.output.TextOutputFormat;
public class Max_temp {
            public static class Map extends
            Mapper<LongWritable, Text, Text, IntWritable> {
            //Mapper
            Text k= new Text();
       @Override
       public void map(LongWritable key, Text value, Context context)
                        throws IOException, InterruptedException {
             String line = value.toString();
StringTokenizer tokenizer = new StringTokenizer(line," ");
             while (tokenizer.hasMoreTokens()) {
            String year= tokenizer.nextToken();
            k.set(year);
            String temp= tokenizer.nextToken().trim();
            int v = Integer.parseInt(temp);
context.write(k,newIntWritable(v)); }}}
       public void reduce(Text key, Iterable<IntWritable> values, Context context)
                        throws IOException, InterruptedException {
            int maxtemp=0;
          for(IntWritable it : values) {
          int temperature= it.get();
            if(maxtemp<temperature)
            {maxtemp =temperature;}}
context.write(key, new IntWritable(maxtemp)); }}
 //Driver
   public static void main(String[] args) throws Exception {
                        Configuration conf = new Configuration();
                        Job job = new Job(conf, "Max_temp");
                        job.setOutputKeyClass(Text.class);
                        job.setOutputValueClass(IntWritable.class);
job.setInputFormatClass(TextInputFormat.class);
                        job.setOutputFormatClass(TextOutputFormat.class);
       Path outputPath = new Path(args[1]);
                        FileInputFormat.addInputPath(job, new Path(args[0]));
                        FileOutputFormat.setOutputPath(job, new Path(args[1]));
                        outputPath.getFileSystem(conf).delete(outputPath);
                        System.exit(job.waitForCompletion(true) ? 0 : 1);}}
```

Output:



```
1997    49
1998    48
1999    46
2000    49
2001    45
2002    45
2003    30
2004    48
2005    48
2006    47
2007    47
2008    46
2009    43
2010    47
```

Experiment 5

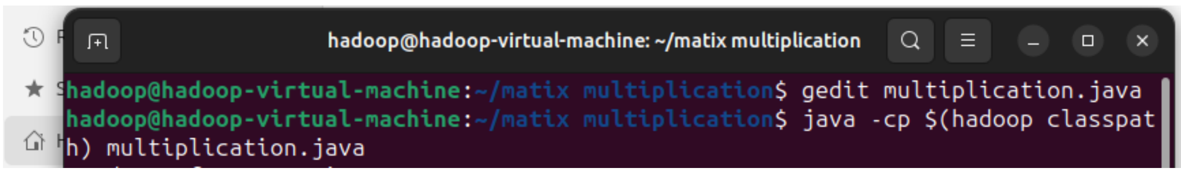
Aim: Develop a map reduce program to implement matrix multiplication.

Theory:

Matrix multiplication is a fundamental operation in many computational tasks, and implementing it in a distributed computing framework like Apache Hadoop can provide significant benefits in terms of scalability and performance.
Matrix multiplication involves multiplying two matrices to produce another matrix. Given two matrices A (of dimensions m x n) and B (of dimensions n x p), the resulting matrix C (of dimensions m x p) is computed as follows: C[i][j] = Σ(A[i][k] * B[k][j]) for k = 1 to n, where 0 <= i< m and 0 <= j < p.
To implement matrix multiplication in Apache Hadoop using MapReduce, we can follow these steps:

1. Input Data Representation: Represent each input matrix as a set of keyvalue pairs, where the key represents the row/column index, and the value represents the matrix element. For example, for matrix A, the key would be (i, j) where i is the row index and j is the column index, and the value would be the corresponding matrix element.
2. Map Function: In the map function, we emit intermediate keyvalue pairs for each element of the input matrices.
   For matrix A, emit (i, (A, j, A[i][j])) for each element.
   For matrix B, emit (j, (B, i, B[j][i])) for each element.
3. Partitioning and Shuffle: The Hadoop framework shuffles and sorts the intermediate keyvalue pairs based on keys. All pairs with the same key (i.e., the same row/column index) will be grouped and sent to the same reducer.
4. Reduce Function: In the reduce function, compute the product of corresponding elements from the intermediate pairs to get the resulting matrix elements. For each key (i.e., row/column index), multiply corresponding elements from matrix A and matrix B and sum them up to get the result for C[i][j]. Emit the final result as (i, j, C[i][j]).
5. Output Data: Collect all the output keyvalue pairs from reducers to get the final result matrix C.

Steps:

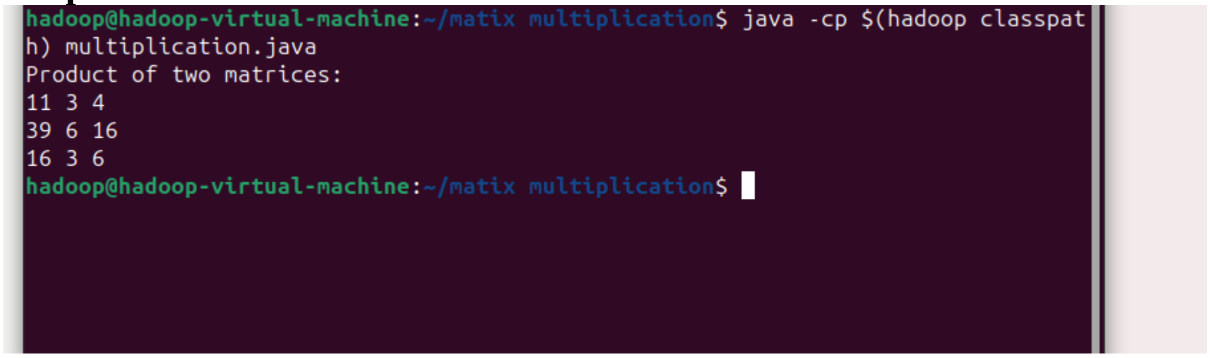


```
hadoop@hadoop-virtual-machine:~/matix multiplication$ gedit multiplication.java
hadoop@hadoop-virtual-machine:~/matix multiplication$ java -cp $(hadoop classpat
h) multiplication.java
```

Code:

```
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 TwoStepMatrixMultiplication {
    public static class Map extends Mapper<LongWritable, Text, Text, Text> {
        public void map(LongWritable key, Text value, Context context) throws IOException, InterruptedException {
            String line = value.toString();
            String[] indicesAndValue = line.split(",");
            Text outputKey = new Text();
            Text outputValue = new Text();
            if (indicesAndValue[0].equals("A")) {
outputKey.set(indicesAndValue[2]);
outputValue.set("A," + indicesAndValue[1] + "," + indicesAndValue[3]);
context.write(outputKey, outputValue);
            } else {
outputKey.set(indicesAndValue[1]);
outputValue.set("B," + indicesAndValue[2] + "," + 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<Integer, Float>>listA = new ArrayList<Entry<Integer, Float>>();
ArrayList<Entry<Integer, Float>>listB = new ArrayList<Entry<Integer, Float>>();
            for (Text val : values) {
                value = val.toString().split(",");
                if (value[0].equals("A")) {
listA.add(new SimpleEntry<Integer, Float>(Integer.parseInt(value[1]), Float.parseFloat(value[2])));
                } else {
listB.add(new SimpleEntry<Integer, Float>(Integer.parseInt(value[1]), Float.parseFloat(value[2])));
                }
            }
            String i;
            float a_ij;
            String k;
            float b_jk;
            Text outputValue = new Text();
            for (Entry<Integer, Float> a : listA) {
i = Integer.toString(a.getKey());
a_ij = a.getValue();
                for (Entry<Integer, Float> b : listB) {
                    k = Integer.toString(b.getKey());
b_jk = b.getValue();
outputValue.set(i + "," + k + "," + Float.toString(a_ij*b_jk));
context.write(null, outputValue);
                }
            }
        }
    }
    public static void main(String[] args) throws Exception {
        Configuration conf = new Configuration();
        Job job = new Job(conf, "MatrixMatrixMultiplicationTwoSteps");
job.setJarByClass(TwoStepMatrixMultiplication.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("hdfs://127.0.0.1:9000/matrixin"));
              FileOutputFormat.setOutputPath(job, new Path("hdfs://127.0.0.1:9000/matrixout"));
job.waitForCompletion(true);
    }
}
```

Output:



```
hadoop@hadoop-virtual-machine:~/matix multiplication$ java -cp $(hadoop classpat
h) multiplication.java
Product of two matrices:
11 3 4
39 6 16
16 3 6
hadoop@hadoop-virtual-machine:~/matix multiplication$ 
```

Experiment 6

Aim: Develop a map reduce program to find the maximum electrical consumption in each yeargiven electrical consumption for each month in each year.

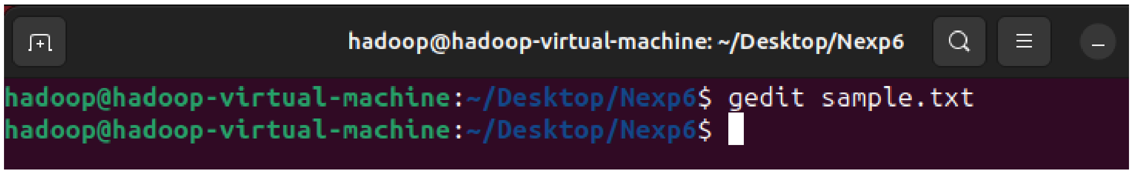
Theory:

1. Input Data: The input data will consist of records containing information about electrical consumption for each month in each year. Each record will include fields such as year, month, and consumption value.
2. Mapper Function: The Mapper function will parse each input record and emit keyvalue pairs where the key is the year, and the value is the consumption for that month.
   - Example input record: `(year, month, consumption)`
   - Mapper emits: `(year, consumption)`

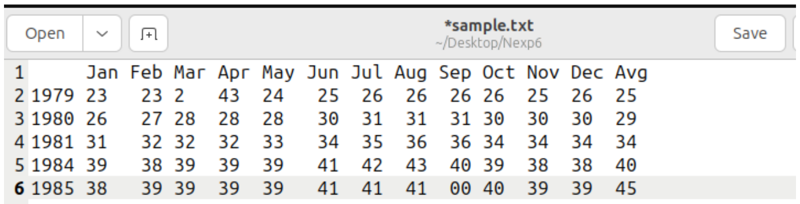
3. Partitioner: Optionally, a custom partitioner can be implemented to ensure that all records with the same key (year) are sent to the same reducer.
4. Sorting: Hadoop's shuffle and sort phase will automatically group the keyvalue pairs by key (year) and sort them in ascending order of the key.
5. Reducer Function:The Reducer function will receive all the consumption values for a particular year.
   - It will then iterate through these values to find the maximum consumption for that year.
   - Finally, it will emit the maximum consumption for each year.
   - Example input to Reducer: `(year, [consumption1, consumption2, ...])`
   - Reducer emits: `(year, max_consumption)`

6. Output: The output of the MapReduce job will consist of keyvalue pairs where the key is the year, and the value is the maximum electrical consumption for that year.
7. Execution:The MapReduce job will be submitted to the Hadoop cluster for execution.
   - Hadoop will automatically distribute the input data across the cluster, execute the Mapper and Reducer tasks in parallel, and handle the shuffle and sort phase.
   - The output will be written to HDFS (Hadoop Distributed File System) or any specified output location.

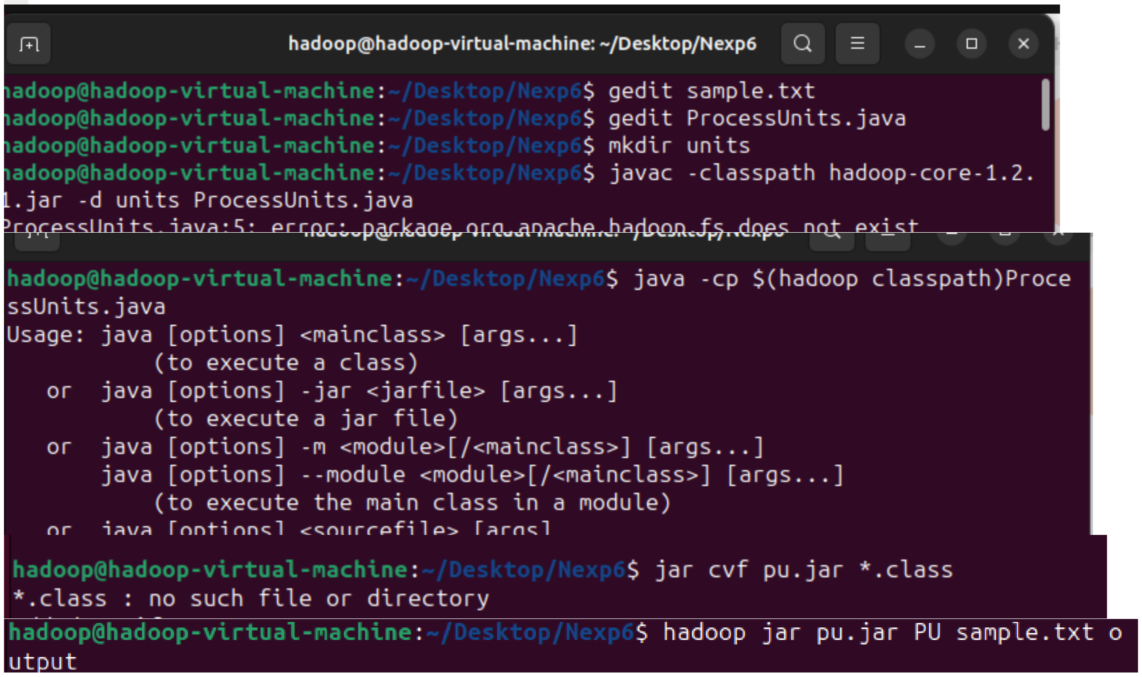
Steps:



```
hadoop@hadoop-virtual-machine:~/Desktop/Nexp6$ gedit sample.txt
hadoop@hadoop-virtual-machine:~/Desktop/Nexp6$ 
```



```
*sample.txt
~/Desktop/Nexp6

     Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Avg
1979 23   23 2   43  24   25  26  26  26 26  25  26  25
1980 26   27 28  28  28   30  31  31  31 30  30  30  29
1981 31   32 32  32  33   34  35  36  36 34  34  34  34
1984 39   38 39  39  39   41  42  43  40 39  38  38  40
1985 38   39 39  39  39   41  41  41  00 40  39  39  45
```



```
hadoop@hadoop-virtual-machine: ~/Desktop/Nexp6
hadoop@hadoop-virtual-machine:~/Desktop/Nexp6$ gedit sample.txt
hadoop@hadoop-virtual-machine:~/Desktop/Nexp6$ gedit ProcessUnits.java
hadoop@hadoop-virtual-machine:~/Desktop/Nexp6$ mkdir units
hadoop@hadoop-virtual-machine:~/Desktop/Nexp6$ javac -classpath hadoop-core-1.2.
1.jar -d units ProcessUnits.java
ProcessUnits.java:5: error: package org.apache.hadoop.fs does not exist
```

```
hadoop@hadoop-virtual-machine:~/Desktop/Nexp6$ java -cp $(hadoop classpath)Proce
ssUnits.java
Usage: java [options] <mainclass> [args...]
           (to execute a class)
   or  java [options] -jar <jarfile> [args...]
           (to execute a jar file)
   or  java [options] -m <module>[/<mainclass>] [args...]
       java [options] --module <module>[/<mainclass>] [args...]
           (to execute the main class in a module)
   or  java [options] <sourcefile> [args]
```

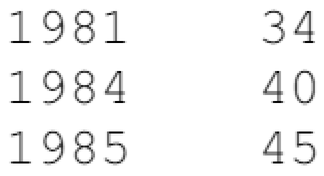
```
hadoop@hadoop-virtual-machine:~/Desktop/Nexp6$ jar cvf pu.jar *.class
*.class : no such file or directory
```

```
hadoop@hadoop-virtual-machine:~/Desktop/Nexp6$ hadoop jar pu.jar PU sample.txt o
utput
```

Code:

```
package hadoop;
import java.io.IOException;
import java.util.StringTokenizer;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.conf.*;
import org.apache.hadoop.io.*;
import org.apache.hadoop.mapred.*;
import org.apache.hadoop.util.*;
public class ProcessUnits {
    // Mapper class
    public static class E_EMapper extends MapReduceBase implements Mapper<LongWritable, Text, Text,
IntWritable> {

        // Map function
        public void map(LongWritable key, Text value, OutputCollector<Text, IntWritable> output, Reporter reporter)
throws IOException {
            String line = value.toString();
            String lastToken = null;
            StringTokenizer s = new StringTokenizer(line, "\t");
            String year = s.nextToken();

            while (s.hasMoreTokens()) {
                lastToken = s.nextToken();
            }
            int avgPrice = Integer.parseInt(lastToken);
            output.collect(new Text(year), new IntWritable(avgPrice));
        }
    }

    // Main method
    public static void main(String[] args) throws Exception {
        JobConf conf = new JobConf(ProcessUnits.class);
        conf.setJobName("max_electricity_units");

        conf.setOutputKeyClass(Text.class);
        conf.setOutputValueClass(IntWritable.class);

        conf.setInputFormat(TextInputFormat.class);
        conf.setOutputFormat(TextOutputFormat.class);

        FileInputFormat.setInputPaths(conf, new Path(args[0]));
        FileOutputFormat.setOutputPath(conf, new Path(args[1]));

        JobClient.runJob(conf);
    }
}
```

Output:



```
1981     34
1984     40
1985     45
```

Experiment 7

Aim: Develop a map reduce program to analyze weather data set and print whether the day is shiny or cool day.

Theory:

1. Input Data: The input dataset will contain weather information such as temperature, humidity, wind speed, etc., recorded over a period of time, typically on a daily basis. Each record in the dataset represents the weather conditions for a particular day.

2. Mapper Function:Mapper function reads each record from the input dataset.

- It extracts relevant information such as temperature and weather conditions for each day.
- Based on certain criteria (e.g., temperature range), it categorizes each day as either shiny or cool.
- It emits key-value pairs where the key is the day (or date) and the value is the category (shiny or cool).

3. Reducer Function: The Reducer function receives key-value pairs emitted by the Mapper function.

- It aggregates the data based on the key, which is the day (or date).
- For each day, it determines the majority category (shiny or cool) based on the values associated with that key.
- It outputs the day along with the corresponding majority category.

4. Output: The output of the MapReduce program will be a list of days (or dates) along with their corresponding weather category (shiny or cool).

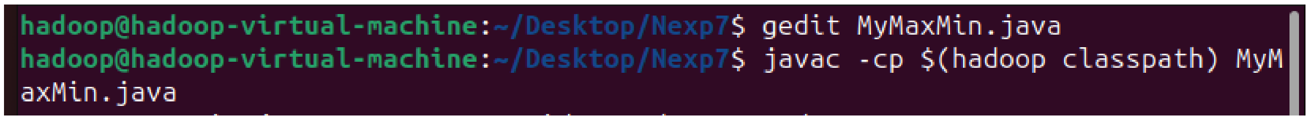
5. Execution: The MapReduce program is executed on a Hadoop cluster. Input data is distributed across the cluster's nodes. Mapper tasks run in parallel across the nodes, processing subsets of the input data.

- Intermediate key-value pairs generated by the mappers are shuffled and sorted.
- Reducer tasks receive shuffled data, aggregate it, and produce the final output.

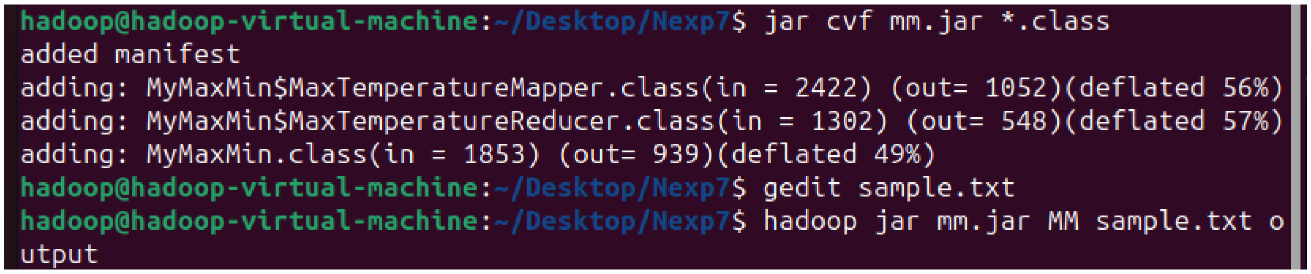
6. Parameters and Thresholds: Thresholds for categorizing days as shiny or cool can be set based on temperature ranges, humidity levels, or other relevant factors.These thresholds can be configurable parameters in the MapReduce program, allowing users to adjust them as needed.

7. Handling Edge Cases:The MapReduce program should handle edge cases such as missing or invalid data gracefully. It should also consider scenarios where a day's weather conditions might fall into neither the shiny nor cool category.

Steps:



```
hadoop@hadoop-virtual-machine:~/Desktop/Nexp7$ gedit MyMaxMin.java
hadoop@hadoop-virtual-machine:~/Desktop/Nexp7$ javac -cp $(hadoop classpath) MyM
axMin.java
```

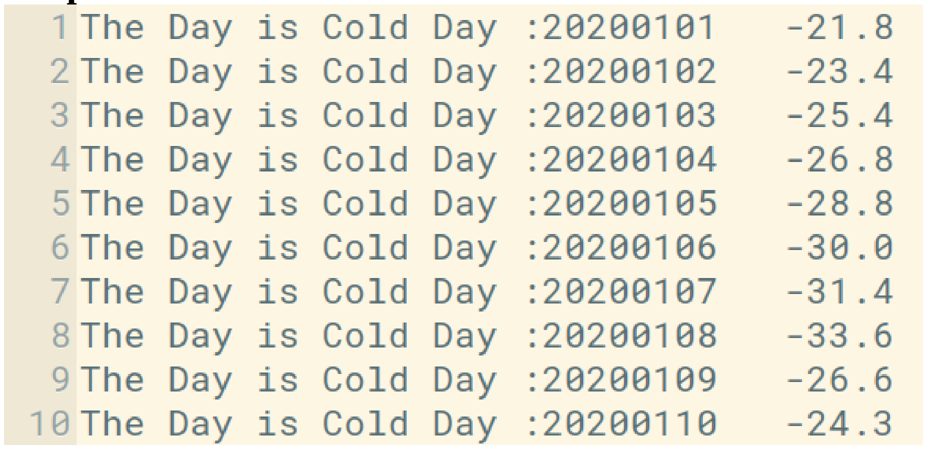


```
hadoop@hadoop-virtual-machine:~/Desktop/Nexp7$ jar cvf mm.jar *.class
added manifest
adding: MyMaxMin$MaxTemperatureMapper.class(in = 2422) (out= 1052)(deflated 56%)
adding: MyMaxMin$MaxTemperatureReducer.class(in = 1302) (out= 548)(deflated 57%)
adding: MyMaxMin.class(in = 1853) (out= 939)(deflated 49%)
hadoop@hadoop-virtual-machine:~/Desktop/Nexp7$ gedit sample.txt
hadoop@hadoop-virtual-machine:~/Desktop/Nexp7$ hadoop jar mm.jar MM sample.txt o
utput
```

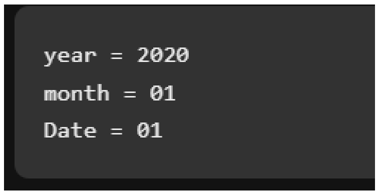
Code:

```
// importing Libraries
import java.io.IOException;
import java.util.Iterator;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
import org.apache.hadoop.mapreduce.lib.output.TextOutputFormat;
import org.apache.hadoop.mapreduce.lib.input.TextInputFormat;
import org.apache.hadoop.mapreduce.Job;
import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.conf.Configuration;
public class MyMaxMin {
        public static class MaxTemperatureMapper extends
                        Mapper<LongWritable, Text, Text, Text> {
        public static final int MISSING = 9999;
        @Override
                public void map(LongWritable arg0, Text Value, Context context)
                                throws IOException, InterruptedException {
                String line = Value.toString();
                        if (!(line.length() == 0)) {
                                String date = line.substring(6, 14);
                                float temp_Max = Float.parseFloat(line.substring(39, 45).trim());
                                float temp_Min = Float.parseFloat(line.substring(47, 53).trim());
                                if (temp_Max> 30.0) {
                                        context.write(new Text("The Day is Hot Day :" + date),
                                                                                new
Text(String.valueOf(temp_Max)));
                                }
                                if (temp_Min< 15) {
                                        context.write(new Text("The Day is Cold Day :" + date),
                                                        new Text(String.valueOf(temp_Min)));
}}}}    public static class MaxTemperatureReducer extends
                        Reducer<Text, Text, Text, Text> {
                public void reduce(Text Key, Iterator<Text> Values, Context context)
                                throws IOException, InterruptedException {
                        String temperature = Values.next().toString();
                        context.write(Key, new Text(temperature));
}}          public static void main(String[] args) throws Exception {
                Configuration conf = new Configuration();
                Job job = new Job(conf, "weather example");
                job.setJarByClass(MyMaxMin.class);
                job.setMapOutputKeyClass(Text.class);
                job.setMapOutputValueClass(Text.class);
                job.setMapperClass(MaxTemperatureMapper.class);
                job.setReducerClass(MaxTemperatureReducer.class);

                job.setInputFormatClass(TextInputFormat.class);
                job.setOutputFormatClass(TextOutputFormat.class);
                Path OutputPath = new Path(args[1]);
                FileInputFormat.addInputPath(job, new Path(args[0]));
                FileOutputFormat.setOutputPath(job, new Path(args[1]));
                OutputPath.getFileSystem(conf).delete(OutputPath);
                System.exit(job.waitForCompletion(true) ? 0 : 1);
        }
}
```

Output:



```
The Day is Cold Day :20200101   -21.8
The Day is Cold Day :20200102   -23.4
The Day is Cold Day :20200103   -25.4
The Day is Cold Day :20200104   -26.8
The Day is Cold Day :20200105   -28.8
The Day is Cold Day :20200106   -30.0
The Day is Cold Day :20200107   -31.4
The Day is Cold Day :20200108   -33.6
The Day is Cold Day :20200109   -26.6
The Day is Cold Day :20200110   -24.3
```



```
year = 2020
month = 01
Date = 01
```

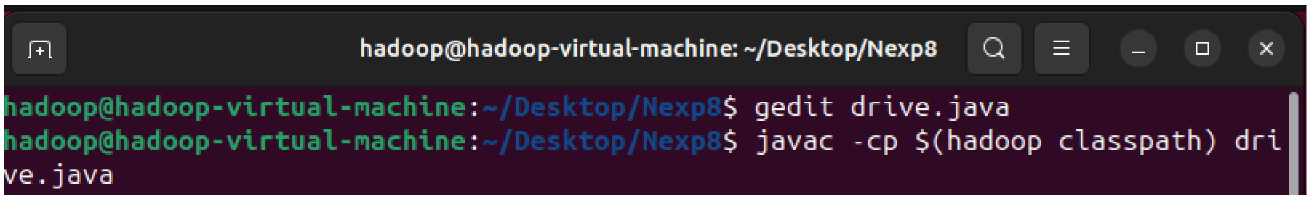
Experiment 8

Aim: Develop a map-reduce program to find the tags associated with each movie by analyzingmovie lens data.

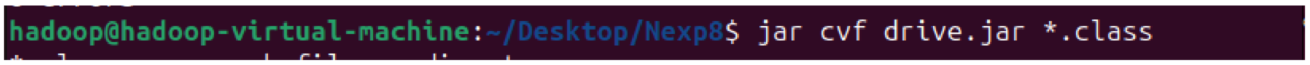
Theory:

1. Data Understanding: need to understand the structure of the MovieLens dataset. It typically consists of several CSV or JSON files containing information about movies, ratings, tags, etc. In particular, you need to focus on the files containing movie data and tags associated with each movie.
2. MapReduce Workflow: Mapper Phase: In this phase, each mapper task reads a portion of the input data and processes it. For this program, each mapper will take as input a portion of the movie data, extract movie IDs and associated tags, and emit key-value pairs where the movie ID is the key and the tag(s) associated with the movie are the value(s).
Reducer Phase: In this phase, all key-value pairs emitted by the mappers are shuffled and sorted by key (movie ID). Then, each reducer task processes all values associated with a particular movie ID and aggregates them to find the complete list of tags associated with that movie.
3. Mapper Function: mapper function will parse each line of input data and extract the movie ID and its associated tags. It will emit key-value pairs where the movie ID is the key and the tags associated with that movie are the values.
4. Reducer Function: The reducer function will receive key-value pairs where the key is a movie ID and the values are lists of tags associated with that movie. It will iterate through the list of tags for each movie, eliminating duplicates if any, and aggregate them into a single list.
5. Output: The output of the MapReduce job will be key-value pairs where the key is a movie ID and the value is a list of tags associated with that movie.
6. Execution: The MapReduce job will be executed on a Hadoop cluster, where the input data will be distributed across multiple nodes for parallel processing. Mappers and reducers will run concurrently on different nodes, processing their respective portions of the input data.
7. Optimizations: To optimize performance, you can consider techniques such as combiners, which perform local aggregation in the mapper phase to reduce the amount of data shuffled across the network, partitioning the data based on movie ID can improve the efficiency of the shuffle phase.

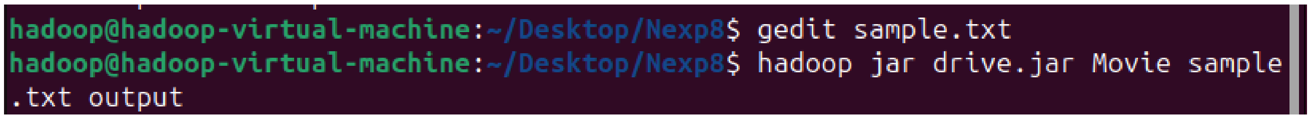
Steps:



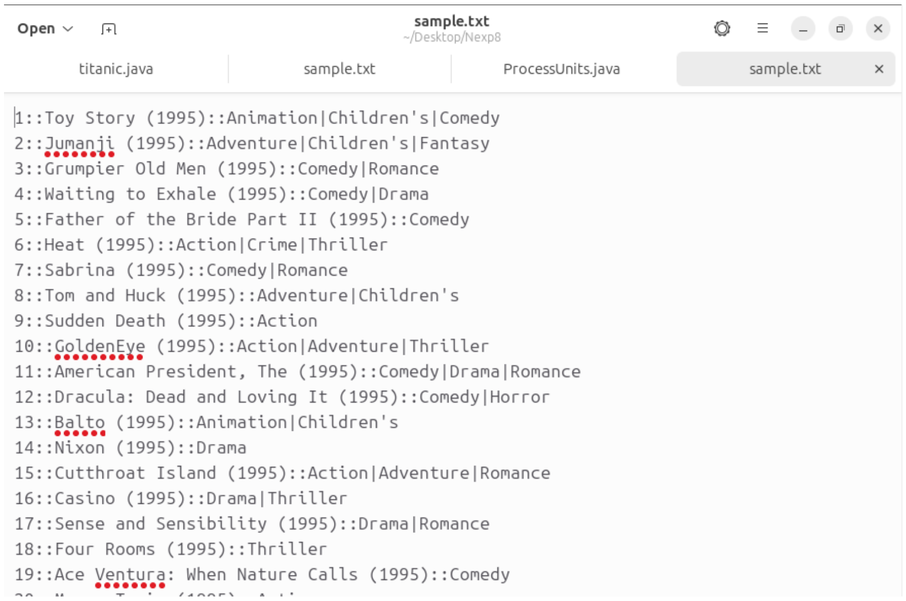
```
hadoop@hadoop-virtual-machine:~/Desktop/Nexp8$ gedit drive.java
hadoop@hadoop-virtual-machine:~/Desktop/Nexp8$ javac -cp $(hadoop classpath) dri
ve.java
```



```
hadoop@hadoop-virtual-machine:~/Desktop/Nexp8$ jar cvf drive.jar *.class
```



```
hadoop@hadoop-virtual-machine:~/Desktop/Nexp8$ gedit sample.txt
hadoop@hadoop-virtual-machine:~/Desktop/Nexp8$ hadoop jar drive.jar Movie sample
.txt output
```



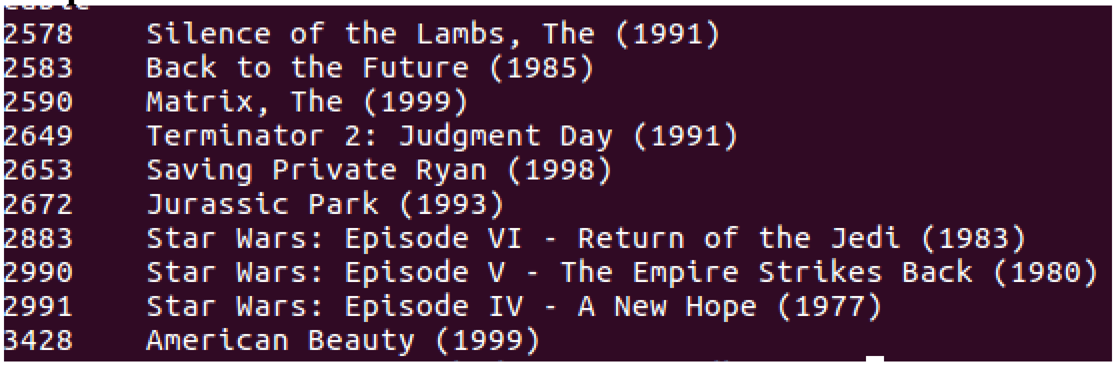
```
1::Toy Story (1995)::Animation|Children's|Comedy
2::Jumanji (1995)::Adventure|Children's|Fantasy
3::Grumpier Old Men (1995)::Comedy|Romance
4::Waiting to Exhale (1995)::Comedy|Drama
5::Father of the Bride Part II (1995)::Comedy
6::Heat (1995)::Action|Crime|Thriller
7::Sabrina (1995)::Comedy|Romance
8::Tom and Huck (1995)::Adventure|Children's
9::Sudden Death (1995)::Action
10::GoldenEye (1995)::Action|Adventure|Thriller
11::American President, The (1995)::Comedy|Drama|Romance
12::Dracula: Dead and Loving It (1995)::Comedy|Horror
13::Balto (1995)::Animation|Children's
14::Nixon (1995)::Drama
15::Cutthroat Island (1995)::Action|Adventure|Romance
16::Casino (1995)::Drama|Thriller
17::Sense and Sensibility (1995)::Drama|Romance
18::Four Rooms (1995)::Thriller
19::Ace Ventura: When Nature Calls (1995)::Comedy
```

Code:

```
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Job;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.input.MultipleInputs;
import org.apache.hadoop.mapreduce.lib.input.TextInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
import org.apache.hadoop.util.GenericOptionsParser;
public class Driver1
{
		public static void main(String[] args) throws Exception {
				Path firstPath = new Path(args[0]);
				Path sencondPath = new Path(args[1]);
				Path outputPath_1 = new Path(args[2]);
				Path outputPath_2 = new Path(args[3]);
				Configuration conf = new Configuration();
				 Job job = Job.getInstance(conf, "Most Viewed Movies");
				job.setJarByClass(Driver1.class);
				job.setMapOutputKeyClass(LongWritable.class);
				job.setMapOutputValueClass(Text.class);
				job.setOutputKeyClass(Text.class);
				job.setOutputValueClass(LongWritable.class);
				MultipleInputs.addInputPath(job, firstPath, TextInputFormat.class, movieDataMapper.class);
				MultipleInputs.addInputPath(job, sencondPath, TextInputFormat.class, ratingDataMapper.class);
				job.setReducerClass(dataReducer.class);
```

```
                                FileOutputFormat.setOutputPath(job, outputPath_1);
                                job.waitForCompletion(true);
                                  Job job1 = Job.getInstance(conf, "Most Viewed Movies2");
                                  job1.setJarByClass(Driver1.class);
                                        job1.setMapperClass(topTenMapper.class);
                                        job1.setReducerClass(topTenReducer.class);
                                        job1.setMapOutputKeyClass(Text.class);
                                        job1.setMapOutputValueClass(LongWritable.class);
                                        job1.setOutputKeyClass(LongWritable.class);
                                        job1.setOutputValueClass(Text.class);
                                        FileInputFormat.addInputPath(job1, outputPath_1);
                                        FileOutputFormat.setOutputPath(job1, outputPath_2);
                                        job1.waitForCompletion(true);
                }
}
```

Output:



```
2578    Silence of the Lambs, The (1991)
2583    Back to the Future (1985)
2590    Matrix, The (1999)
2649    Terminator 2: Judgment Day (1991)
2653    Saving Private Ryan (1998)
2672    Jurassic Park (1993)
2883    Star Wars: Episode VI - Return of the Jedi (1983)
2990    Star Wars: Episode V - The Empire Strikes Back (1980)
2991    Star Wars: Episode IV - A New Hope (1977)
3428    American Beauty (1999)
```

Experiment 9

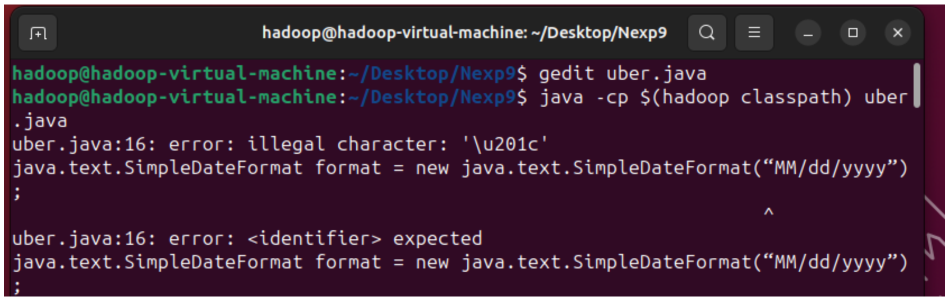
Aim: Develop a map reduce program to analyze Uber data set to find the days on which each basement has more trips using the following data set. The Uber data set consists of fourcolumns they are:Dispatching, base, no. date active, vehicle trips.

Theory:

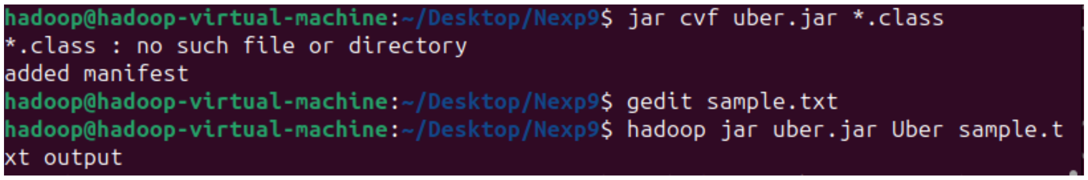
1. Input Data: The input data consists of Uber records with four columns: Dispatching, base, date active, and vehicle trips.
2. Mapper: The Mapper reads each line from the input data. It extracts the base and date information from each record. The key emitted by the Mapper would be a composite key consisting of the base and date, while the value would be the number of trips on that day for that base.
3. Shuffle and Sort: The MapReduce framework shuffles and sorts the Mapper output based on the composite key (base and date) to group records with the same base together.
4. Reducer: Reducer receives groups of records, each group representing trips for a specific base on a particular date.For each group, the Reducer calculates the total number of trips.
5. Output: The output of the Reducer is written to the Hadoop Distributed File System (HDFS) or any other storage system as required. The output format could be base along with the dates with the maximum number of trips.
6. Execution: The MapReduce job is executed on a Hadoop cluster. The Hadoop framework distributes the task among Mapper and Reducer nodes, ensuring parallel processing.
7. Optimizations: Combiners can be used to optimize the amount of data shuffled between Mappers and Reducers, especially if there's a significant amount of data for each base.

Use of appropriate data types and serialization techniques can improve performance and reduce storage requirements.

Steps:



```
hadoop@hadoop-virtual-machine:~/Desktop/Nexp9$ gedit uber.java
hadoop@hadoop-virtual-machine:~/Desktop/Nexp9$ java -cp $(hadoop classpath) uber
.java
uber.java:16: error: illegal character: '\u201c'
java.text.SimpleDateFormat format = new java.text.SimpleDateFormat(“MM/dd/yyyy”)
;
                                                                   ^
uber.java:16: error: <identifier> expected
java.text.SimpleDateFormat format = new java.text.SimpleDateFormat(“MM/dd/yyyy”)
;
```



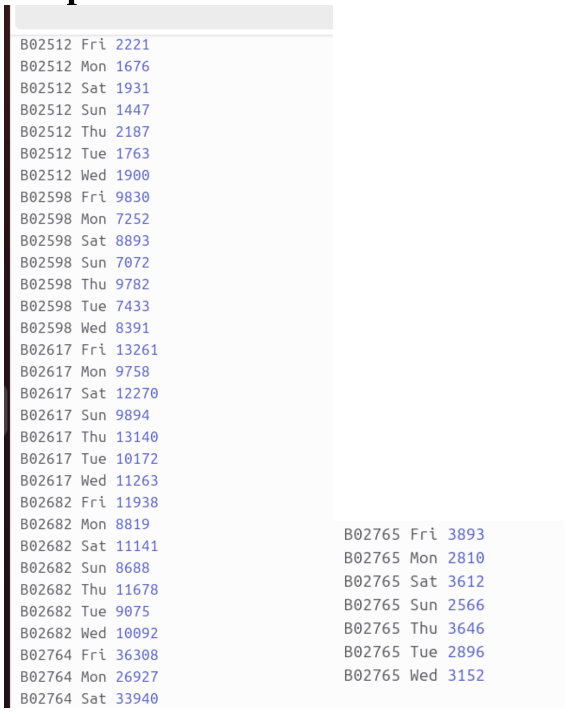
```
hadoop@hadoop-virtual-machine:~/Desktop/Nexp9$ jar cvf uber.jar *.class
*.class : no such file or directory
added manifest
hadoop@hadoop-virtual-machine:~/Desktop/Nexp9$ gedit sample.txt
hadoop@hadoop-virtual-machine:~/Desktop/Nexp9$ hadoop jar uber.jar Uber sample.t
xt output
```

Code:

```
import java.io.IOException;
import java.text.ParseException;
import java.util.Date;
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Job;
import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
public class Uber1 {
  // Mapper class
  public static class TokenizerMapper extends Mapper<Object, Text, Text, IntWritable> {
    java.text.SimpleDateFormat format = new java.text.SimpleDateFormat("MM/dd/yyyy");
    String[] days = {"Sun", "Mon", "Tue", "Wed", "Thu", "Fri", "Sat"};
    private Text basement = new Text();
    Date date = null;
    private int trips;
    // Map function
    public void map(Object key, Text value, Context context) throws IOException, InterruptedException {
      String line = value.toString();
      String[] splits = line.split(",");
      basement.set(splits[0]);  // basement = first column (presumably a location or similar)
      try {
        date = format.parse(splits[1]); // Parsing the date (second column)
      } catch (ParseException e) {
        e.printStackTrace();
      }
      trips = Integer.parseInt(splits[3]); // Parsing trips (fourth column)
      // Creating a composite key from basement and day of the week
      String keys = basement.toString() + " " + days[date.getDay()];
      context.write(new Text(keys), new IntWritable(trips)); // Writing the output
    }
  }
  // Reducer class
  public static class IntSumReducer extends Reducer<Text, IntWritable, Text, IntWritable> {

    private IntWritable result = new IntWritable();
    // Reduce function
    public void reduce(Text key, Iterable<IntWritable> values, Context context) throws IOException,
InterruptedException {
      int sum = 0;
      // Summing up the values (total trips for the given key)
      for (IntWritable val : values) {
        sum += val.get();
      }
      result.set(sum);
      context.write(key, result); // Writing the result
    }
  }
  // Main method
  public static void main(String[] args) throws Exception {
    Configuration conf = new Configuration();
    Job job = Job.getInstance(conf, "Uber1");

    // Setting the job's main class and Mapper/Reducer classes
    job.setJarByClass(Uber1.class);
    job.setMapperClass(TokenizerMapper.class);
    job.setCombinerClass(IntSumReducer.class);
    job.setReducerClass(IntSumReducer.class);
```

```
        // Setting output key/value types
        job.setOutputKeyClass(Text.class);
        job.setOutputValueClass(IntWritable.class);

        // Setting input and output paths
        FileInputFormat.addInputPath(job, new Path(args[0]));
        FileOutputFormat.setOutputPath(job, new Path(args[1]));

        // Exiting based on job completion status
        System.exit(job.waitForCompletion(true) ? 0 : 1);
    }
}
```

Output:



```
B02512 Fri 2221
B02512 Mon 1676
B02512 Sat 1931
B02512 Sun 1447
B02512 Thu 2187
B02512 Tue 1763
B02512 Wed 1900
B02598 Fri 9830
B02598 Mon 7252
B02598 Sat 8893
B02598 Sun 7072
B02598 Thu 9782
B02598 Tue 7433
B02598 Wed 8391
B02617 Fri 13261
B02617 Mon 9758
B02617 Sat 12270
B02617 Sun 9894
B02617 Thu 13140
B02617 Tue 10172
B02617 Wed 11263
B02682 Fri 11938
B02682 Mon 8819
B02682 Sat 11141
B02682 Sun 8688
B02682 Thu 11678
B02682 Tue 9075
B02682 Wed 10092
B02764 Fri 36308
B02764 Mon 26927
B02764 Sat 33940
B02765 Fri 3893
B02765 Mon 2810
B02765 Sat 3612
B02765 Sun 2566
B02765 Thu 3646
B02765 Tue 2896
B02765 Wed 3152
```

Experiment 10

Aim: Develop a map reduce program to analyze titanic dataset to find the average age of thepeople (both male and female) who died in the tragedy. How many people survived in eachclass.

Theory:

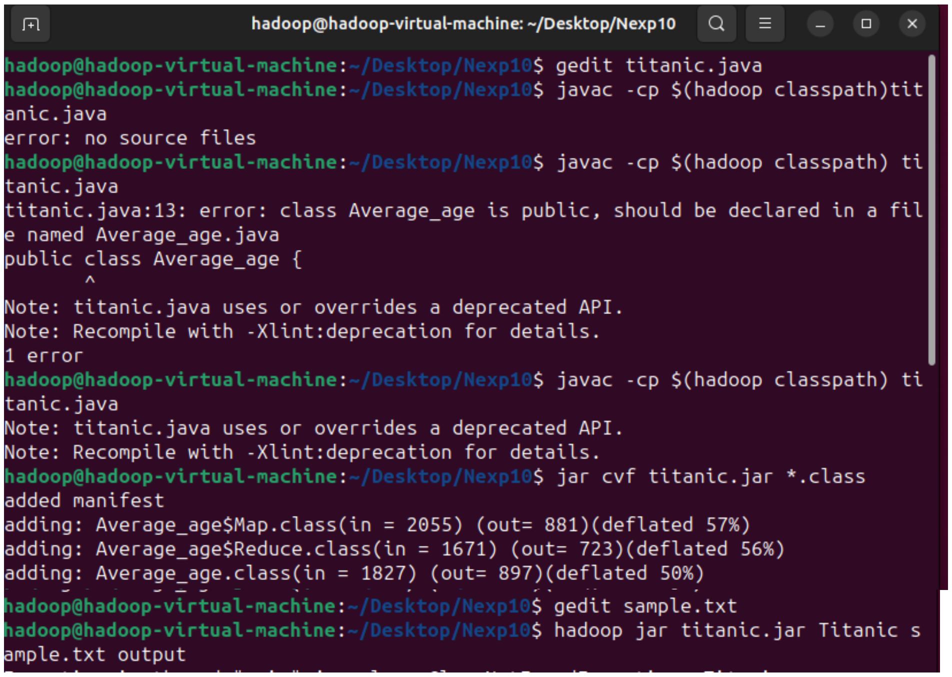
1. Understanding the Dataset: Before diving into the MapReduce implementation, it's essential to understand the structure and format of the Titanic dataset. It typically contains columns such as PassengerId, Survived, Pclass, Name, Sex, Age, etc. For this analysis, we are particularly interested in the 'Survived', 'Sex', 'Age', and 'Pclass' columns.
2. MapReduce Workflow: Mapper: Input: Each mapper receives a line of input from the dataset.
    - Task: Extract necessary information from each line, such as 'Survived', 'Sex', 'Age', and 'Pclass'.
    - Output: Emit key-value pairs where the key is a composite key consisting of 'Sex' and 'Survived' or just 'Pclass', and the value is the age or count of survivors.

Reducer:Input: Receives key-value pairs emitted by the mappers.
Task: For finding the average age of people who died:Accumulate the sum of ages for each combination of 'Sex' and 'Survived'.Keep track of the count of occurrences for each combination.
Output: Emit the key-value pairs where the key indicates 'Sex' and 'Survived' or just 'Pclass', and the value is either the average age or the count of survivors.
 3. Algorithm Steps:Mapper:
1. Read each line of the dataset.
2. Extract 'Sex', 'Age', 'Survived', and 'Pclass' from the line.
3. If 'Survived' is 0 (indicating the person died), emit key-value pairs with keys as 'Sex:Survived' and value as 'Age'.
4. Emit key-value pairs with keys as 'Pclass' and value as '1' for each passenger regardless of survival status.

 Reducer:
1. Receive key-value pairs from all mappers.
2. For each unique key:If the key indicates 'Sex:Survived':
    - Sum up the ages and count occurrences.
    - If the key indicates 'Pclass':
    - Count the occurrences.

3. Calculate the average age for each combination of 'Sex' and 'Survived'.
4. Emit the results for both tasks.
 4. Output: The output will include the average age of people who died categorized by sex, and the count of survivors in each passenger class.
 5. Hadoop Setup: Ensure that Hadoop is properly configured and the Titanic dataset is stored in Hadoop's distributed file system (HDFS).
 6. MapReduce Job Execution: Submit the MapReduce job to the Hadoop cluster, specifying the input dataset location, mapper, reducer, and output directory.
 7. Result Analysis:
Once the MapReduce job is completed, analyze the output to get insights into the average age of people who died and the count of survivors in each class.

Steps:

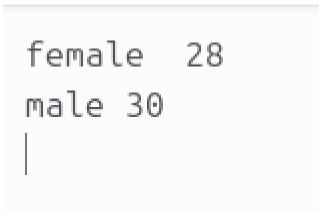


```
hadoop@hadoop-virtual-machine:~/Desktop/Nexp10$ gedit titanic.java
hadoop@hadoop-virtual-machine:~/Desktop/Nexp10$ javac -cp $(hadoop classpath)tit
anic.java
error: no source files
hadoop@hadoop-virtual-machine:~/Desktop/Nexp10$ javac -cp $(hadoop classpath) ti
tanic.java
titanic.java:13: error: class Average_age is public, should be declared in a fil
e named Average_age.java
public class Average_age {
       ^
Note: titanic.java uses or overrides a deprecated API.
Note: Recompile with -Xlint:deprecation for details.
1 error
hadoop@hadoop-virtual-machine:~/Desktop/Nexp10$ javac -cp $(hadoop classpath) ti
tanic.java
Note: titanic.java uses or overrides a deprecated API.
Note: Recompile with -Xlint:deprecation for details.
hadoop@hadoop-virtual-machine:~/Desktop/Nexp10$ jar cvf titanic.jar *.class
added manifest
adding: Average_age$Map.class(in = 2055) (out= 881)(deflated 57%)
adding: Average_age$Reduce.class(in = 1671) (out= 723)(deflated 56%)
adding: Average_age.class(in = 1827) (out= 897)(deflated 50%)
hadoop@hadoop-virtual-machine:~/Desktop/Nexp10$ gedit sample.txt
hadoop@hadoop-virtual-machine:~/Desktop/Nexp10$ hadoop jar titanic.jar Titanic s
ample.txt output
```

Code:

```
// import libraries
import java.io.IOException;
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;

// Making a class with name Average_age
public class Average_age {
        public static class Map extends Mapper<LongWritable, Text, Text, IntWritable> {
                private Text gender = new Text();
                private IntWritable age = new IntWritable();
                public void map(LongWritable key, Text value, Context context) throws IOException,
InterruptedException
                {
                        String line = value.toString();
                        String str[] = line.split(", ");
                        if (str.length> 6) {
                                gender.set(str[4]);
                                if ((str[1].equals("0"))) {
                                        if (str[5].matches("\\d+")) {
                                                int i = Integer.parseInt(str[5]);
                                                age.set(i);}}}
                        context.write(gender, age);}}
        public static class Reduce extends Reducer<Text, IntWritable, Text, IntWritable> {
                public void reduce(Text key, Iterable<IntWritable> values, Context context)
                        throws IOException, InterruptedException
                {int sum = 0;
                        int l = 0;
                        for (IntWritableval : values) {
                                l += 1;
                                sum += val.get();
                        }
                        sum = sum / l;
                        context.write(key, new IntWritable(sum));
                }
        }

        public static void main(String[] args) throws Exception
        {Configuration conf = new Configuration();
                @SuppressWarnings("deprecation")
                Job job = new Job(conf, "Averageage_survived");
                job.setJarByClass(Average_age.class);
                job.setMapOutputKeyClass(Text.class);
                job.setMapOutputValueClass(IntWritable.class);
                job.setOutputKeyClass(Text.class);
                job.setOutputValueClass(IntWritable.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]));
                Path out = new Path(args[1]);
                out.getFileSystem(conf).delete(out);
                job.waitForCompletion(true);
        }
}
```

Output:



```
female  28
male 30
```