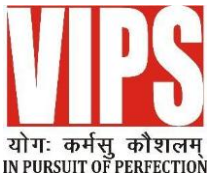


VIVEKANANDA INSTITUTE OF PROFESSIONAL STUDIES - TECHNICAL CAMPUS

Grade A++ Accredited Institution by NAAC

NBA Accredited for MCA Programme; Recognized under Section 2(f) by UGC;

Affiliated to GGSIP University, Delhi; Recognized by Bar Council of India and AICTE

An ISO 9001:2015 Certified Institution

SCHOOL OF ENGINEERING & TECHNOLOGY

BTECH Programme: AIDS-A

Course Title: Big Data Analytics Lab

Course Code: AIDS306P

Submitted To

Dr. Lakshita Aggarwal

Submitted By

Name: Parina Garg

Enrollment No:02917711922

VIPS
योगः कर्मसु कौशलम्
IN PURSUIT OF PERFECTION

VIVEKANANDA INSTITUTE OF PROFESSIONAL STUDIES - TECHNICAL CAMPUS
Grade A++ Accredited Institution by NAAC
NBA Accredited for MCA Programme; Recognized under Section 2(f) by UGC;
Affiliated to GGSIP University, Delhi; Recognized by Bar Council of India and AICTE
An ISO 9001:2015 Certified Institution
SCHOOL OF ENGINEERING & TECHNOLOGY

VISION OF INSTITUTE

To be an educational institute that empowers the field of engineering to build a sustainable future by providing quality education with innovative practices that supports people, planet and profit.

MISSION OF INSTITUTE

To groom the future engineers by providing value-based education and awakening students' curiosity, nurturing creativity and building
capabilities to enable them to make significant contributions to the world.

VIPS
योगः कर्मसु कौशलम्
IN PURSUIT OF PERFECTION

VIVEKANANDA INSTITUTE OF PROFESSIONAL STUDIES - TECHNICAL CAMPUS
Grade A++ Accredited Institution by NAAC
NBA Accredited for MCA Programme; Recognized under Section 2(f) by UGC;
Affiliated to GGSIP University, Delhi; Recognized by Bar Council of India and AICTE
An ISO 9001:2015 Certified Institution
SCHOOL OF ENGINEERING & TECHNOLOGY

INDEX

S.No	Experiment Name	Date	Marks			Remark	Updated Marks	Faculty Signature
			Laboratory Assessment (15 Marks)	Class Participation (5 Marks)	Viva (5 Marks)			

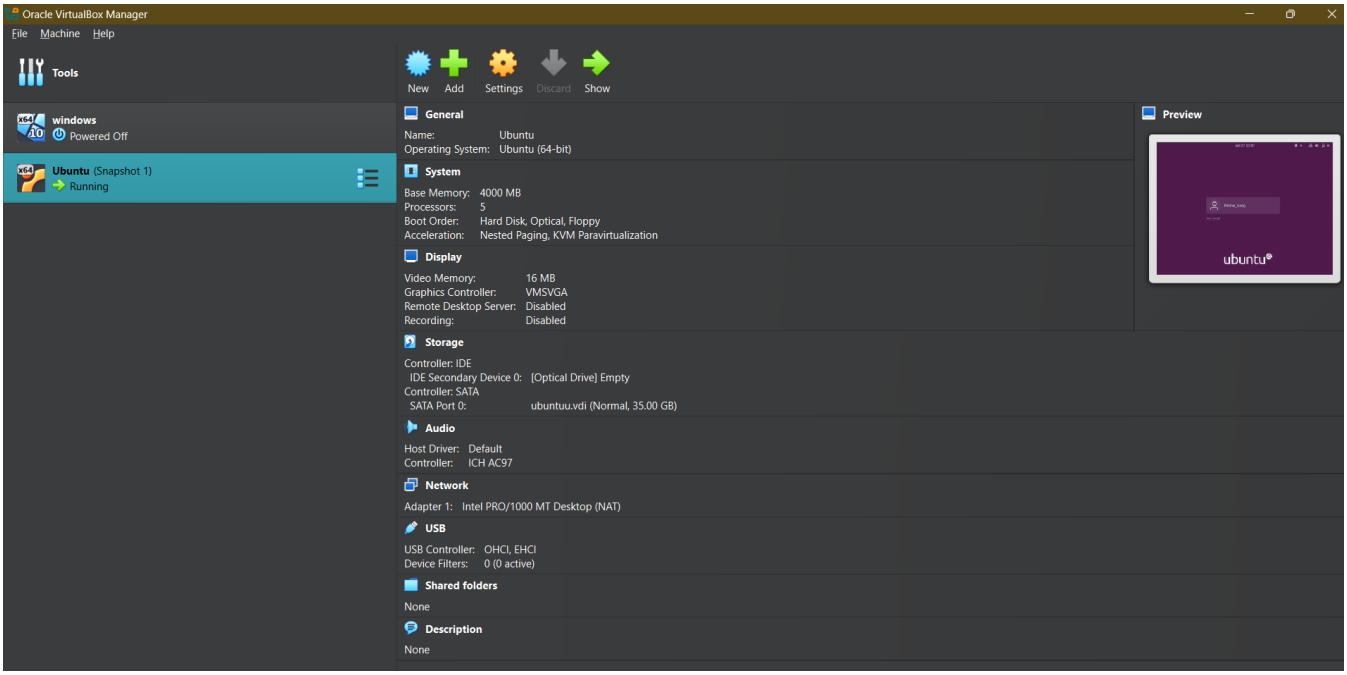
EXPERIMENT-1

Title -: Install Apache Hadoop.

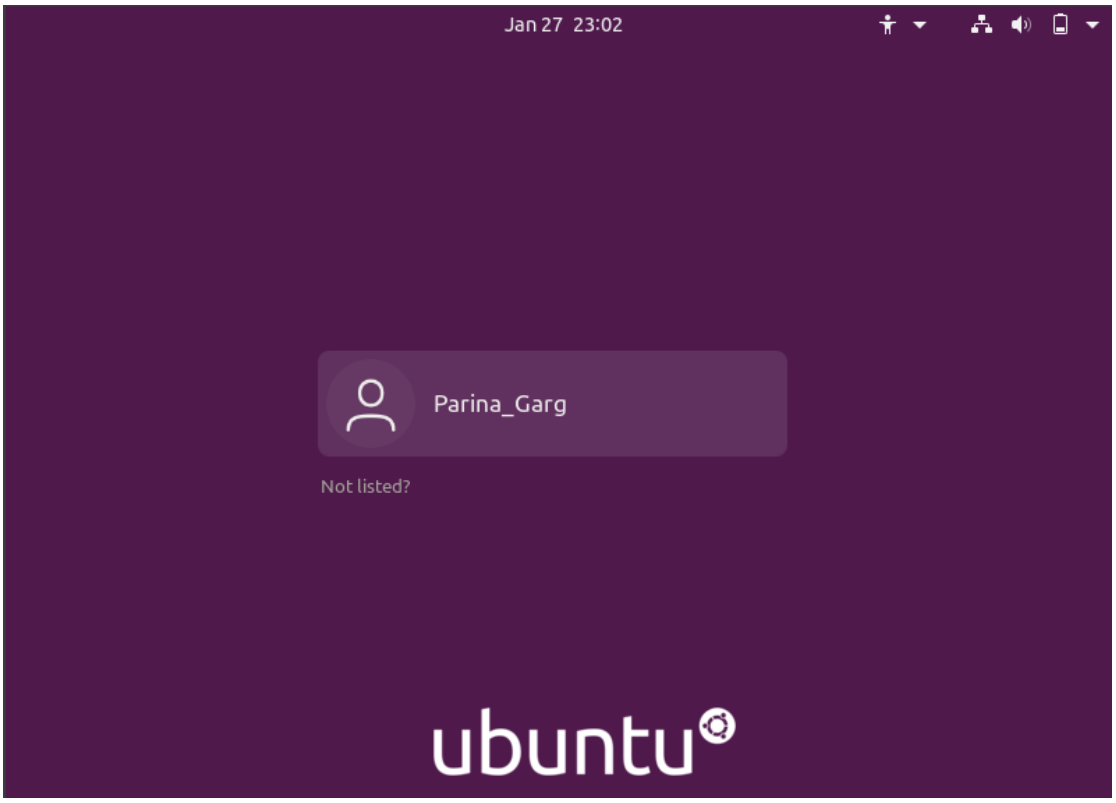
- **Introduction -**

- **Setting up Ubuntu on Virtual Machine:**

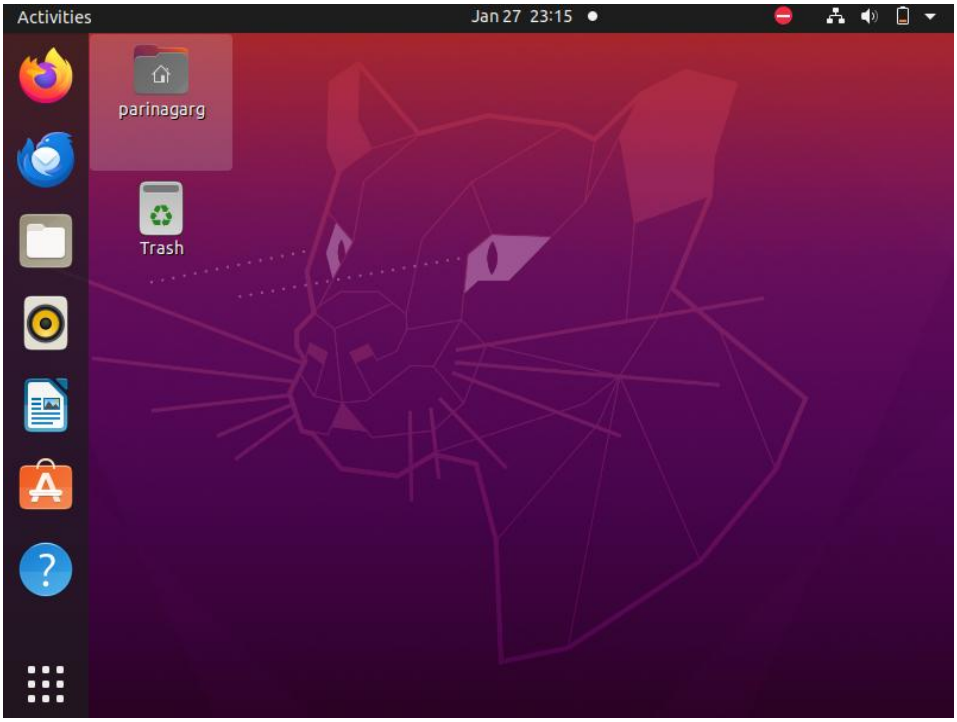
Step 1:



Step 2:

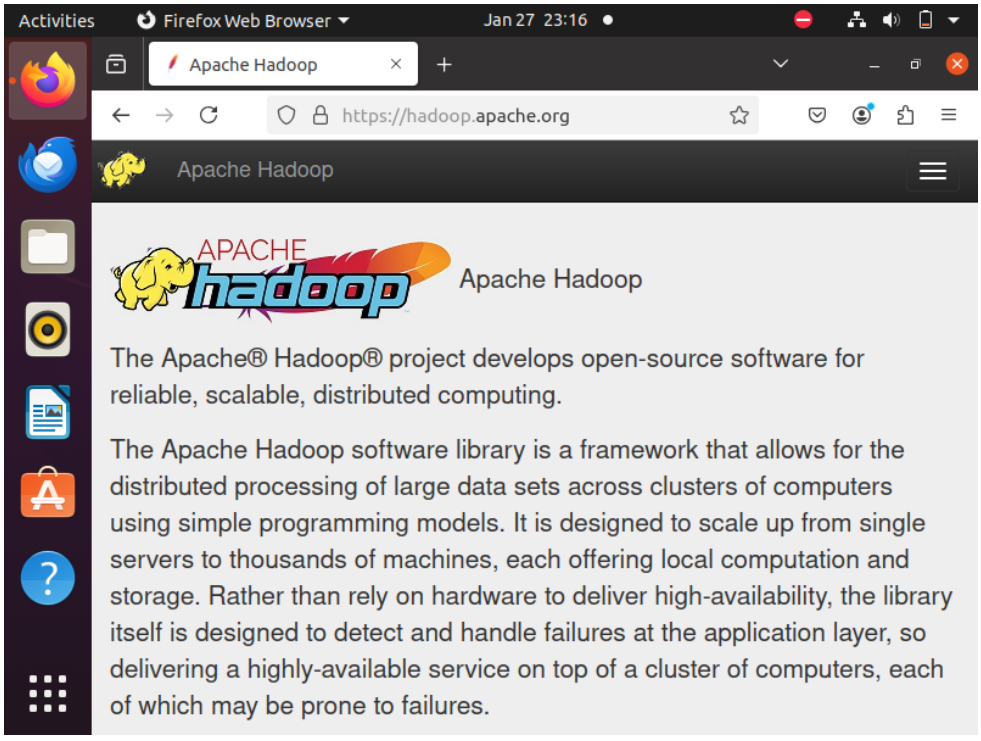


Step 3:

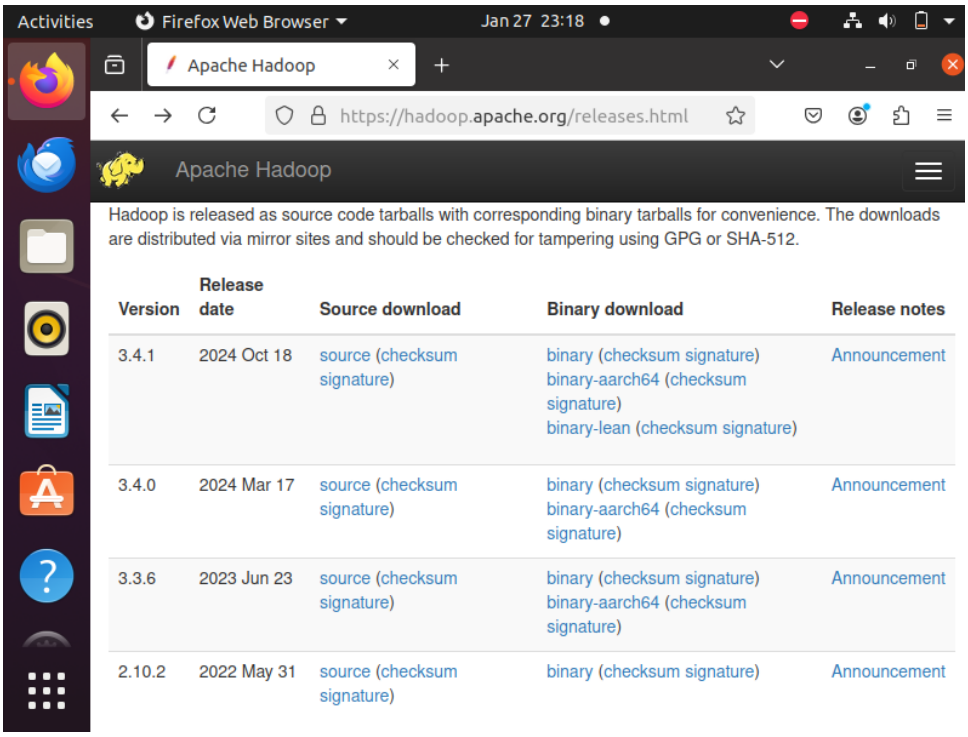


- **Installing Apache Hadoop**

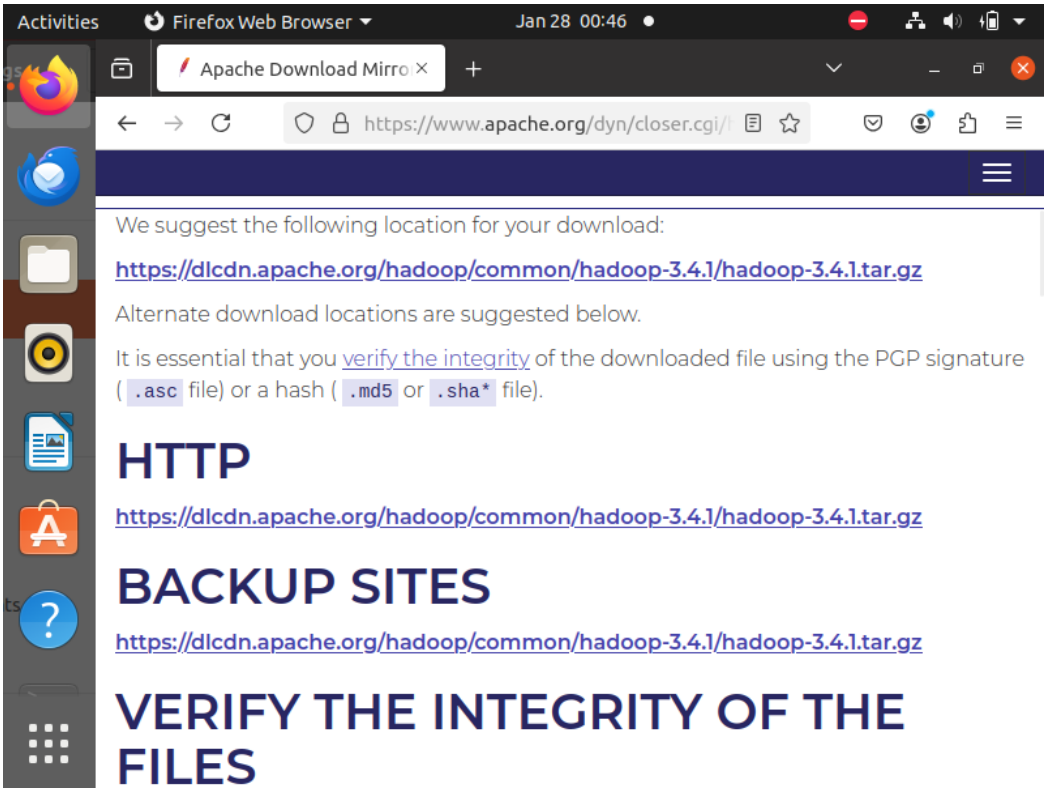
Step 4:



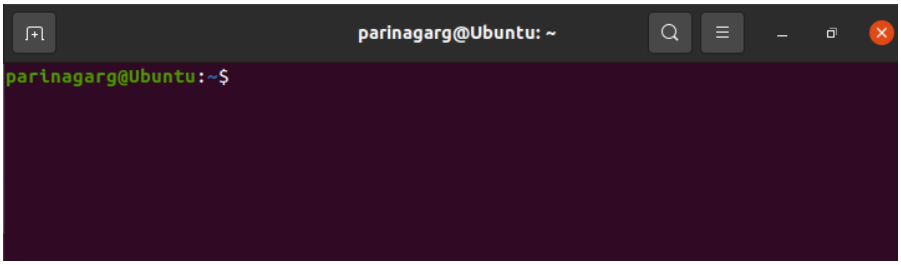
Step 5:


Activities
Firefox Web Browser
Jan 27 23:18
Apache Hadoop
https://hadoop.apache.org/releases.html
Apache Hadoop
Hadoop is released as source code tarballs with corresponding binary tarballs for convenience. The downloads are distributed via mirror sites and should be checked for tampering using GPG or SHA-512.
Version
Release date
Source download
Binary download
Release notes
3.4.1
2024 Oct 18
source (checksum signature)
binary (checksum signature)
binary-aarch64 (checksum signature)
binary-lean (checksum signature)
Announcement
3.4.0
2024 Mar 17
source (checksum signature)
binary (checksum signature)
binary-aarch64 (checksum signature)
Announcement
3.3.6
2023 Jun 23
source (checksum signature)
binary (checksum signature)
binary-aarch64 (checksum signature)
Announcement
2.10.2
2022 May 31
source (checksum signature)
binary (checksum signature)
Announcement

Step 6:


Activities
Firefox Web Browser
Jan 28 00:46
Apache Download Mirro
https://www.apache.org/dyn/closer.cgi/
We suggest the following location for your download:
https://dlcdn.apache.org/hadoop/common/hadoop-3.4.1/hadoop-3.4.1.tar.gz
Alternate download locations are suggested below.
It is essential that you verify the integrity of the downloaded file using the PGP signature (.asc file) or a hash (.md5 or .sha* file).
HTTP
https://dlcdn.apache.org/hadoop/common/hadoop-3.4.1/hadoop-3.4.1.tar.gz
BACKUP SITES
https://dlcdn.apache.org/hadoop/common/hadoop-3.4.1/hadoop-3.4.1.tar.gz
VERIFY THE INTEGRITY OF THE FILES

Step 7:



Step 8:

```
parinagarg@Ubuntu:~$ wget https://dlcdn.apache.org/hadoop/common/hadoop-3.4.1/h
adoop-3.4.1.tar.gz
--2025-01-27 23:24:04--  https://dlcdn.apache.org/hadoop/common/hadoop-3.4.1/ha
doop-3.4.1.tar.gz
Resolving dlcdn.apache.org (dlcdn.apache.org)... 151.101.2.132, 2a04:4e42::644
Connecting to dlcdn.apache.org (dlcdn.apache.org)|151.101.2.132|:443... connect
ed.
HTTP request sent, awaiting response... 200 OK
Length: 974002355 (929M) [application/x-gzip]
Saving to: 'hadoop-3.4.1.tar.gz'

hadoop-3.4.1.tar.gz 100%[==================>] 928.88M  4.60MB/s    in 6m 42s

2025-01-27 23:30:48 (2.31 MB/s) - 'hadoop-3.4.1.tar.gz' saved [974002355/974002
355]

parinagarg@Ubuntu:~$
```

Step 9:

```
parinagarg@Ubuntu:~$ tar xzf hadoop-3.4.1.tar.gz
parinagarg@Ubuntu:~$
```

- **Installing Java**

Step 10:

```
parinagarg@Ubuntu:~$ sudo apt install default-jre
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  ca-certificates-java default-jre-headless fonts-dejavu-extra java-common
  libatk-wrapper-java libatk-wrapper-java-jni openjdk-11-jre
  openjdk-11-jre-headless
Suggested packages:
  fonts-ipafont-gothic fonts-ipafont-mincho fonts-wqy-microhei
  | fonts-wqy-zenhei
The following NEW packages will be installed:
  ca-certificates-java default-jre default-jre-headless fonts-dejavu-extra
  java-common libatk-wrapper-java libatk-wrapper-java-jni openjdk-11-jre
  openjdk-11-jre-headless
0 upgraded, 9 newly installed, 0 to remove and 355 not upgraded.
```

- **Setting Up Environment**

Step 11:

```
parinagarg@Ubuntu:~$ sudo gedit /etc/profile
```

Step 12:

```
export JAVA_HOME=/usr/lib/jvm/java-11-openjdk-amd64
export PATH=$JAVA_HOME/bin:$PATH

export HADOOP_HOME=/usr/local/hadoop
export HADOOP_CONF_DIR=$HADOOP_HOME/etc/hadoop
export PATH=$HADOOP_HOME/bin:$HADOOP_HOME/sbin:$PATH
```

Step 13:

```
parinagarg@Ubuntu:~$ source /etc/profile
parinagarg@Ubuntu:~$ echo $JAVA_HOME
/usr/lib/jvm/java-11-openjdk-amd64
```

- **Java path and Version**

Step 14:

```
parinagarg@Ubuntu:~$ echo $JAVA_HOME
/usr/lib/jvm/java-11-openjdk-amd64
parinagarg@Ubuntu:~$ java -version
openjdk version "11.0.25" 2024-10-15
OpenJDK Runtime Environment (build 11.0.25+9-post-Ubuntu-1ubuntu120.04)
OpenJDK 64-Bit Server VM (build 11.0.25+9-post-Ubuntu-1ubuntu120.04, mixed mode
, sharing)
```

Step 15:

```
parinagarg@Ubuntu:~$ echo $HADOOP_HOME
/usr/local/hadoop
parinagarg@Ubuntu:~$
```

Step 16:

```
parinagarg@Ubuntu:~$ hadoop version
Hadoop 3.4.1
Source code repository https://github.com/apache/hadoop.git -r 4d78253093489563
36b8f06a08322b78422849b1
Compiled by mthakur on 2024-10-09T14:57Z
Compiled on platform linux-x86_64
Compiled with protoc 3.23.4
From source with checksum 7292fe9dba5e2e44e3a9f763fce3e680
This command was run using /usr/local/hadoop/share/hadoop/common/hadoop-common-
3.4.1.jar
parinagarg@Ubuntu:~$
```

- **Learning Outcomes:**

EXPERIMENT-2

Title -: Develop a map reduce program to calculate the frequency of a given word in a given file.

Introduction -

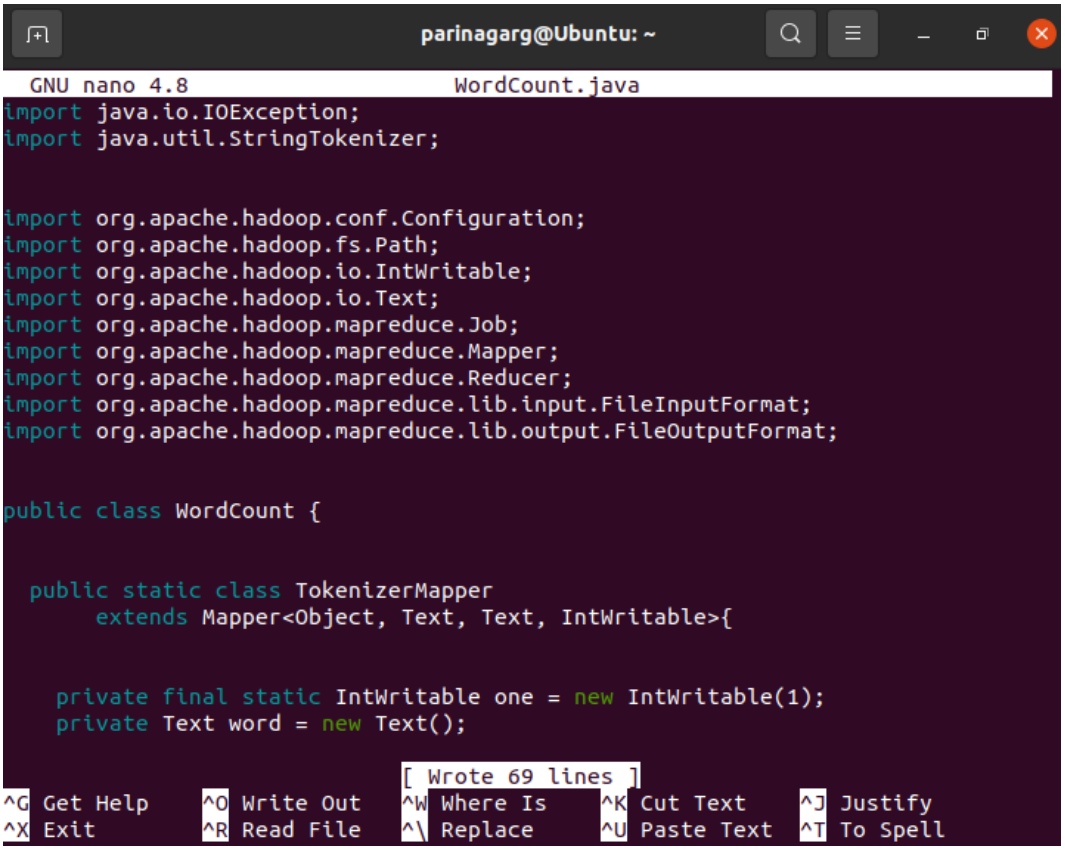
Code:

```
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);
  }
}
```

Step 1:

```
parinagarg@Ubuntu:~$ nano WordCount.java
```

Step 2:



Step 3:

```
parinagarg@Ubuntu:~$ javac -classpath $(hadoop classpath) -d . WordCount.java

parinagarg@Ubuntu:~$
```

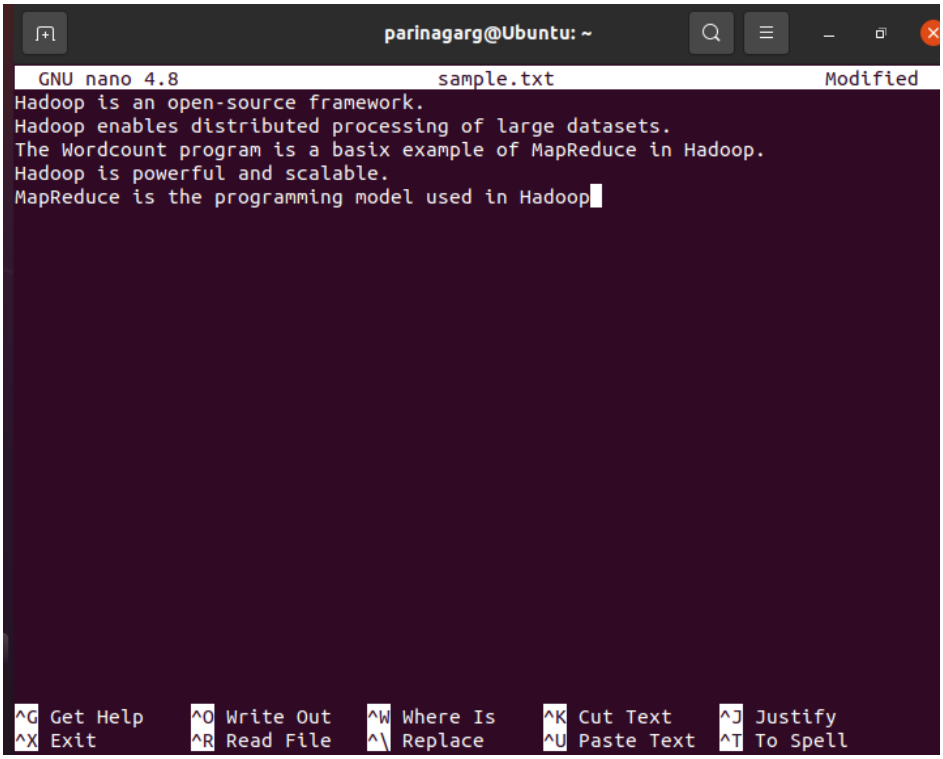
Step 4:

```
parinagarg@Ubuntu:~$ jar cvf wc.jar *.class
added manifest
adding: WordCount$IntSumReducer.class(in = 1755) (out= 750)(deflated 57%)
adding: WordCount$TokenizerMapper.class(in = 1752) (out= 762)(deflated 56%)
adding: WordCount.class(in = 1511) (out= 832)(deflated 44%)
parinagarg@Ubuntu:~$
```

Step 5:

```
parinagarg@Ubuntu:~$ nano sample.txt
parinagarg@Ubuntu:~$
```

Step 6:



Step 7: :

```
parinagarg@Ubuntu:~$ hadoop jar wc.jar WordCount sample.txt output
2025-02-06 02:25:47,553 INFO impl.MetricsConfig: Loaded properties from hadoop-
metrics2.properties
2025-02-06 02:25:47,738 INFO impl.MetricsSystemImpl: Scheduled Metric snapshot
period at 10 second(s).
2025-02-06 02:25:47,741 INFO impl.MetricsSystemImpl: JobTracker metrics system
started
```

Step 8:

```
                Map input records=5
                Map output records=36
                Map output bytes=385
                Map output materialized bytes=363
                Input split bytes=97
                Combine input records=36
                Combine output records=27
                Reduce input groups=27
                Reduce shuffle bytes=363
                Reduce input records=27
                Reduce output records=27
                Spilled Records=54
                Shuffled Maps =1
                Failed Shuffles=0
                Merged Map outputs=1
                GC time elapsed (ms)=18
                Total committed heap usage (bytes)=406847488
        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=241
        File Output Format Counters
                Bytes Written=261
parinagarg@Ubuntu:~$
```

Step 9:

```
parinagarg@Ubuntu:~$ hdfs dfs -cat output/part-r-00000
Hadoop  4
Hadoop. 1
MapReduce       2
The     1
Wordcount       1
a       1
an      1
and     1
basix   1
datasets.       1
distributed     1
enables 1
example 1
framework.      1
in      2
is      4
large   1
model   1
of      2
open-source     1
powerful        1
processing      1
program 1
programming     1
scalable.       1
the     1
used    1
parinagarg@Ubuntu:~$
```

Learning Outcomes:

EXPERIMENT-3

Title -: Develop a map reduce program to find the maximum temperature in each year.

Introduction -

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 Max_temp {
    public static class TemperatureMapper
        extends Mapper<Object, Text, Text, IntWritable>{

        private Text year = new Text();
        private IntWritable temperature = new IntWritable();

        public void map(Object key, Text value, Context context
                        ) throws IOException, InterruptedException {
            StringTokenizer itr = new StringTokenizer(value.toString());

            if (itr.hasMoreTokens()) {
                String yearString = itr.nextToken();
                String temperatureString = itr.nextToken();

                try {
                    year.set(yearString);
                    temperature.set(Integer.parseInt(temperatureString));
                    context.write(year, temperature);
                } catch (NumberFormatException e) {

                    System.err.println("Skipping invalid record: " +
                    value.toString());
                }
            }
        }
    }

    public static class MaxTemperatureReducer
        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 maxTemp = Integer.MIN_VALUE;
            for (IntWritable val : values) {
                maxTemp = Math.max(maxTemp, val.get());
            }
            result.set(maxTemp);
            context.write(key, result);
        }
    }

    public static void main(String[] args) throws Exception {
        Configuration conf = new Configuration();
```

```
        Job job = Job.getInstance(conf, "Maximum Temperature");

        job.setJarByClass(Max_temp.class);

        job.setMapperClass(TemperatureMapper.class);
        job.setReducerClass(MaxTemperatureReducer.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);
    }
}
```

Step 1:

```
parinagarg@Ubuntu:~$ nano Max_temp.java
parinagarg@Ubuntu:~$
```

Step 2:

parinagarg@Ubuntu: ~

GNU nano 4.8 max_temp.java Modified

```
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 Max_temp {
    public static class TemperatureMapper
        extends Mapper<Object, Text, Text, IntWritable>{


        private Text year = new Text();
        private IntWritable temperature = new IntWritable();


        public void map(Object key, Text value, Context context
                        ) throws IOException, InterruptedException {
            StringTokenizer itr = new StringTokenizer(value.toString());
```

^G Get Help ^O Write Out ^W Where Is ^K Cut Text ^J Justify
^X Exit ^R Read File ^\ Replace ^U Paste Text ^T To Spell

Step 3:

```
parinagarg@Ubuntu:~$ javac -cp $(hadoop classpath) Max_temp.java
parinagarg@Ubuntu:~$
```

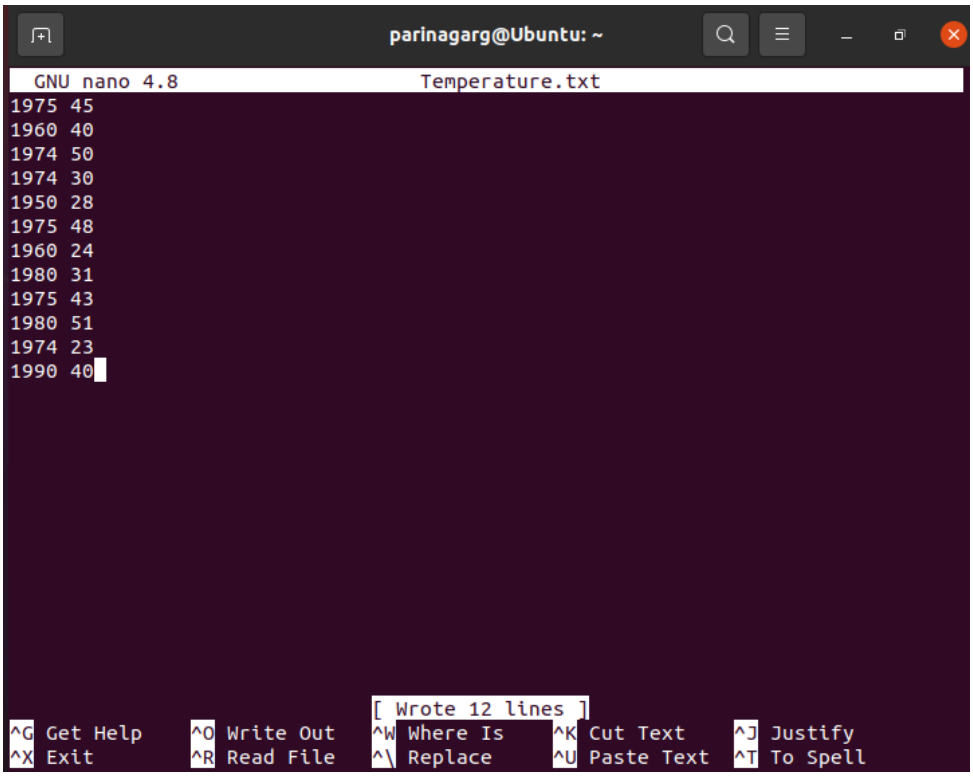
Step 4:

```
parinagarg@Ubuntu:~$ jar cvf mt.jar *.class
added manifest
adding: Max_temp$MaxTemperatureReducer.class(in = 1843) (out= 796)(deflated 56%
)
adding: Max_temp$TemperatureMapper.class(in = 2533) (out= 1114)(deflated 56%)
adding: Max_temp.class(in = 1497) (out= 810)(deflated 45%)
adding: WordCount$IntSumReducer.class(in = 1755) (out= 750)(deflated 57%)
adding: WordCount$TokenizerMapper.class(in = 1752) (out= 762)(deflated 56%)
adding: WordCount.class(in = 1511) (out= 832)(deflated 44%)
parinagarg@Ubuntu:~$
```

Step 5:

```
parinagarg@Ubuntu:~$ nano Temperature.txt
parinagarg@Ubuntu:~$
```

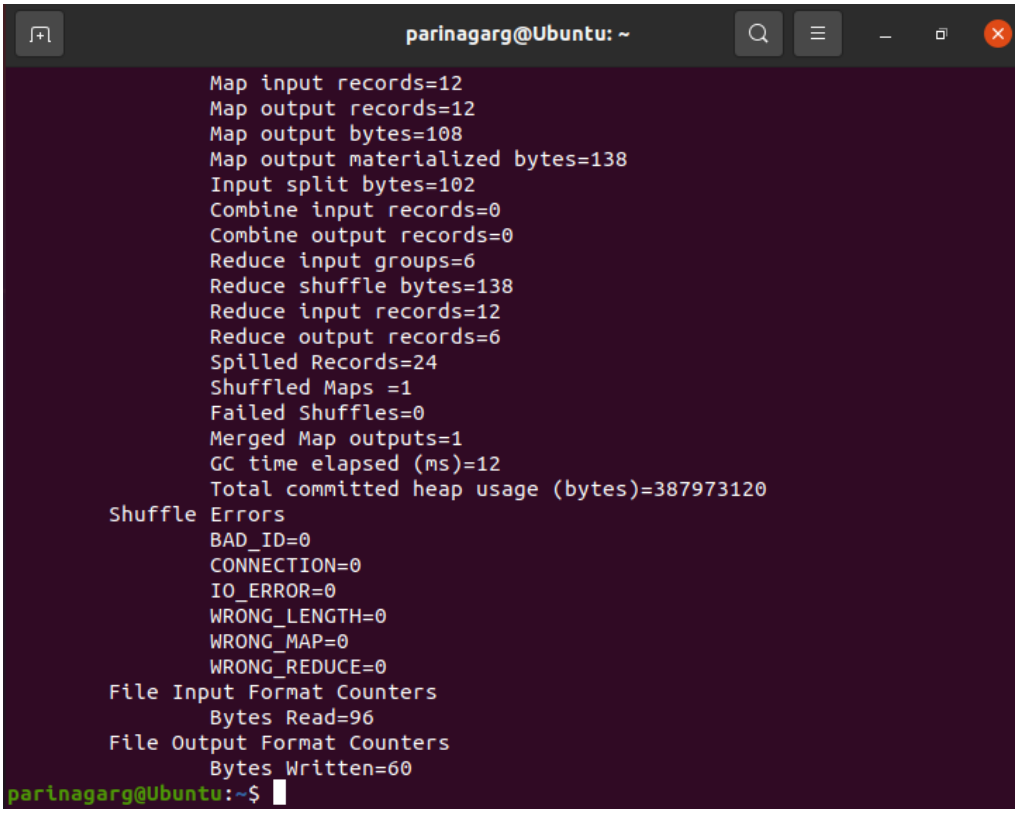
Step 6:



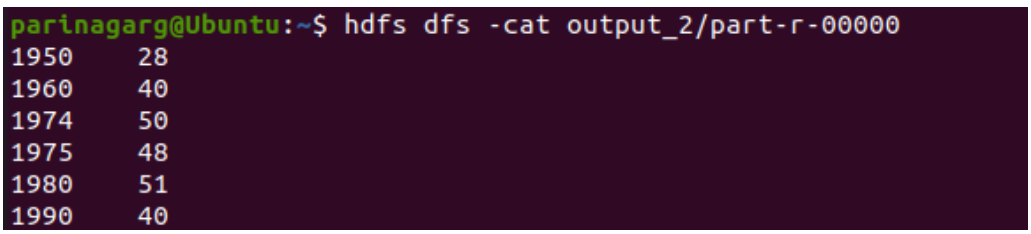
Step 7: **:**

```
parinagarg@Ubuntu:~$ hadoop jar mt.jar Max_temp Temperature.txt output_2
2025-02-09 22:29:51,676 INFO impl.MetricsConfig: Loaded properties from hadoop-
metrics2.properties
2025-02-09 22:29:51,873 INFO impl.MetricsSystemImpl: Scheduled Metric snapshot
period at 10 second(s).
2025-02-09 22:29:51,873 INFO impl.MetricsSystemImpl: JobTracker metrics system
started
2025-02-09 22:29:52,008 WARN mapreduce.JobResourceUploader: Hadoop command-line
 option parsing not performed. Implement the Tool interface and execute your ap
plication with ToolRunner to remedy this.
2025-02-09 22:29:52,100 INFO input.FileInputFormat: Total input files to proces
s : 1
```

Step 8:



Step 9:



Learning Outcomes:

EXPERIMENT-4

Title -: Develop a map reduce program to find the grade of students.

Introduction -

Code:

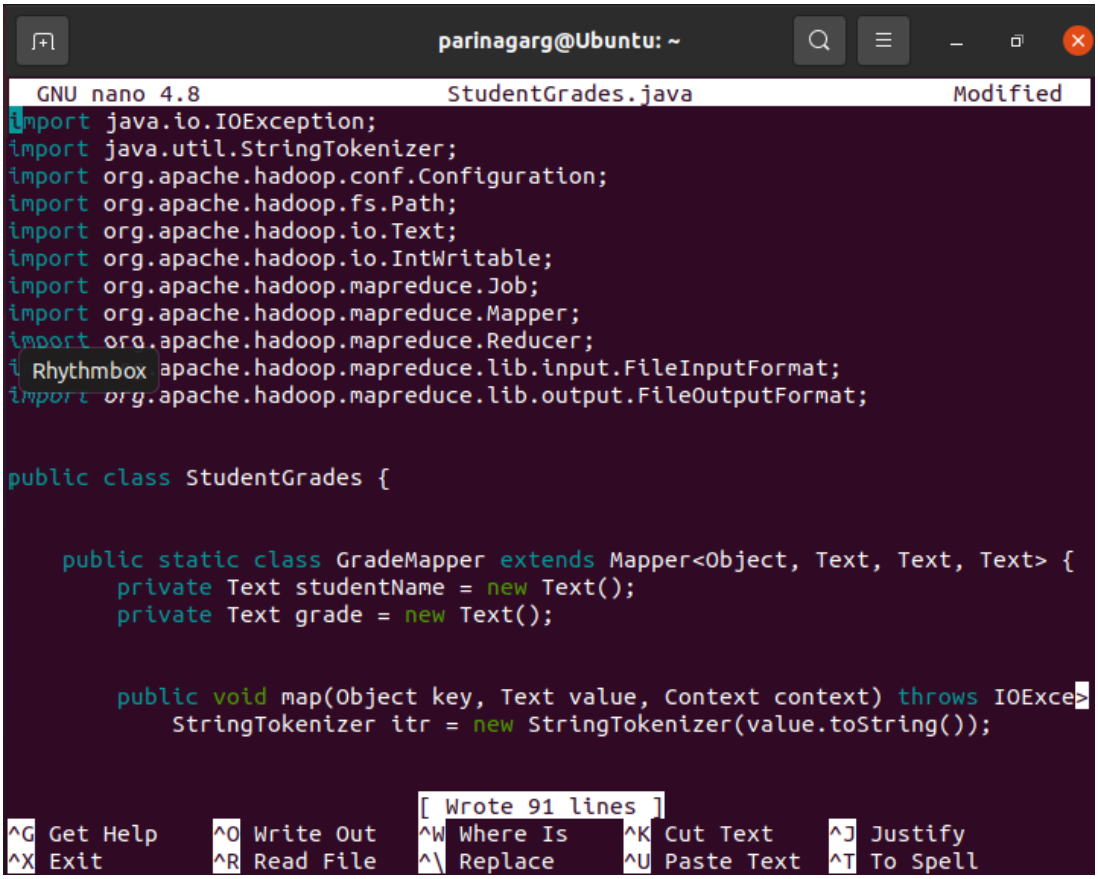
```
import java.io.IOException;
import java.util.StringTokenizer;
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.mapreduce.Job;
import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;

public class StudentGrades {

    public static class GradeMapper extends Mapper<Object, Text, Text, Text> {
        private Text studentName = new Text();
        private Text grade = new Text();

        public void map(Object key, Text value, Context context) throws IOException,
InterruptedException {
            StringTokenizer itr = new StringTokenizer(value.toString());

            if (itr.hasMoreTokens()) {
                String name = itr.nextToken();  // Student name
                String marksStr = itr.nextToken();  // Marks

                try {
                    int marks = Integer.parseInt(marksStr);
                    String gradeLetter;

                    if (marks >= 90) {
                        gradeLetter = "A";
                    } else if (marks >= 80) {
                        gradeLetter = "B";
                    } else if (marks >= 70) {
                        gradeLetter = "C";
                    } else if (marks >= 60) {
                        gradeLetter = "D";
                    } else {
                        gradeLetter = "F";
                    }

                    studentName.set(name);
                    grade.set(gradeLetter);
                    context.write(studentName, grade);

                } catch (NumberFormatException e) {
                    System.err.println("Skipping invalid record: " + value.toString());
                }
            }
        }
    }

    public static class GradeReducer extends Reducer<Text, Text, Text, Text> {
        public void reduce(Text key, Iterable<Text> values, Context context) throws
IOException, InterruptedException {
            for (Text val : values) {
                context.write(key, val); // Output (StudentName -> Grade)
```

```
            }
        }
    }

    public static void main(String[] args) throws Exception {
        Configuration conf = new Configuration();
        Job job = Job.getInstance(conf, "Student Grades Calculation");

        job.setJarByClass(StudentGrades.class);
        job.setMapperClass(GradeMapper.class);
        job.setReducerClass(GradeReducer.class);

        job.setOutputKeyClass(Text.class);
        job.setOutputValueClass(Text.class);

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

        System.exit(job.waitForCompletion(true) ? 0 : 1);
    }
}
```

Step 1:

```
parinagarg@Ubuntu:~$ nano StudentGrades.java
parinagarg@Ubuntu:~$
```

Step 2:



Step 3:

```
parinagarg@Ubuntu:~$ javac -cp $(hadoop classpath) StudentGrades.java
parinagarg@Ubuntu:~$
```

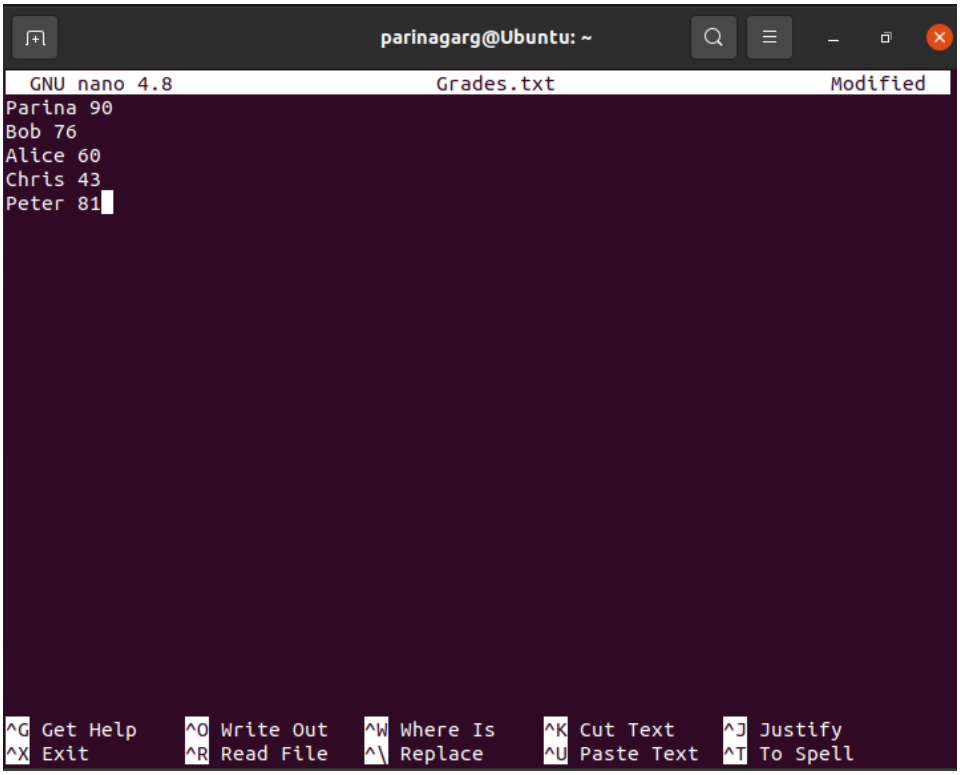
Step 4:

```
parinagarg@Ubuntu:~$ jar cvf sg.jar *.class
added manifest
adding: Max_temp$MaxTemperatureReducer.class(in = 1843) (out= 796)(deflated 56%
)
adding: Max_temp$TemperatureMapper.class(in = 2533) (out= 1114)(deflated 56%)
adding: Max_temp.class(in = 1497) (out= 810)(deflated 45%)
adding: StudentGrades$GradeMapper.class(in = 2595) (out= 1185)(deflated 54%)
adding: StudentGrades$GradeReducer.class(in = 1526) (out= 635)(deflated 58%)
adding: StudentGrades.class(in = 1456) (out= 793)(deflated 45%)
adding: WordCount$IntSumReducer.class(in = 1755) (out= 750)(deflated 57%)
adding: WordCount$TokenizerMapper.class(in = 1752) (out= 762)(deflated 56%)
adding: WordCount.class(in = 1511) (out= 832)(deflated 44%)
```

Step 5:

```
parinagarg@Ubuntu:~$ nano Grades.txt
parinagarg@Ubuntu:~$
```

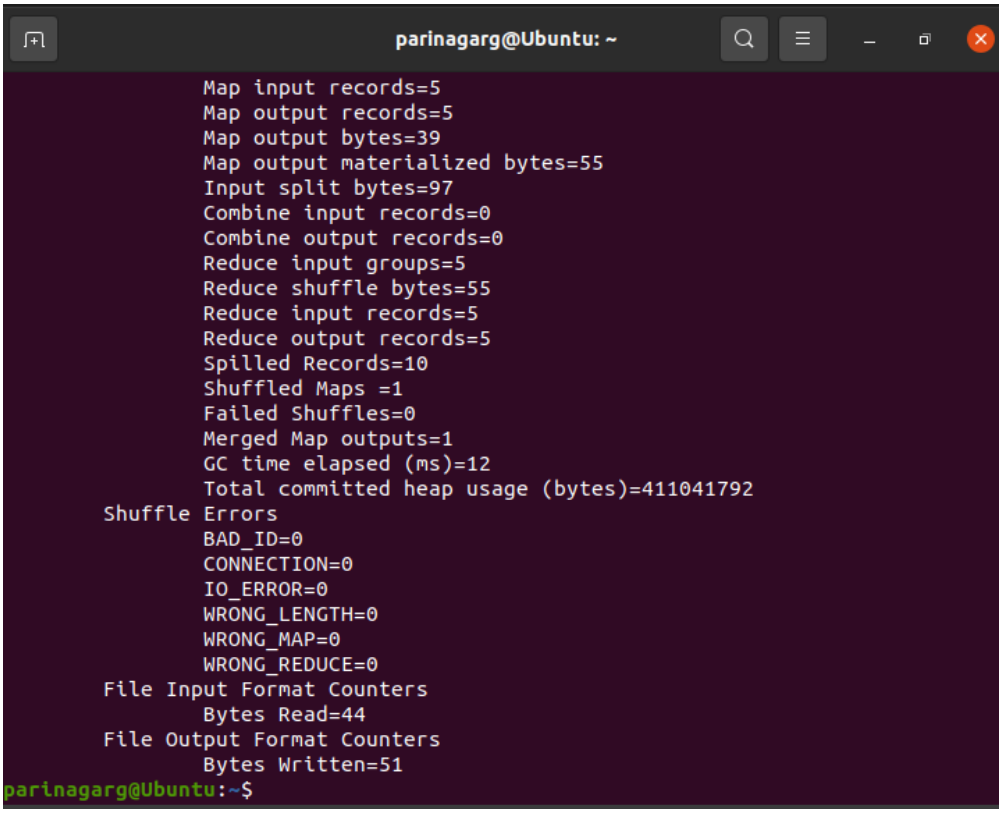
Step 6:



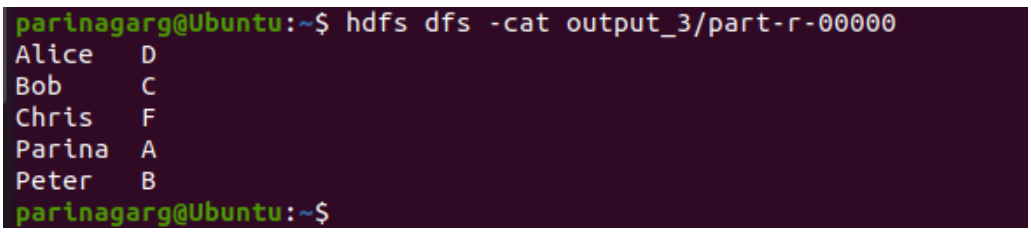
Step 7: **:**

```
parinagarg@Ubuntu:~$ hadoop jar sg.jar StudentGrades Grades.txt output_3
2025-02-09 22:44:18,806 INFO impl.MetricsConfig: Loaded properties from hadoop-
metrics2.properties
2025-02-09 22:44:18,909 INFO impl.MetricsSystemImpl: Scheduled Metric snapshot
period at 10 second(s).
2025-02-09 22:44:18,910 INFO impl.MetricsSystemImpl: JobTracker metrics system
started
2025-02-09 22:44:18,970 WARN mapreduce.JobResourceUploader: Hadoop command-line
 option parsing not performed. Implement the Tool interface and execute your ap
plication with ToolRunner to remedy this.
2025-02-09 22:44:19,036 INFO input.FileInputFormat: Total input files to proces
s : 1
```

Step 8:



Step 9:



Learning Outcomes:

EXPERIMENT-5

Title -: Develop a map reduce program to implement matrix multiplication.

Introduction -

Code:

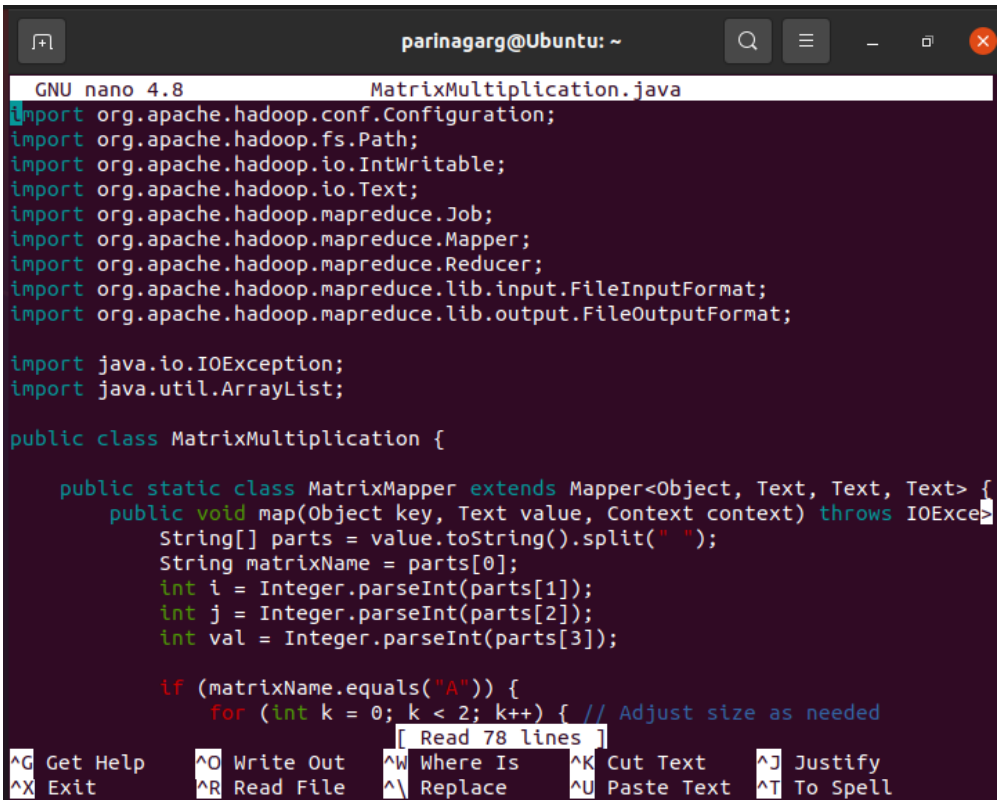
```
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Job;
import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;

import java.io.IOException;
import java.util.ArrayList;

public class MatrixMultiplication {

    public static class MatrixMapper extends Mapper<Object, Text, Text, Text> {
        public void map(Object key, Text value, Context context) throws IOException,
InterruptedException {
            String[] parts = value.toString().split(" ");
            String matrixName = parts[0];
            int i = Integer.parseInt(parts[1]);
            int j = Integer.parseInt(parts[2]);
            int val = Integer.parseInt(parts[3]);

            if (matrixName.equals("A")) {
                for (int k = 0; k < 2; k++) {
                    context.write(new Text(i + "," + k), new Text("A," + j + "," + val));
                }
            } else {
                for (int k = 0; k < 2; k++) { //
                    context.write(new Text(k + "," + j), new Text("B," + i + "," + val));
                }
            }
        }
    }

    public static class MatrixReducer extends Reducer<Text, Text, Text, IntWritable> {
        public void reduce(Text key, Iterable<Text> values, Context context) throws
IOException, InterruptedException {
            ArrayList<String> A = new ArrayList<>();
            ArrayList<String> B = new ArrayList<>();

            for (Text val : values) {
                String value = val.toString();
                if (value.startsWith("A")) {
                    A.add(value.substring(2));
                } else {
                    B.add(value.substring(2));
                }
            }
```

```
            int sum = 0;
            for (String a : A) {
                for (String b : B) {
                    String[] aParts = a.split(",");
                    String[] bParts = b.split(",");
                    if (aParts[0].equals(bParts[0])) {
                        sum += Integer.parseInt(aParts[1]) * Integer.parseInt(bParts[1]);
                    }
                }
            }
            context.write(key, new IntWritable(sum));
        }
    }

    public static void main(String[] args) throws Exception {
        Configuration conf = new Configuration();
        Job job = Job.getInstance(conf, "Matrix Multiplication");
        job.setJarByClass(MatrixMultiplication.class);
        job.setMapperClass(MatrixMapper.class);
        job.setReducerClass(MatrixReducer.class);
        job.setMapOutputKeyClass(Text.class);
        job.setMapOutputValueClass(Text.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);
    }
}
```

Step 1:

```
parinagarg@Ubuntu:~$ nano MatrixMultiplication.java
parinagarg@Ubuntu:~$
```

Step 2:



Step 3:

```
parinagarg@Ubuntu:~$ javac -cp $(hadoop classpath) MatrixMultiplication.java
parinagarg@Ubuntu:~$
```

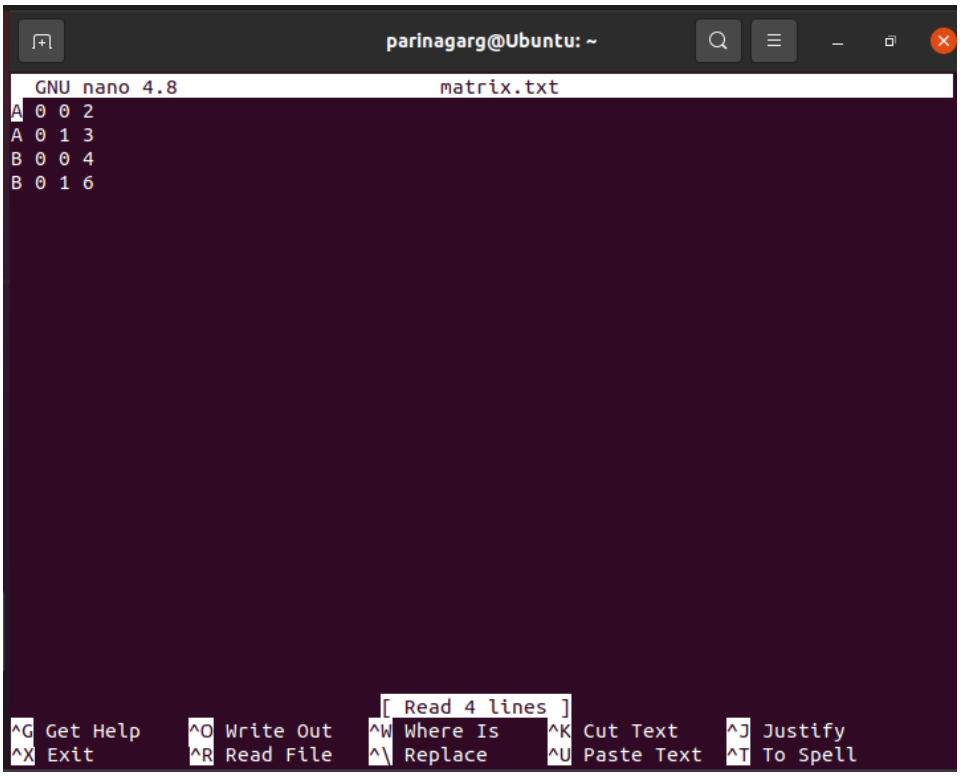
Step 4:

```
parinagarg@Ubuntu:~$ jar cvf mm.jar *.class
added manifest
adding: MatrixMultiplication$MatrixMapper.class(in = 2297) (out= 989)(deflated
56%)
adding: MatrixMultiplication$MatrixReducer.class(in = 2304) (out= 1052)(deflate
d 54%)
adding: MatrixMultiplication.class(in = 1609) (out= 842)(deflated 47%)
adding: Max_temp$MaxTemperatureReducer.class(in = 1843) (out= 796)(deflated 56%
)
adding: Max_temp$TemperatureMapper.class(in = 2533) (out= 1114)(deflated 56%)
adding: Max_temp.class(in = 1497) (out= 810)(deflated 45%)
adding: StudentGrades$GradeMapper.class(in = 2595) (out= 1185)(deflated 54%)
adding: StudentGrades$GradeReducer.class(in = 1526) (out= 635)(deflated 58%)
adding: StudentGrades.class(in = 1456) (out= 793)(deflated 45%)
adding: WordCount$IntSumReducer.class(in = 1755) (out= 750)(deflated 57%)
adding: WordCount$TokenizerMapper.class(in = 1752) (out= 762)(deflated 56%)
adding: WordCount.class(in = 1511) (out= 832)(deflated 44%)
```

Step 5:

```
parinagarg@Ubuntu:~$ nano matrix.txt
parinagarg@Ubuntu:~$
```

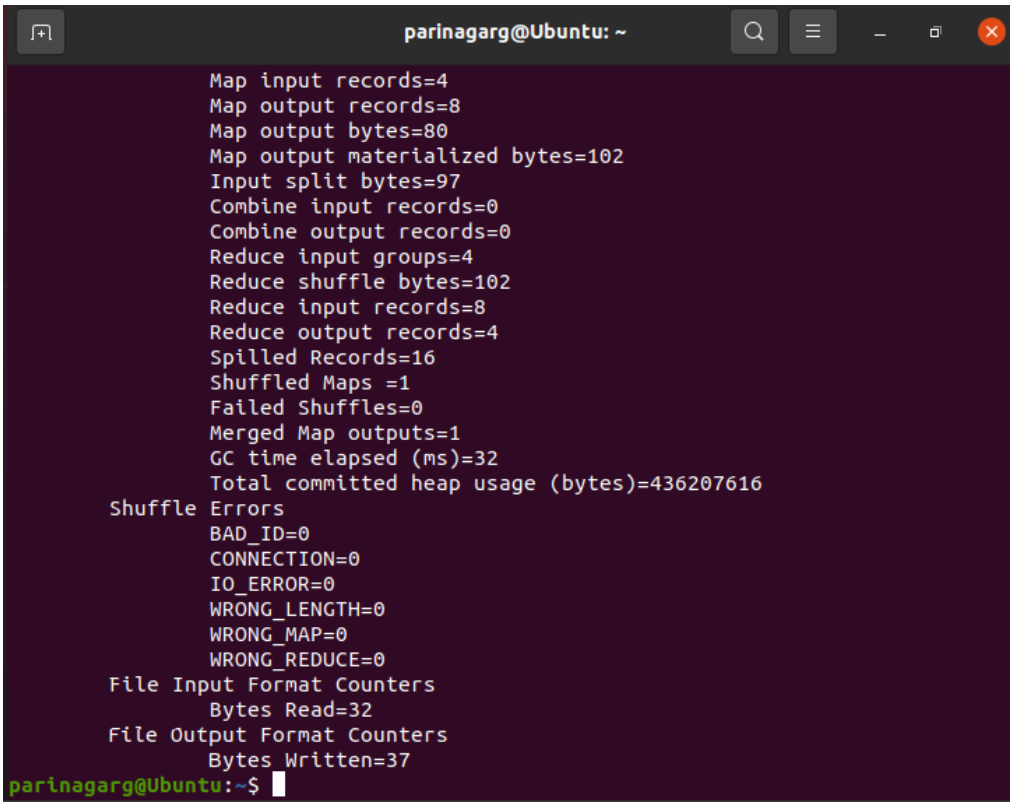
Step 6:



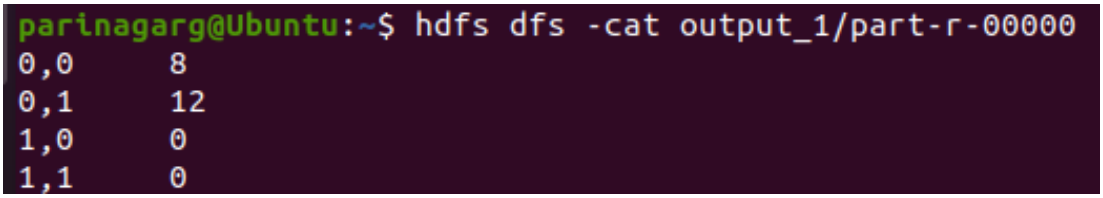
Step 7: **:**

```
parinagarg@Ubuntu:~$ hadoop jar mm.jar MatrixMultiplication matrix.txt output_1
2025-02-11 10:26:17,505 INFO impl.MetricsConfig: Loaded properties from hadoop-
metrics2.properties
2025-02-11 10:26:17,657 INFO impl.MetricsSystemImpl: Scheduled Metric snapshot
period at 10 second(s).
2025-02-11 10:26:17,657 INFO impl.MetricsSystemImpl: JobTracker metrics system
started
2025-02-11 10:26:17,761 WARN mapreduce.JobResourceUploader: Hadoop command-line
 option parsing not performed. Implement the Tool interface and execute your ap
plication with ToolRunner to remedy this.
2025-02-11 10:26:17,926 INFO input.FileInputFormat: Total input files to proces
s : 1
```

Step 8:



Step 9:



Learning Outcomes:

EXPERIMENT-6

Title -: Develop a map reduce program to find the maximum electrical consumption in each year given electrical consumption for each month in each year.

Introduction -

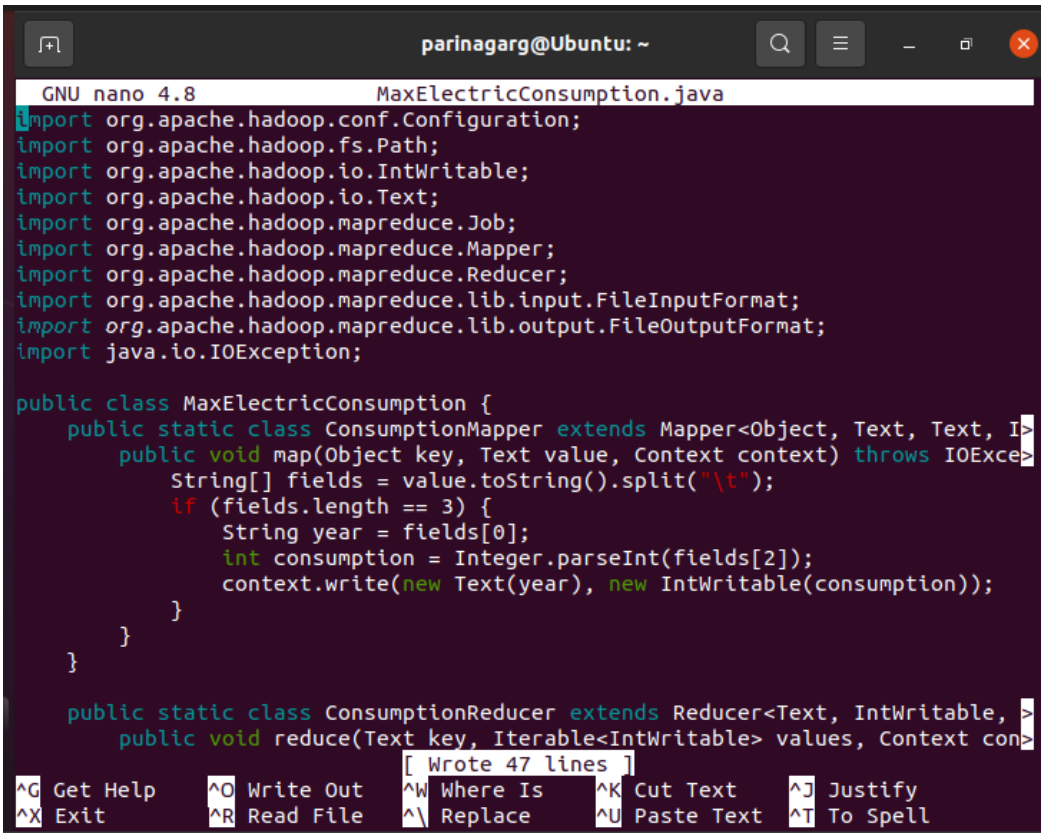
Code:

```
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;
import java.io.IOException;

public class MaxElectricConsumption {
    public static class ConsumptionMapper extends Mapper<Object, Text, Text, IntWritable>
{
        public void map(Object key, Text value, Context context) throws IOException,
InterruptedException {
            String[] fields = value.toString().split("\\s+");
            if (fields.length == 3) {
                String year = fields[0];
                int consumption = Integer.parseInt(fields[2]);
                context.write(new Text(year), new IntWritable(consumption));
            }
        }
    }

    public static class ConsumptionReducer extends Reducer<Text, IntWritable, Text,
IntWritable> {
        public void reduce(Text key, Iterable<IntWritable> values, Context context) throws
IOException, InterruptedException {
            int maxConsumption = Integer.MIN_VALUE;
            for (IntWritable val : values) {
                maxConsumption = Math.max(maxConsumption, val.get());
            }
            context.write(key, new IntWritable(maxConsumption));
        }
    }

    public static void main(String[] args) throws Exception {
        Configuration conf = new Configuration();
        Job job = Job.getInstance(conf, "max electrical consumption");
        job.setJarByClass(MaxElectricConsumption.class);
        job.setMapperClass(ConsumptionMapper.class);
        job.setCombinerClass(ConsumptionReducer.class);
        job.setReducerClass(ConsumptionReducer.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);
    }
}
```

Step 1:

```
parinagarg@Ubuntu:~$ nano MaxElectricConsumption.java
parinagarg@Ubuntu:~$
```

Step 2:



Step 3:

```
parinagarg@Ubuntu:~$ javac -cp $(hadoop classpath) -d . MaxElectricConsumption.
java
parinagarg@Ubuntu:~$
```

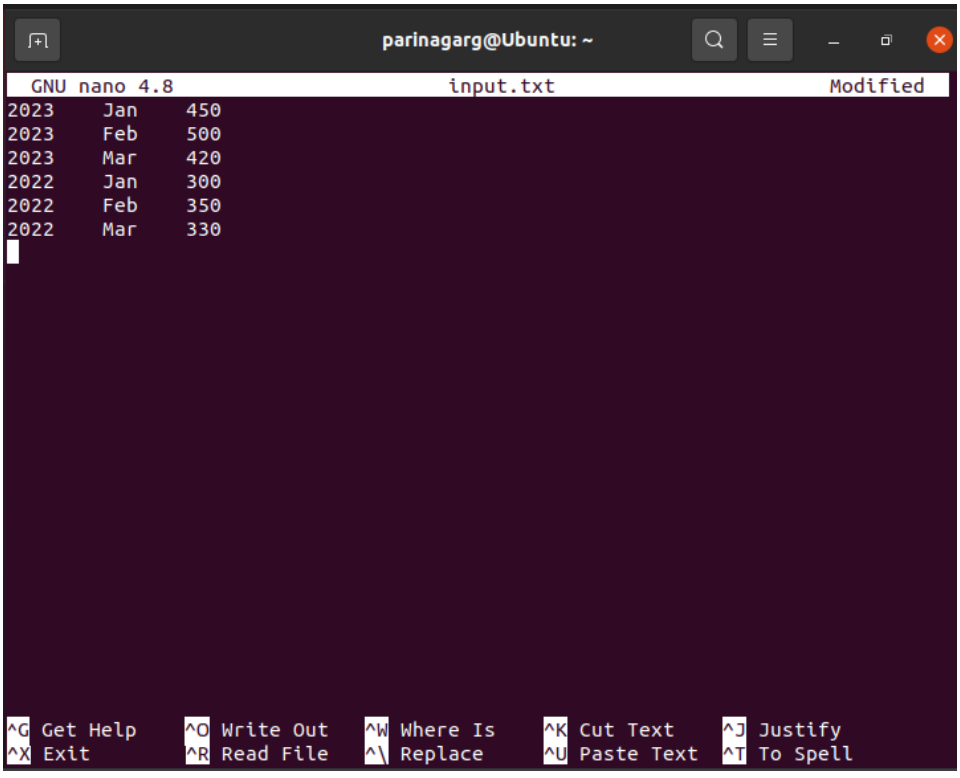
Step 4:

```
parinagarg@Ubuntu:~$ jar cvf mec.jar *.class
added manifest
adding: matrixMultiplication$MatrixMapper.class(in = 2297) (out= 990)(deflated
56%)
adding: MatrixMultiplication$MatrixMapper.class(in = 2297) (out= 989)(deflated
56%)
adding: matrixMultiplication$MatrixReducer.class(in = 2304) (out= 1053)(deflate
d 54%)
adding: MatrixMultiplication$MatrixReducer.class(in = 2304) (out= 1052)(deflate
d 54%)
adding: matrixMultiplication.class(in = 1609) (out= 843)(deflated 47%)
adding: MatrixMultiplication.class(in = 1609) (out= 842)(deflated 47%)
adding: MaxElectricConsumption$ConsumptionMapper.class(in = 1690) (out= 694)(de
flated 58%)
adding: MaxElectricConsumption$ConsumptionReducer.class(in = 1781) (out= 752)(d
eflated 57%)
adding: MaxElectricConsumption.class(in = 1593) (out= 837)(deflated 47%)
adding: Max_temp$MaxTemperatureReducer.class(in = 1843) (out= 796)(deflated 56%
)
adding: Max_temp$TemperatureMapper.class(in = 2533) (out= 1114)(deflated 56%)
adding: Max_temp.class(in = 1497) (out= 810)(deflated 45%)
adding: StudentGrades$GradeMapper.class(in = 2595) (out= 1185)(deflated 54%)
adding: StudentGrades$GradeReducer.class(in = 1526) (out= 635)(deflated 58%)
adding: StudentGrades.class(in = 1456) (out= 793)(deflated 45%)
adding: WordCount$IntSumReducer.class(in = 1755) (out= 750)(deflated 57%)
adding: WordCount$TokenizerMapper.class(in = 1752) (out= 762)(deflated 56%)
adding: WordCount.class(in = 1511) (out= 832)(deflated 44%)
```

Step 5:

```
parinagarg@Ubuntu:~$ nano input.txt
```

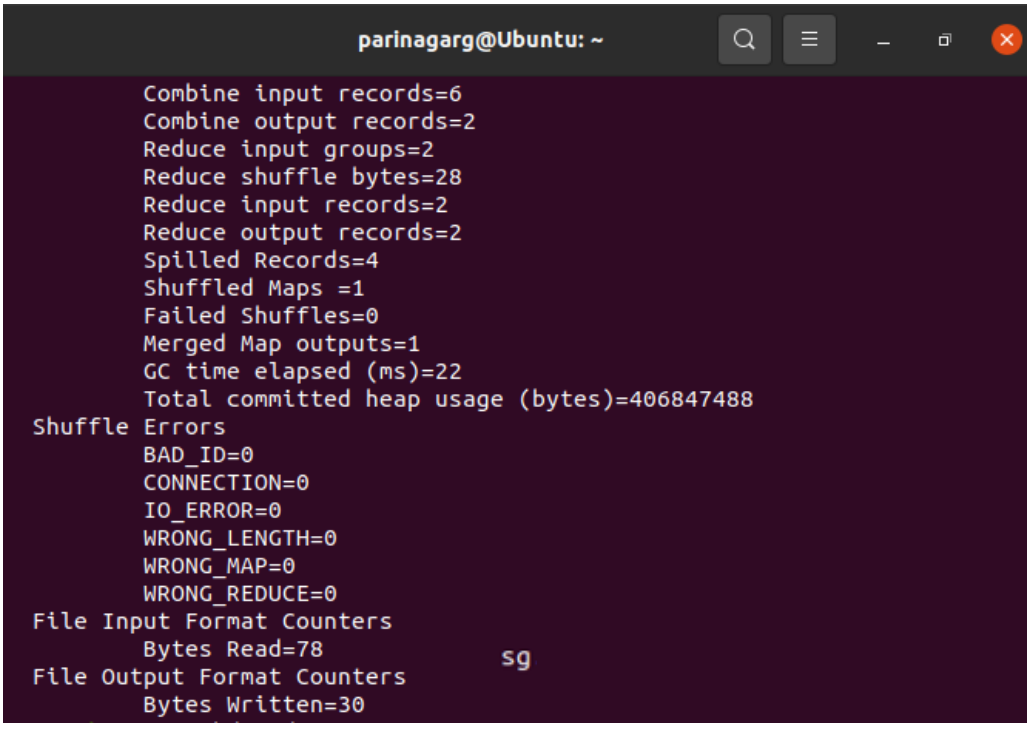
Step 6:



Step 7:

```
parinagarg@Ubuntu:~$ hadoop jar mec.jar MaxElectricConsumption input.txt output
_6
2025-02-21 01:25:54,167 INFO impl.MetricsConfig: Loaded properties from hadoop-
metrics2.properties
2025-02-21 01:25:54,251 INFO impl.MetricsSystemImpl: Scheduled Metric snapshot
period at 10 second(s).
2025-02-21 01:25:54,251 INFO impl.MetricsSystemImpl: JobTracker metrics system
started
2025-02-21 01:25:54,311 WARN mapreduce.JobResourceUploader: Hadoop command-line
 option parsing not performed. Implement the Tool interface and execute your ap
plication with ToolRunner to remedy this.
2025-02-21 01:25:54,407 INFO input.FileInputFormat: Total input files to proces
s : 1
```

Step 8:



Step 9:

```
parinagarg@Ubuntu:~$ hdfs dfs -cat output_6/part-r-00000
2022    350
2023    500
```

Learning Outcomes:

EXPERIMENT-7

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

Introduction -

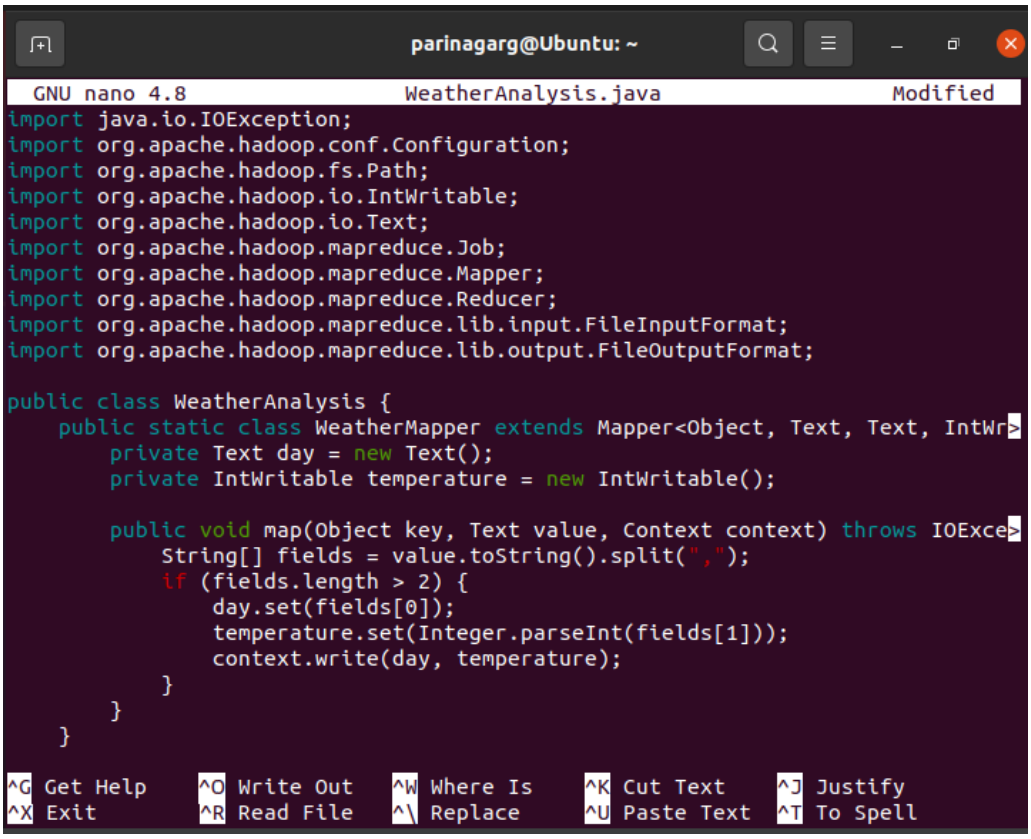
Code:

```
import java.io.IOException;
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 WeatherAnalysis {
    public static class WeatherMapper extends Mapper<Object, Text, Text, IntWritable> {
        private Text date = new Text();
        private IntWritable temperature = new IntWritable();

        public void map(Object key, Text value, Context context) throws IOException,
InterruptedException {
            String[] fields = value.toString().split(",");
            if (fields.length > 1) {
                date.set(fields[0]);
                int temp = Integer.parseInt(fields[1]);
                temperature.set(temp);
                context.write(date, temperature);
            }
        }
    }

    public static class WeatherReducer extends Reducer<Text, IntWritable, Text, Text> {
        public void reduce(Text key, Iterable<IntWritable> values, Context context) throws
IOException, InterruptedException {
            for (IntWritable val : values) {
                String result = val.get() > 30 ? "Shiny Day" : "Cool Day";
                context.write(key, new Text(result));
            }
        }
    }

    public static void main(String[] args) throws Exception {
        Configuration conf = new Configuration();
        Job job = Job.getInstance(conf, "weather analysis");
        job.setJarByClass(WeatherAnalysis.class);
        job.setMapperClass(WeatherMapper.class);
        job.setReducerClass(WeatherReducer.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);
    }
}
```

Step 1:

```
parinagarg@Ubuntu:~$ nano WeatherAnalysis.java
parinagarg@Ubuntu:~$
```

Step 2:



Step 3:

```
parinagarg@Ubuntu:~$ javac -cp $(hadoop classpath) -d . WeatherAnalysis.java
parinagarg@Ubuntu:~$
```

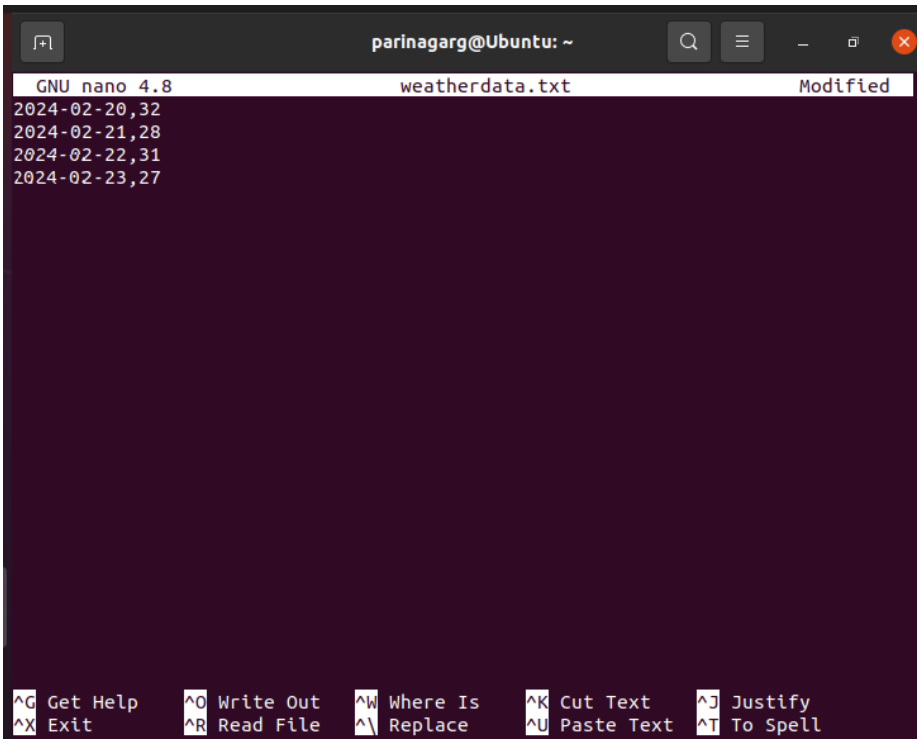
Step 4:

```
parinagarg@Ubuntu:~$ jar cvf wa.jar *.class
added manifest
adding: matrixMultiplication$MatrixMapper.class(in = 2297) (out= 990)(deflated
56%)
adding: MatrixMultiplication$MatrixMapper.class(in = 2297) (out= 989)(deflated
56%)
adding: matrixMultiplication$MatrixReducer.class(in = 2304) (out= 1053)(deflate
d 54%)
adding: MatrixMultiplication$MatrixReducer.class(in = 2304) (out= 1052)(deflate
d 54%)
adding: matrixMultiplication.class(in = 1609) (out= 843)(deflated 47%)
adding: MatrixMultiplication.class(in = 1609) (out= 842)(deflated 47%)
adding: MaxElectricConsumption$ConsumptionMapper.class(in = 1690) (out= 694)(de
flated 58%)
adding: MaxElectricConsumption$ConsumptionReducer.class(in = 1781) (out= 752)(d
eflated 57%)
adding: MaxElectricConsumption.class(in = 1593) (out= 837)(deflated 47%)
adding: Max_temp$MaxTemperatureReducer.class(in = 1843) (out= 796)(deflated 56%
)
adding: Max_temp$TemperatureMapper.class(in = 2533) (out= 1114)(deflated 56%)
adding: Max_temp.class(in = 1497) (out= 810)(deflated 45%)
adding: StudentGrades$GradeMapper.class(in = 2595) (out= 1185)(deflated 54%)
adding: StudentGrades$GradeReducer.class(in = 1526) (out= 635)(deflated 58%)
adding: StudentGrades.class(in = 1456) (out= 793)(deflated 45%)
adding: WeatherAnalysis$WeatherMapper.class(in = 1830) (out= 766)(deflated 58%)
adding: WeatherAnalysis$WeatherReducer.class(in = 1740) (out= 751)(deflated 56%
)
adding: WeatherAnalysis.class(in = 1500) (out= 802)(deflated 46%)
adding: WordCount$IntSumReducer.class(in = 1755) (out= 750)(deflated 57%)
```

Step 5:

```
parinagarg@Ubuntu:~$ nano weatherdata.txt
parinagarg@Ubuntu:~$
```

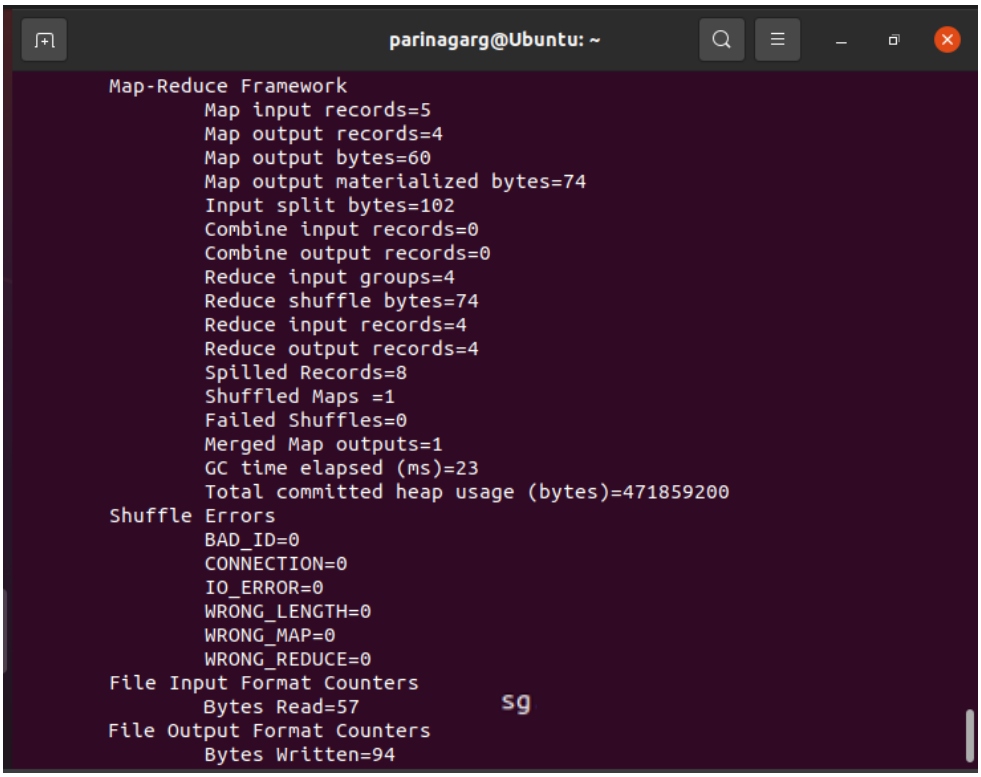
Step 6:



Step 7:

```
parinagarg@Ubuntu:~$ hadoop jar wa.jar WeatherAnalysis weatherdata.txt outputwa
2025-02-21 02:10:07,716 INFO impl.MetricsConfig: Loaded properties from hadoop-
metrics2.properties
2025-02-21 02:10:07,872 INFO impl.MetricsSystemImpl: Scheduled Metric snapshot
period at 10 second(s).
2025-02-21 02:10:07,873 INFO impl.MetricsSystemImpl: JobTracker metrics system
started
2025-02-21 02:10:07,977 WARN mapreduce.JobResourceUploader: Hadoop command-line
 option parsing not performed. Implement the Tool interface and execute your ap
plication with ToolRunner to remedy this.
2025-02-21 02:10:08,116 INFO input.FileInputFormat: Total input files to proces
s : 1
```

Step 8:



Step 9:

```
parinagarg@Ubuntu:~$ hdfs dfs -cat outputwa/part-r-00000
2024-02-20      Shiny Day
2024-02-21      Cool Day
2024-02-22      Shiny Day
2024-02-23      Cool Day
parinagarg@Ubuntu:~$
```

Learning Outcomes:

EXPERIMENT-8

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

Introduction -

Code:

```
import java.io.IOException;
import java.util.ArrayList;
import java.util.List;
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
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 MovieTagsAnalysis {

    public static class TagsMapper extends Mapper<Object, Text, Text, Text> {
        private Text movieID = new Text();
        private Text tag = new Text();

        public void map(Object key, Text value, Context context) throws IOException,
InterruptedException {
            String[] fields = value.toString().split(",");
            if (fields.length >= 3) {  // Ensuring proper data format
                movieID.set(fields[1]);  // Movie ID is in the second column
                tag.set(fields[2]);  // Tag is in the third column
                context.write(movieID, tag);
            }
        }
    }

    public static class TagsReducer extends Reducer<Text, Text, Text, Text> {
        public void reduce(Text key, Iterable<Text> values, Context context) throws
IOException, InterruptedException {
            List<String> tagsList = new ArrayList<>();
            for (Text val : values) {
                tagsList.add(val.toString());
            }
            context.write(key, new Text(String.join(", ", tagsList)));
        }
    }

    public static void main(String[] args) throws Exception {
        Configuration conf = new Configuration();
        Job job = Job.getInstance(conf, "Movie Tags Analysis");

        job.setJarByClass(MovieTagsAnalysis.class);
        job.setMapperClass(TagsMapper.class);
        job.setReducerClass(TagsReducer.class);
```

```
        job.setOutputKeyClass(Text.class);
        job.setOutputValueClass(Text.class);

        FileInputFormat.addInputPath(job, new Path(args[0])); // Input directory
(tags.csv)
        FileOutputFormat.setOutputPath(job, new Path(args[1])); // Output directory

        System.exit(job.waitForCompletion(true) ? 0 : 1);
    }
}
```

Step 1:

```
parinagarg@Ubuntu:~$ nano MovieTagsAnalysis.java
parinagarg@Ubuntu:~$
```

Step 2:

```
parinagarg@Ubuntu: ~
 GNU nano 4.8                  MovieTagsAnalysis.java
import java.io.IOException;
import java.util.ArrayList;
import java.util.List;
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
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 MovieTagsAnalysis {


    public static class TagsMapper extends Mapper<Object, Text, Text, Text> {
        private Text movieID = new Text();
        private Text tag = new Text();


        public void map(Object key, Text value, Context context) throws IOExce>
            String[] fields = value.toString().split(",");
            if (fields.length >= 3) {  // Ensuring proper data format
                movieID.set(fields[1]);  // Movie ID is in the second column

^G Get Help    ^O Write Out   ^W Where Is    ^K Cut Text    ^J Justify
^X Exit        ^R Read File   ^\ Replace     ^U Paste Text  ^T To Spell
```

Step 3:

```
parinagarg@Ubuntu:~$ javac -cp $(hadoop classpath) MovieTagsAnalysis.java
parinagarg@Ubuntu:~$
```

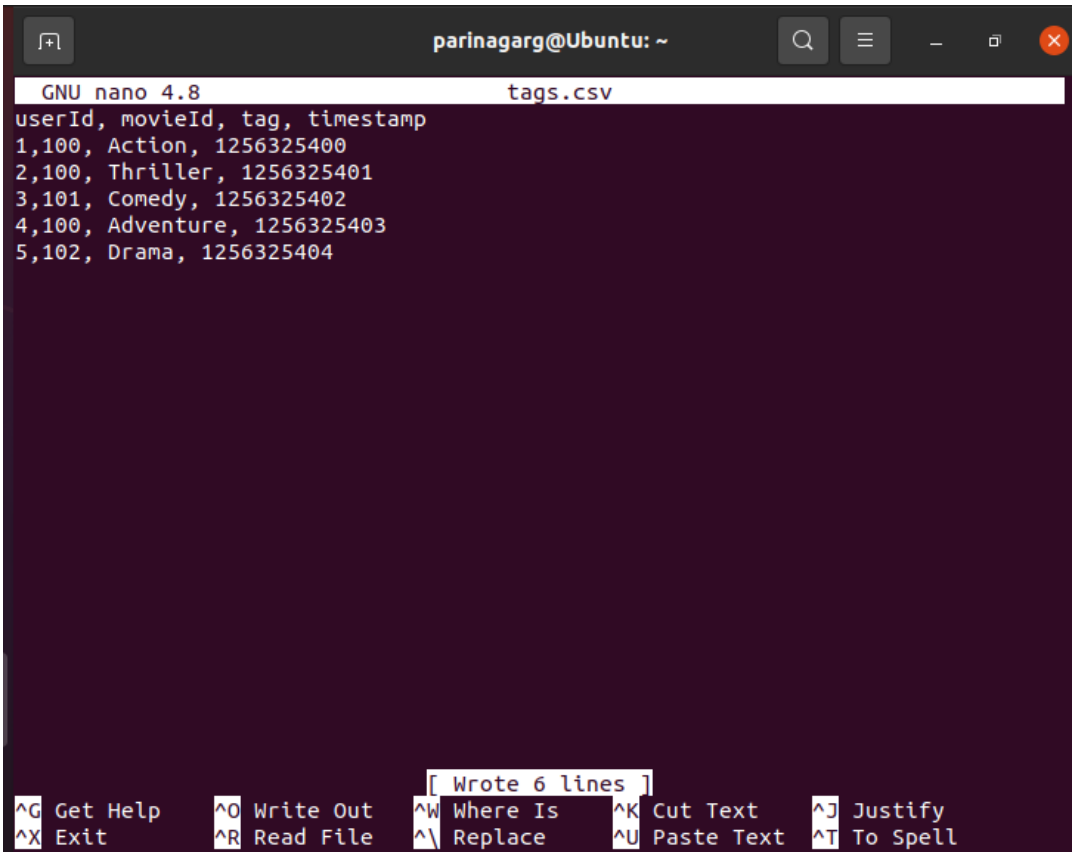
Step 4:

```
parinagarg@Ubuntu:~$ jar cvf mta.jar MovieTagsAnalysis*.class
added manifest
adding: MovieTagsAnalysis$TagsMapper.class(in = 1644) (out= 694)(deflated 57%)
adding: MovieTagsAnalysis$TagsReducer.class(in = 1863) (out= 795)(deflated 57%)
adding: MovieTagsAnalysis.class(in = 1461) (out= 793)(deflated 45%)
parinagarg@Ubuntu:~$
```

Step 5:

```
parinagarg@Ubuntu:~$ nano tags.csv
parinagarg@Ubuntu:~$
```

Step 6:



Step 7:

```
parinagarg@Ubuntu:~$ hadoop jar mta.jar MovieTagsAnalysis tags.csv output_mta
2025-03-18 01:33:45,575 INFO impl.MetricsConfig: Loaded properties from hadoop-
metrics2.properties
2025-03-18 01:33:45,764 INFO impl.MetricsSystemImpl: Scheduled Metric snapshot
period at 10 second(s).
2025-03-18 01:33:45,765 INFO impl.MetricsSystemImpl: JobTracker metrics system
started
2025-03-18 01:33:45,859 WARN mapreduce.JobResourceUploader: Hadoop command-line
 option parsing not performed. Implement the Tool interface and execute your ap
plication with ToolRunner to remedy this.
2025-03-18 01:33:45,942 INFO input.FileInputFormat: Total input files to proces
s : 1
```

Step 8:

```
                Combine input records=0
                Combine output records=0
                Reduce input groups=4
                Reduce shuffle bytes=96
                Reduce input records=6
                Reduce output records=4
                Spilled Records=12
                Shuffled Maps =1
                Failed Shuffles=0
                Merged Map outputs=1
                GC time elapsed (ms)=15
                Total committed heap usage (bytes)=404750336
        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=171
        File Output Format Counters
                Bytes Written=84
```

Step 9:

```
parinagarg@Ubuntu:~$ hdfs dfs -cat output_mta/part-r-00000
 movieId         tag
100      Adventure,  Thriller,  Action
101      Comedy
102      Drama
```

Learning Outcomes:

EXPERIMENT-9

Title -: 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 number	Date	Active vehicle	Trips

Introduction -

Code:

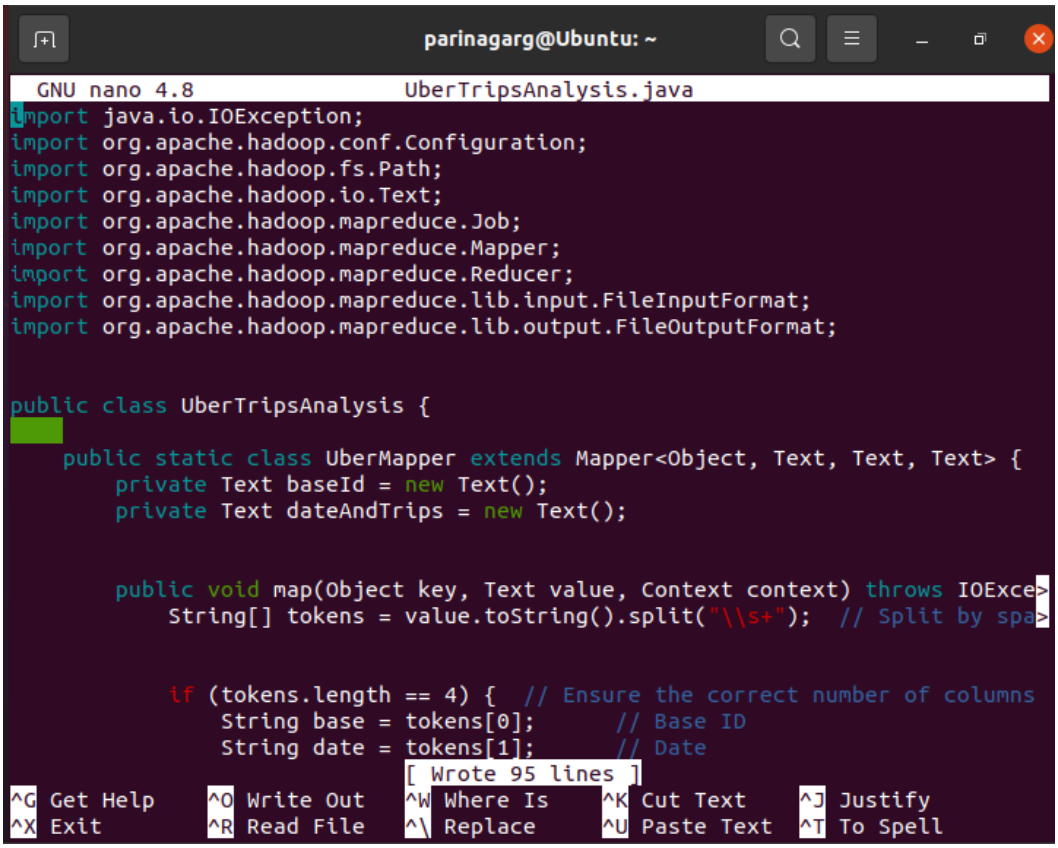
```
import java.io.IOException;
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Job;
import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;

public class UberTripsAnalysis {

    public static class UberMapper extends Mapper<Object, Text, Text, Text> {
        private Text baseId = new Text();
        private Text dateAndTrips = new Text();

        public void map(Object key, Text value, Context context) throws IOException,
InterruptedException {
            String[] tokens = value.toString().split("\\s+");  // Split by spaces

            if (tokens.length == 4) {  // Ensure the correct number of columns
                String base = tokens[0];      // Base ID
                String date = tokens[1];      // Date
                String trips = tokens[3];     // Number of trips

                baseId.set(base);
                dateAndTrips.set(date + "," + trips);
                context.write(baseId, dateAndTrips);
            }
        }
    }

    public static class UberReducer extends Reducer<Text, Text, Text, Text> {
        private Text maxTripDate = new Text();

        public void reduce(Text key, Iterable<Text> values, Context context) throws
IOException, InterruptedException {
            int maxTripsValue = Integer.MIN_VALUE;
            String maxDay = "";

            for (Text val : values) {
                String[] parts = val.toString().split(",");
                String date = parts[0];
                int trips = Integer.parseInt(parts[1]);

                if (trips > maxTripsValue) {
                    maxTripsValue = trips;
                    maxDay = date;
                }
            }
```

```
            maxTripDate.set(maxDay + " " + maxTripsValue);
            context.write(key, maxTripDate);
        }
    }

    public static void main(String[] args) throws Exception {
        if (args.length < 2) {
            System.err.println("Usage: UberTripsAnalysis <input file> <output dir>");
            System.exit(1);
        }

        Configuration conf = new Configuration();
        Job job = Job.getInstance(conf, "Uber Trips Analysis");

        job.setJarByClass(UberTripsAnalysis.class);
        job.setMapperClass(UberMapper.class);
        job.setReducerClass(UberReducer.class);

        job.setMapOutputKeyClass(Text.class);
        job.setMapOutputValueClass(Text.class);

        job.setOutputKeyClass(Text.class);
        job.setOutputValueClass(Text.class);

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

        System.exit(job.waitForCompletion(true) ? 0 : 1);
    }
}
```

Step 1:

```
parinagarg@Ubuntu:~$ nano UberTripsAnalysis.java
parinagarg@Ubuntu:~$
```

Step 2:



Step 3:

```
parinagarg@Ubuntu:~$ javac -cp $(hadoop classpath) UberTripsAnalysis.java
parinagarg@Ubuntu:~$
```

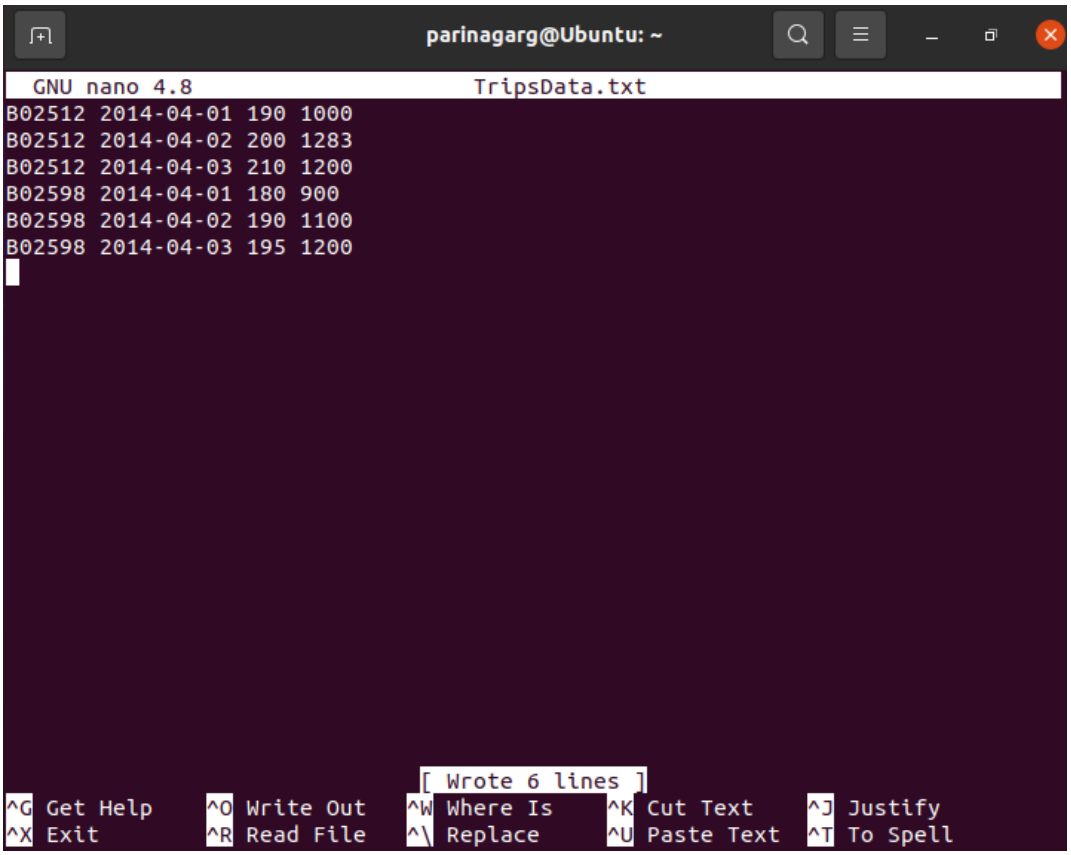
Step 4:

```
parinagarg@Ubuntu:~$ jar cvf uta.jar UberTripsAnalysis*.class
added manifest
adding: UberTripsAnalysis$UberMapper.class(in = 2131) (out= 897)(deflated 57%)
adding: UberTripsAnalysis$UberReducer.class(in = 2406) (out= 1049)(deflated 56%
)
adding: UberTripsAnalysis.class(in = 1721) (out= 928)(deflated 46%)
```

Step 5:

```
parinagarg@Ubuntu:~$ nano TripsData.txt
parinagarg@Ubuntu:~$
```

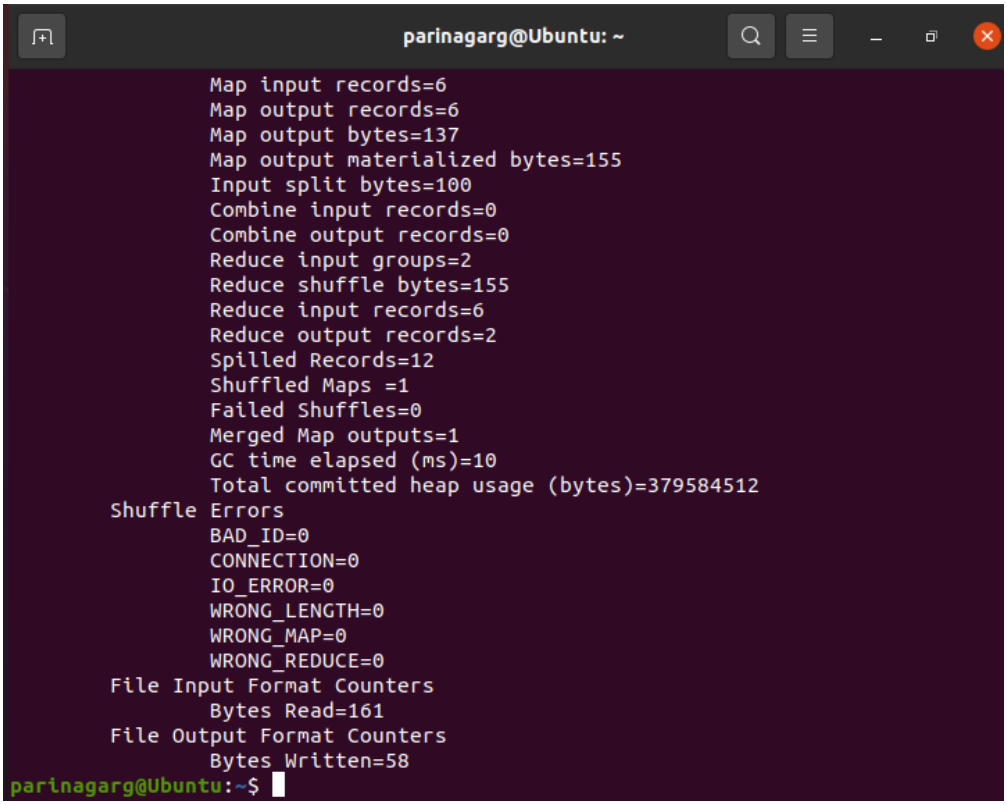
Step 6:



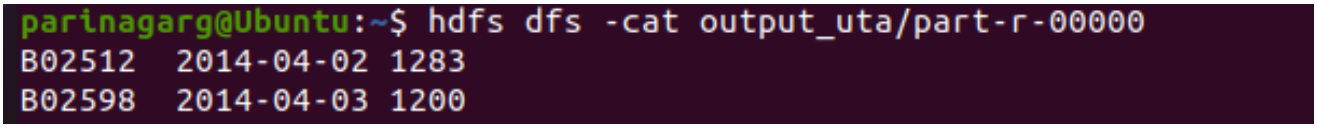
Step 7:

```
parinagarg@Ubuntu:~$ hadoop jar uta.jar UberTripsAnalysis TripsData.txt output_
uta
2025-03-22 11:10:51,458 INFO impl.MetricsConfig: Loaded properties from hadoop-
metrics2.properties
2025-03-22 11:10:51,623 INFO impl.MetricsSystemImpl: Scheduled Metric snapshot
period at 10 second(s).
2025-03-22 11:10:51,623 INFO impl.MetricsSystemImpl: JobTracker metrics system
started
2025-03-22 11:10:51,717 WARN mapreduce.JobResourceUploader: Hadoop command-line
 option parsing not performed. Implement the Tool interface and execute your ap
plication with ToolRunner to remedy this.
2025-03-22 11:10:51,812 INFO input.FileInputFormat: Total input files to proces
s : 1
```

Step 8:



Step 9:



Learning Outcomes:

EXPERIMENT-10

Title -: 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.

Introduction -

Code:

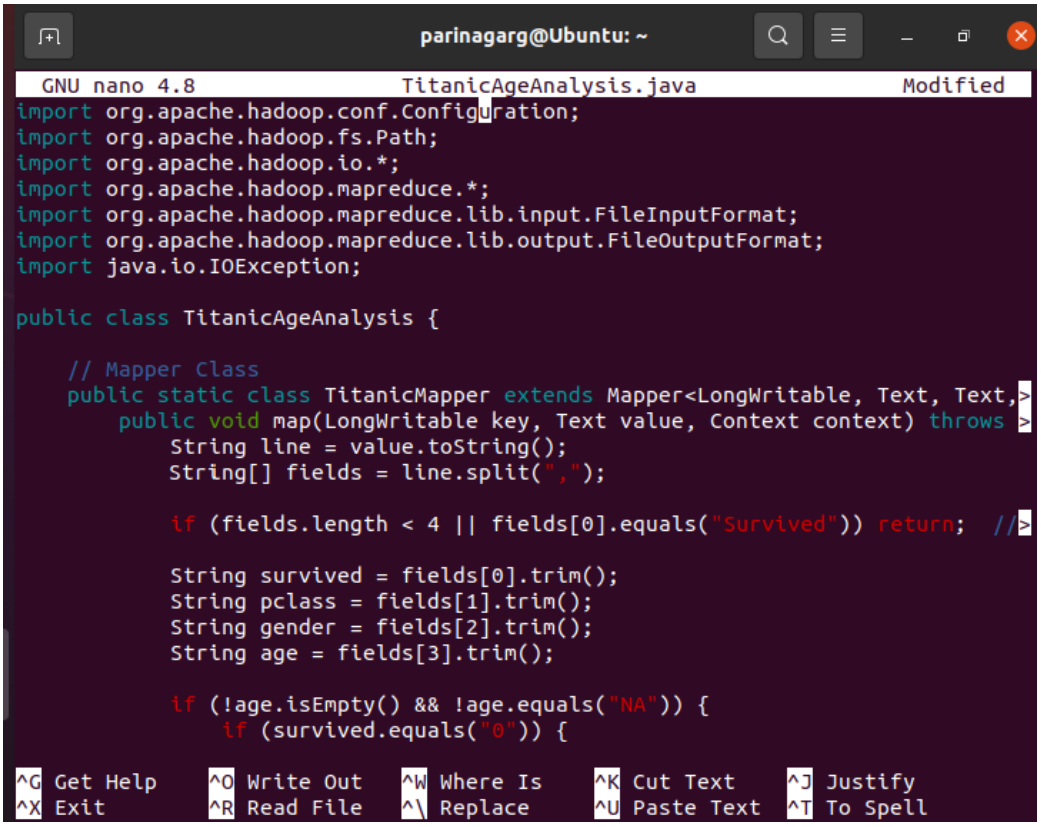
```
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.*;
import org.apache.hadoop.mapreduce.*;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
import java.io.IOException;

public class TitanicAnalysis {

    // Mapper Class
    public static class TitanicMapper extends Mapper<LongWritable, Text, Text, Text> {
        public void map(LongWritable key, Text value, Context context) throws IOException,
InterruptedException {
            String line = value.toString();
            String[] fields = line.split(",");

            if (fields.length < 4 || fields[0].equals("Survived")) return;  // Skip header

            String survived = fields[0].trim();
            String pclass = fields[1].trim();
            String gender = fields[2].trim();
            String age = fields[3].trim();

            if (!age.isEmpty() && !age.equals("NA")) {
                if (survived.equals("0")) {
                    context.write(new Text("Deceased_" + gender), new Text(age));
                } else {
                    context.write(new Text("Survived_Class_" + pclass), new Text("1"));
                }
            }
        }
    }

    // Reducer Class
    public static class TitanicReducer extends Reducer<Text, Text, Text, Text> {
        public void reduce(Text key, Iterable<Text> values, Context context) throws
IOException, InterruptedException {
            int count = 0;
            double sum = 0.0;

            for (Text val : values) {
                try {
                    double num = Double.parseDouble(val.toString());
                    sum += num;
                    count++;
                } catch (NumberFormatException e) {
                    count++;
                }
            }
```

```
            if (key.toString().startsWith("Deceased")) {
                double avgAge = count == 0 ? 0 : sum / count;
                context.write(key, new Text("Average Age: " + avgAge));
            } else {
                context.write(key, new Text("Survivors: " + count));
            }
        }
    }

    // Driver Code
    public static void main(String[] args) throws Exception {
        Configuration conf = new Configuration();
        Job job = Job.getInstance(conf, "Titanic Analysis");
        job.setJarByClass(TitanicAnalysis.class);
        job.setMapperClass(TitanicMapper.class);
        job.setReducerClass(TitanicReducer.class);
        job.setOutputKeyClass(Text.class);
        job.setOutputValueClass(Text.class);

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

        System.exit(job.waitForCompletion(true) ? 0 : 1);
    }
}
```

Step 1:

```
parinagarg@Ubuntu:~$ nano TitanicAgeAnalysis.java
parinagarg@Ubuntu:~$
```

Step 2:



Step 3:

```
parinagarg@Ubuntu:~$ javac -cp $(hadoop classpath) TitanicAgeAnalysis.java
parinagarg@Ubuntu:~$
```

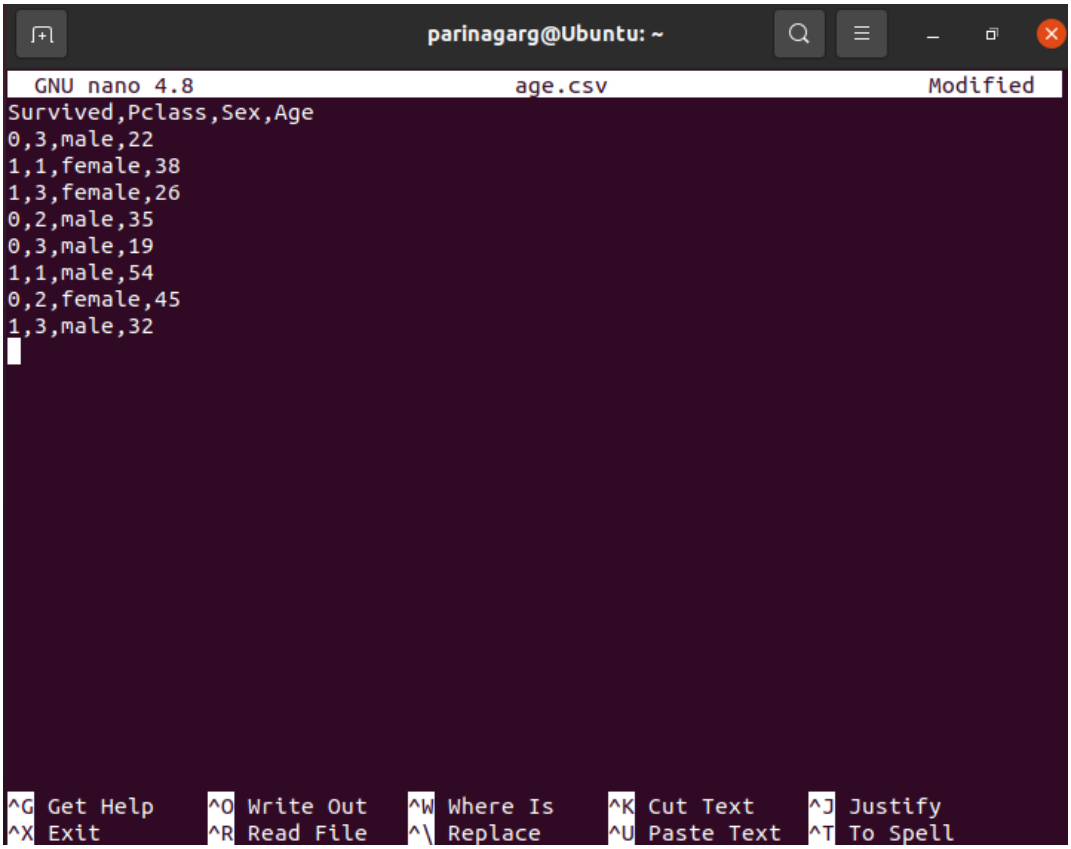
Step 4:

```
parinagarg@Ubuntu:~$ jar cvf taa.jar TitanicAgeAnalysis*.class
added manifest
adding: TitanicAgeAnalysis$TitanicMapper.class(in = 2398) (out= 1030)(deflated
57%)
adding: TitanicAgeAnalysis$TitanicReducer.class(in = 2484) (out= 1091)(deflated
 56%)
adding: TitanicAgeAnalysis.class(in = 1474) (out= 793)(deflated 46%)
```

Step 5:

```
parinagarg@Ubuntu:~$ nano age.csv
parinagarg@Ubuntu:~$
```

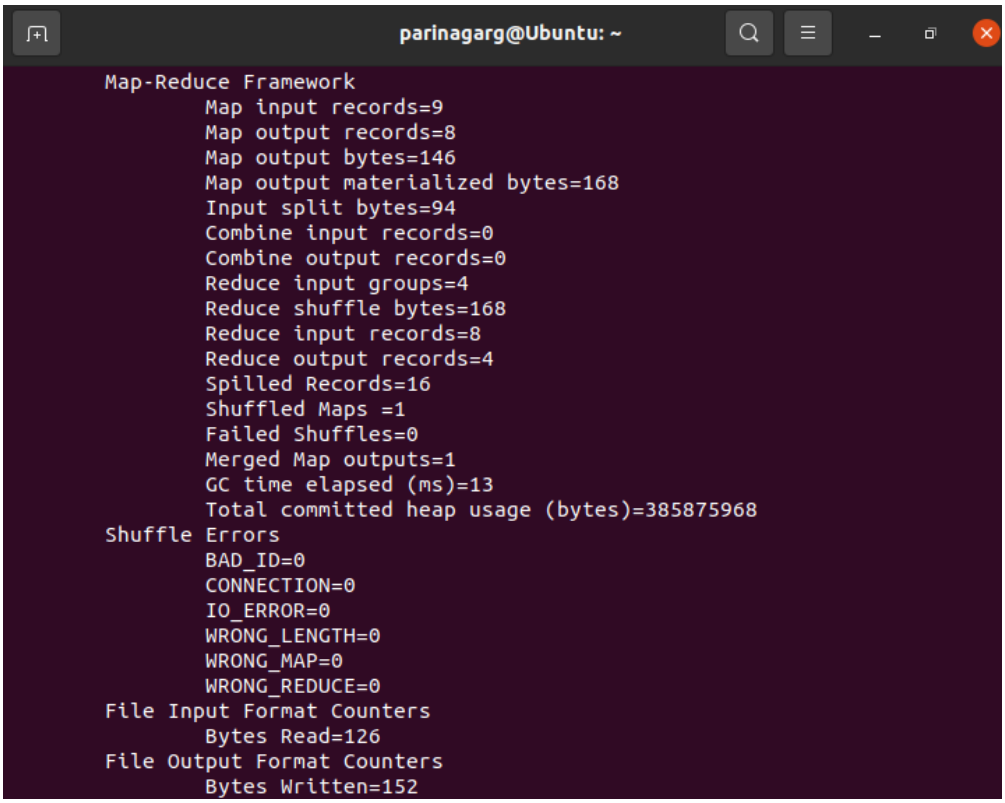
Step 6:



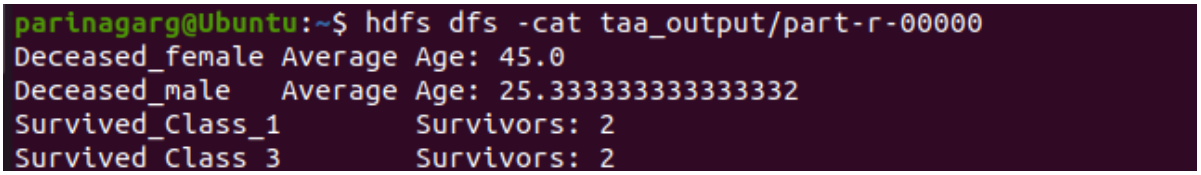
Step 7:

```
parinagarg@Ubuntu:~$ hadoop jar taa.jar TitanicAgeAnalysis age.csv taa_output
2025-03-18 10:35:02,158 INFO impl.MetricsConfig: Loaded properties from hadoop-
metrics2.properties
2025-03-18 10:35:02,242 INFO impl.MetricsSystemImpl: Scheduled Metric snapshot
period at 10 second(s).
2025-03-18 10:35:02,243 INFO impl.MetricsSystemImpl: JobTracker metrics system
started
2025-03-18 10:35:02,302 WARN mapreduce.JobResourceUploader: Hadoop command-line
 option parsing not performed. Implement the Tool interface and execute your ap
plication with ToolRunner to remedy this.
2025-03-18 10:35:02,384 INFO input.FileInputFormat: Total input files to proces
s : 1
```

Step 8:



Step 9:



Learning Outcomes:

EXPERIMENT-11

Title -: Develop a map reduce program to find the maximum temperature in each month for each year.

Introduction -

Code:

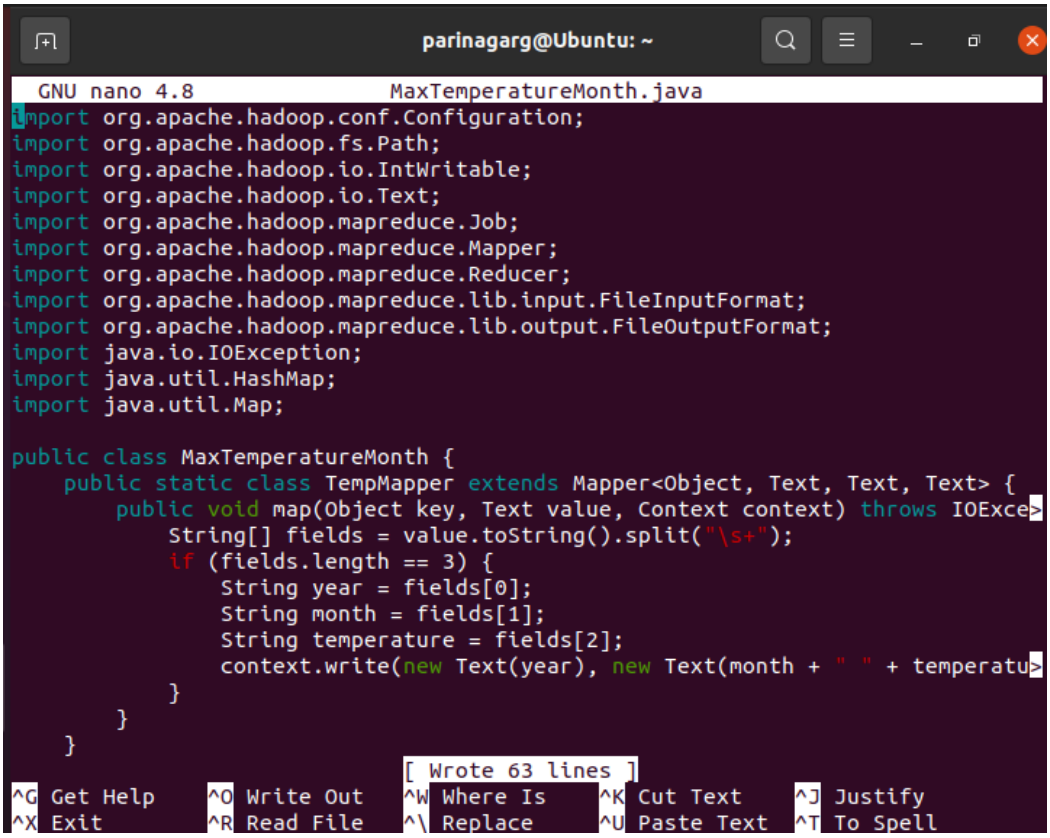
```
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Job;
import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
import java.io.IOException;
import java.util.HashMap;
import java.util.Map;

public class MaxTemperatureMonth {
    public static class TempMapper extends Mapper<Object, Text, Text, Text> {
        public void map(Object key, Text value, Context context) throws IOException,
InterruptedException {
            String[] fields = value.toString().split("\s+");
            if (fields.length == 3) {
                String year = fields[0];
                String month = fields[1];
                String temperature = fields[2];
                context.write(new Text(year), new Text(month + " " + temperature));y
            }
        }
    }

    public static class TempReducer extends Reducer<Text, Text, Text, Text> {
        public void reduce(Text key, Iterable<Text> values, Context context) throws
IOException, InterruptedException {
            String maxMonth = "";
            int maxTemp = Integer.MIN_VALUE;

            for (Text val : values) {
                String[] parts = val.toString().split(" ");
                String month = parts[0];
                int temp = Integer.parseInt(parts[1]);

                if (temp > maxTemp) {
                    maxTemp = temp;
                    maxMonth = month;
                }
            }
            context.write(key, new Text(maxMonth + " " + maxTemp));
        }
    }

    public static void main(String[] args) throws Exception {
        Configuration conf = new Configuration();
        Job job = Job.getInstance(conf, "Max Temperature Month");
```

```
job.setJarByClass(MaxTemperatureMonth.class);
        job.setMapperClass(TempMapper.class);
        job.setReducerClass(TempReducer.class);

        job.setMapOutputKeyClass(Text.class);
        job.setMapOutputValueClass(Text.class);
        job.setOutputKeyClass(Text.class);
        job.setOutputValueClass(Text.class);

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

        System.exit(job.waitForCompletion(true) ? 0 : 1);
    }
}
```

Step 1:

```
parinagarg@Ubuntu:~$ nano MaxTemperatureMonth.java
parinagarg@Ubuntu:~$
```

Step 2:



Step 3:

```
parinagarg@Ubuntu:~$ javac -cp $(hadoop classpath) MaxTemperatureMonth.java
parinagarg@Ubuntu:~$
```

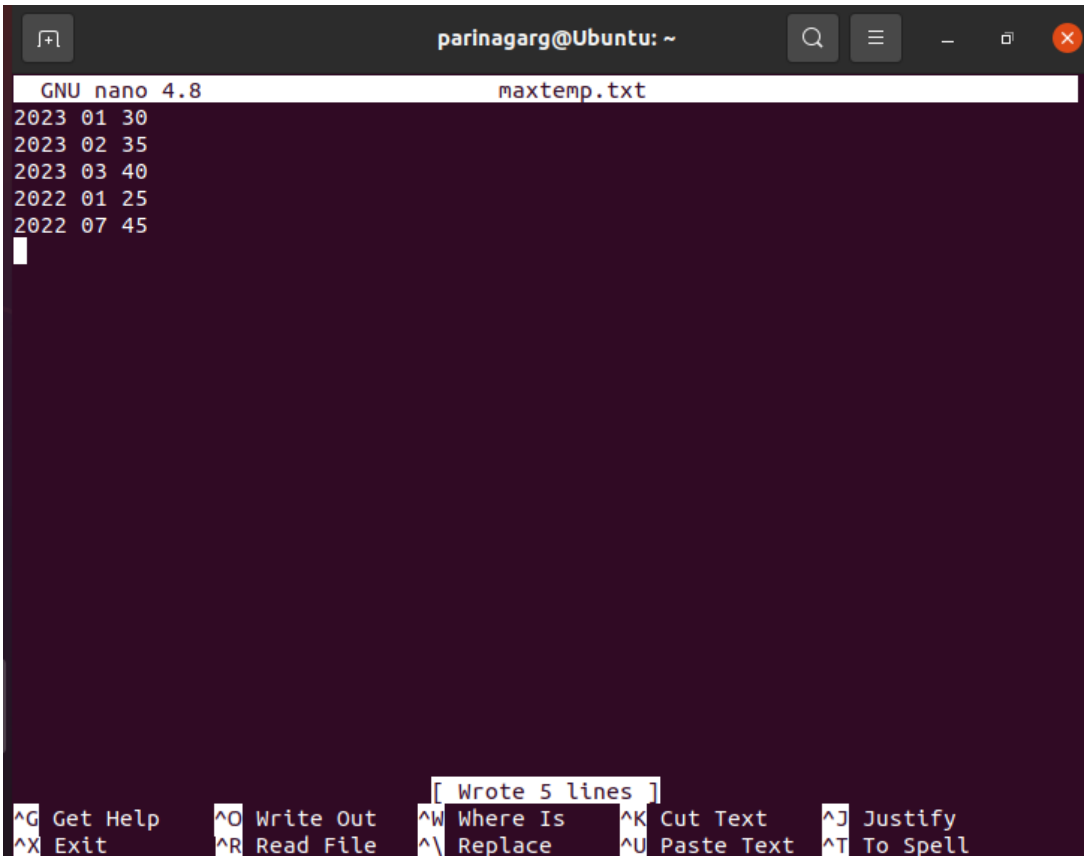
Step 4:

```
parinagarg@Ubuntu:~$ jar cvf mtm.jar MaxTemperatureMonth*.class
added manifest
adding: MaxTemperatureMonth$TempMapper.class(in = 1990) (out= 808)(deflated 59%
)
adding: MaxTemperatureMonth$TempReducer.class(in = 2316) (out= 997)(deflated 56
%)
adding: MaxTemperatureMonth.class(in = 1559) (out= 825)(deflated 47%)
```

Step 5:

```
parinagarg@Ubuntu:~$ nano maxtemp.txt
parinagarg@Ubuntu:~$
```

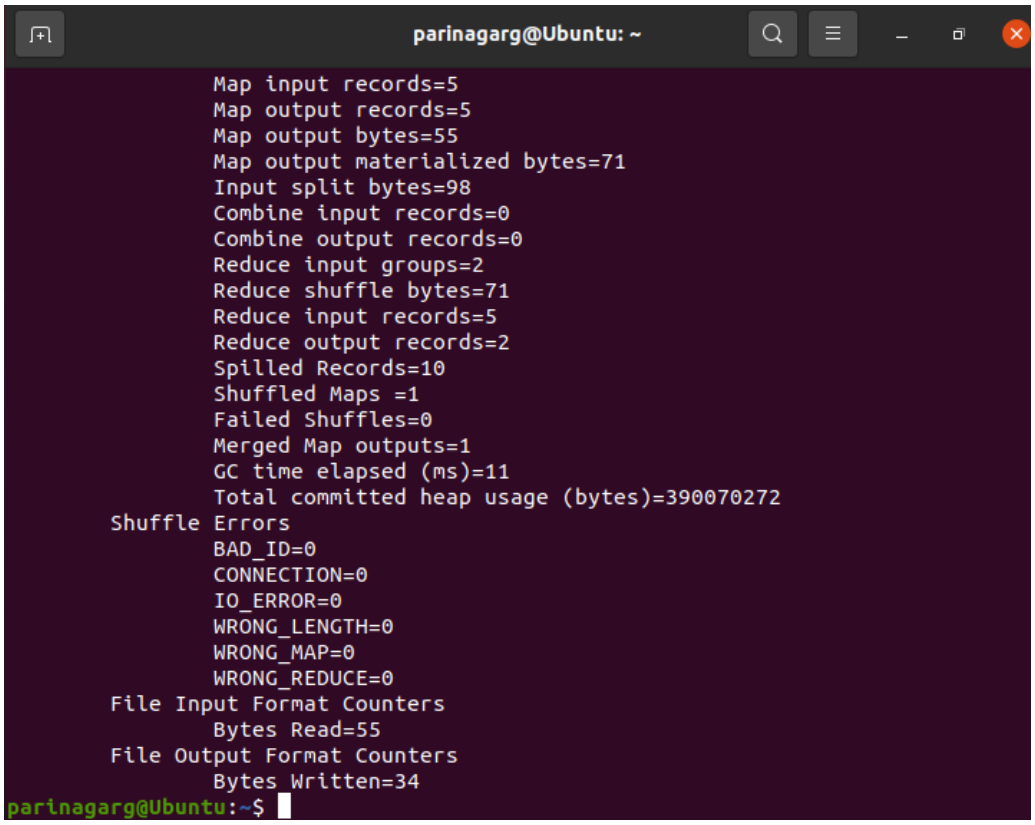
Step 6:



Step 7:

```
parinagarg@Ubuntu:~$ hadoop jar mtm.jar MaxTemperatureMonth maxtemp.txt output_
mtm
2025-03-25 10:09:58,759 INFO impl.MetricsConfig: Loaded properties from hadoop-
metrics2.properties
2025-03-25 10:09:58,864 INFO impl.MetricsSystemImpl: Scheduled Metric snapshot
period at 10 second(s).
2025-03-25 10:09:58,864 INFO impl.MetricsSystemImpl: JobTracker metrics system
started
2025-03-25 10:09:58,941 WARN mapreduce.JobResourceUploader: Hadoop command-line
 option parsing not performed. Implement the Tool interface and execute your ap
plication with ToolRunner to remedy this.
2025-03-25 10:09:59,031 INFO input.FileInputFormat: Total input files to proces
s : 1
```

Step 8:



Step 9:

```
parinagarg@Ubuntu:~$ hdfs dfs -cat output_mtm/part-r-00000
2022    07 45
2023    03 40
```

Learning Outcomes:

EXPERIMENT-12

Title -: Develop a map reduce program to Sort and aggregate the data in Hadoop.

Introduction -

Code:

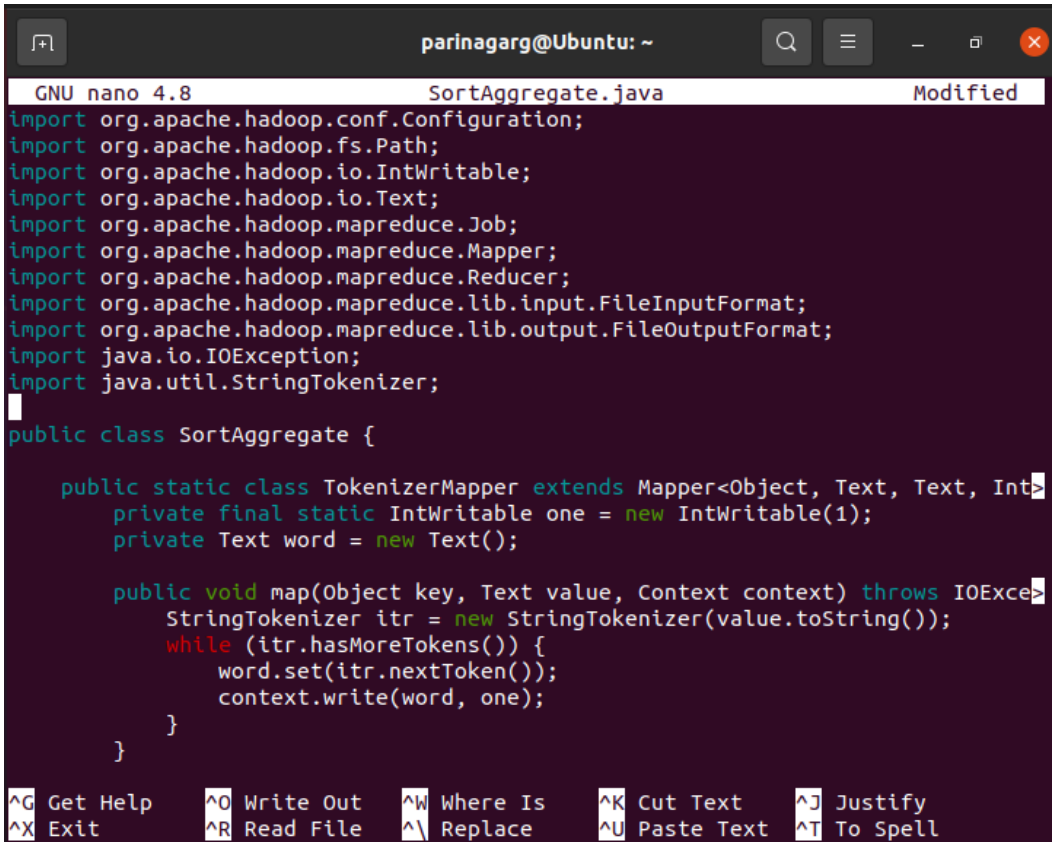
```
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Job;
import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
import java.io.IOException;
import java.util.StringTokenizer;

public class SortAggregate {

    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, "sort and aggregate");
        job.setJarByClass(SortAggregate.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);
    }
}
```

Step 1:

```
parinagarg@Ubuntu:~$ nano SortAggregate.java
parinagarg@Ubuntu:~$
```

Step 2:



Step 3:

```
parinagarg@Ubuntu:~$ javac -cp $(hadoop classpath) SortAggregate.java
parinagarg@Ubuntu:~$
```

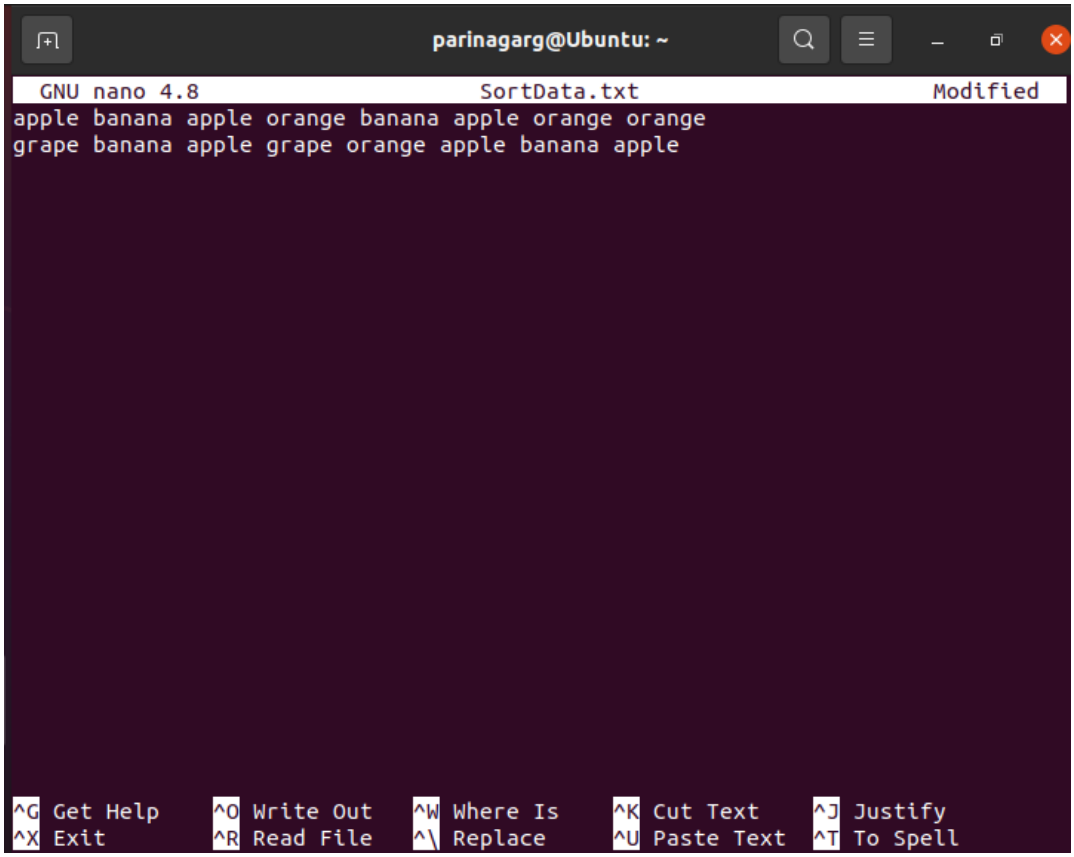
Step 4:

```
parinagarg@Ubuntu:~$ jar cvf sa.jar SortAggregate*.class
added manifest
adding: SortAggregate$IntSumReducer.class(in = 1767) (out= 756)(deflated 57%)
adding: SortAggregate$TokenizerMapper.class(in = 1764) (out= 766)(deflated 56%)
adding: SortAggregate.class(in = 1535) (out= 834)(deflated 45%)
parinagarg@Ubuntu:~$
```

Step 5:

```
parinagarg@Ubuntu:~$ nano SortData.txt
parinagarg@Ubuntu:~$
```

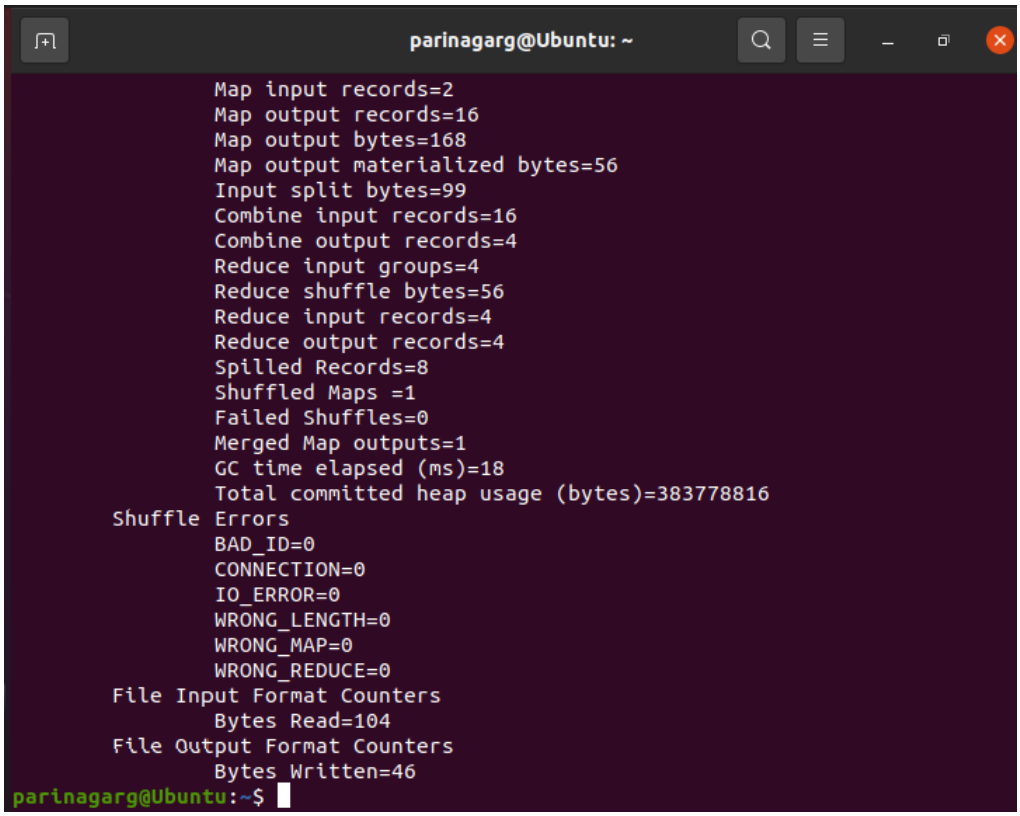
Step 6:



Step 7:

```
parinagarg@Ubuntu:~$ hadoop jar sa.jar SortAggregate SortData.txt output_sa
2025-04-06 16:28:34,619 INFO impl.MetricsConfig: Loaded properties from hadoop-
metrics2.properties
2025-04-06 16:28:34,808 INFO impl.MetricsSystemImpl: Scheduled Metric snapshot
period at 10 second(s).
2025-04-06 16:28:34,809 INFO impl.MetricsSystemImpl: JobTracker metrics system
started
2025-04-06 16:28:34,907 WARN mapreduce.JobResourceUploader: Hadoop command-line
 option parsing not performed. Implement the Tool interface and execute your ap
plication with ToolRunner to remedy this.
2025-04-06 16:28:35,006 INFO input.FileInputFormat: Total input files to proces
s : 1
```

Step 8:



Step 9:

```
parinagarg@Ubuntu:~$ hdfs dfs -cat output_sa/part-r-00000
apple   6
banana  4
grape   2
orange  4
```

Learning Outcomes: