Map Reduce Analysis on Motor Vehicle Collisions in New York City

Statement and Summary

The below New York city datasets track several measurable collision statistics. The goal is to measure certain patterns/trends with this data and identify if certain factors contribute more to these
crashes and formulate solutions to mitigate them and improve people's safety.

There are three datasets that track information on crashes that took place in New York city

Collisions – Crashes
Collisions – Vehicles
Collisions -- Persons

https://data.cityofnewyork.us/Public-Safety/Motor-Vehicle-Collisions-Crashes/h9gi-nx95

https://data.cityofnewyork.us/Public-Safety/Motor-Vehicle-Collisions-Vehicles/bm4k-52h4/data#Filter

https://data.cityofnewyork.us/Public-Safety/Motor-Vehicle-Collisions-Person/f55k-p6yu/data

I have filtered the dataset to include only records from 2019 onwards

Collisions – Crashes Data set

This data records the location details of a crash event – Borough, Street Name, Latitude and Longitude etc.

Table Preview

View Data | Create Visualization

CRASH DATE	CRASH TIME	BOROUGH	ZIP C...	LATI...	LON...	LOCA...	ON S...	CROS...	OFF S...
04/13/2021	0:00	BROOKLYN	11222	40.726444	-73.95233	(40.72644...			745 MAN...
04/13/2021	0:00	BROOKLYN	11231	40.678524	-74.0021	(40.67852...			667 HEN...
04/13/2021	0:00	QUEENS	11420	40.677498	-73.8276	(40.67749...	111 STREET	ROCKAW...	
04/13/2021	0:00						ALEXAND...		
04/13/2021	0:00			40.877235	-73.91781	(40.87723...	JOHNSON...		
04/13/2021	0:00			40.90021	-73.8865	(40.90021...	MOSHOL...		
04/13/2021	0:07	BRONX	10456	40.82942	-73.91226	(40.82942...	EAST 166 ...	CLAY AVE...	
04/13/2021	0:15	QUEENS	11378	40.727432	-73.90713	(40.72743...	LONG ISL...	MAURICE ...	
04/13/2021	0:45			40.843956	-73.8978	(40.84395...	CROSS B...		
04/13/2021	10:00	BRONX	10463				Ft indepe...	Bailey pla...	
04/13/2021	10:00	BROOKLYN	11207	40.686226	-73.9124	(40.68622...	BUSHWIC...	COVERT S...	
04/13/2021	10:00	BROOKLYN	11209	40.634743	-74.03529	(40.63474...	NARROW...	73 STREET	
04/13/2021	10:00			40.81782	-73.915276	(40.81782...	3 AVENUE	EAST 152 ...	

Collisions – Vehicle Data set

This data set includes information on the vehicles involved in the crash.
There could be multiple vehicle records linked to the same crash id

Table Preview

View Data | Create Visualization

UNIQ...	COLL...	CRAS...	CRAS...	VEHI...	STAT...	VEHI...	VEHI...	VEHI...	VEHI...	TRAV...	VEHI...	DRI
10385780	100201	09/07/2012	9:03	1	NY	PASSENG...						
14887647	3307608	10/02/2015	17:18	2	NY	TAXI						
14889754	3308693	10/04/2015	20:34	1	NY	PASSENG...						
14400270	297666	04/25/2013	21:15	1	NY	PASSENG...						
17044639	3434155	05/02/2016	17:35	219456	NY	4 dr sedan	MERZ -CA...		2015	East	2	M
17303317	3503027	08/18/2016	12:39	672828	NY	Station W...	FORD -CA...		2005	Southwest	2	F
12254536	196425	07/16/2013	11:20	1	NY	PASSENG...						
11804847	2975897	11/26/2012	18:12	2	NY	PASSENG...						
17285715	3487936	07/22/2016	15:40	554272	NY	Convertible	VOLK -CA...		2013	South	1	M
14809587	3268858	08/01/2015	8:17	2	NJ	PASSENG...						
17307366	3499697	08/13/2016	21:05	650962	NY	Sedan	NISS -CAR...		2015	West	2	F
11912713	176016	08/11/2012	19:36	2	NY	BICYCLE						
17401424	3516125	09/08/2016	14:40	764668	NY	Station W...	LINC -CA...		2015	West	1	M

MERZ -CAR/SUV

Crashes – Persons

This dataset includes information on the persons involved in the crash and what their role was – whether they were an vehicle occupant, pedestrian, cyclists etc

Table Preview

View Data | Create Visualization

UNIQ...	COLL...	CRAS...	CRAS...	PERS...	PERS...	PERS...	VEHI...	PERS...	EJECT...	EMO...	BODI...	POS
6650180	3565527	11/21/2016	13:05	2782525	Occupant	Unspecifi...						
5783504	3428861	03/29/2016	16:30	204724	Occupant	Unspecifi...						
6377814	3491131	07/06/2016	1:51	1380463	Occupant	Unspecifi...						
6341088	3487108	07/19/2016	21:50	1273001	Occupant	Unspecifi...						
6618640	3577702	12/10/2016	6:01	2994887	Occupant	Unspecifi...						
6687364	3565713	11/22/2016	18:30	2792542	Occupant	Unspecifi...						
6503982	3464681	06/17/2016	14:00	1004357	Occupant	Unspecifi...						
5733678	3414732	03/14/2016	8:30	97248	Pedestrian	Injured		30	Does Not ...	Conscious	Shoulder ...	Does
6529616	3514065	08/25/2016	14:00	1849393	Pedestrian	Injured		42		Conscious	Knee-Low...	
6482113	3493179	07/29/2016	11:00	1417915	Occupant	Unspecifi...						
5830513	3409015	04/21/2016	21:40	452620	Occupant	Unspecifi...						
5975062	3439295	05/07/2016	20:00	608018	Occupant	Unspecifi...						
6748026	3549869	10/30/2016	12:00	2570219	Pedestrian	Injured		61		Conscious	Entire Body	

There could be multiple records linked to a crash id , depending on the number of persons involved in the crash.

All these data sets are loaded into Hadoop File System.

Analysis Performed

Evaluate top Boroughs in NYC with collisions and the streets within this boroughs with most number of crashes.

Evaluate major contributing factors for crashes by Sex – Male/Female

Analyse if more crashes occur during the day time or night

Analyse which streets have higher number of Pedestrian casualties

Observe monthly trend in Crash numbers

Evaluate the average number of persons affected by month due to collisions

Vehicle make (manufacturers) involved in crashes by percentage

Analyse which type of vehicles are causing accidents with Bicyclists.

Review if persons getting ejected from their vehicles were using any form of safety equipment

Filter data – Vehicle type using Bloom filter to evaluate if a vehicle is member of a set

Files loaded to HDFS

hadoop fs -copyFromLocal ~/downloads/MotorVehiclesSelect.csv /NYC_Project

hadoop fs -copyFromLocal ~/downloads/MotorCrashesSelect.csv /NYC_Crashes

hadoop fs -copyFromLocal ~/downloads/MotorPersonsSelect.csv /NYC_Persons

First Step - Evaluate the top Boroughs in New York City by Crash numbers

```
hadoop jar ~/Desktop/Hadoop_FinalProject/nyc_borough.jar nyc_borough.
DriverClass /NYC_Crashes /NYC_Crash_top5_borough
```

Get the first top 5 boroughs for crashes

```
madhav437@MacBook-Pro hadoop-3.3.1 % hadoop fs
2021-12-11 00:29:04,350 WARN util.NativeCodeLoa
g builtin-java classes where applicable
STATEN ISLAND   13034
MANHATTAN       73019
BRONX   74881
QUEENS  120092
BROOKLYN        142696
madhav437@MacBook-Pro hadoop-3.3.1 %
```

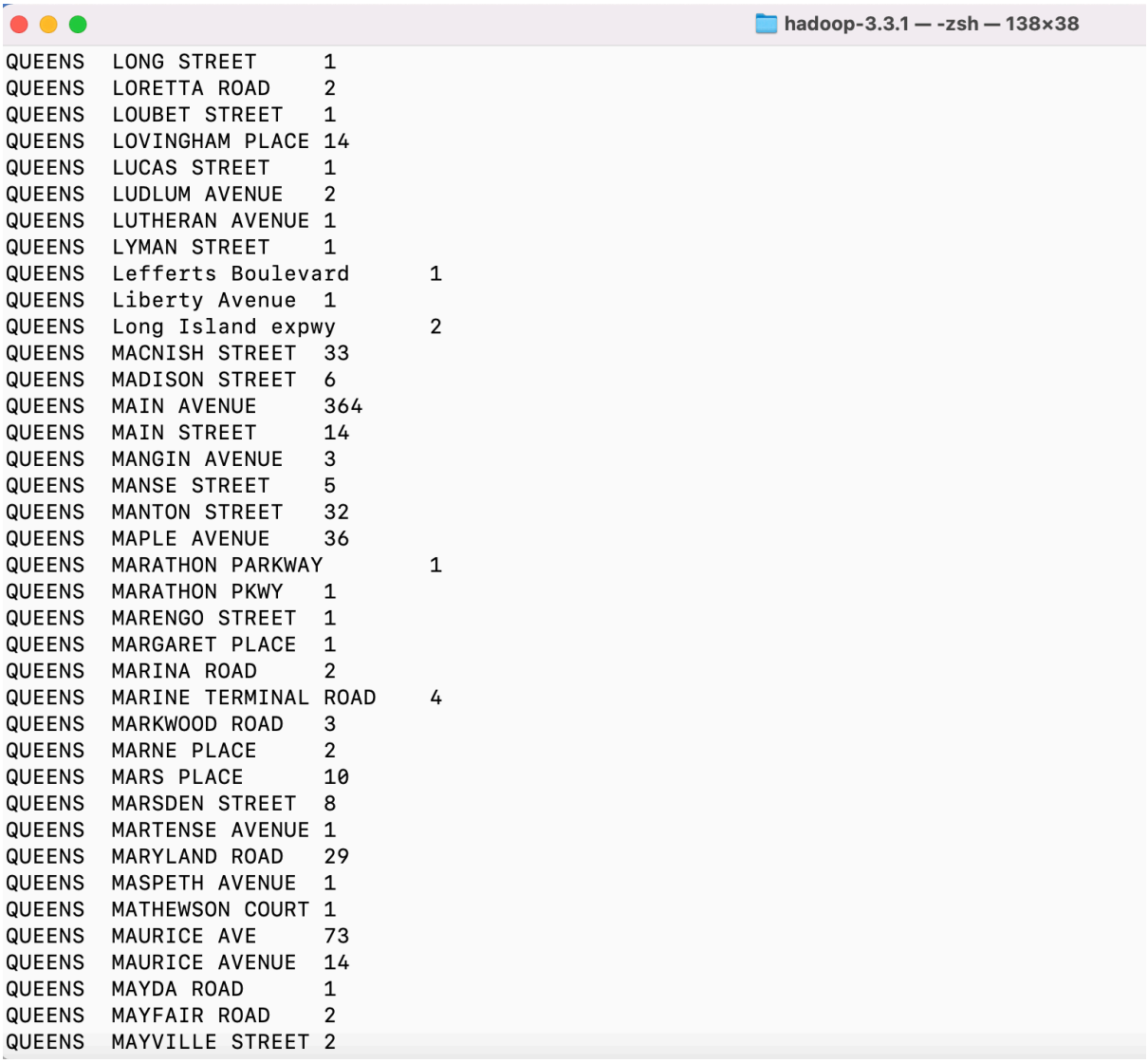
Take a subset of top 3 boroughs in NYC, use Borough as Natural Grouping Key and Secondary sort by Street within these boroughs

```
hadoop jar ~/Desktop/Hadoop_FinalProject/nyc_borough_compare2.jar
nyc_borough_compare2.DriverClass /NYC_Crashes
/NYC_Crash_boroughCompare2
```

Do Secondary sorting based on Streets within the Borough

KeyCompare.java

```java
/* To change this license header, choose License Headers in Project Properties.
package nyc_borough_compare2;

import org.apache.hadoop.io.Text;

public class KeyCompare implements WritableComparable<KeyCompare>{


   // private Date crashDate = new Date();
    private String borough;
    private String streetName;



private final static SimpleDateFormat frmt = new SimpleDateFormat("yyyy-MM-dd");

    public int compareTo(KeyCompare k) {

            int result = 0 ;
            try {
             result = this.borough.compareTo(k.getBorough());
            if(0 == result) {
             result = -1*this.streetName.compareTo(k.getStreetName());

    }
            }
            catch (Exception e) {

                }
            return result;
        }



    @Override
    public String toString() {
        return (new StringBuilder().append(borough).append("\t")
                .append(streetName)).toString();
    }
```



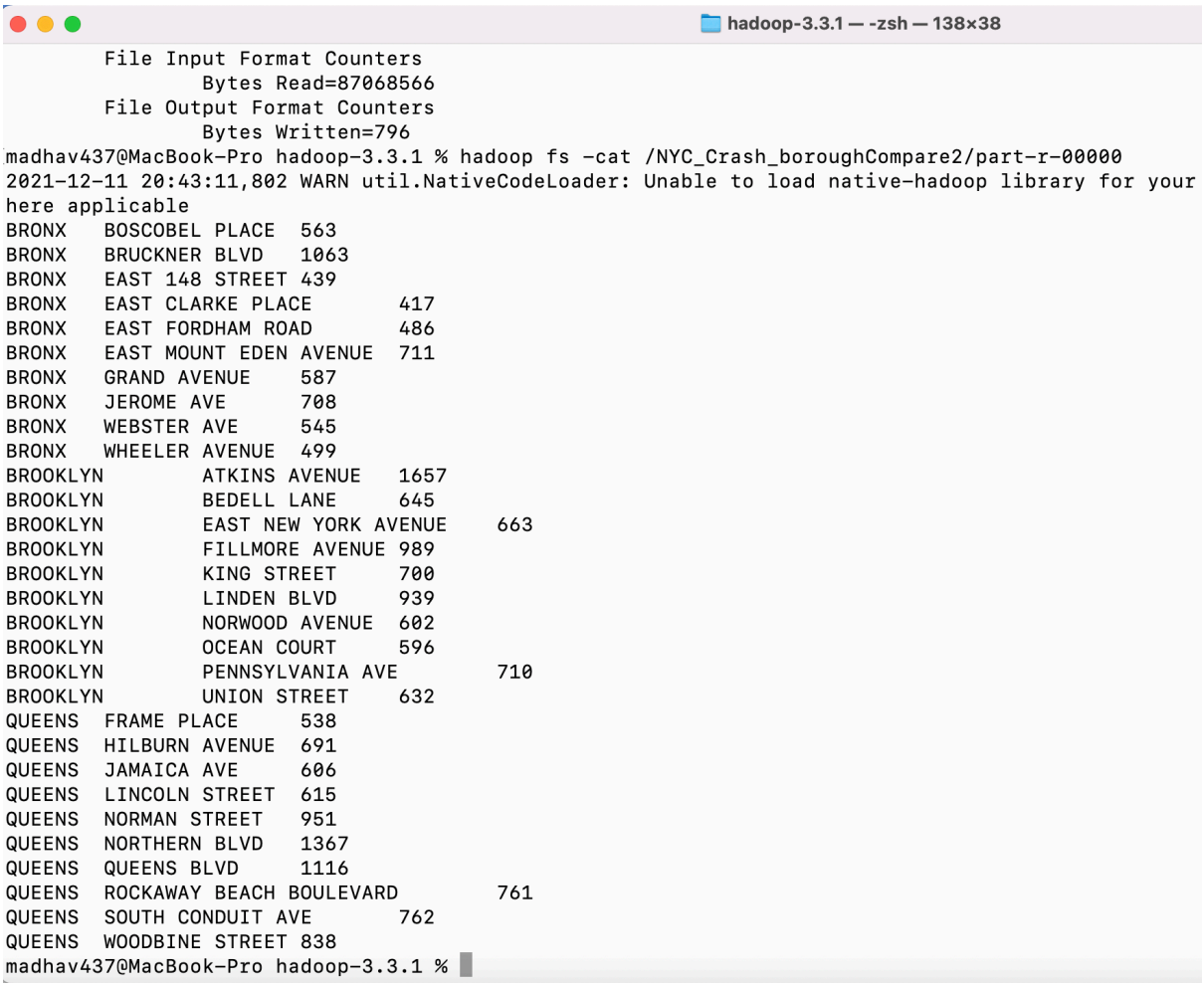
Filter Top 10 streets by crash numbers within the top 3 boroughs – Brooklyn, Bronx and Queens

Using internal tree map within each of the mentioned boroughs

MapperClass.java

```java
public class MapperClass extends Mapper<LongWritable, Text, KeyCompare, IntWritable> {


    //    hadoop datatype
    KeyCompare kc = new  KeyCompare();
    //private final static SimpleDateFormat frmt = new SimpleDateFormat("yyyy-MM-dd");
    IntWritable one = new IntWritable(1);
    String crsDate;
    static final List<String> boroughs = Arrays.asList("BROOKLYN", "QUEENS", "BRONX");


    @Override
    protected void map(LongWritable key, Text value, Mapper.Context context) throws IOExce

        String line = value.toString();

        String[] logs = line.split(",");

        if(logs.length>0 && boroughs.contains(logs[2])
                && !logs[8].isBlank()) {

            String borough = logs[2].trim();



            if (!borough.equals("BOROUGH") && !borough.isEmpty())  {


                kc.setBorough(borough);

                String crsDate = logs[8].trim();

             /*  String[] dateSplit = crsDt.split("/");

                try {

                 crsDate = dateSplit[2]+"/"+dateSplit[0]+"/"+dateSplit[1];
```

```java


    protected void reduce(KeyCompare key, Iterable<IntWritable> values, Context conte

        int sum=0;
        String temp = " ";

        for(IntWritable v: values) {
            if (temp.equals(" "))
                temp = key.getStreetName();


            if (!temp.equals(key.getStreetName())) {
            temp = key.getStreetName();
            tmapTemp.put(sum,key.toString());

            // Add Top 5
             if (tmapTemp.size() > 10)
             {
                 tmapTemp.remove(tmapTemp.firstKey());
             }
            sum = 0;}

            sum += v.get();
```



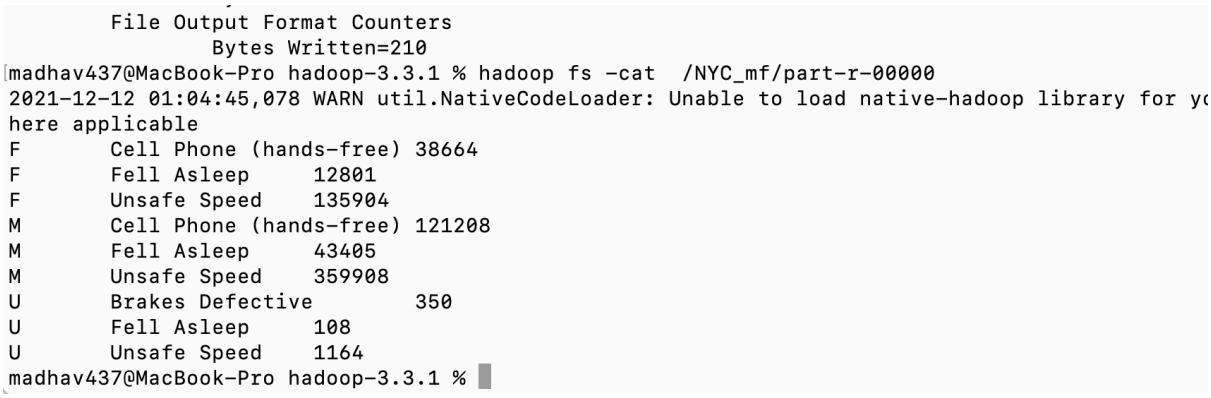
Demographics

Male/Female – Top contributing factors for crashes

Secondary Sort and Top N

Using Natural Key as Driver Sex and top contributing factors by Driver Sex

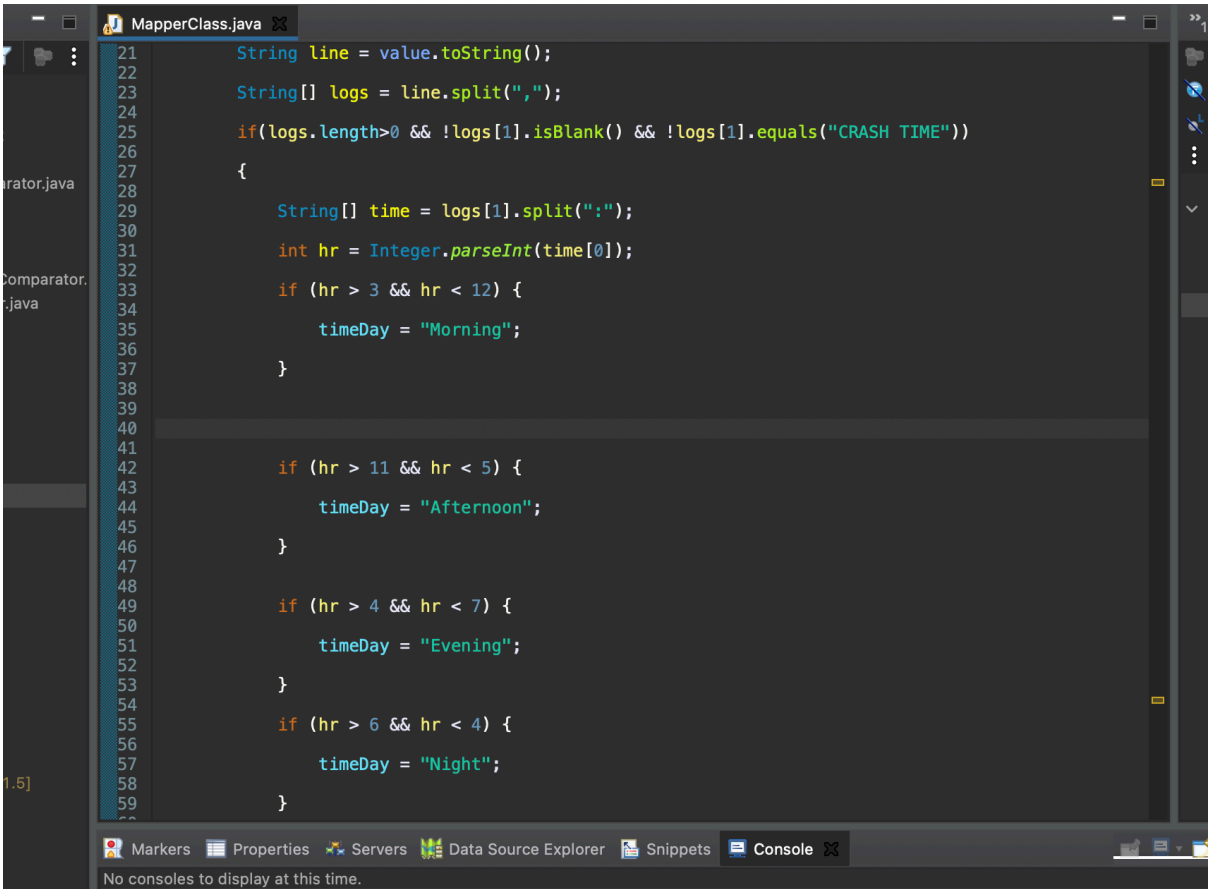
```
hadoop jar ~/Desktop/Hadoop_FinalProject/nyc_mf_compare.jar
nyc_mf_compare.DriverClass /NYC_Project /NYC_mf
```



'Cell Phone' and 'Fell Asleep' are the top factors contributing to crashes for both Males and Females

Evaluate Crashes by time of the day – Morning/Afternoon/Evening/Night

```
hadoop jar ~/Desktop/Hadoop_FinalProject/nyc_crash_time.jar
nyc_crash_time.DriverClass /NYC_Crashes /NYC_time
```




```
                Bytes Written=29
madhav437@MacBook-Pro hadoop-3.3.1 % hadoop fs -cat  /NYC_time/part-r-00000
2021-12-12 02:01:48,471 WARN util.NativeCodeLoader: Unable to load native-hadoop library for yo
here applicable
Evening 59332
Morning 364383
madhav437@MacBook-Pro hadoop-3.3.1 %
```

Evening and Morning (during rush hours) seem to be the ones when most of the crashes take place.

Joining Two Datasets to evaluate Streets where more Pedestrians are affected with collisions

This would need inner joining of **Crashes** and **Persons** datasets using Collision id as key

File inputs would be done using Multiple Inputs

```
public class DriverClass2 extends Configured implements Tool {
  private static final String DATA_SEPARATOR = ",";
  public int run(String[] args) throws Exception {
    Configuration configuration = new Configuration();
  //  configuration.set("mapreduce.output.textoutputformat.separator", DATA_SEPARATOR);
    Job job = Job.getInstance(configuration);
    job.setJobName("New Job");
    job.setJarByClass(DriverClass2.class);
    // Map
    job.setMapOutputKeyClass(Text.class);
    job.setMapOutputValueClass(Text.class);
    // Job
    job.setOutputKeyClass(LongWritable.class);
    job.setOutputValueClass(Text.class);
    job.setInputFormatClass(TextInputFormat.class);
    job.setOutputFormatClass(TextOutputFormat.class);
    job.setReducerClass(ReducerClass.class);
    MultipleInputs.addInputPath(job, new Path(args[0]), TextInputFormat.class,
        CrashMapperClass.class);
    MultipleInputs.addInputPath(job, new Path(args[1]), TextInputFormat.class,
            PersonMapperClass.class);
    FileOutputFormat.setOutputPath(job, new Path(args[2]));
    job.waitForCompletion(true);
    return 0;
  }
  public static void main(String[] args) throws Exception {
    if (args.length == 3) {
      int result = ToolRunner.run(new Configuration(), new DriverClass2(), args);
      if (0 == result) {
        System.out.println("");
      } else {
        System.out.println("");
      }
    } else {
      System.out.println("USAGE <InputPath1><InputPath2><OutputPath>");
    }
```

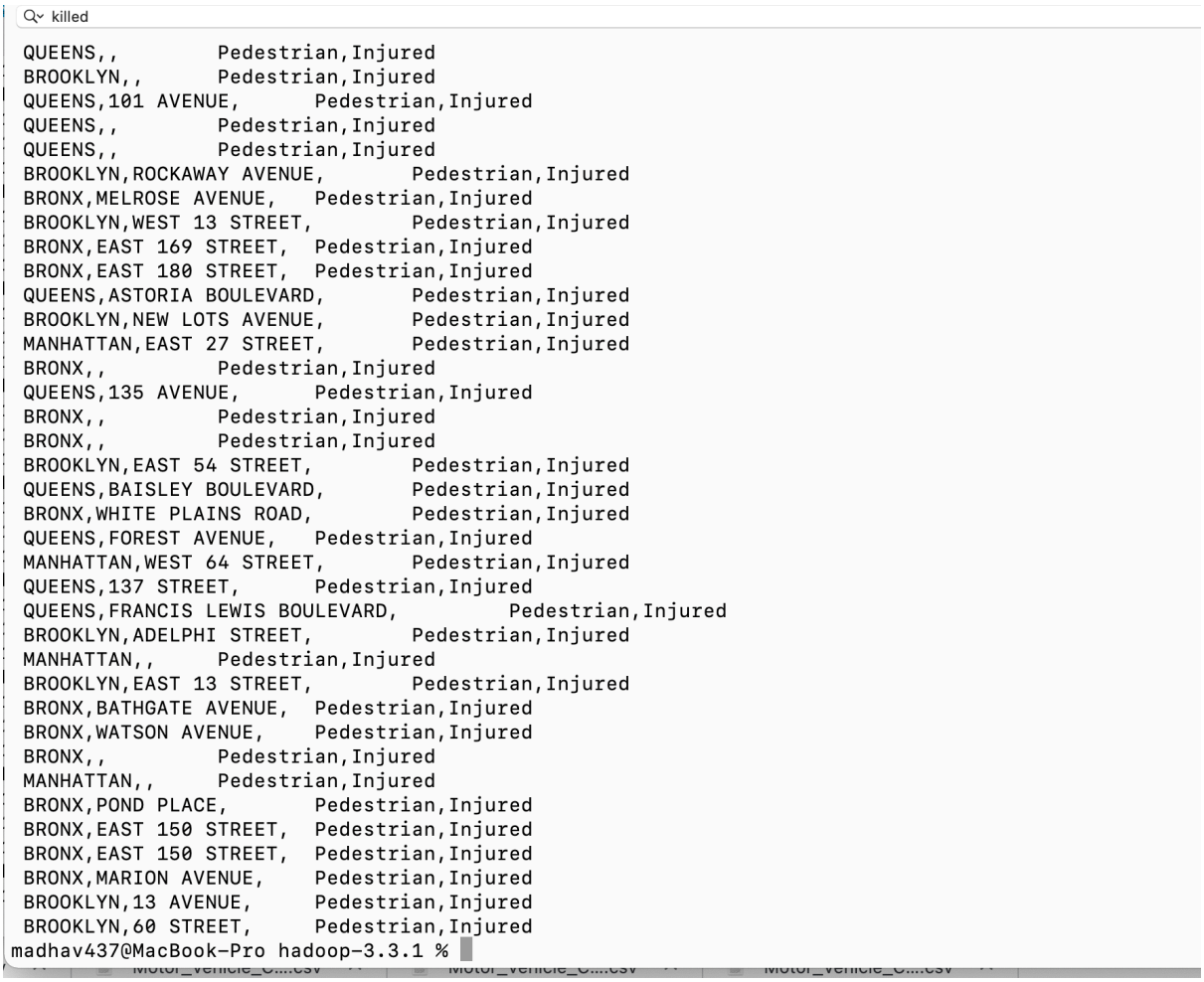
```
hadoop jar
~/Desktop/Hadoop_FinalProject/nyc_ped_compare.jar
nyc_ped_compare.DriverClass2  /NYC_Crashes
/NYC_Persons /NYC_Out2
```

ReducerClass.java | PersonMapperClass.java

```
    String tempVal= " ";
    String tempVal1= " ";

    @Override
    protected void map(LongWritable key, Text value, Mapper.Context context) throws IOException,

        String line = value.toString();

        String[] logs = line.split(",");




        if(logs.length>0
        //  && !logs2[1].isBlank()
        //    && !logs2[2].isBlank()
            && !logs[1].isBlank()
            && !logs[1].equals("COLLISION_ID")
            &&  logs[5].equals("Pedestrian")
            &&  (logs[6].equals("Injured") || logs[6].equals("Killed")))



        {




            String colId = logs[1];

            tempVal = logs[5].trim()+ "," + logs[6];
        //  String tempVal  = logs2[1].trim() + ' ' + logs2[2].trim();

            tempVal  = "Z" + " " + tempVal ;
```

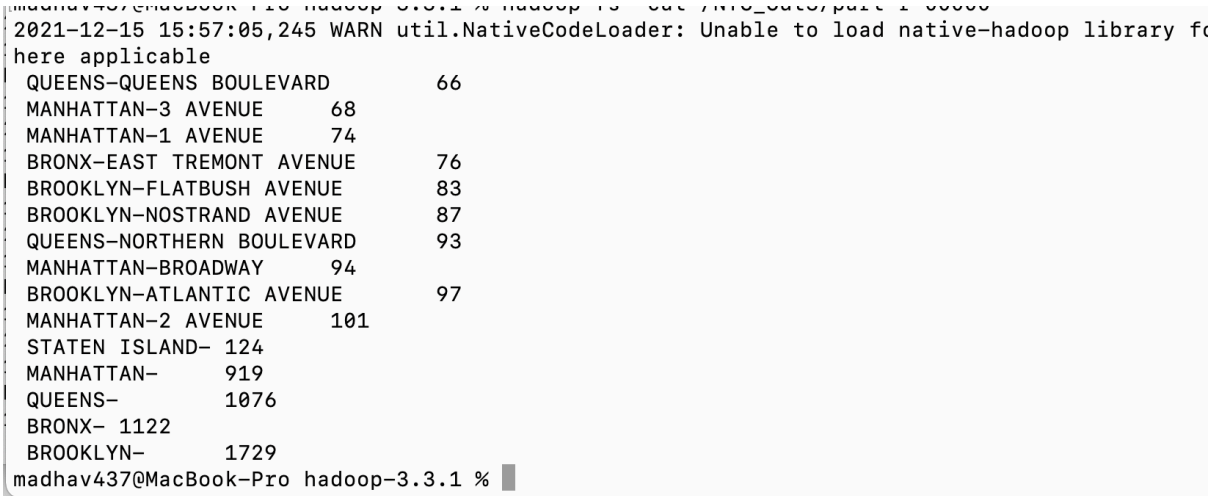
ReducerClass.java

```


    @Override
    protected void reduce(Text key, Iterable<Text> values, Context context) throws IOException,

      listA.clear();
      listB.clear();


      for(Text v: values) {
          if (v.charAt(0) == 'Y')
              listA.add(new Text(v.toString().substring(1)+ ","));
          else if (v.charAt(0) == 'Z')
              listB.add(new Text(v.toString().substring(1)));
      }

         executeJoin(context);


}

    private void executeJoin(Context context) throws IOException,
    InterruptedException{

        if(!listA.isEmpty() && !listB.isEmpty())
        {
            for(Text A: listA){

                for(Text B : listB)
                {
                    context.write(A,B);
                    }
            }

        }

}
```




```
hadoop jar ~/Desktop/Hadoop_FinalProject/nyc_ped_compare2.jar nyc_ped_compare2.DriverClass  /NYC_Out2/part-r-00000 /NYC_Out3
```

This output shows the top 15 locations where Pedestrians are getting injured or killed



Accidents by Month – Breakup using Crashes dataset

```
hadoop jar
~/Desktop/Hadoop_FinalProject/nyc_crash_month.jar
nyc_crash_month.DriverClass  /NYC_Crashes  /NYC_Out4
```

```
        File Output Format Counters
                Bytes Written=158
madhav437@MacBook-Pro hadoop-3.3.1 % hadoop fs -cat /NYC_Out4/part-r-00000
2021-12-15 16:23:34,258 WARN util.NativeCodeLoader: Unable to load native-hadoop library fo
here applicable
December        25435
April   29705
November        32918
May     36029
February        36731
August  36900
September       37022
March   37092
October 37477
July    37695
June    37761
January 38960
madhav437@MacBook-Pro hadoop-3.3.1 %
```

Average number of people getting affected by month using Combiner

```
hadoop-3.3.1 % hadoop jar
~/Desktop/Hadoop_FinalProject/nyc_month_avg.jar
nyc_month_avg.DriverClass  /NYC_Crashes /NYC_Out6
```

DriverClass.java | Reducer2Class.java | MapperClass.java | CombinerClass.java

```
        Configuration conf = new Configuration();
        // Create a new Job
        Job job = Job.getInstance(conf,"logcount");
        job.setJarByClass(DriverClass.class);

        // Specify various job-specific parameters
        job.setJobName("myJob");


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


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

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

        job.setMapperClass(MapperClass.class);
        job.setReducerClass(Reducer2Class.class);
        job.setCombinerClass(CombinerClass.class);

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

        // Submit the job, then poll for progress until the job is complete
        System.exit(job.waitForCompletion(true)?0:1);
```

DriverClass.java | Reducer2Class.java | MapperClass.java | CombinerClass.java

```java
public class CombinerClass extends Reducer<Text, Text, Text, Text>  {


  Text mainValue = new Text();
  String mainVal = " ";


    @Override
    protected void reduce(Text key, Iterable<Text> values, Context context) throws IOException, Interru

        int sum=0;
        int cnt=0;
        String num = " ";

        for(Text v: values) {
            num = v.toString();
            sum += Integer.parseInt(num);
            cnt += 1;}

         mainVal  = String.valueOf(sum) + "," + String.valueOf(cnt);


        context.write(key,mainValue);
```

DriverClass.java | Reducer2Class.java | MapperClass.java | CombinerClass.java

```java
    }

    @Override
    protected void reduce(Text key, Iterable<Text> values, Context context) throws IOException, Interru

        int sum=0;
        int cnt=0;


        for(Text v: values) {
            String nums = v.toString();
            String num1 [] = nums.split(",");
            sum += Integer.parseInt(num1[0]);
            sum += Integer.parseInt(num1[1]);

        }
        float sum2 = (float)sum/cnt;



        tmap.put(sum2,key.toString());




       if (tmap.size() > 12)
        {
            tmap.remove(tmap.firstKey());
        }
    }
```

For every 10 crashes – 3 people are getting killed or injured.

```
February        0.2943835
January 0.3032084
March   0.30650815
December        0.34027913
April   0.34600237
May     0.3713675
November        0.3741418
June    0.3898202
October 0.3925074
July    0.39551663
September       0.40659606
August  0.4119512
madhav437@MacBook-Pro hadoop-3.3.1 %
```

Top Car manufacturers involved in crashes by percentage

```
34
35                String [] vehMk = logs[7].split("-");
36
37                if (vehMk[0].equals("CHEV ")) {
38
39                    vehicleMake = "CHEVROLET";
40
41                }
42
43                if (vehMk[0].equals("FORD ")) {
44
45                    vehicleMake = "FORD";
46
47                }
48
49               if (vehMk[0].equals("NISS ")) {
50
51                    vehicleMake = "NISSAN";
52
53                }
54               if (vehMk[0].equals("HOND ")) {
55
56                vehicleMake = "HONDA";
57
58               }
59
60               if (vehMk[0].equals("TOYT ")) {
61
62                    vehicleMake = "TOYOTA";
63
64                   }
65
66
67
68
69
70                vehicle.set(vehicleMake);
```

MapperClass.java | Reducer2Class.java

```
        {

            //Count Total Records


            for (Map.Entry<Integer, String> entry : tmap.entrySet())
            {

                 totSum += entry.getKey();



            }


            for (Map.Entry<Integer, String> entry : tmap.entrySet())
            {

                int count = entry.getKey();
                double percentage = ((float)count/totSum)*100;

                DecimalFormat df = new DecimalFormat("#,###,##0.00");

                String per =  String.valueOf(df.format(percentage)) + " %" ;


                String name = entry.getValue();

                context.write(new Text(name), new Text(per));
            }
        }

}
```

```
here applicable
CHEVROLET       8.87 %
FORD    15.40 %
NISSAN  19.55 %
HONDA   23.85 %
TOYOTA  32.33 %
madhav437@MacBook-Pro hadoop-3.3.1 %
```

Evaluate Bicyclists hit by vehicles

Bicyclists come from Persons dataset

Vehicles information comes from Vehicles dataset

Using Pig

```
crashes = LOAD 'hdfs://localhost:9000/NYC_Crashes' USING  PigStorage(',')
as
(CRASH_DATE,CRASH_TIME,BOROUGH,ZIP_CODE,LATITUDE,LONGITUDE,LOCATION,ON_STR
EET_NAME,CROSS_STREET_NAME,OFF_STREET_NAME,NUMBER_OF_PERSONS_INJURED,N
UMBER_OF_PERSONS_KILLED,NUMBER_OF_PEDESTRIANS_INJURED,NUMBER_OF_PEDESTR
IANS_KILLED,NUMBER_OF_CYCLIST_INJURED,NUMBER_OF_CYCLIST_KILLED,NUMBER_OF_
MOTORIST_INJURED,NUMBER_OF_MOTORIST_KILLED,CONTRIBUTING_FACTOR_VEHICLE_1,
CONTRIBUTING_FACTOR_VEHICLE_2,CONTRIBUTING_FACTOR_VEHICLE_3,CONTRIBUTING_
FACTOR_VEHICLE_4,CONTRIBUTING_FACTOR_VEHICLE_5,COLLISION_ID,VEHICLE_TYPE_CO
```

```
DE_1,VEHICLE_TYPE_CODE_2,VEHICLE_TYPE_CODE_3,VEHICLE_TYPE_CODE_4,VEHICLE_TYP
E_CODE_5);

persons = LOAD 'hdfs://localhost:9000/NYC_Persons' USING  PigStorage(',')
as
(UNIQUE_ID,COLLISION_ID,CRASH_DATE,CRASH_TIME,PERSON_ID,PERSON_TYPE:chararray,
PERSON_INJURY,VEHICLE_ID,PERSON_AGE,EJECTION,EMOTIONAL_STATUS,BODILY_INJURY,
POSITION_IN_VEHICLE,SAFETY_EQUIPMENT,PED_LOCATION,PED_ACTION,COMPLAINT,PED
_ROLE,CONTRIBUTING_FACTOR_1,CONTRIBUTING_FACTOR_2,PERSON_SEX);

filter_bicylists = FILTER persons BY PERSON_TYPE == 'Bicyclist';

crash_persons = JOIN crashes BY COLLISION_ID, filter_bicylists BY COLLISION_ID;

group_veh_hittingBicyclists  = GROUP crash_persons by VEHICLE_TYPE_CODE_1;

count_veh = foreach group_veh_hittingBicyclists  generate group, COUNT(crash_persons)as
veh_cnt;

vehicle_order = ORDER count_veh BY veh_cnt DESC;
```

```
(Bike,530)
(Sedan,247)
(Station Wagon/Sport Utility Vehicle,216)
(Taxi,33)
(E-Bike,29)
(E-Scooter,29)
(Box Truck,10)
(E-Bik,9)
(Pick-up Truck,8)
(Bus,5)
(Convertible,5)
(E-Sco,5)
(Van,3)
(Dump,2)
(Moped,2)
(Pedicab,2)
(Flat Rack,1)
(PK,1)
(SCOOTER,1)
(Motorcycle,1)
(Horse,1)
(Garbage or Refuse,1)
(Motorbike,1)
```

```
 STORE vehicle_order  INTO 'hdfs://localhost:9000/NYC_Bicylists';
```

Evaluate if persons ejected from their motor vehicles were using safety equipment

```
crashes = LOAD 'hdfs://localhost:9000/NYC_Crashes' USING  PigStorage(',')
as
(CRASH_DATE,CRASH_TIME,BOROUGH,ZIP_CODE,LATITUDE,LONGITUDE,LOCATION,ON_STR
EET_NAME,CROSS_STREET_NAME,OFF_STREET_NAME,NUMBER_OF_PERSONS_INJURED,N
UMBER_OF_PERSONS_KILLED,NUMBER_OF_PEDESTRIANS_INJURED,NUMBER_OF_PEDESTR
IANS_KILLED,NUMBER_OF_CYCLIST_INJURED,NUMBER_OF_CYCLIST_KILLED,NUMBER_OF_
```

```
MOTORIST_INJURED,NUMBER_OF_MOTORIST_KILLED,CONTRIBUTING_FACTOR_VEHICLE_1,
CONTRIBUTING_FACTOR_VEHICLE_2,CONTRIBUTING_FACTOR_VEHICLE_3,CONTRIBUTING_
FACTOR_VEHICLE_4,CONTRIBUTING_FACTOR_VEHICLE_5,COLLISION_ID,VEHICLE_TYPE_CO
DE_1,VEHICLE_TYPE_CODE_2,VEHICLE_TYPE_CODE_3,VEHICLE_TYPE_CODE_4,VEHICLE_TYP
E_CODE_5);


persons = LOAD 'hdfs://localhost:9000/NYC_Persons' USING  PigStorage(',')
as
(UNIQUE_ID,COLLISION_ID,CRASH_DATE,CRASH_TIME,PERSON_ID,PERSON_TYPE:chararray,
PERSON_INJURY,VEHICLE_ID,PERSON_AGE,EJECTION,EMOTIONAL_STATUS,BODILY_INJURY,
POSITION_IN_VEHICLE,SAFETY_EQUIPMENT,PED_LOCATION,PED_ACTION,COMPLAINT,PED
_ROLE,CONTRIBUTING_FACTOR_1,CONTRIBUTING_FACTOR_2,PERSON_SEX);

filter_ejection= FILTER persons BY EJECTION == 'Ejected';

group_ejections = GROUP filter_ejection by SAFETY_EQUIPMENT;

count_ejections = foreach group_ejections generate group, COUNT(filter_ejection)as
saf_cnt;

SafetyEquip = ORDER count_ejections BY saf_cnt DESC;

STORE SafetyEquipINTO 'hdfs://localhost:9000/NYC_SafetyEq';
```

```
2021-12-15 22:33:12,822 [main] INFO  org.apache.pig.backend.hadoop.executio
(None,4004)
(Helmet (Motorcycle Only),1388)
(Unknown,1083)
(Helmet Only (In-Line Skater/Bicyclist),983)
(Helmet/Other (In-Line Skater/Bicyclist),307)
( or rear passenger on a bicycle,205)
(Lap Belt & Harness,132)
(Other,116)
( if two or more persons,60)
( or passenger lying across a seat",56)
(Lap Belt,39)
( pick-up truck,24)
(Air Bag Deployed,11)
(Air Bag Deployed/Lap Belt/Harness,6)
(Harness,4)
(Stoppers Only (In-Line Skater/Bicyclist),4)
(Pads Only (In-Line Skater/Bicyclist),2)
(Air Bag Deployed/Lap Belt,1)
(Child Restraint Only,1)
grunt>
```

Bloom filter to select Vehicle Types involved

```
        String[] logs = line.split(",");

        filter.add(key1);

        if(logs.length>0){
            String vehicle = logs[6].trim();


            if (!vehicle.equals("VEHICLE_TYPE") && !vehicle.isEmpty()) {
                if (filter.membershipTest(new Key(vehicle.trim().getBytes())))
                {
                    vehicleSelect.set(vehicle);



            context.write(vehicleSelect,one);}
        }
    }

    }
```

```
madhav437@MacBook-Pro hadoop-3.3.1 % hadoop fs -cat /NYC_Out8/part
2021-12-16 14:15:02,888 WARN util.NativeCodeLoader: Unable to load
Sedan   541318
madhav437@MacBook-Pro hadoop-3.3.1 %
```

Appendix – Source Codes

nyc_borough

```
package nyc_borough;

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.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 DriverClass {
    public static void main(String[] args) throws IOException,
InterruptedException, ClassNotFoundException  {

        Configuration conf = new Configuration();
        // Create a new Job
        Job job = Job.getInstance(conf,"logcount");
        job.setJarByClass(DriverClass.class);

        // Specify various job-specific parameters
        job.setJobName("myJob");


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


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

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

        job.setMapperClass(MapperClass.class);
        job.setReducerClass(Reducer2Class.class);
       // job.setCombinerClass(ReducerClass.class);

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

        // Submit the job, then poll for progress until the job is
complete
        System.exit(job.waitForCompletion(true)?0:1);


    }

}

package nyc_borough;

import java.io.IOException;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;

public class MapperClass extends Mapper<LongWritable, Text, Text,
IntWritable> {


    //    hadoop datatype
    Text boroughs = new Text();
    IntWritable one = new IntWritable(1);

    @Override
```

```
    protected void map(LongWritable key, Text value, Mapper.Context
context) throws IOException, InterruptedException {

        String line = value.toString();

        String[] logs = line.split(",");

        if(logs.length>0){

         String borough = logs[2];

         if (!borough.equals("BOROUGH") && !borough.isEmpty()) {
         boroughs.set(borough);
         }
         context.write(boroughs,one);
        }
    }



}

package nyc_borough;

import java.io.IOException;
import java.util.Map;
import java.util.TreeMap;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;

public class Reducer2Class extends Reducer<Text, IntWritable, Text,
IntWritable>  {


    private TreeMap<Integer,String> tmap;

    @Override
    public void setup(Context context) throws IOException,
                                      InterruptedException
    {
        tmap = new TreeMap<Integer,String>();
    }

    @Override
    protected void reduce(Text key, Iterable<IntWritable> values,
Context context) throws IOException, InterruptedException {

        int sum=0;
        for(IntWritable v: values)
            sum += v.get();



        tmap.put(sum,key.toString());
```

```
       if (tmap.size() > 5)
        {
            tmap.remove(tmap.firstKey());
        }
    }



        @Override


        public void cleanup(Context context) throws IOException,
                                            InterruptedException

        {


            for (Map.Entry<Integer, String> entry : tmap.entrySet())
            {

                int count = entry.getKey();
                String name = entry.getValue();

                context.write(new Text(name), new
IntWritable(count));
            }
        }

}
```

nyc_borough_compare2

```
package nyc_borough_compare2;

import java.io.IOException;
import java.text.ParseException;
import java.text.SimpleDateFormat;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.io.WritableComparable;
import org.apache.hadoop.io.WritableComparator;
import org.apache.hadoop.mapreduce.Mapper;

public class CompositeKeyComparator extends WritableComparator
{
    protected CompositeKeyComparator()
    {
        super(KeyCompare.class, true);}

    @Override
    public int compare(WritableComparable w1, WritableComparable
w2) {
        KeyCompare k1 = (KeyCompare)w1;
        KeyCompare k2 = (KeyCompare)w2;
        int result = 0;
```

```
        try {
         result = k1.getBorough().compareTo(k2.getBorough());
        if(result == 0) {
         result = -
1*k1.getStreetName().compareTo(k2.getStreetName());

}
        }
        catch (Exception e) {

            }
        return result;
    }
}



package nyc_borough_compare2;

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.io.WritableComparator;
import org.apache.hadoop.mapreduce.Job;
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 DriverClass {
    public static void main(String[] args) throws IOException,
InterruptedException, ClassNotFoundException  {

        Configuration conf = new Configuration();
        // Create a new Job
        Job job = Job.getInstance(conf,"logcount");
        job.setJarByClass(DriverClass.class);

        // Specify various job-specific parameters
        job.setJobName("myJob");


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

        job.setPartitionerClass(NaturalKeyPartitioner.class);

job.setGroupingComparatorClass(NaturalKeyGroupingComparator.class);
        job.setSortComparatorClass(CompositeKeyComparator.class);
        job.setInputFormatClass(TextInputFormat.class);
        job.setOutputFormatClass(TextOutputFormat.class);

        job.setMapOutputKeyClass(KeyCompare.class);
        job.setMapOutputValueClass(IntWritable.class);

        job.setMapperClass(MapperClass.class);
```

```
        job.setReducerClass(ReducerClass2.class);
       // job.setCombinerClass(ReducerClass.class);

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

        // Submit the job, then poll for progress until the job is
complete
        System.exit(job.waitForCompletion(true)?0:1);


    }

}

/*
 * To change this license header, choose License Headers in Project
Properties.
 * To change this template file, choose Tools | Templates
 * and open the template in the editor.
 */
package nyc_borough_compare2;

import org.apache.hadoop.io.Text;

import java.io.DataInput;
import java.io.DataOutput;
import java.io.EOFException;
import java.io.IOException;
import java.text.SimpleDateFormat;
import java.util.Date;

import org.apache.hadoop.io.Writable;
import org.apache.hadoop.io.WritableComparable;
import org.apache.hadoop.io.WritableUtils;

public class KeyCompare implements WritableComparable<KeyCompare>{


   // private Date crashDate = new Date();
    private String borough;
    private String streetName;



private final static SimpleDateFormat frmt = new
SimpleDateFormat("yyyy-MM-dd");

    public int compareTo(KeyCompare k) {

             int result = 0 ;
             try {
              result = this.borough.compareTo(k.getBorough());
             if(0 == result) {
              result = -
1*this.streetName.compareTo(k.getStreetName());

    }
             }
```

```
            catch (Exception e) {

                }
            return result;
        }



    @Override
    public String toString() {
        return (new StringBuilder().append(borough).append("\t")
                .append(streetName)).toString();
    }

    public void readFields(DataInput dataInput) throws IOException
{
        borough = WritableUtils.readString(dataInput);
        streetName = WritableUtils.readString(dataInput);
    }

    public void write(DataOutput dataOutput) throws IOException {
        WritableUtils.writeString(dataOutput, borough);
        WritableUtils.writeString(dataOutput, streetName);
    }



    public String getStreetName() {
        return streetName;
    }


    public void setStreetName(String streetName) {
        this.streetName = streetName;
    }


    public String getBorough() {
        return borough;
    }


    public void setBorough(String borough) {
        this.borough = borough;
    }


}

package nyc_borough_compare2;

import java.io.IOException;
import java.text.ParseException;
import java.text.SimpleDateFormat;
import java.util.Arrays;
import java.util.List;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
```

```
import org.apache.hadoop.io.Text;
import org.apache.hadoop.io.WritableComparable;
import org.apache.hadoop.io.WritableComparator;
import org.apache.hadoop.mapreduce.Mapper;

public class MapperClass extends Mapper<LongWritable, Text,
KeyCompare, IntWritable> {


    //    hadoop datatype
    KeyCompare kc = new  KeyCompare();
    //private final static SimpleDateFormat frmt = new
SimpleDateFormat("yyyy-MM-dd");
    IntWritable one = new IntWritable(1);
    String crsDate;
    static final List<String> boroughs = Arrays.asList("BROOKLYN",
"QUEENS", "BRONX");


    @Override
    protected void map(LongWritable key, Text value, Mapper.Context
context) throws IOException, InterruptedException {

        String line = value.toString();

        String[] logs = line.split(",");

        if(logs.length>0 && boroughs.contains(logs[2])
             && !logs[8].isBlank()) {

         String borough = logs[2].trim();



         if (!borough.equals("BOROUGH") && !borough.isEmpty())  {


             kc.setBorough(borough);

             String crsDate = logs[8].trim();

             /*  String[] dateSplit = crsDt.split("/");

                try {

              crsDate =
dateSplit[2]+"/"+dateSplit[0]+"/"+dateSplit[1];

                } catch (Exception e) {}; */

             kc.setStreetName(crsDate);


         }
         context.write(kc,one);
        }
    }
```

```
}

package nyc_borough_compare2;

import java.io.IOException;
import java.text.ParseException;
import java.text.SimpleDateFormat;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.io.WritableComparable;
import org.apache.hadoop.io.WritableComparator;
import org.apache.hadoop.mapreduce.Mapper;

public class NaturalKeyGroupingComparator extends WritableComparator
{
    protected NaturalKeyGroupingComparator()
    {
        super(KeyCompare.class, true);}


    public int compare(WritableComparable w1, WritableComparable
w2) {
        KeyCompare k1 = (KeyCompare)w1;
        KeyCompare k2 = (KeyCompare)w2;
return k1.getBorough().compareTo(k2.getBorough());}}


package nyc_borough_compare2;

import java.io.IOException;
import java.text.ParseException;
import java.text.SimpleDateFormat;

import org.apache.hadoop.io.DoubleWritable;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.io.WritableComparable;
import org.apache.hadoop.io.WritableComparator;
import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.Partitioner;

public class NaturalKeyPartitioner extends Partitioner<KeyCompare,
DoubleWritable>
{
@Override
public int getPartition(KeyCompare key, DoubleWritable val, int
numPartitions) {
int hash = key.getStreetName().hashCode();
int partition = hash % numPartitions;
return partition;
}
}
```

```
package nyc_borough_compare2;

import java.io.IOException;
import java.util.Map;
import java.util.TreeMap;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.io.WritableComparable;
import org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.mapreduce.Reducer.Context;

public class ReducerClass2 extends Reducer<KeyCompare, IntWritable,
Text, IntWritable>  {

    Text sortKey = new Text();
     private TreeMap<String,Integer> tmap;

     private TreeMap<Integer,String> tmapTemp;

     @Override
        public void setup(Context context) throws IOException,
                                          InterruptedException
        {
            tmap = new TreeMap<String,Integer>();
            tmapTemp = new TreeMap<Integer,String>();

        }


    protected void reduce(KeyCompare key, Iterable<IntWritable>
values, Context context) throws IOException, InterruptedException {

        int sum=0;
        String temp = " ";

        for(IntWritable v: values) {
         if (temp.equals(" "))
             temp = key.getStreetName();


         if (!temp.equals(key.getStreetName())) {
         temp = key.getStreetName();
         tmapTemp.put(sum,key.toString());

         // Add Top 5
          if (tmapTemp.size() > 10)
              {
                  tmapTemp.remove(tmapTemp.firstKey());
              }
         sum = 0;}

            sum += v.get();
        }


       //Add from Temp tmapTemp to Main tmap
```

```
        for (Map.Entry<Integer,String> entry : tmapTemp.entrySet())
        {

            int count = entry.getKey();
            String name = entry.getValue();

            tmap.put(name,count);
            ;
        }

        tmapTemp.clear();
    }




      // context.write(key, new IntWritable(sum));


     @Override


     public void cleanup(Context context) throws IOException,
                                          InterruptedException

     {


         for (Map.Entry<String,Integer> entry : tmap.entrySet())
         {

             int count = entry.getValue();
             String name = entry.getKey();

             context.write(new Text(name), new IntWritable(count));
         }
     }

}
```

nyc_crash_compare

```
package nyc_crash_compare;

import java.io.IOException;
import java.text.ParseException;
import java.text.SimpleDateFormat;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.io.WritableComparable;
import org.apache.hadoop.io.WritableComparator;
import org.apache.hadoop.mapreduce.Mapper;
```

```
public class CompositeKeyComparator extends WritableComparator
{
    protected CompositeKeyComparator()
    {
        super(KeyCompare.class, true);}

    @Override
    public int compare(WritableComparable w1, WritableComparable
w2) {
        KeyCompare k1 = (KeyCompare)w1;
        KeyCompare k2 = (KeyCompare)w2;
        int result = 0;
        try {
         result = k1.getStreetName().compareTo(k2.getStreetName());
        if(result == 0) {
         result = -1*k1.getCrashDate().compareTo(k2.getCrashDate());

}
        }
        catch (Exception e) {

            }
        return result;
    }
}


package nyc_crash_compare;

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.io.WritableComparator;
import org.apache.hadoop.mapreduce.Job;
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 DriverClass {
    public static void main(String[] args) throws IOException,
InterruptedException, ClassNotFoundException  {

        Configuration conf = new Configuration();
        // Create a new Job
        Job job = Job.getInstance(conf,"logcount");
        job.setJarByClass(DriverClass.class);

        // Specify various job-specific parameters
        job.setJobName("myJob");


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

```
        job.setPartitionerClass(NaturalKeyPartitioner.class);

job.setGroupingComparatorClass(NaturalKeyGroupingComparator.class);
        job.setSortComparatorClass(CompositeKeyComparator.class);
        job.setInputFormatClass(TextInputFormat.class);
        job.setOutputFormatClass(TextOutputFormat.class);

        job.setMapOutputKeyClass(KeyCompare.class);
        job.setMapOutputValueClass(IntWritable.class);

        job.setMapperClass(MapperClass.class);
        job.setReducerClass(ReducerClass.class);
     //   job.setCombinerClass(ReducerClass.class);

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

        // Submit the job, then poll for progress until the job is
complete
        System.exit(job.waitForCompletion(true)?0:1);


    }

}

package nyc_crash_compare;

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.io.WritableComparator;
import org.apache.hadoop.mapreduce.Job;
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 DriverClass {
    public static void main(String[] args) throws IOException,
InterruptedException, ClassNotFoundException  {

        Configuration conf = new Configuration();
        // Create a new Job
        Job job = Job.getInstance(conf,"logcount");
        job.setJarByClass(DriverClass.class);

        // Specify various job-specific parameters
        job.setJobName("myJob");


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

        job.setPartitionerClass(NaturalKeyPartitioner.class);
```

```
job.setGroupingComparatorClass(NaturalKeyGroupingComparator.class);
        job.setSortComparatorClass(CompositeKeyComparator.class);
        job.setInputFormatClass(TextInputFormat.class);
        job.setOutputFormatClass(TextOutputFormat.class);

        job.setMapOutputKeyClass(KeyCompare.class);
        job.setMapOutputValueClass(IntWritable.class);

        job.setMapperClass(MapperClass.class);
        job.setReducerClass(ReducerClass.class);
     //   job.setCombinerClass(ReducerClass.class);

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

        // Submit the job, then poll for progress until the job is
complete
        System.exit(job.waitForCompletion(true)?0:1);


    }

}

package nyc_crash_compare;

import java.io.IOException;
import java.text.ParseException;
import java.text.SimpleDateFormat;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.io.WritableComparable;
import org.apache.hadoop.io.WritableComparator;
import org.apache.hadoop.mapreduce.Mapper;

public class MapperClass extends Mapper<LongWritable, Text,
KeyCompare, IntWritable> {


    //    hadoop datatype
    KeyCompare kc = new  KeyCompare();
    //private final static SimpleDateFormat frmt = new
SimpleDateFormat("yyyy-MM-dd");
    IntWritable one = new IntWritable(1);
    String crsDate;


    @Override
    protected void map(LongWritable key, Text value, Mapper.Context
context) throws IOException, InterruptedException {

        String line = value.toString();

        String[] logs = line.split(",");

        if(logs.length>0){
```

```
        String streetName = logs[8];



        if (!streetName.equals("ON STREET NAME")) {


            kc.setStreetName(streetName);

            String crsDt = logs[0];

               String[] dateSplit = crsDt.split("/");

               try {

             crsDate =
dateSplit[2]+"/"+dateSplit[0]+"/"+dateSplit[1];

               } catch (Exception e) {};

            kc.setCrashDate(crsDate);


        }
        context.write(kc,one);
        }
    }



}

package nyc_crash_compare;

import java.io.IOException;
import java.text.ParseException;
import java.text.SimpleDateFormat;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.io.WritableComparable;
import org.apache.hadoop.io.WritableComparator;
import org.apache.hadoop.mapreduce.Mapper;

public class NaturalKeyGroupingComparator extends WritableComparator
{
    protected NaturalKeyGroupingComparator()
    {
        super(KeyCompare.class, true);}


    public int compare(WritableComparable w1, WritableComparable
w2) {
        KeyCompare k1 = (KeyCompare)w1;
        KeyCompare k2 = (KeyCompare)w2;
return k1.getStreetName().compareTo(k2.getStreetName());}}
```

```
package nyc_crash_compare;

import java.io.IOException;
import java.text.ParseException;
import java.text.SimpleDateFormat;

import org.apache.hadoop.io.DoubleWritable;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.io.WritableComparable;
import org.apache.hadoop.io.WritableComparator;
import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.Partitioner;

public class NaturalKeyPartitioner extends Partitioner<KeyCompare,
DoubleWritable>
{
@Override
public int getPartition(KeyCompare key, DoubleWritable val, int
numPartitions) {
int hash = key.getStreetName().hashCode();
int partition = hash % numPartitions;
return partition;
}
}

 package nyc_crash_compare;

import java.io.IOException;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.io.WritableComparable;
import org.apache.hadoop.mapreduce.Reducer;

public class ReducerClass extends Reducer<KeyCompare, IntWritable,
KeyCompare, IntWritable>  {

      Text sortKey = new Text();

      protected void reduce(KeyCompare key, Iterable<IntWritable>
values, Context context) throws IOException, InterruptedException {

         int sum=0;
         for(IntWritable v: values) {
             sum += v.get();}



         context.write(key, new IntWritable(sum));
   }

}

nyc_crash_compare2;

package nyc_crash_compare2;
```

```
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.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 DriverClass {
     public static void main(String[] args) throws IOException,
InterruptedException, ClassNotFoundException  {

        Configuration conf = new Configuration();
        // Create a new Job
        Job job = Job.getInstance(conf,"logcount");
        job.setJarByClass(DriverClass.class);

        // Specify various job-specific parameters
        job.setJobName("myJob");


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


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

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

        job.setMapperClass(MapperClass.class);
        job.setReducerClass(ReducerClass.class);
        job.setCombinerClass(ReducerClass.class);

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

        // Submit the job, then poll for progress until the job is
complete
        System.exit(job.waitForCompletion(true)?0:1);


     }

}

package nyc_crash_compare2;

import java.io.IOException;
import java.text.ParseException;
import java.text.SimpleDateFormat;

import org.apache.hadoop.io.IntWritable;
```

```
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;

public class MapperClass extends Mapper<LongWritable, Text, Text,
IntWritable> {

     private final static SimpleDateFormat frmt = new
SimpleDateFormat("yyyy-MM-dd");


    //    hadoop datatype
    Text street = new Text();
    IntWritable one = new IntWritable(1);

    @Override
    protected void map(LongWritable key, Text value, Mapper.Context
context) throws IOException, InterruptedException {

        String line = value.toString();

        String[] logs = line.split(",");

        if(logs.length>0){

           //String streetName  = logs[8];

           String crsDate = logs[0];

           if (!crsDate.equals("CRASH DATE")) {

                String[] dateSplit = crsDate.split("/");


      street.set(dateSplit[2]+"/"+dateSplit[0]+"/"+dateSplit[1]);
           }

           /*   try {
                      crsDate = frmt.parse(logs[0]).toString();
                } catch (ParseException e) {
                      // TODO Auto-generated catch block
                      e.printStackTrace();
                }

           if (!crsDate.equals("CRASH DATE")) {
                street.set(crsDate);
           } */
           context.write(street,one);
        }
    }


}

package nyc_crash_compare2;

import java.io.IOException;

import org.apache.hadoop.io.IntWritable;
```

```
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;

public class ReducerClass extends Reducer<Text, IntWritable, Text,
IntWritable>  {

     @Override
    protected void reduce(Text key, Iterable<IntWritable> values,
Context context) throws IOException, InterruptedException {

        int sum=0;
        for(IntWritable v: values)
            sum += v.get();
        context.write(key, new IntWritable(sum));
   }

}
```

nyc_crash_month

```
package nyc_crash_month;

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.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 DriverClass {
     public static void main(String[] args) throws IOException,
InterruptedException, ClassNotFoundException  {

        Configuration conf = new Configuration();
        // Create a new Job
        Job job = Job.getInstance(conf,"logcount");
        job.setJarByClass(DriverClass.class);

        // Specify various job-specific parameters
        job.setJobName("myJob");


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


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

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

        job.setMapperClass(MapperClass.class);
        job.setReducerClass(Reducer2Class.class);
```

```
       // job.setCombinerClass(ReducerClass.class);

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

        // Submit the job, then poll for progress until the job is
complete
        System.exit(job.waitForCompletion(true)?0:1);


     }

}

package nyc_crash_month;

import java.io.IOException;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;

public class MapperClass extends Mapper<LongWritable, Text, Text,
IntWritable> {


    //    hadoop datatype
    Text monthSet = new Text();
    IntWritable one = new IntWritable(1);
    String monthString = "";

    @Override
    protected void map(LongWritable key, Text value, Mapper.Context
context) throws IOException, InterruptedException {

        String line = value.toString();

        String[] logs = line.split(",");

        if(logs.length>0 && !logs[1].isBlank() &&
!logs[0].equals("CRASH DATE"))

        {

           String[] months = logs[0].split("/");

           int month = Integer.parseInt(months[0]);

           switch (month) {
            case 1:  monthString = "January";
                     break;
            case 2:  monthString = "February";
                     break;
            case 3:  monthString = "March";
                     break;
            case 4:  monthString = "April";
                     break;
            case 5:  monthString = "May";
```

```
                    break;
            case 6:  monthString = "June";
                    break;
            case 7:  monthString = "July";
                    break;
            case 8:  monthString = "August";
                    break;
            case 9:  monthString = "September";
                    break;
            case 10: monthString = "October";
                    break;
            case 11: monthString = "November";
                    break;
            case 12: monthString = "December";
                    break;
            default: monthString = "Invalid month";
                    break;
        }

            monthSet.set(monthString);

           context.write(monthSet,one);

        }
    }
}

package nyc_crash_month;

import java.io.IOException;
import java.util.Map;
import java.util.TreeMap;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;

public class Reducer2Class extends Reducer<Text, IntWritable, Text,
IntWritable>  {


    private TreeMap<Integer,String> tmap;

    @Override
    public void setup(Context context) throws IOException,
                                    InterruptedException
    {
        tmap = new TreeMap<Integer,String>();
    }

     @Override
    protected void reduce(Text key, Iterable<IntWritable> values,
Context context) throws IOException, InterruptedException {

        int sum=0;
        for(IntWritable v: values)
            sum += v.get();
```

```
        tmap.put(sum,key.toString());



       if (tmap.size() > 12)
        {
            tmap.remove(tmap.firstKey());
        }
     }



        @Override


        public void cleanup(Context context) throws IOException,
                                            InterruptedException

        {


            for (Map.Entry<Integer, String> entry : tmap.entrySet())
            {

                int count = entry.getKey();
                String name = entry.getValue();

                context.write(new Text(name), new
IntWritable(count));
            }
        }

}
```

nyc_crash_time

```
package nyc_crash_time;

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.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 DriverClass {
     public static void main(String[] args) throws IOException,
InterruptedException, ClassNotFoundException  {

        Configuration conf = new Configuration();
        // Create a new Job
        Job job = Job.getInstance(conf,"logcount");
```

```
        job.setJarByClass(DriverClass.class);

        // Specify various job-specific parameters
        job.setJobName("myJob");


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


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

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

        job.setMapperClass(MapperClass.class);
        job.setReducerClass(ReducerClass.class);
       // job.setCombinerClass(ReducerClass.class);

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

        // Submit the job, then poll for progress until the job is
complete
        System.exit(job.waitForCompletion(true)?0:1);


     }

}

package nyc_crash_time;

import java.io.IOException;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;

public class MapperClass extends Mapper<LongWritable, Text, Text,
IntWritable> {


    //    hadoop datatype
    Text timeOfDay = new Text();
    IntWritable one = new IntWritable(1);
    String timeDay  = " ";

    @Override
    protected void map(LongWritable key, Text value, Mapper.Context
context) throws IOException, InterruptedException {

        String line = value.toString();

        String[] logs = line.split(",");
```

```
        if(logs.length>0 && !logs[1].isBlank() &&
!logs[1].equals("CRASH TIME"))

        {

           String[] time = logs[1].split(":");

           int hr = Integer.parseInt(time[0]);

           if (hr > 3 && hr < 12) {

                timeDay = "Morning";

           }



           if (hr > 11 && hr < 5) {

                timeDay = "Afternoon";

           }


           if (hr > 4 && hr < 7) {

                timeDay = "Evening";

           }

            if (hr > 6 && hr < 4) {

                timeDay = "Night";

           }


           if (!timeDay.isBlank()){

           timeOfDay.set(timeDay);

           context.write(timeOfDay,one);
           }
        }
    }







}

package nyc_crash_time;

import java.io.IOException;
import java.util.Map;
import java.util.TreeMap;
```

```
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;

public class Reducer2Class extends Reducer<Text, IntWritable, Text,
IntWritable>  {


    private TreeMap<Integer,String> tmap;

    @Override
    public void setup(Context context) throws IOException,
                                    InterruptedException
    {
        tmap = new TreeMap<Integer,String>();
    }

     @Override
    protected void reduce(Text key, Iterable<IntWritable> values,
Context context) throws IOException, InterruptedException {

        int sum=0;
        for(IntWritable v: values)
            sum += v.get();



        tmap.put(sum,key.toString());




       if (tmap.size() > 5)
        {
            tmap.remove(tmap.firstKey());
        }
     }



        @Override


        public void cleanup(Context context) throws IOException,
                                            InterruptedException

        {


            for (Map.Entry<Integer, String> entry : tmap.entrySet())
            {

                int count = entry.getKey();
                String name = entry.getValue();

                context.write(new Text(name), new
IntWritable(count));
            }
```

```
        }

}
```

nyc_factors

```
package nyc_factors;

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.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 DriverClass {
     public static void main(String[] args) throws IOException,
InterruptedException, ClassNotFoundException  {

        Configuration conf = new Configuration();
        // Create a new Job
        Job job = Job.getInstance(conf,"logcount");
        job.setJarByClass(DriverClass.class);

        // Specify various job-specific parameters
        job.setJobName("myJob");


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


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

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

        job.setMapperClass(MapperClass.class);
        job.setReducerClass(Reducer2Class.class);
       // job.setCombinerClass(ReducerClass.class);

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

        // Submit the job, then poll for progress until the job is
complete
        System.exit(job.waitForCompletion(true)?0:1);


     }
```

```
}

package nyc_factors;

import java.io.IOException;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;

public class MapperClass extends Mapper<LongWritable, Text, Text,
IntWritable> {


    //    hadoop datatype
    Text vehicleType = new Text();
    IntWritable one = new IntWritable(1);

    @Override
    protected void map(LongWritable key, Text value, Mapper.Context
context) throws IOException, InterruptedException {

        String line = value.toString();

        String[] logs = line.split(",");

        if(logs.length>0){

           String veh_type = logs[6];

           if (!veh_type.equals("VEHICLE_TYPE")) {
           vehicleType.set(veh_type);
           }
           context.write(vehicleType,one);
        }
    }




}

package nyc_factors;

import java.io.IOException;
import java.util.Map;
import java.util.TreeMap;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;

public class Reducer2Class extends Reducer<Text, IntWritable, Text,
IntWritable>  {
```

```
    private TreeMap<Integer,String> tmap;

    @Override
    public void setup(Context context) throws IOException,
                                      InterruptedException
    {
        tmap = new TreeMap<Integer,String>();
    }

     @Override
    protected void reduce(Text key, Iterable<IntWritable> values,
Context context) throws IOException, InterruptedException {

        int sum=0;
        for(IntWritable v: values)
            sum += v.get();



        tmap.put(sum,key.toString());




       if (tmap.size() > 10)
        {
            tmap.remove(tmap.firstKey());
        }
     }



        @Override


        public void cleanup(Context context) throws IOException,
                                             InterruptedException

        {


            for (Map.Entry<Integer, String> entry : tmap.entrySet())
            {

                int count = entry.getKey();
                String name = entry.getValue();

                context.write(new Text(name), new
IntWritable(count));
            }
        }

}
```

nyc_mf_compare

```
package nyc_mf_compare;
```

```
import java.io.IOException;
import java.text.ParseException;
import java.text.SimpleDateFormat;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.io.WritableComparable;
import org.apache.hadoop.io.WritableComparator;
import org.apache.hadoop.mapreduce.Mapper;

public class CompositeKeyComparator extends WritableComparator
{
      protected CompositeKeyComparator()
      {
            super(KeyCompare.class, true);}

      @Override
      public int compare(WritableComparable w1, WritableComparable
w2) {
            KeyCompare k1 = (KeyCompare)w1;
            KeyCompare k2 = (KeyCompare)w2;
            int result = 0;
            try {
             result = k1.getMf().compareTo(k2.getMf());
            if(result == 0) {
           result = -1*k1.getConFactor().compareTo(k2.getConFactor());

}
            }
            catch (Exception e) {

                }
            return result;
      }
}

package nyc_mf_compare;

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.io.WritableComparator;
import org.apache.hadoop.mapreduce.Job;
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 DriverClass {
      public static void main(String[] args) throws IOException,
InterruptedException, ClassNotFoundException  {

         Configuration conf = new Configuration();
         // Create a new Job
```

```
        Job job = Job.getInstance(conf,"logcount");
        job.setJarByClass(DriverClass.class);

        // Specify various job-specific parameters
        job.setJobName("myJob");


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

        job.setPartitionerClass(NaturalKeyPartitioner.class);

job.setGroupingComparatorClass(NaturalKeyGroupingComparator.class);
        job.setSortComparatorClass(CompositeKeyComparator.class);
        job.setInputFormatClass(TextInputFormat.class);
        job.setOutputFormatClass(TextOutputFormat.class);

        job.setMapOutputKeyClass(KeyCompare.class);
        job.setMapOutputValueClass(IntWritable.class);

        job.setMapperClass(MapperClass.class);
        job.setReducerClass(ReducerClass2.class);
       // job.setCombinerClass(ReducerClass.class);

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

        // Submit the job, then poll for progress until the job is
complete
        System.exit(job.waitForCompletion(true)?0:1);


     }

}

/*
 * To change this license header, choose License Headers in Project
Properties.
 * To change this template file, choose Tools | Templates
 * and open the template in the editor.
 */
package nyc_mf_compare;

import org.apache.hadoop.io.Text;

import java.io.DataInput;
import java.io.DataOutput;
import java.io.EOFException;
import java.io.IOException;
import java.text.SimpleDateFormat;
import java.util.Date;

import org.apache.hadoop.io.Writable;
import org.apache.hadoop.io.WritableComparable;
import org.apache.hadoop.io.WritableUtils;

public class KeyCompare implements WritableComparable<KeyCompare>{
```

```
   // private Date crashDate = new Date();
     private String mf;
    private String conFactor;



private final static SimpleDateFormat frmt = new
SimpleDateFormat("yyyy-MM-dd");

    public int compareTo(KeyCompare k) {

                int result = 0 ;
                try {
                 result = this.mf.compareTo(k.getMf());
                if(0 == result) {
               result = -
1*this.conFactor.compareTo(k.getConFactor());

     }
                }
                catch (Exception e) {

                    }
                return result;
          }



    @Override
     public String toString() {
           return (new StringBuilder().append(mf).append("\t")
                      .append(conFactor)).toString();
     }

     public void readFields(DataInput dataInput) throws IOException
{
           mf = WritableUtils.readString(dataInput);
           conFactor = WritableUtils.readString(dataInput);
     }

     public void write(DataOutput dataOutput) throws IOException {
           WritableUtils.writeString(dataOutput, mf);
           WritableUtils.writeString(dataOutput, conFactor);
     }



     public String getConFactor() {
           return conFactor;
     }


     public void setConFactor(String conFactor) {
           this.conFactor = conFactor;
     }


     public String getMf() {
```

```
		return mf;
	}


	public void setMf(String mf) {
		this.mf = mf;
	}









}

package nyc_mf_compare;

import java.io.IOException;
import java.text.ParseException;
import java.text.SimpleDateFormat;
import java.util.Arrays;
import java.util.List;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.io.WritableComparable;
import org.apache.hadoop.io.WritableComparator;
import org.apache.hadoop.mapreduce.Mapper;

public class MapperClass extends Mapper<LongWritable, Text,
KeyCompare, IntWritable> {


    //    hadoop datatype
    KeyCompare kc = new  KeyCompare();
    //private final static SimpleDateFormat frmt = new
SimpleDateFormat("yyyy-MM-dd");
    IntWritable one = new IntWritable(1);
    String crsDate;


    @Override
    protected void map(LongWritable key, Text value, Mapper.Context
context) throws IOException, InterruptedException {

        String line = value.toString();

        String[] logs = line.split(",");

        String mf = logs[12].trim();

        if(logs.length>23
                && !logs[12].isBlank()
               && !mf.equals("DRIVER_SEX")
```

```
              && !logs[23].isBlank())
             //  && !mf.equals("U"))

                {



                kc.setMf(mf);

                String crsDate = logs[23].trim();


             /*  String[] dateSplit = crsDt.split("/");

                try {

                 crsDate =
dateSplit[2]+"/"+dateSplit[0]+"/"+dateSplit[1];

                } catch (Exception e) {}; */

                kc.setConFactor(crsDate);



          context.write(kc,one);
        }
    }


}

package nyc_mf_compare;

import java.io.IOException;
import java.text.ParseException;
import java.text.SimpleDateFormat;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.io.WritableComparable;
import org.apache.hadoop.io.WritableComparator;
import org.apache.hadoop.mapreduce.Mapper;

public class NaturalKeyGroupingComparator extends WritableComparator
{
     protected NaturalKeyGroupingComparator()
     {
          super(KeyCompare.class, true);}


     public int compare(WritableComparable w1, WritableComparable
w2) {
          KeyCompare k1 = (KeyCompare)w1;
          KeyCompare k2 = (KeyCompare)w2;
return k1.getMf().compareTo(k2.getMf());}}

package nyc_mf_compare;
```

```
import java.io.IOException;
import java.text.ParseException;
import java.text.SimpleDateFormat;

import org.apache.hadoop.io.DoubleWritable;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.io.WritableComparable;
import org.apache.hadoop.io.WritableComparator;
import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.Partitioner;

public class NaturalKeyPartitioner extends Partitioner<KeyCompare,
DoubleWritable>
{
@Override
public int getPartition(KeyCompare key, DoubleWritable val, int
numPartitions) {
int hash = key.getMf().hashCode();
int partition = hash % numPartitions;
return partition;
}
}

package nyc_mf_compare;

import java.io.IOException;
import java.util.Map;
import java.util.TreeMap;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.io.WritableComparable;
import org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.mapreduce.Reducer.Context;

public class ReducerClass2 extends Reducer<KeyCompare, IntWritable,
Text, IntWritable>  {

      Text sortKey = new Text();
       private TreeMap<String,Integer> tmap;

       private TreeMap<Integer,String> tmapTemp;

       @Override
          public void setup(Context context) throws IOException,
                                              InterruptedException
          {
              tmap = new TreeMap<String,Integer>();
              tmapTemp = new TreeMap<Integer,String>();

          }


      protected void reduce(KeyCompare key, Iterable<IntWritable>
values, Context context) throws IOException, InterruptedException {
```

```
    int sum=0;
    String temp = " ";

    for(IntWritable v: values) {
       if (temp.equals(" "))
            temp = key.getConFactor();


       if (!temp.equals(key.getConFactor())) {
       temp = key.getConFactor();
       tmapTemp.put(sum,key.toString());

       // Add Top 5
        if (tmapTemp.size() > 3)
         {
             tmapTemp.remove(tmapTemp.firstKey());
         }
       sum = 0;}

        sum += v.get();
    }


   //Add from Temp tmapTemp to Main tmap



    for (Map.Entry<Integer,String> entry : tmapTemp.entrySet())
    {

        int count = entry.getKey();
        String name = entry.getValue();

        tmap.put(name,count);
        ;
    }

    tmapTemp.clear();
}







   // context.write(key, new IntWritable(sum));


  @Override


 public void cleanup(Context context) throws IOException,
                                     InterruptedException

 {


     for (Map.Entry<String,Integer> entry : tmap.entrySet())
     {
```

```
            int count = entry.getValue();
            String name = entry.getKey();

            context.write(new Text(name), new IntWritable(count));
         }
     }

}
```

nyc_month_avg

```
package nyc_month_avg;

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.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 DriverClass {
     public static void main(String[] args) throws IOException,
InterruptedException, ClassNotFoundException  {

        Configuration conf = new Configuration();
        // Create a new Job
        Job job = Job.getInstance(conf,"logcount");
        job.setJarByClass(DriverClass.class);

        // Specify various job-specific parameters
        job.setJobName("myJob");


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


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

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

        job.setMapperClass(MapperClass.class);
        job.setReducerClass(Reducer2Class.class);
        job.setCombinerClass(ReducerClass.class);

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

        // Submit the job, then poll for progress until the job is
complete
        System.exit(job.waitForCompletion(true)?0:1);
```

```
     }

}

package nyc_month_avg;

import java.io.IOException;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;

public class MapperClass extends Mapper<LongWritable, Text, Text,
Text> {


    //    hadoop datatype
    Text monthSet = new Text();
    Text mainValue = new Text();
   // IntWritable one = new IntWritable(1);
    String monthString = "";
    String num1 = " ";
    String num2 = " ";
    int persons = 0;


    @Override
    protected void map(LongWritable key, Text value, Mapper.Context
context) throws IOException, InterruptedException {

        String line = value.toString();

        String[] logs = line.split(",");

        if(logs.length>0 && !logs[1].isBlank() &&
!logs[0].equals("CRASH DATE"))

        {

           String[] months = logs[0].split("/");



           int month = Integer.parseInt(months[0]);
           int index = line.indexOf('"');

               if (index>0) {
                    num1  = logs[11].trim();
                    num2  = logs[12].trim();


                           }
                            else {
                      num1  = logs[10].trim();
                      num2  = logs[11].trim();
                              }
```

```
                        if (num1.isBlank())
                            num1 = "0";

                        if (num2.isBlank())
                            num2 = "0";




            switch (month) {
             case 1:  monthString = "January";
                      break;
             case 2:  monthString = "February";
                      break;
             case 3:  monthString = "March";
                      break;
             case 4:  monthString = "April";
                      break;
             case 5:  monthString = "May";
                      break;
             case 6:  monthString = "June";
                      break;
             case 7:  monthString = "July";
                      break;
             case 8:  monthString = "August";
                      break;
             case 9:  monthString = "September";
                      break;
             case 10: monthString = "October";
                      break;
             case 11: monthString = "November";
                      break;
             case 12: monthString = "December";
                      break;
             default: monthString = "Invalid month";
                      break;
        }

           persons = Integer.parseInt(num1) +
Integer.parseInt(num2);

             monthSet.set(monthString);
             mainValue.set(String.valueOf(persons));

           context.write(monthSet,mainValue);

        }
    }
}

package nyc_month_avg;

import java.io.IOException;
import java.util.Map;
import java.util.TreeMap;

import org.apache.hadoop.io.FloatWritable;
```

```
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;

public class CombinerClass extends Reducer<Text, Text, Text, Text>
{


  Text mainValue = new Text();
  String mainVal = " ";


     @Override
    protected void reduce(Text key, Iterable<Text> values, Context
context) throws IOException, InterruptedException {

        int sum=0;
        int cnt=0;
        String num = " ";

        for(Text v: values) {
            num = v.toString();
            sum += Integer.parseInt(num);
            cnt += 1;}

         mainVal  = String.valueOf(sum) + "," + String.valueOf(cnt);



        context.write(key,mainValue);









     }



}




package nyc_month_avg;

import java.io.IOException;
import java.util.Map;
import java.util.TreeMap;

import org.apache.hadoop.io.FloatWritable;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;
```

```
public class Reducer2Class extends Reducer<Text, Text, Text,
FloatWritable>  {


    private TreeMap<Float,String> tmap;

    @Override
    public void setup(Context context) throws IOException,
                                    InterruptedException
    {
        tmap = new TreeMap<Float,String>();
    }

     @Override
    protected void reduce(Text key, Iterable<Text> values, Context
context) throws IOException, InterruptedException {

        int sum=0;
        int cnt=0;


        for(Text v: values) {
           String nums = v.toString();
           String num1 [] = nums.split(",");
           sum += Integer.parseInt(num1[0]);
           sum += Integer.parseInt(num1[1]);

        }
        float sum2 = (float)sum/cnt;



        tmap.put(sum2,key.toString());




       if (tmap.size() > 12)
        {
            tmap.remove(tmap.firstKey());
        }
     }



        @Override


        public void cleanup(Context context) throws IOException,
                                          InterruptedException

        {


            for (Map.Entry<Float, String> entry : tmap.entrySet())
            {

                float count = entry.getKey();
                String name = entry.getValue();
```

```
                context.write(new Text(name), new
FloatWritable(count));
            }
        }

}
```

```
package nyc_ped_compare;

import java.io.IOException;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;

public class CrashMapperClass extends Mapper<LongWritable, Text,
Text, Text> {


    //    hadoop datatype
    Text collisionId = new Text();
    Text values = new Text();
    String tempVal = " ";
    String colId = " ";

    @Override
    protected void map(LongWritable key, Text value, Mapper.Context
context) throws IOException, InterruptedException {

        String line = value.toString();

        String[] logs = line.split(",");

        int index = line.indexOf('"');

          if (index>0) {
              tempVal  = logs[2].trim() + "," + logs[8].trim();
               colId = logs[24];
       }else {
           if(logs.length>23 && !logs[1].equals("CRASH DATE")){
              tempVal  = logs[2].trim() + ","+ logs[7].trim();
           colId = logs[23];
           }
       }


        if(logs.length>23
           && !logs[2].isBlank()
          //  && !colId.isBlank()
            && !logs[2].equals("BOROUGH"))
           // &&  colId.equals("4230968"))
```

```
        {


            collisionId.set(colId);
            tempVal  = "Y" + " " + tempVal ;
           values.set(tempVal);

           context.write(collisionId,values);
        }

    }
}
```

nyc_ped_compare

```
package nyc_ped_compare;

import java.io.IOException;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;

public class CrashMapperClass extends Mapper<LongWritable, Text,
Text, Text> {


    //    hadoop datatype
    Text collisionId = new Text();
    Text values = new Text();
    String tempVal = " ";
    String colId = " ";

    @Override
    protected void map(LongWritable key, Text value, Mapper.Context
context) throws IOException, InterruptedException {

        String line = value.toString();

        String[] logs = line.split(",");

        int index = line.indexOf('"');

          if (index>0) {
              tempVal  = logs[2].trim() + "," + logs[8].trim();
               colId = logs[24];
       }else {
           if(logs.length>23 && !logs[1].equals("CRASH DATE")){
              tempVal  = logs[2].trim() + ","+ logs[7].trim();
           colId = logs[23];
           }
       }
```

```
        if(logs.length>23
           && !logs[2].isBlank()
          //  && !colId.isBlank()
            && !logs[2].equals("BOROUGH"))
           // &&  colId.equals("4230968"))


        {


            collisionId.set(colId);
            tempVal  = "Y" + " " + tempVal ;
           values.set(tempVal);

           context.write(collisionId,values);
        }

    }
}

package nyc_ped_compare;


import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.conf.Configured;
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.MultipleInputs;
import org.apache.hadoop.mapreduce.lib.input.TextInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
import org.apache.hadoop.mapreduce.lib.output.TextOutputFormat;
import org.apache.hadoop.util.Tool;
import org.apache.hadoop.util.ToolRunner;




public class DriverClass2 extends Configured implements Tool {
  private static final String DATA_SEPARATOR = ",";
  public int run(String[] args) throws Exception {
    Configuration configuration = new Configuration();
  //
configuration.set("mapreduce.output.textoutputformat.separator",
DATA_SEPARATOR);
    Job job = Job.getInstance(configuration);
    job.setJobName("New Job");
    job.setJarByClass(DriverClass2.class);
    // Map
    job.setMapOutputKeyClass(Text.class);
    job.setMapOutputValueClass(Text.class);
    // Job
    job.setOutputKeyClass(LongWritable.class);
    job.setOutputValueClass(Text.class);
    job.setInputFormatClass(TextInputFormat.class);
    job.setOutputFormatClass(TextOutputFormat.class);
    job.setReducerClass(ReducerClass.class);
```

```
    MultipleInputs.addInputPath(job, new Path(args[0]),
TextInputFormat.class,
      CrashMapperClass.class);
    MultipleInputs.addInputPath(job, new Path(args[1]),
TextInputFormat.class,
           PersonMapperClass.class);
    FileOutputFormat.setOutputPath(job, new Path(args[2]));
    job.waitForCompletion(true);
    return 0;
  }
  public static void main(String[] args) throws Exception {
    if (args.length == 3) {
      int result = ToolRunner.run(new Configuration(), new
DriverClass2(), args);
      if (0 == result) {
        System.out.println("");
      } else {
        System.out.println("");
      }
    } else {
      System.out.println("USAGE
<InputPath1><InputPath2><OutputPath>");
    }
  }
}

package nyc_ped_compare;

import java.io.IOException;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;

public class PersonMapperClass extends Mapper<LongWritable, Text,
Text, Text> {


    //    hadoop datatype
    Text collisionId = new Text();
    Text values = new Text();
    String tempVal= " ";
    String tempVal1= " ";

    @Override
    protected void map(LongWritable key, Text value, Mapper.Context
context) throws IOException, InterruptedException {

        String line = value.toString();

        String[] logs = line.split(",");




        if(logs.length>0
```

```
        // && !logs2[1].isBlank()
        //    && !logs2[2].isBlank()
            && !logs[1].isBlank()
            && !logs[1].equals("COLLISION_ID")
           &&  logs[5].equals("Pedestrian")
           &&  (logs[6].equals("Injured") ||
logs[6].equals("Killed")))



        {




           String colId = logs[1];

           tempVal = logs[5].trim()+ "," + logs[6];
        // String tempVal  = logs2[1].trim() + ' ' +
logs2[2].trim();

           tempVal  = "Z" + " " + tempVal ;


            collisionId.set(colId);
           values.set(tempVal);

           context.write(collisionId,values);
        }
    }

}
```

```
package nyc_ped_compare;

import java.io.IOException;
import java.util.Map;
import java.util.TreeMap;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;

public class Reducer2Class extends Reducer<Text, IntWritable, Text,
IntWritable>  {


    private TreeMap<Integer,String> tmap;

    @Override
    public void setup(Context context) throws IOException,
                                      InterruptedException
    {
```

```
        tmap = new TreeMap<Integer,String>();
    }

     @Override
    protected void reduce(Text key, Iterable<IntWritable> values,
Context context) throws IOException, InterruptedException {

        int sum=0;
        for(IntWritable v: values)
            sum += v.get();



        tmap.put(sum,key.toString());




       if (tmap.size() > 5)
        {
            tmap.remove(tmap.firstKey());
        }
     }



        @Override


        public void cleanup(Context context) throws IOException,
                                            InterruptedException

        {


            for (Map.Entry<Integer, String> entry : tmap.entrySet())
            {

                int count = entry.getKey();
                String name = entry.getValue();

                context.write(new Text(name), new
IntWritable(count));
            }
        }

}




package nyc_ped_compare;

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

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;
```

```
public class ReducerClass extends Reducer<Text, Text, Text, Text>  {

      private ArrayList<Text> listA = new ArrayList<Text>();
      private ArrayList<Text> listB = new ArrayList<Text>();



      @Override
    protected void reduce(Text key, Iterable<Text> values, Context
context) throws IOException, InterruptedException {

       listA.clear();
       listB.clear();


       for(Text v: values) {
        if (v.charAt(0) == 'Y')
              listA.add(new Text(v.toString().substring(1)+ ","));
        else if (v.charAt(0) == 'Z')
              listB.add(new Text(v.toString().substring(1)));
       }

          executeJoin(context);


}

      private void executeJoin(Context context) throws IOException,
      InterruptedException{

            if(!listA.isEmpty() && !listB.isEmpty())
            {
                  for(Text A: listA){

                        for(Text B : listB)
                        {
                              context.write(A,B);
                              }
                  }

            }

}
}
```

nyc_ped_compare2

```
package nyc_ped_compare2;

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.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 DriverClass {
     public static void main(String[] args) throws IOException,
InterruptedException, ClassNotFoundException  {

        Configuration conf = new Configuration();
        // Create a new Job
        Job job = Job.getInstance(conf,"logcount");
        job.setJarByClass(DriverClass.class);

        // Specify various job-specific parameters
        job.setJobName("myJob");


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


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

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

        job.setMapperClass(MapperClass.class);
        job.setReducerClass(Reducer2Class.class);
       // job.setCombinerClass(ReducerClass.class);

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

        // Submit the job, then poll for progress until the job is
complete
        System.exit(job.waitForCompletion(true)?0:1);


     }

}

package nyc_ped_compare2;

import java.io.IOException;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;

public class MapperClass extends Mapper<LongWritable, Text, Text,
IntWritable> {


    //    hadoop datatype
    Text location = new Text();
    IntWritable one = new IntWritable(1);

    @Override
```

```
    protected void map(LongWritable key, Text value, Mapper.Context
context) throws IOException, InterruptedException {

        String line = value.toString();

        String[] logs = line.split(",");

        if(logs.length>0){

           String loc = logs[0] + "-" + logs[1];


           location.set(loc);

           context.write(location,one);
        }
    }


}

package nyc_ped_compare2;

import java.io.IOException;
import java.util.Map;
import java.util.TreeMap;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;

public class Reducer2Class extends Reducer<Text, IntWritable, Text,
IntWritable>  {


    private TreeMap<Integer,String> tmap;

    @Override
    public void setup(Context context) throws IOException,
                                      InterruptedException
    {
        tmap = new TreeMap<Integer,String>();
    }

     @Override
    protected void reduce(Text key, Iterable<IntWritable> values,
Context context) throws IOException, InterruptedException {

        int sum=0;
        for(IntWritable v: values)
            sum += v.get();



        tmap.put(sum,key.toString());
```

```
        if (tmap.size() > 15)
         {
             tmap.remove(tmap.firstKey());
         }
      }



         @Override


         public void cleanup(Context context) throws IOException,
                                              InterruptedException

         {


             for (Map.Entry<Integer, String> entry : tmap.entrySet())
             {

                 int count = entry.getKey();
                 String name = entry.getValue();

                 context.write(new Text(name), new
IntWritable(count));
             }
         }

}




package nyc_ped_compare2;

import java.io.IOException;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;

public class ReducerClass extends Reducer<Text, IntWritable, Text,
IntWritable>  {

      @Override
    protected void reduce(Text key, Iterable<IntWritable> values,
Context context) throws IOException, InterruptedException {

         int sum=0;
         for(IntWritable v: values)
             sum += v.get();
         context.write(key, new IntWritable(sum));
   }

}
```

nyc_vehicles

```
package nyc_vehicles;
```

```
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.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 DriverClass {
     public static void main(String[] args) throws IOException,
InterruptedException, ClassNotFoundException  {

        Configuration conf = new Configuration();
        // Create a new Job
        Job job = Job.getInstance(conf,"logcount");
        job.setJarByClass(DriverClass.class);

        // Specify various job-specific parameters
        job.setJobName("myJob");


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


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

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

        job.setMapperClass(MapperClass.class);
        job.setReducerClass(Reducer2Class.class);
       // job.setCombinerClass(ReducerClass.class);

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

        // Submit the job, then poll for progress until the job is
complete
        System.exit(job.waitForCompletion(true)?0:1);


     }

}
package nyc_vehicles;

import java.io.IOException;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;
```

```
public class MapperClass extends Mapper<LongWritable, Text, Text,
IntWritable> {


    //    hadoop datatype
    Text vehicle = new Text();
    IntWritable one = new IntWritable(1);
    String vehicleMake = " ";

    @Override
    protected void map(LongWritable key, Text value, Mapper.Context
context) throws IOException, InterruptedException {

        String line = value.toString();

        String[] logs = line.split(",");



        if(logs.length>0){



           if (!logs[7].equals("VEHICLE_TYPE") &&
!logs[7].isEmpty()) {
                //String vehicleMake = logs[7].substring(0,4);


                String [] vehMk = logs[7].split("-");

                if (vehMk[0].equals("CHEV ")) {

                     vehicleMake = "CHEVROLET";

                }

                if (vehMk[0].equals("FORD ")) {

                     vehicleMake = "FORD";

                }

               if (vehMk[0].equals("NISS ")) {

                     vehicleMake = "NISSAN";

                }
               if (vehMk[0].equals("HOND ")) {

                     vehicleMake = "HONDA";

                   }

               if (vehMk[0].equals("TOYT ")) {

                     vehicleMake = "TOYOTA";

                   }
```

```
                vehicle.set(vehicleMake);
                }
                context.write(vehicle,one);
            }
    }


}

package nyc_vehicles;

import java.io.IOException;
import java.text.DecimalFormat;
import java.util.Map;
import java.util.TreeMap;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;

public class Reducer2Class extends Reducer<Text, IntWritable, Text,
Text>  {


    private TreeMap<Integer,String> tmap;
    long  totSum = 0;

    @Override
    public void setup(Context context) throws IOException,
                                    InterruptedException
    {
        tmap = new TreeMap<Integer,String>();

    }

     @Override
    protected void reduce(Text key, Iterable<IntWritable> values,
Context context) throws IOException, InterruptedException {

        int sum=0;
        for(IntWritable v: values)
            sum += v.get();



        tmap.put(sum,key.toString());




       if (tmap.size() > 5)
        {
            tmap.remove(tmap.firstKey());
        }
```

```
     }


        @Override


        public void cleanup(Context context) throws IOException,
                                            InterruptedException

        {

           //Count Total Records


            for (Map.Entry<Integer, String> entry : tmap.entrySet())
            {

                 totSum += entry.getKey();



            }


            for (Map.Entry<Integer, String> entry : tmap.entrySet())
            {

                int count = entry.getKey();
                double percentage = ((float)count/totSum)*100;

                DecimalFormat df = new
DecimalFormat("#,###,##0.00");

                String per =  String.valueOf(df.format(percentage))
+ " %" ;


                String name = entry.getValue();

                context.write(new Text(name), new Text(per));
            }
        }

}
```

nyc_bloom

```
package nyc_bloom;

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.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 DriverClass {
     public static void main(String[] args) throws IOException,
InterruptedException, ClassNotFoundException  {

        Configuration conf = new Configuration();
        conf.set("bloom_filter_file_location",args[2]);
        // Create a new Job
        Job job = Job.getInstance(conf,"logcount");
        job.setJarByClass(DriverClass.class);

        // Specify various job-specific parameters
        job.setJobName("myJob");


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




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

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

        job.setMapperClass(MapperClass.class);
        job.setReducerClass(ReducerClass.class);
       // job.setCombinerClass(ReducerClass.class);

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

        // Submit the job, then poll for progress until the job is
complete
        System.exit(job.waitForCompletion(true)?0:1);


     }

}

package nyc_bloom;

import java.io.DataInputStream;
import java.io.EOFException;
import java.io.FileInputStream;
import java.io.IOException;

import org.apache.hadoop.filecache.DistributedCache;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;
```

```
import org.apache.hadoop.util.bloom.BloomFilter;
import org.apache.hadoop.util.bloom.Key;
import org.apache.hadoop.util.hash.Hash;

public class MapperClass extends Mapper<LongWritable, Text, Text,
IntWritable> {


    //    hadoop datatype
    Text vehicleSelect = new Text();
    IntWritable one = new IntWritable(1);
    DataInputStream dataInputStream;



    private BloomFilter filter = new
BloomFilter(40,10,Hash.MURMUR_HASH);

    static String test = "Sedan";

    static Key key1 = new Key(test.getBytes());


    protected void setup(Context context) throws IOException,
InterruptedException, EOFException{

     // Path[] localFiles =
DistributedCache.getLocalCacheFiles(context.getConfiguration().get("
bloom_filter_file_location"));

     /*try {
     dataInputStream = new DataInputStream(
     new
FileInputStream(context.getConfiguration().get("bloom_filter_file_lo
cation")));
     filter.readFields(dataInputStream);
     //dataInputStream.close();
     }catch (EOFException e) {
          dataInputStream.close();
     }*/
     }



    @Override
    protected void map(LongWritable key, Text value, Mapper.Context
context) throws IOException, InterruptedException {

        String line = value.toString();

        String[] logs = line.split(",");


     filter.add(key1);


        if(logs.length>0){
```

```
           String vehicle = logs[6].trim();



           if (!vehicle.equals("VEHICLE_TYPE") &&
!vehicle.isEmpty()) {

                 if (filter.membershipTest(new
Key(vehicle.trim().getBytes())))
                 {
                       vehicleSelect.set(vehicle);




           context.write(vehicleSelect,one);}
        }
    }

    }


}




package nyc_bloom;

import java.io.IOException;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;

public class ReducerClass extends Reducer<Text, IntWritable, Text,
IntWritable>  {

     @Override
    protected void reduce(Text key, Iterable<IntWritable> values,
Context context) throws IOException, InterruptedException {

        int sum=0;
        for(IntWritable v: values)
            sum += v.get();
        context.write(key, new IntWritable(sum));
   }

}
```