

MapReduce Case Study

MapReduce with mrjob

1) Setup mrjob

```
pip3 install mrjob
```

2) Create script

Create python script "mrtask_a.py":

```
from mrjob.job import MRJob

# This includes our definition of map and reduce functions
class MyMapReduce(MRJob):

    # The key is vendorID and the value is (1: count ad 1 trip and the total amount
    # charged to passengers.)
    def mapper(self, _, line):
        line = line.split(",")
        if (line[0] != "VendorID"):
            yield line[0], (1, float(line[16]))

    # Our reducer takes a group of (key, value) where key = word, and produces a
    # final (key, value)
    def reducer(self, vendorID, total_amount):
        counts = 0
        total = 0
        for count, revenue in total_amount:
            counts += count
            total += revenue
        yield vendorID, (counts, round(total, 2))

if __name__ == '__main__':
    MyMapReduce.run()
```

Create python script "mrtask_b.py":

```

from mrjob.job import MRJob
from mrjob.step import MRStep

# This includes our definition of map and reduce functions
class MyMapReduce(MRJob):

    # The key is PULocationID (pickup location) and the value is the total amount
    # charged to passengers.
    def mapper(self, _, line):
        line = line.split(",")
        if (line[0] != "VendorID"):
            yield (line[7], float(line[16]))

    # Our reducer takes a group of (key, value) where key = word, and produces a
    # final (key, value)
    def reducer(self, location, total_amount):
        yield None, (sum(total_amount), location)

    def sort_by_amount(self, _, pair):
        sorted_pairs = sorted(pair, reverse=True)
        for revenue, location in sorted_pairs:
            yield location, revenue

    def steps(self):
        return [
            MRStep(mapper=self.mapper,
                    reducer=self.reducer),
            MRStep(reducer=self.sort_by_amount)
        ]

if __name__ == '__main__':
    MyMapReduce.run()

```

Create python script "mrtask_c.py":

```

from mrjob.job import MRJob
from mrjob.step import MRStep

class MyMapReduce(MRJob):

    # Our mapper takes a fragment of text as an input and produces a list of (key,
    value)
    # The key is payment_type and the value is 1, indicating one count of the
    payment_type has been read
    def mapper(self, _, line):
        line = line.split(',')
        if line[0] != "VendorID":
            yield(line[9], 1)

    # Our reducer takes a group of (key, value) where key = payment_type, and
    produces a final (key, value)
    # The key is a payment_type and its value is the number of occurrences of the
    payment_type
    def reducer(self, payment_type, counts):
        yield None, (sum(counts), payment_type)

    def sort_counts(self, _, pair):
        for counts, payment_type in sorted(pair, reverse=True):
            yield(payment_type, counts)

    def steps(self):
        return [MRStep(mapper=self.mapper,
                        reducer=self.reducer),
                MRStep(reducer=self.sort_counts)]

if __name__ == '__main__':
    MyMapReduce.run()

```

Create python script "mrtask_d.py":

```

from mrjob.job import MRJob
from mrjob.step import MRStep
from datetime import datetime

class MyMapReduce(MRJob):

    # Our mapper takes a fragment of text as an input and produces a list of (key,
    value)
    # The key is PULocationID and the value is
    (tpep_pickup_datetime,tpep_dropoff_datetime), indicating one count of the
    payment_type has been read
    def mapper(self, _, line):
        line = line.split(',')
        if line[0] != "VendorID":
            yield line[7], (line[1], line[2])

    # Our combiner calculate the trip time
    def combiner(self, locationID, time):
        for pickup_datetime_str, dropoff_datetime_str in time:
            pickup_datetime = datetime.strptime(pickup_datetime_str, '%Y-%m-%d
%H:%M:%S')
            dropoff_datetime = datetime.strptime(dropoff_datetime_str, '%Y-%m-%d
%H:%M:%S')
            trip_time = dropoff_datetime - pickup_datetime
            trip_time_in_s = trip_time.total_seconds()
            yield (locationID, trip_time_in_s)

    # Our reducer takes (key, value) where key = locationID, and calculate average
    trip time
    # The key is a locationID and its value is the average trip time
    def reducer(self, locationID, time_list):
        count = 0
        total = 0
        for time in time_list:
            count += 1
            total += time
        yield (locationID, total/count)

    def steps(self):
        return [MRStep(mapper=self.mapper,
                        combiner=self.combiner,
                        reducer=self.reducer)]

if __name__ == '__main__':
    MyMapReduce.run()

```

Create python script "mrtask_e.py":

```

from mrjob.job import MRJob
from mrjob.step import MRStep

class MyMapReduce(MRJob):

    # Our mapper takes a fragment of text as an input and produces a list of (key,
    value)
    # The key is PULocationID and the value is (tip_amount, total_amount)
    def mapper(self, _, line):
        line = line.split(',')
        if line[0] != "VendorID":
            yield line[7], (line[13], line[16])

    # Our combiner calculate the tips to revenue ratio
    def combiner(self, locationID, pair):
        for tip_amount, total_amount in pair:
            tip_amount = float(tip_amount)
            total_amount = float(total_amount)
            if total_amount != 0:
                yield locationID, (float(tip_amount)/float(total_amount))
            else:
                yield locationID, 0

    # Our reducer takes (key, value) where key = locationID, and calculate average
    trip time
    # The key is a locationID and its value is the average trip time
    def reducer(self, locationID, ratio):
        count = 0
        total = 0
        for item in ratio:
            count += 1
            total += item
        yield None, (total/count, locationID)

    # Sort the result in step 2
    def sort_result(self, _, pair):
        for ratio, locationID in sorted(pair, reverse=True):
            yield (locationID, ratio)

    def steps(self):
        return [MRStep(mapper=self.mapper,
                        combiner=self.combiner,
                        reducer=self.reducer),
                MRStep(reducer=self.sort_result)]

if __name__ == '__main__':
    MyMapReduce.run()

```

Create python script "mrtask_f.py":

```
from mrjob.job import MRJob
from mrjob.step import MRStep
from datetime import datetime

# This includes our definition of map and reduce functions
class MyMapReduce(MRJob):

    # The key is the composite of (month, weekday, hour) and the value is the
    total_amount charged to passengers.
    def mapper(self, _, line):
        line = line.split(",")
        if (line[0] != "VendorID"):
            pickup_date = datetime.strptime(line[1], '%Y-%m-%d %H:%M:%S')
            month = pickup_date.month
            hour = pickup_date.hour
            weekday = pickup_date.weekday()
            yield (month, weekday, hour), float(line[16])

    # Calculate the average revenue in reducer
    def reducer(self, composite_time, revenue):
        count = 0
        total = 0
        for item in revenue:
            count += 1
            total += item
        yield None, (composite_time, total/count)

    # Sort the result by month, weekday, hour
    def sort_by_amount(self, _, pair):
        sorted_pairs = sorted(pair, reverse=False)
        for composite_time, avg_revenue in sorted_pairs:
            yield composite_time, avg_revenue

    def steps(self):
        return [
            MRStep(mapper=self.mapper,
                    reducer=self.reducer),
            MRStep(reducer=self.sort_by_amount)
        ]

if __name__ == '__main__':
    MyMapReduce.run()
```

3) Run script

First, download and load the csv file to HDFS

```
wget https://nyc-tlc-upgrad.s3.amazonaws.com/yellow_tripdata_2017-06.csv
```

```
hadoop fs -put yellow_tripdata_2017-06.csv /user/root/
```

a) Which vendors have the most trips, and what is the total revenue generated by that vendor

```
python mrtask_a.py -r hadoop hdfs:///user/root//yellow_tripdata_2017-06.csv -o /user/root/output1
```

```
[root@ip-172-31-43-128 ~]# python mrtask_a.py -r hadoop hdfs:///user/root//yellow_tripdata_2017-06.csv -o /user/root/output1
No configs found; falling back on auto-configuration
No configs specified for hadoop runner
Looking for hadoop binary in $PATH...
Found hadoop binary: /bin/hadoop
Using Hadoop version 2.8.5
Looking for Hadoop streaming jar in /home/hadoop/contrib...
Looking for Hadoop streaming jar in /usr/lib/hadoop-mapreduce...
Found Hadoop streaming jar: /usr/lib/hadoop-mapreduce/hadoop-streaming.jar
Creating temp directory /tmp/mrtask_a.root.20240303.085956.265679
uploading working dir files to hdfs:///user/root/tmp/mrjob/mrtask_a.root.20240303.085956.265679/files/wd...
Copying other local files to hdfs:///user/root/tmp/mrjob/mrtask_a.root.20240303.085956.265679/files/
Running step 1 of 1...
packageJobJar: [] [/usr/lib/hadoop/hadoop-streaming-2.8.5-amzn-6.jar] /tmp/streamjob2770397496816985724.jar tmpDir=null
Connecting to ResourceManager at ip-172-31-43-128.ec2.internal/172.31.43.128:8032
Connecting to ResourceManager at ip-172-31-43-128.ec2.internal/172.31.43.128:8032
Loaded native gpl library
Successfully loaded & initialized native-lzo library [hadoop-lzo rev ff8f5709577defb6b78cdclf98cfel29c4b6fe46]
Total input files to process : 1
Adding a new node: /default-rack/172.31.43.128:50010
number of splits:8
Submitting tokens for job: job_1709455590151_0001
Submitted application application_1709455590151_0001
The url to track the job: http://ip-172-31-43-128.ec2.internal:20888/proxy/application_1709455590151_0001/
Running job: job_1709455590151_0001
Job job_1709455590151_0001 running in uber mode : false
  map 0% reduce 0%
  map 10% reduce 0%
  map 15% reduce 0%
  map 25% reduce 0%
  map 33% reduce 0%
  map 36% reduce 0%
  map 40% reduce 0%
  map 45% reduce 0%
  map 50% reduce 0%
  map 54% reduce 0%
  map 57% reduce 0%
  map 60% reduce 0%
  map 63% reduce 0%
  map 69% reduce 0%
  map 75% reduce 0%
  map 80% reduce 0%
  map 85% reduce 0%
  map 88% reduce 0%
  map 91% reduce 0%
  map 100% reduce 0%
  map 100% reduce 33%
  map 100% reduce 56%
  map 100% reduce 67%
  map 100% reduce 89%
  map 100% reduce 100%
Job job_1709455590151_0001 completed successfully
Output directory: hdfs:///user/root/output1
```

```
[root@ip-172-31-43-128 ~]# hadoop fs -cat /user/root/output1/part*
"1"      [4374994, 72089536.81]
"2"      [5281999, 88663878.2]
```

Vendor VeriFone Inc. has the most trips with 5281999 and the total revenue is: 88663878.2

b) Which pickup location generates the most revenue?

```
python mrtask_b.py -r hadoop hdfs:///user/root//yellow_tripdata_2017-06.csv -o /user/root/output2
```

```
[root@ip-172-31-43-128 ~]# python mrtask_b.py -r hadoop hdfs:///user/root//yellow_tripdata_2017-06.csv -o /user/root/output2
No configs found; falling back on auto-configuration
No configs specified for hadoop runner
Looking for hadoop binary in $PATH...
Found hadoop binary: /bin/hadoop
Using Hadoop version 2.8.5
Looking for Hadoop streaming jar in /home/hadoop/contrib...
Looking for Hadoop streaming jar in /usr/lib/hadoop-mapreduce...
Found Hadoop streaming jar: /usr/lib/hadoop-mapreduce/hadoop-streaming.jar
Creating temp directory /tmp/mrtask_b.root.20240303.090230.238070
uploading working dir files to hdfs:///user/root/tmp/mrjob/mrtask_b.root.20240303.090230.238070/files/wd...
Copying other local files to hdfs:///user/root/tmp/mrjob/mrtask_b.root.20240303.090230.238070/files/
Running step 1 of 2...
packageJobJar: [] [/usr/lib/hadoop/hadoop-streaming-2.8.5-amzn-6.jar] /tmp/streamjob6252916302865576275.jar tmpDir=null
Connecting to ResourceManager at ip-172-31-43-128.ec2.internal/172.31.43.128:8032
Connecting to ResourceManager at ip-172-31-43-128.ec2.internal/172.31.43.128:8032
Loaded native gpl library
Successfully loaded & initialized native-lzo library [hadoop-lzo rev ff8f5709577defb6b78cdc1f98cfel29c4b6fe46]
Total input files to process : 1
Adding a new node: /default-rack/172.31.43.128:50010
number of splits:8
Submitting tokens for job: job_1709455590151_0002
Submitted application application_1709455590151_0002
The url to track the job: http://ip-172-31-43-128.ec2.internal:20888/proxy/application_1709455590151_0002/
Running job: job_1709455590151_0002
Job job_1709455590151_0002 running in uber mode : false
  map 0% reduce 0%
  map 11% reduce 0%
  map 25% reduce 0%
  map 35% reduce 0%
  map 40% reduce 0%
  map 50% reduce 0%
  map 59% reduce 0%
  map 65% reduce 0%
  map 75% reduce 0%
  map 80% reduce 0%
  map 86% reduce 0%
  map 88% reduce 0%
  map 90% reduce 0%
  map 95% reduce 0%
  map 100% reduce 0%
  map 100% reduce 28%
  map 100% reduce 31%
  map 100% reduce 33%
  map 100% reduce 65%
  map 100% reduce 67%
  map 100% reduce 95%
  map 100% reduce 98%
  map 100% reduce 100%
Job job_1709455590151_0002 completed successfully
Output directory: hdfs:///user/root/tmp/mrjob/mrtask_b.root.20240303.090230.238070/step-output/0000
Counters: 51
  File Input Format Counters
    Bytes Read=910204372
  File Output Format Counters
    Bytes Written=8041
  File System Counters
    FILE: Number of bytes read=38590250
    FILE: Number of bytes written=79244970
```

```
[root@ip-172-31-43-128 ~]# hadoop fs -cat /user/root/output2/part*
"132" 13022071.030008659
"138" 11947356.560005879
"161" 5421240.249981632
"230" 5204483.789982826
"162" 4975409.649985077
"186" 4955117.499983642
"170" 4619487.209986442
"237" 4587580.4899826
"48" 4374879.999986883
"236" 4329380.099986097
"234" 4321097.349988832
"163" 3970013.04999078
"79" 3927531.6999908243
"142" 3744778.0199909364
"164" 3408842.789994286
```



```

101 3168812.789991288
"141" 3367443.18999802
"68" 3280302.0499951653
"239" 3267015.3299946794
"107" 3137537.069995814
"231" 2920193.559997922
"100" 2769640.2399982023
"249" 2764356.4899983685
"229" 2463725.310000214
"238" 2439349.100000353
"90" 2427999.1000004215
"264" 2411055.1600006516
"140" 2279025.2500015143
"148" 2277588.0300012263
"263" 2231485.1600019163
"246" 2130940.780002182
"113" 2120051.740002502
"233" 2093908.7100024268
"158" 1968337.380001762
"13" 1961515.0900015018
"43" 1905895.3300025333
"114" 1902946.9900021455
"87" 1717934.640001204
"137" 1679949.2100019124
"144" 1659175.1600017096
"262" 1562147.1000017363
"143" 1379820.1100014541
"50" 1356314.2100013075
"261" 1211506.7800007772
"211" 1197666.2000008966
"151" 1151506.5000010098
"88" 919733.8700003374
"125" 899294.8200004261
"75" 856858.3300005336
"166" 677888.8800000924
"74" 508771.829999781
"41" 480939.0899998132
"265" 442404.7999999746
"24" 412220.7599998768
"224" 382964.2099998993
"209" 382140.7899999234
"45" 366982.3199999111
"4" 347417.33999991365
"232" 301557.98999994394
"226" 296320.479999931
"65" 265076.7599999606
"255" 235892.48999996926
"33" 232767.5899999763

```

Pickup location id "132" generate the most revenue: 13022071.03

c) What are the different payment types used by customers and their count? The final results should be in a sorted format.

```
python mrtask_c.py -r hadoop hdfs:///user/root//yellow_tripdata_2017-06.csv -o /user/root/output3
```

```
[root@ip-172-31-43-128 ~]# python mrtask_c.py -r hadoop hdfs:///user/root//yellow_tripdata_2017-06.csv -o /user/root/output3
No configs found; falling back on auto-configuration
No configs specified for hadoop runner
Looking for hadoop binary in $PATH...
Found hadoop binary: /bin/hadoop
Using Hadoop version 2.8.5
Looking for Hadoop streaming jar in /home/hadoop/contrib...
Looking for Hadoop streaming jar in /usr/lib/hadoop-mapreduce...
Found Hadoop streaming jar: /usr/lib/hadoop-mapreduce/hadoop-streaming.jar
Creating temp directory /tmp/mrtask_c.root.20240303.091803.109952
uploading working dir files to hdfs:///user/root/tmp/mrjob/mrtask_c.root.20240303.091803.109952/files/wd...
Copying other local files to hdfs:///user/root/tmp/mrjob/mrtask_c.root.20240303.091803.109952/files/
Running step 1 of 2...
packageJobJar: [] [/usr/lib/hadoop/hadoop-streaming-2.8.5-amzn-6.jar] /tmp/streamjob7145674024997995816.jar tmpDir=null
Connecting to ResourceManager at ip-172-31-43-128.ec2.internal/172.31.43.128:8032
Connecting to ResourceManager at ip-172-31-43-128.ec2.internal/172.31.43.128:8032
Loaded native gpl library
Successfully loaded & initialized native-lzo library [hadoop-lzo rev ff8f5709577defb6b78cdc1f98cfel29c4b6fe46]
Total input files to process : 1
Adding a new node: /default-rack/172.31.43.128:50010
number of splits:8
Submitting tokens for job: job_1709455590151_0005
Submitted application application_1709455590151_0005
The url to track the job: http://ip-172-31-43-128.ec2.internal:20888/proxy/application_1709455590151_0005/
Running job: job_1709455590151_0005
Job job_1709455590151_0005 running in uber mode : false
map 0% reduce 0%
map 11% reduce 0%
map 25% reduce 0%
map 28% reduce 0%
map 32% reduce 0%
map 34% reduce 0%
map 36% reduce 0%
map 39% reduce 0%
map 41% reduce 0%
map 50% reduce 0%
map 58% reduce 0%
map 65% reduce 0%
map 75% reduce 0%
map 81% reduce 0%
map 86% reduce 0%
map 93% reduce 0%
map 100% reduce 0%
map 100% reduce 33%
map 100% reduce 56%
map 100% reduce 67%
map 100% reduce 89%
map 100% reduce 100%
Job job_1709455590151_0005 completed successfully
Output directory: hdfs:///user/root/tmp/mrjob/mrtask_c.root.20240303.091803.109952/step-output/0000
```

```
[root@ip-172-31-43-128 ~]# hadoop fs -cat /user/root/output3/part*
"1"      6514906
"2"      3073865
"3"      52711
"4"      15510
"5"      1
```

1= Credit card 6514906 times 2= Cash 3073865 times 3= No charge 52711 times 4= Dispute 15510 times 5= Unknown 1 times

d) What is the average trip time for different pickup locations?

```
python mrtask_d.py -r hadoop hdfs:///user/root//yellow_tripdata_2017-06.csv -o /user/root/output4
```

```
[root@ip-172-31-43-128 ~]# python mrtask_d.py -r hadoop hdfs:///user/root/yellow_tripdata_2017-06.csv -o /user/root/output4
No configs found; falling back on auto-configuration
No configs specified for hadoop runner
Looking for hadoop binary in $PATH...
Found hadoop binary: /bin/hadoop
Using Hadoop version 2.8.5
Looking for Hadoop streaming jar in /home/hadoop/contrib...
Looking for Hadoop streaming jar in /usr/lib/hadoop-mapreduce...
Found Hadoop streaming jar: /usr/lib/hadoop-mapreduce/hadoop-streaming.jar
Creating temp directory /tmp/mrtask_d.root.20240303.091902.038330
uploading working dir files to hdfs:///user/root/tmp/mrjob/mrtask_d.root.20240303.091902.038330/files/wd...
Copying other local files to hdfs:///user/root/tmp/mrjob/mrtask_d.root.20240303.091902.038330/files/
Running step 1 of 1...
packageJobJar: [] [/usr/lib/hadoop/hadoop-streaming-2.8.5-amzn-6.jar] /tmp/streamjob3842447728834333607.jar tmpDir=null
Connecting to ResourceManager at ip-172-31-43-128.ec2.internal/172.31.43.128:8032
Connecting to ResourceManager at ip-172-31-43-128.ec2.internal/172.31.43.128:8032
Loaded native gpl library
Successfully loaded & initialized native-lzo library [hadoop-lzo rev ff8f5709577defb6b78cdc1f98cfe129c4b6fe46]
Total input files to process : 1
Adding a new node: /default-rack/172.31.43.128:50010
number of splits:8
Submitting tokens for job: job_1709455590151_0006
Submitted application application_1709455590151_0006
The url to track the job: http://ip-172-31-43-128.ec2.internal:20888/proxy/application_1709455590151_0006/
Running job: job_1709455590151_0006
Job job_1709455590151_0006 running in uber mode : false
map 0% reduce 0%
map 9% reduce 0%
map 12% reduce 0%
map 14% reduce 0%
map 15% reduce 0%
map 17% reduce 0%
map 25% reduce 0%
map 35% reduce 0%
map 40% reduce 0%
map 42% reduce 0%
map 46% reduce 0%
map 50% reduce 0%
map 54% reduce 0%
map 59% reduce 0%
map 62% reduce 0%
map 65% reduce 0%
map 66% reduce 0%
map 67% reduce 0%
map 71% reduce 0%
map 75% reduce 0%
map 80% reduce 0%
map 84% reduce 0%
map 86% reduce 0%
map 89% reduce 0%
map 90% reduce 0%
map 92% reduce 0%
map 96% reduce 0%
map 100% reduce 0%
map 100% reduce 28%
map 100% reduce 31%
map 100% reduce 33%
map 100% reduce 64%
map 100% reduce 67%
map 100% reduce 94%
map 100% reduce 96%
map 100% reduce 100%
```

```
[root@ip-172-31-43-128 ~]# hadoop fs -cat /user/root/output4/part*
"102" 1076.1573033707866
"105" 1392.357142857143
"108" 989.9761904761905
"111" 655.9130434782609
"114" 977.6730138684966
"117" 1045.851851851852
"12" 1481.030947408392
"120" 977.3623188405797
"123" 878.336
"126" 895.4302325581396
"129" 844.8253580160671
"132" 2800.6091054175295
"135" 1246.7802197802198
"138" 2398.8628218024664
"141" 748.3066160560385
"144" 1034.6588943522815
"147" 622.1891891891892
"15" 1090.5
"150" 838.8068767441861
```

150 938.9069767441861
"153" 810.1477272727273
"156" 2278.0
"159" 792.6066176470588
"162" 924.5542543662558
"165" 1566.2251655629138
"168" 752.390779363337
"171" 687.9402985074627
"174" 651.7065217391304
"177" 1089.5435684647302
"18" 1727.4719101123596
"180" 3776.370786516854
"183" 728.5
"186" 1047.4157303712814
"189" 842.712284131639
"192" 763.8014184397163
"195" 1397.4748091603053
"198" 825.3807829181495
"201" 667.4545454545455
"204" 41.333333333333336
"207" 437.12406015037595
"21" 3334.7297297297296
"210" 1115.5740740740741
"213" 982.9485294117648
"216" 1721.7284122562673
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"81" 582.0

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"121"	699.5714285714286
"124"	1570.0077519379845
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"142"	875.5698904858197
"145"	749.3720799550454
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"151"	825.9021361388194
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"157"	1169.7609649122808
"16"	832.0
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"166"	933.4752033879416
"169"	779.9554140127389
"172"	728.8571428571429
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"52"	1035.8338688946014
"55"	1493.2698412698412
"58"	439.2
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"64"	557.5416666666666
"67"	2046.4558823529412
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"70"	1709.9663461538462
"73"	2012.25
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"101"	365.75555555555553
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"116"	1016.8315115286081
"119"	1212.168115942029
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"131"	710.7222222222222
"134"	840.7218934911242
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"14"	856.781512605042
"140"	849.839119944638

"143"	813.0498667535804
"146"	898.0881837648433
"149"	682.2142857142857
"152"	856.631366616238
"155"	3531.890625
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"167"	1680.8076923076924
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"176"	2741.0
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"2"	2179.2727272727275
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"203"	3268.6511627906975
"206"	509.1111111111111
"209"	1225.193918270445
"212"	675.046511627907
"215"	2883.9666666666667
"218"	1207.590909090909
"221"	475.5
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"23"	981.3809523809524
"230"	1084.3506138758187
"233"	953.8294230869271
"236"	782.310736701082
"239"	812.1788268955651
"242"	1057.8110236220473
"245"	23.0
"248"	614.6857142857143
"251"	1034.8181818181818
"254"	799.3454545454546
"257"	849.7564102564103
"26"	712.9844357976654
"260"	946.570233530847
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"29"	827.7049180327868
"32"	961.7297297297297
"35"	956.1216216216217
"38"	4610.058823529412
"41"	817.150512039856
"44"	1015.0
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"50"	912.4771895165187
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"56"	1203.282738095238
"59"	172.5
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"68"	945.321726371542
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"74"	820.2451278525531
"77"	2461.090909090909

"8"	967.4817518248175
"80"	932.9837424290723
"83"	908.8763277693475
"86"	1138.857142857143
"89"	940.2078580481623
"92"	985.8654970760234
"95"	1042.8010825439783
"98"	690.55

e) Calculate the average tips to revenue ratio of the drivers for different pickup locations in sorted format.

```
python mrtask_e.py -r hadoop hdfs:///user/root//yellow_tripdata_2017-06.csv -o /user/root/output5
```

```
[root@ip-172-31-43-128 ~]# python mrtask_e.py -r hadoop hdfs:///user/root//yellow_tripdata_2017-06.csv -o /user/root/output5
No configs found; falling back on auto-configuration
No configs specified for hadoop runner
Looking for hadoop binary in $PATH...
Found hadoop binary: /bin/hadoop
Using Hadoop version 2.8.5
Looking for Hadoop streaming jar in /home/hadoop/contrib...
Looking for Hadoop streaming jar in /usr/lib/hadoop-mapreduce...
Found Hadoop streaming jar: /usr/lib/hadoop-mapreduce/hadoop-streaming.jar
Creating temp directory /tmp/mrtask_e.root.20240303.093744.219503
uploading working dir files to hdfs:///user/root/tmp/mrjob/mrtask_e.root.20240303.093744.219503/files/wd...
Copying other local files to hdfs:///user/root/tmp/mrjob/mrtask_e.root.20240303.093744.219503/files/
Running step 1 of 2...
packageJobJar: [ [/usr/lib/hadoop/hadoop-streaming-2.8.5-amzn-6.jar] /tmp/streamjob1626137063828561736.jar tmpDir=null
Connecting to ResourceManager at ip-172-31-43-128.ec2.internal/172.31.43.128:8032
Connecting to ResourceManager at ip-172-31-43-128.ec2.internal/172.31.43.128:8032
Loaded native gpl library
Successfully loaded & initialized native-lzo library [hadoop-lzo rev ff8f5709577defb6b78cdclf98cfe129c4b6fe46]
Total input files to process : 1
Adding a new node: /default-rack/172.31.43.128:50010
number of splits:8
Submitting tokens for job: job_1709455590151_0008
Submitted application application_1709455590151_0008
The url to track the job: http://ip-172-31-43-128.ec2.internal:20888/proxy/application_1709455590151_0008/
Running job: job_1709455590151_0008
Job job_1709455590151_0008 running in uber mode : false
  map 0% reduce 0%
  map 9% reduce 0%
  map 15% reduce 0%
  map 17% reduce 0%
  map 25% reduce 0%
  map 30% reduce 0%
  map 35% reduce 0%
  map 37% reduce 0%
  map 40% reduce 0%
  map 41% reduce 0%
  map 42% reduce 0%
  map 50% reduce 0%
  map 54% reduce 0%
  map 59% reduce 0%
  map 62% reduce 0%
  map 64% reduce 0%
  map 66% reduce 0%
  map 67% reduce 0%
  map 71% reduce 0%
  map 75% reduce 0%
  map 85% reduce 0%
  map 91% reduce 0%
  map 92% reduce 0%
  map 96% reduce 0%
  map 100% reduce 0%
  map 100% reduce 26%
  map 100% reduce 29%
  map 100% reduce 32%
  map 100% reduce 33%
  map 100% reduce 64%
  map 100% reduce 67%
  map 100% reduce 94%
  map 100% reduce 97%
  map 100% reduce 100%
Job job_1709455590151_0008 completed successfully
Output directory: hdfs:///user/root/tmp/mrjob/mrtask_e.root.20240303.093744.219503/step-output/0000
```

```
[root@ip-172-31-43-128 ~]# hadoop fs -cat /user/root/output5/part*
"187"    0.35993431437445905
"30"     0.2781315808235432
"221"    0.20444448874256568
"104"    0.2000665778961385
"117"    0.19780107488973278
"118"    0.17004866794890885
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"23"     0.13075980786114136
"3"      0.1257013584960645
"138"    0.123096943109162
```


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"90" 0.11049342424482494
"246" 0.11049099114515189
"162" 0.11026411166866955
"79" 0.10997335570596145
"39" 0.10970862002905302
"113" 0.10964372039771295
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"194" 0.10898641345319002
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"66" 0.10784129315081642
"148" 0.10721832465961804
"211" 0.1070389370318074
"137" 0.10699591784910366
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"163" 0.10190555149221317
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"252"	0.07174312247218405
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"51"	0.04210185228869742
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"193"	0.04089087481923947
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"82"	0.038843818293698124
"83"	0.03877319711795957
"182"	0.038736592846391395
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"227"	0.03509898044046717
"254"	0.03481216912023673
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"94"	0.03424223173897039
"168"	0.03399321196729288
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"46"	0.030407354882879357
"241"	0.030015537816439404
"108"	0.028172861022775646
"207"	0.028097255452994994
"18"	0.02719690875036601
"47"	0.026134408136377185
"178"	0.026039901294760574
"147"	0.02522848334967555

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"81"    0.021810924173885894
"167"   0.020593160844349947
"9"     0.019197453734643842
"115"   0.01765536723163842
"73"    0.0146355404690273
"59"    0.014285714285714285
"86"    0.011502185415228893
"176"   0.0
"109"   0.0
```

f) How does revenue vary over time? Calculate the average trip revenue per month - analysing it by hour of the day (day vs night) and the day of the week (weekday vs weekend).

```
python mrtask_f.py -r hadoop hdfs:///user/root//yellow_tripdata_2017-06.csv -o
/user/root/output6
```

```
[root@ip-172-31-43-128 ~]# python mrtask_f.py -r hadoop hdfs:///user/root//yellow_tripdata_2017-06.csv -o /user/root/output6
No configs found; falling back on auto-configuration
No configs specified for hadoop runner
Looking for hadoop binary in $PATH...
Found hadoop binary: /bin/hadoop
Using Hadoop version 2.8.5
Looking for Hadoop streaming jar in /home/hadoop/contrib...
Looking for Hadoop streaming jar in /usr/lib/hadoop-mapreduce...
Found Hadoop streaming jar: /usr/lib/hadoop-mapreduce/hadoop-streaming.jar
Creating temp directory /tmp/mrtask_f.root.20240303.094805.640636
uploading working dir files to hdfs:///user/root/tmp/mrjob/mrtask_f.root.20240303.094805.640636/files/wd...
Copying other local files to hdfs:///user/root/tmp/mrjob/mrtask_f.root.20240303.094805.640636/files/
Running step 1 of 2...
packageJobJar: [] [/usr/lib/hadoop/hadoop-streaming-2.8.5-amzn-6.jar] /tmp/streamjob1937231028224450142.jar tmpDir=null
Connecting to ResourceManager at ip-172-31-43-128.ec2.internal/172.31.43.128:8032
Connecting to ResourceManager at ip-172-31-43-128.ec2.internal/172.31.43.128:8032
Loaded native gpl library
Successfully loaded & initialized native-lzo library [hadoop-lzo rev ff8f5709577defb6b78cdc1f98cfe129c4b6fe46]
Total input files to process : 1
Adding a new node: /default-rack/172.31.43.128:50010
number of splits:8
Submitting tokens for job: job_1709455590151_0010
Submitted application application_1709455590151_0010
The url to track the job: http://ip-172-31-43-128.ec2.internal:20888/proxy/application_1709455590151_0010/
Running job: job_1709455590151_0010
Job job_1709455590151_0010 running in uber mode : false
map 0% reduce 0%
map 4% reduce 0%
map 5% reduce 0%
map 7% reduce 0%
map 9% reduce 0%
map 11% reduce 0%
map 13% reduce 0%
map 15% reduce 0%
map 17% reduce 0%
map 25% reduce 0%
map 28% reduce 0%
map 30% reduce 0%
map 32% reduce 0%
map 34% reduce 0%
map 36% reduce 0%
map 38% reduce 0%
map 40% reduce 0%
map 41% reduce 0%
map 50% reduce 0%
map 54% reduce 0%
map 56% reduce 0%
map 57% reduce 0%
map 59% reduce 0%
map 61% reduce 0%
map 63% reduce 0%
map 65% reduce 0%
map 71% reduce 0%
map 75% reduce 0%
map 77% reduce 0%
map 78% reduce 0%
map 79% reduce 0%
map 80% reduce 0%
map 81% reduce 0%
map 82% reduce 0%
map 83% reduce 0%
map 84% reduce 0%
```

```
[root@ip-172-31-43-128 ~]# hadoop fs -cat /user/root/output6/part*
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