Train Accident Analysis and Data Exploration using Apache Spark

This notebook is the assignment (https://console.ng.bluemix.net/data/notebooks/fadb25c7-8554-4ceb-a4f6-7150f1986db7/view?access_token=dcbb44ae304e451cdad622dd46dd42e099d81538ac9250e08a59d69be75d6c68) done by Team 6 for CMPE272 at SJSU. It shows you how to analyze railway accidents using data from trainwreckdb (http://www.trainwreckdb.com). The data range from January to April, 2016. We use Python as our language and we analyzed this data in four perspectives:

- Fistly, we evaluated what are the top 10 cities and railroad having the most vehicle accidents.
- Next, we search the cases which pedestrians were involved.
- Then we found out which top 10 railway companies were involved in those accidents.
- Finally, we divided those accidents into daily hours and investigate to see when do the accident more like to happen.

Importing Data

The data was originally download as csv file. We upload to Object Storage in IBM bluemix so it can be used through Apache Spark. Also we briefly inspect rows and columns of the data.

In [1]:
```
credentials = {
  'auth_url':'https://identity.open.softlayer.com',
  'project':'object_storage_c67bbb5b_5b85_42fc_b4fe_818070c55db7',
  'project_id':'b72aa02b17714f338be87b13934093cc',
  'region':'dallas',
  'user_id':'8b0d9461a687486089854fea4c0a1a88',
  'domain_id':'d84e3e35da554e32b4d0b8ce8334e6b8',
  'domain_name':'1141541',
  'username':'admin_8d2e1a30789bd861f5f7f5b1e338aff014d6d4ae',
  'password':"""TnxytWnjN3b9,N6)""",
  'filename':'traindb_new.csv',
  'container':'notebooks',
  'tenantId':'s842-b4a0e8a248ecef-de62ffe0452b'
}
```

In [2]:
```
def set_hadoop_config(credentials):
    prefix = "fs.swift.service." + credentials['name']
    hconf = sc._jsc.hadoopConfiguration()
    hconf.set(prefix + ".auth.url", credentials['auth_url']+'/v3/au
th/tokens')
    hconf.set(prefix + ".auth.endpoint.prefix", "endpoints")
    hconf.set(prefix + ".tenant", credentials['project_id'])
    hconf.set(prefix + ".username", credentials['user_id'])
    hconf.set(prefix + ".password", credentials['password'])
    hconf.setInt(prefix + ".http.port", 8080)
    hconf.set(prefix + ".region", credentials['region'])
    hconf.setBoolean(prefix + ".public", True)
```

In [3]:
```
credentials['name'] = 'keystone'
set_hadoop_config(credentials)
```

In [4]:
```
test = sc.textFile("swift://notebooks.keystone/traindb_new.csv")
```

In [169]:
```
from __future__ import division
import numpy as np

from pyspark.sql import SQLContext
sqlContext = SQLContext(sc)

# adding the PySpark modul to SparkContext
sc.addPyFile("https://raw.githubusercontent.com/seahboonsiew/pyspar
k-csv/master/pyspark_csv.py")
import pyspark_csv as pycsv

def skip_header(idx, iterator):
    if (idx == 0):
        next(iterator)
    return iterator

test_header = test.first()

test_header_list = test_header.split(",")
test_body = test.mapPartitionsWithIndex(skip_header)

# filter not valid rows
test_body = test_body.filter(lambda line : line.split(","))

# create Spark DataFrame using pyspark-csv
test_df = pycsv.csvToDataFrame(sqlContext, test_body, sep=",", colu
mns=test_header_list)
test_df.cache()
```

Out[169]:
```
DataFrame[Date: timestamp, City/State: string, Street: string, Rai
lroad: string, Description: string]
```

In [170]:
```
test_df.first()
```

Out[170]:
```
Row(Date=datetime.datetime(2016, 4, 30, 17, 45), City/State=u'CROW
LEY, LOUISIANA', Street=u'SIDNEY RICHARD ROAD', Railroad=u'Union P
acific Railroad Company', Description=u'PICKUP TRUCK STOPPED TOO C
LOSE TO THE TRACKS AND WAS STRUCK BY THE ONCOMING TRAIN. #32 WARNI
NG DEVICES: YIELD SIGN')
```

In [171]:
```
test_df
```

Out[171]:
```
DataFrame[Date: timestamp, City/State: string, Street: string, Rai
lroad: string, Description: string]
```

In [172]:
```
test_df.registerTempTable("test")
sqlContext.cacheTable("test")
```

Top 10 City/State with the most accidents involving vehicles

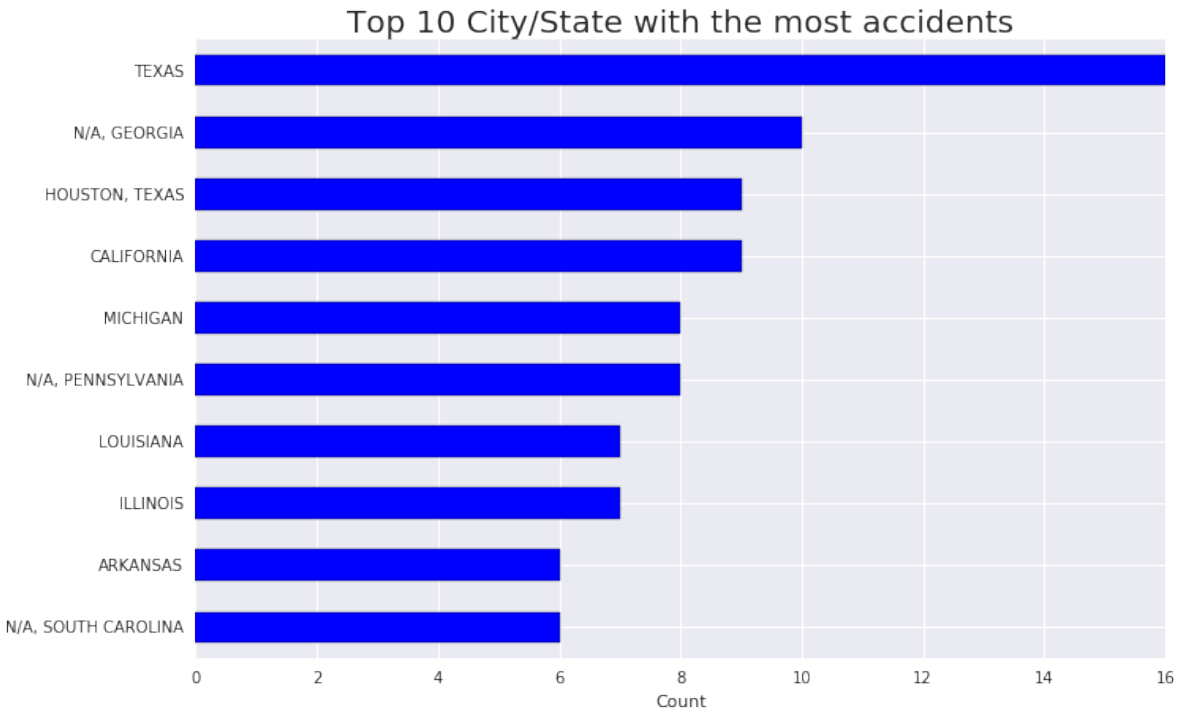
In [173]:
```
test_sql = sqlContext.sql("SELECt * FROM test WHERE Description LIK
E '%VEHICLE%'").collect()
```

In [191]:
```
!pip install --user seaborn

%matplotlib inline

import matplotlib.pyplot as plt
# matplotlib.patches allows us create colored patches, we can use f
or legends in plots
import matplotlib.patches as mpatches
# seaborn also builds on matplotlib and adds graphical features and
new plot types
import seaborn as sns
import pandas as pd
```

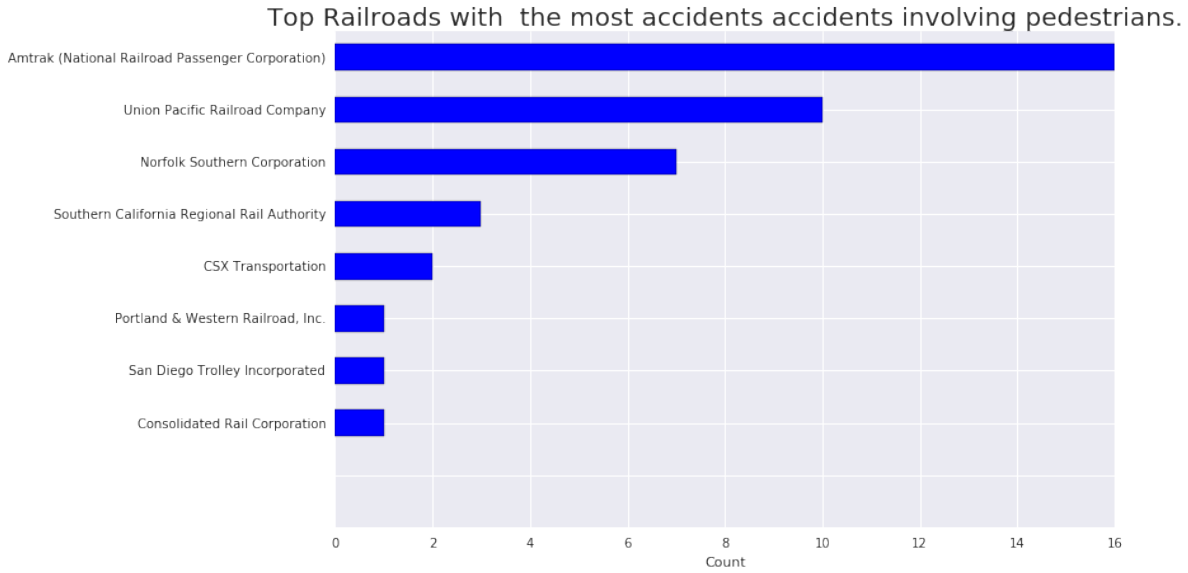
```
Requirement already satisfied (use --upgrade to upgrade): seaborn
in /gpfs/global_fs01/sym_shared/YPProdSpark/user/seae-430bee3c52e7
c3-afed1d8faf1e/.local/lib/python2.7/site-packages
```

In [192]:
```
from pyspark.sql import functions as F
```

In [193]:
```
plottingdf = test_df.groupBy("City/State").agg(F.count("City/State"
).alias("sum(accidents)")).\
sort(F.desc('sum(accidents)')).limit(10).toPandas()
plottingdf[['sum(accidents)']].plot(kind='barh', figsize=(11,7), le
gend=False)
plt.title('Top 10 City/State with the most accidents involving Vehi
cles', size=20)
plt.xlabel('Count')
plt.yticks(range(10),
plottingdf['City/State'])
plt.gca().invert_yaxis()
plt.show()
```



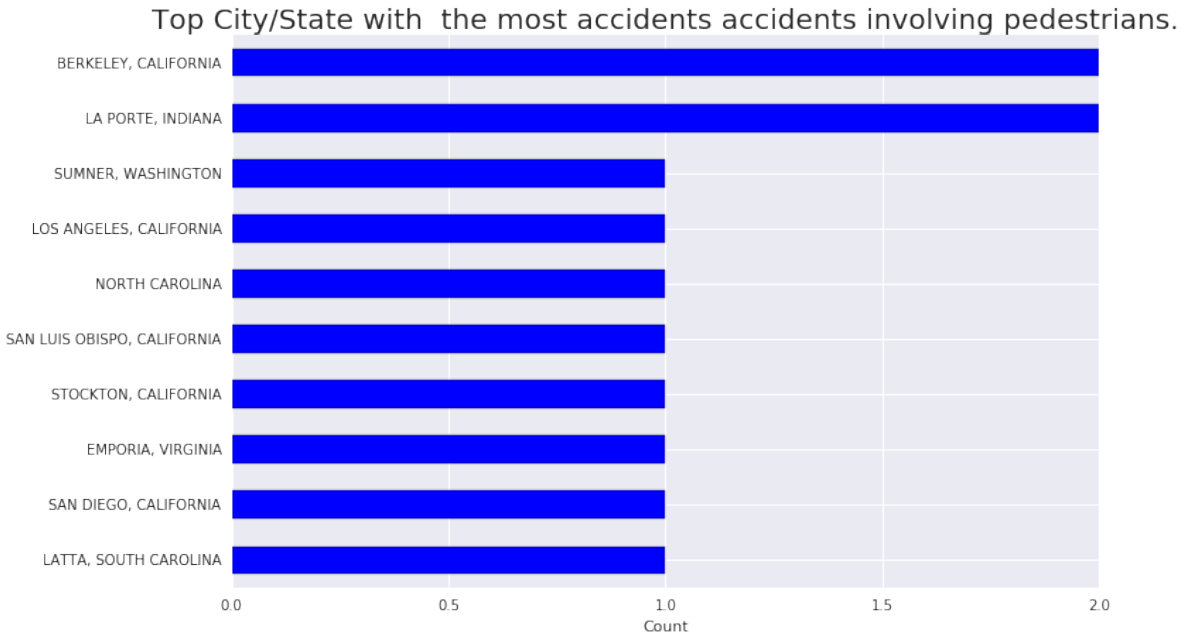
In [187]:
```
plottingdf = test_sql.groupBy("Railroad").agg(F.count("Railroad").a
lias("sum(accidents)")).\
sort(F.desc('sum(accidents)')).limit(10).toPandas()
plottingdf[['sum(accidents)']].plot(kind='barh', figsize=(11,7), le
gend=False)
plt.title('Top Railroads with  the most accidents accidents involvi
ng vehicles', size=20)
plt.xlabel('Count')
plt.yticks(range(10),
plottingdf['Railroad'])
plt.gca().invert_yaxis()
plt.show()
```



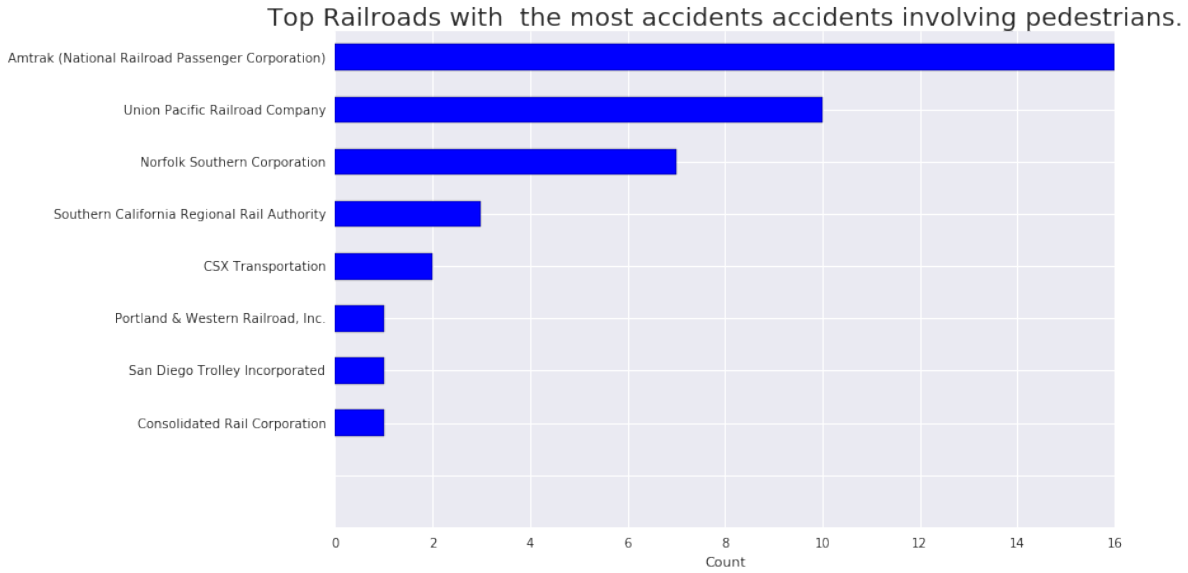
Top City/State and Railroad with the most accidents accidents involving pedestrians

In [185]:
```
test_sql = sqlContext.sql("SELECt * FROM test WHERE Description LIK
E '%PEDESTRIAN%'")
```

In [186]:
```
plottingdf = test_sql.groupBy("City/State").agg(F.count("City/State
").alias("sum(accidents)")).\
sort(F.desc('sum(accidents)')).limit(10).toPandas()
plottingdf[['sum(accidents)']].plot(kind='barh', figsize=(11,7), le
gend=False)
plt.title('Top City/State with  the most accidents accidents involv
ing pedestrians', size=20)
plt.xlabel('Count')
plt.yticks(range(10),
plottingdf['City/State'])
plt.gca().invert_yaxis()
plt.show()
```



In [187]:
```
plottingdf = test_sql.groupBy("Railroad").agg(F.count("Railroad").a
lias("sum(accidents)")).\
sort(F.desc('sum(accidents)')).limit(10).toPandas()
plottingdf[['sum(accidents)']].plot(kind='barh', figsize=(11,7), le
gend=False)
plt.title('Top Railroads with  the most accidents accidents involvi
ng pedestrians.', size=20)
plt.xlabel('Count')
plt.yticks(range(10),
plottingdf['Railroad'])
plt.gca().invert_yaxis()
plt.show()
```



Top 10 Railroads with Most Accidents

In [178]:
```
railroad_accidents = sqlContext.sql("SELECT Railroad, COUNT(*) AS A
ccidents FROM test GROUP BY Railroad ORDER BY Accidents DESC LIMIT
10").collect()
```

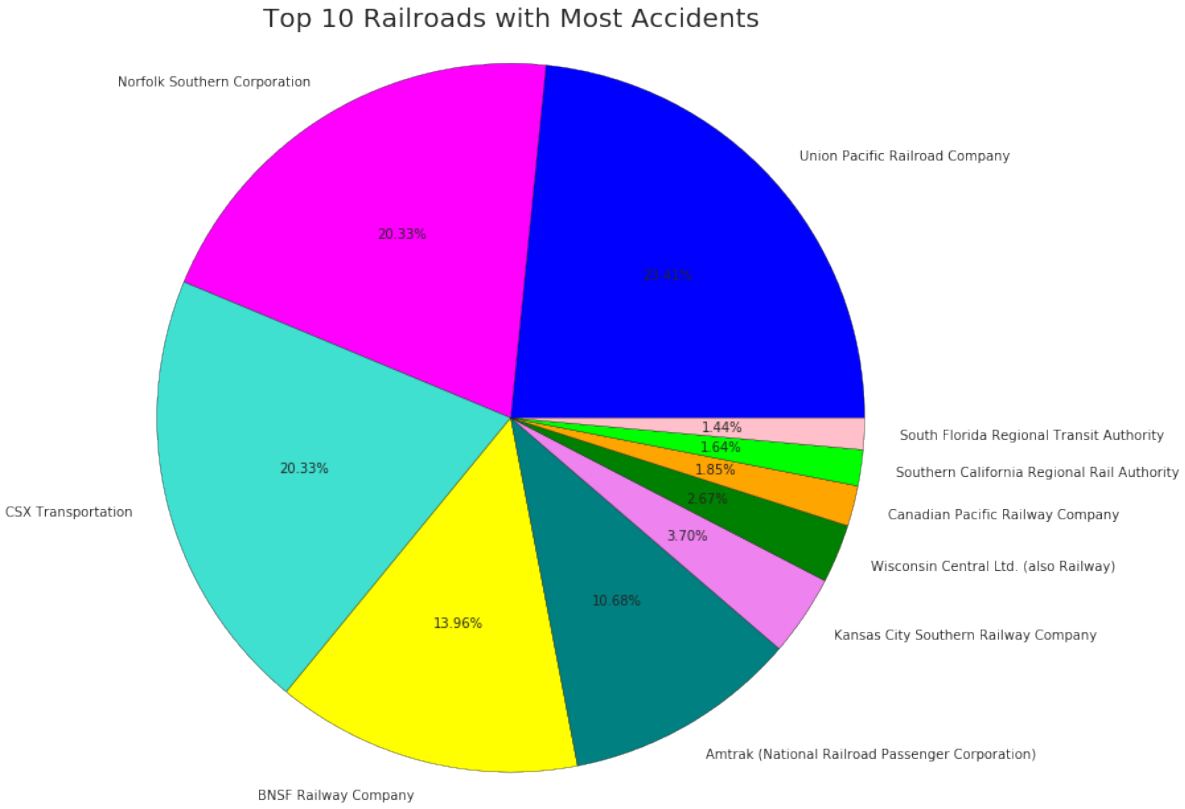
In [179]:
```
railroads = [0] * 10
index = 0
for row in railroad_accidents:
    railroads[index]=row.Railroad
    index = index + 1

print railroads
```

```
[u'Union Pacific Railroad Company', u'Norfolk Southern Corporation
', u'CSX Transportation', u'BNSF Railway Company', u'Amtrak (Natio
nal Railroad Passenger Corporation)', u'Kansas City Southern Railw
ay Company', u'Wisconsin Central Ltd. (also Railway)', u'Canadian
Pacific Railway Company', u'Southern California Regional Rail Auth
ority', u'South Florida Regional Transit Authority']
```

In [180]:
```
accidents = [0] * 10
index = 0
for row in railroad_accidents:
    accidents[index]=row.Accidents
    index = index + 1

print accidents
```

```
[114, 99, 99, 68, 52, 18, 13, 9, 8, 7]
```

In [181]:
```
plt.axis('equal')
plt.title("Top 10 Railroads with Most Accidents", size=20, y=1.8)
plt.pie(
    accidents,
    labels=railroads,
    colors=['blue','magenta','turquoise','yellow','teal','violet','
green','orange','lime','pink'],
    autopct="%1.2f%%",
    radius=3);
```



Accidents by Daily Hours

In [195]:
```
time_accidents = sqlContext.sql("SELECT HOUR(Date) AS Hour, Count(*
) AS Accident FROM test GROUP BY HOUR(Date)")
```

In [196]:
```
plottingdf = time_accidents.toPandas()
plottingdf[['Accident']].plot(kind='bar', figsize=(11,7), legend=Fa
lse)
plt.title('Accidents by Daily Hours', size=20)
plt.xlabel('Count')
plt.show()
```