This notebook was designed to be run from Google Colab (https://colab.research.google.com) to process the 2017 trips dataset (which I have assembled and hosted on my Google Drive (https://drive.google.com/open?id=1L-uci9bnJ5WBJAltvT5kLjF0XsoSOcKs)) to produce the balanced trips dataset.

In [0]:
```
!pip install -U -q PyDrive

from pydrive.auth import GoogleAuth
from pydrive.drive import GoogleDrive
from google.colab import auth
from oauth2client.client import GoogleCredentials


auth.authenticate_user()
gauth = GoogleAuth()
gauth.credentials = GoogleCredentials.get_application_default()
drive = GoogleDrive(gauth)

# PyDrive reference:
# https://googledrive.github.io/PyDrive/docs/build/html/index.html

x_train_id =
y_train_id =
x_test_id = '1eeuGElHLV8-T8ZXSumHCqP5Ym3NqJuR4'
y_test_id = '1EYMc3oAgoVwa2U0NESfM2lkUfnuf-RUN'

csv_import =  drive.CreateFile({'id':'1L-uci9bnJ5WBJAltvT5kLjF0XsoSOcK
s'}) # Load my dataset from google drive
csv_import.GetContentFile('citibike-2017.csv.zip')
```

In [0]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

In [4]:
```
# df = pd.read_csv('july-2017.csv')
df = pd.read_csv('../data/citibike-2017.csv.zip')
df['start station name'] = df['start station name'].str.lower()
df['end station name'] = df['end station name'].str.lower()
print(f'Number of trips: {df.shape}')
df.head()
```

```
Number of trips: (16364657, 15)
```

Out[4]:

	tripduration	starttime	stoptime	start station id	start station name	start station latitude	start station longitude	end station id	
0	680	2017-01-01 00:00:21	2017-01-01 00:11:41	3226	w 82 st & central park west	40.782750	-73.971370	3165	cer par & v
1	1282	2017-01-01 00:00:45	2017-01-01 00:22:08	3263	cooper square & e 7 st	40.729236	-73.990868	498	brc & v
2	648	2017-01-01 00:00:57	2017-01-01 00:11:46	3143	5 ave & e 78 st	40.776829	-73.963888	3152	3 a 71
3	631	2017-01-01 00:01:10	2017-01-01 00:11:42	3143	5 ave & e 78 st	40.776829	-73.963888	3152	3 a 71
4	621	2017-01-01 00:01:25	2017-01-01 00:11:47	3143	5 ave & e 78 st	40.776829	-73.963888	3152	3 a 71

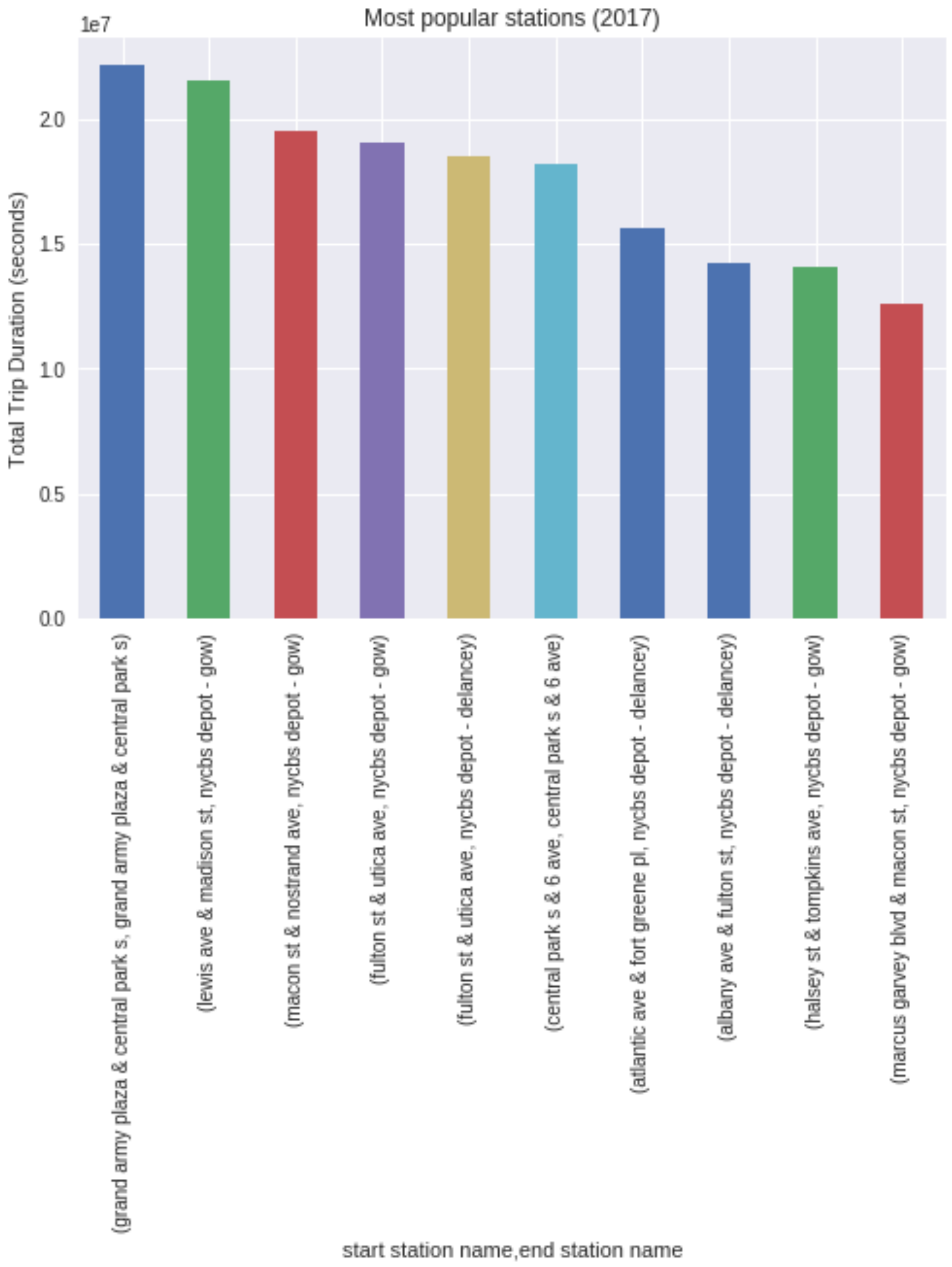
In [5]:
```
trips_agg = df.groupby(['start station name', 'end station name'])['tr
ipduration'].agg(['sum', 'mean'])
trips_agg.head()
```

Out[5]:

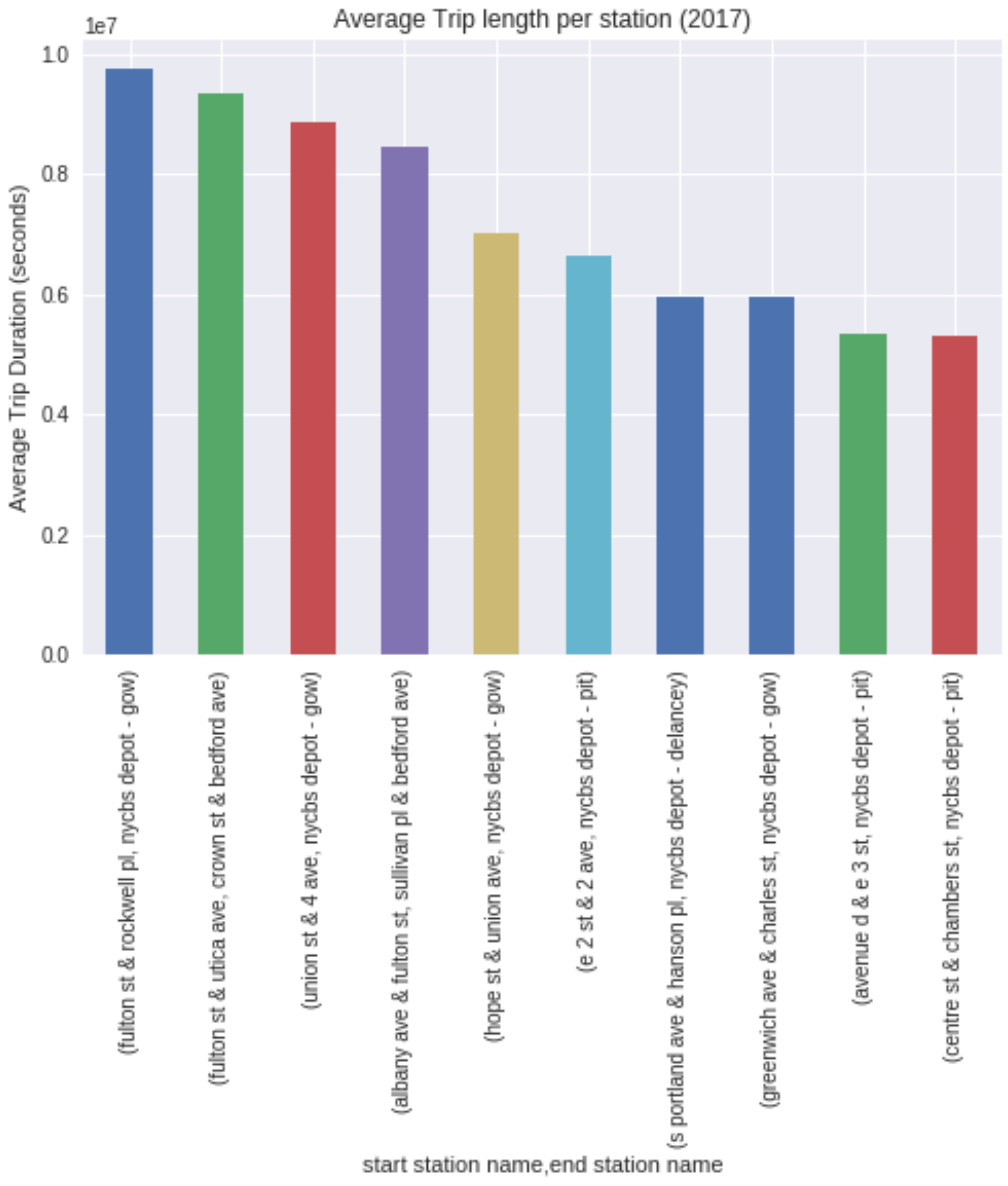
		sum	mean
start station name	**end station name**		
1 ave & e 110 st	**1 ave & e 110 st**	27874	1072.076923
	1 ave & e 68 st	7654	1093.428571
	1 ave & e 78 st	47455	777.950820
	1 ave & e 94 st	7814	520.933333
	11 ave & w 27 st	2221	2221.000000

In [6]:
```
total_trips = trips_agg['sum'].sort_values(ascending=False)
plt.title('Most popular stations (2017)')
plt.ylabel('Total Trip Duration (seconds)')
total_trips.nlargest(10).plot(kind='bar', sort_columns=True)
```

Out[6]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f89a90e73c8>
```

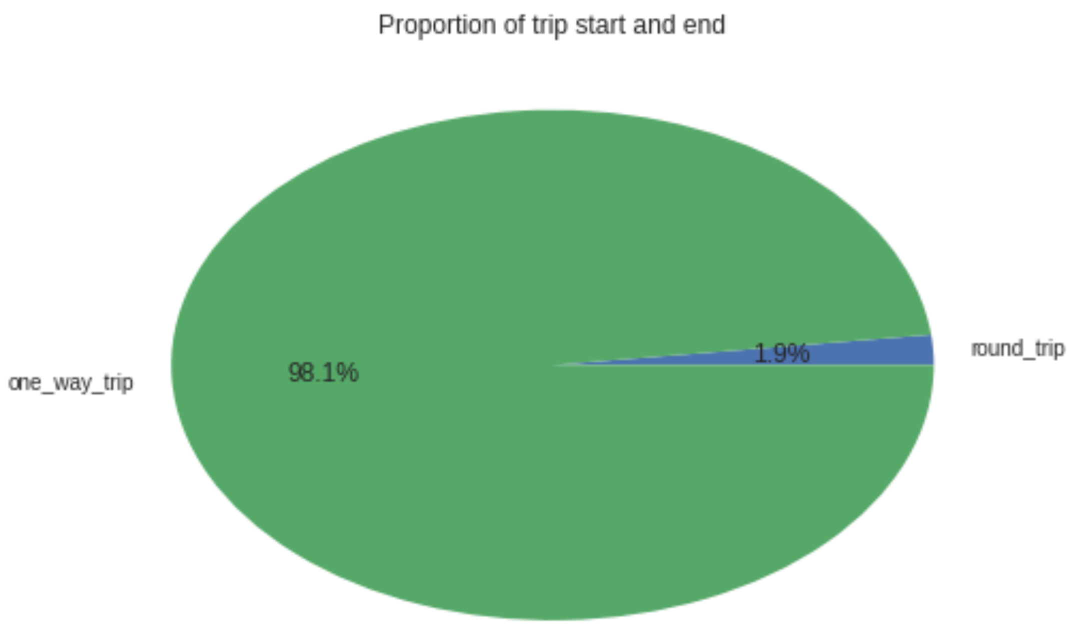

Most popular stations (2017)
1e7
Total Trip Duration (seconds)
2.0
1.5
1.0
0.5
0.0
(grand army plaza & central park s, grand army plaza & central park s)
(lewis ave & madison st, nycbs depot - gow)
(macon st & nostrand ave, nycbs depot - gow)
(fulton st & utica ave, nycbs depot - gow)
(fulton st & utica ave, nycbs depot - delancey)
(central park s & 6 ave, central park s & 6 ave)
(atlantic ave & fort greene pl, nycbs depot - delancey)
(albany ave & fulton st, nycbs depot - delancey)
(halsey st & tompkins ave, nycbs depot - gow)
(marcus garvey blvd & macon st, nycbs depot - gow)
start station name,end station name

```
In [7]: average_trips = trips_agg['mean'].sort_values(ascending=False)
        plt.title('Average Trip length per station (2017)')
        plt.ylabel('Average Trip Duration (seconds)')
        average_trips.nlargest(10).plot(kind='bar', sort_columns=True)

Out[7]: <matplotlib.axes._subplots.AxesSubplot at 0x7f8a689dc9e8>
```

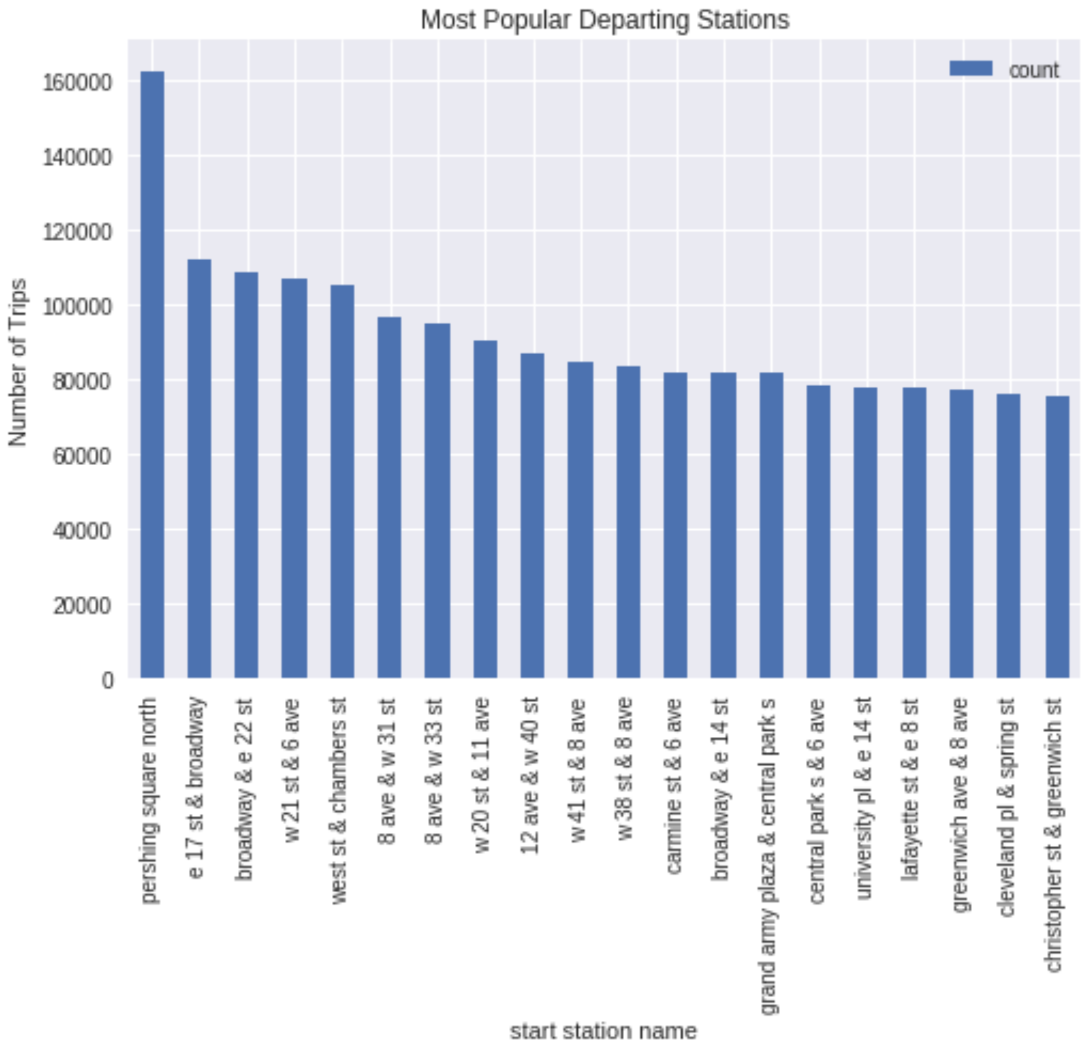


In [8]:
```
round_trip = df.loc[df['start station name'] == df['end station name']
].groupby(['start station name'])['tripduration'].agg(['sum', 'count']
)
one_way_trip = df.loc[df['start station name'] != df['end station name
']].groupby(['start station name', 'end station name'])['tripduration'
].agg(['sum', 'count'])

trip_proportions = {
    'round_trip': round_trip['count'].sum(),
    'one_way_trip': one_way_trip['count'].sum()
}
trip_proportions['round_trip'] = trip_proportions['round_trip'] / (tri
p_proportions['round_trip'] + trip_proportions['one_way_trip'])
trip_proportions['one_way_trip'] = trip_proportions['one_way_trip'] /
(trip_proportions['round_trip'] + trip_proportions['one_way_trip'])

plt.title('Proportion of trip start and end')
plt.pie(list(trip_proportions.values()), labels=list(trip_proportions.
keys()), autopct='%1.1f%%')
```

Out[8]:
```
([<matplotlib.patches.Wedge at 0x7f8a58c754e0>,
  <matplotlib.patches.Wedge at 0x7f8a58c75be0>],
 [Text(1.09804,0.0656802,'round_trip'),
  Text(-1.09804,-0.0656802,'one_way_trip')],
 [Text(0.598929,0.0358256,'1.9%'), Text(-0.598929,-0.0358255,'98.1%'
)])
```

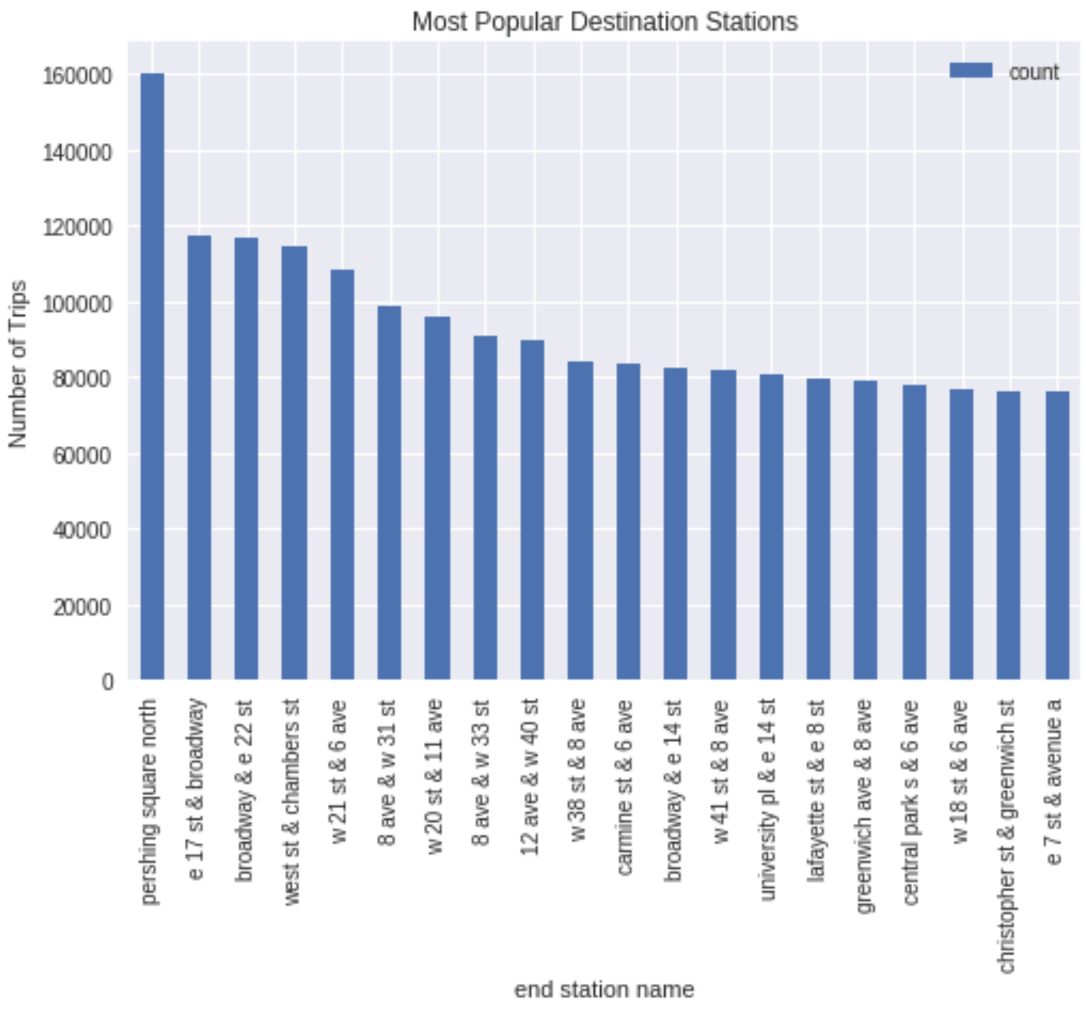


```
In [9]: outgoing_stations = df.groupby(['start station name'])['tripduration']
        .agg(['count'])

        ax = outgoing_stations.nlargest(20, columns=['count']).plot(kind='bar'
        , sort_columns=True, title='Most Popular Departing Stations')
        ax.set_ylabel('Number of Trips')

Out[9]: Text(0,0.5,'Number of Trips')
```



In [10]:
```
incoming_stations = df.groupby(['end station name'])['tripduration'].a
gg(['count'])

ax = incoming_stations.nlargest(20, columns=['count']).plot(kind='bar'
, sort_columns=True, title='Most Popular Destination Stations')
ax.set_ylabel('Number of Trips')
```

Out[10]:
```
Text(0,0.5,'Number of Trips')
```



In [0]:
```
from IPython.display import HTML, display

def progress(value, max=100):
    return HTML("""
        <progress
            value='{value}'
            max='{max}',
            style='width: 100%'
        >
            {value}
        </progress>
    """.format(value=value, max=max))
```

This section constructs the "balancing trips", it finds all trips for each unique bike where a trip starts from a different location then it last ended.

In [10]:
```
bike_ids = df['bikeid'].unique()
rebalanced_bikes = pd.DataFrame(columns=df.columns)

out = display(progress(0, bike_ids.shape[0]), display_id=True)
i = 0

for bike_id in bike_ids:
  i += 1
  out.update(progress(i, bike_ids.shape[0]))
  bike_trips = df.loc[df['bikeid'] == bike_id]
  bike_trips['next start station name'] = bike_trips['start station na
me'].shift(-1) # Sorted by time, get the starting point of the next tr
ip

  # If a trip starts in a different place then the last one ended, i'l
l assume the bike was relocated for rebalancing
  rebalanced_trips = bike_trips.loc[bike_trips['end station name'] !=
bike_trips['next start station name']][:-1]

  rebalanced_bikes = rebalanced_bikes.append(rebalanced_trips, ignore_
index=True)

rebalanced_bikes[['end station name', 'next start station name']].head
()
```

```
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:26: Set
tingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
```

Out[10]:

	end station name	next start station name
0	central park west & w 102 st	w 90 st & amsterdam ave
1	dekalb ave & hudson ave	s 5 pl & s 4 st
2	laight st & hudson st	myrtle ave & lewis ave
3	e 17 st & broadway	1 ave & e 18 st
4	8 ave & w 52 st	pershing square south

In [16]:
```
bike_ids = df['bikeid'].unique()
rebalanced_bikes = pd.DataFrame(columns=df.columns)

out = display(progress(0, bike_ids.shape[0]), display_id=True)
i = 0

for bike_id in bike_ids:
  i += 1
  out.update(progress(i, bike_ids.shape[0]))
  bike_trips = df.loc[df['bikeid'] == bike_id]
  bike_trips['next start station id'] = bike_trips['start station id']
.shift(-1) # Sorted by time, get the starting point of the next trip
  bike_trips['next starttime'] = bike_trips['starttime'].shift(-1)

  # If a trip starts in a different place then the last one ended, i'l
l assume the bike was relocated for rebalancing
  rebalanced_trips = bike_trips.loc[bike_trips['end station id'] != bi
ke_trips['next start station id']][:-1]

  rebalanced_bikes = rebalanced_bikes.append(rebalanced_trips, ignore_
index=True)

rebalanced_bikes.head()
rebalanced_bikes.to_csv('rebalanced_bike2.csv')
```

```
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:11: Set
tingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
  # This is added back by InteractiveShellApp.init_path()
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:12: Set
tingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
  if sys.path[0] == '':
```

In [0]:
```
from google.colab import files

# rebalanced_bikes.to_csv('rebalanced_bike.csv')
# auth.authenticate_user()
# gauth = GoogleAuth()
# gauth.credentials = GoogleCredentials.get_application_default()
# drive = GoogleDrive(gauth)
# file_list = drive.ListFile({'q': "trashed=false"}).GetList()
# for file1 in file_list:
#   print('title: %s, id: %s' % (file1['title'], file1['id']))

files.download('rebalanced_bike2.csv')
```