Question_1

May 4, 2019

In [1]:
```
from google.colab import drive
drive.mount('/content/gdrive')
```

```
Go to this URL in a browser: https://accounts.google.com/o/oauth2/auth?client_id=947318989803-6b

Enter your authorization code:
··········
Mounted at /content/gdrive
```

In [22]:
```
path = '/content/gdrive/My Drive/Colab Notebooks/2018701001'
import networkx as nx
import pandas as pd
import dateutil.parser
import datetime
import numpy as np
from math import radians, sin, cos, acos
import operator
import matplotlib.pyplot as plt
import geopy.distance
!pip3 install pyproj
import plotly.graph_objs as go
from pyproj import Geod
%matplotlib inline
import matplotlib.pyplot as plt
import plotly.plotly as py
import pickle
wgs84_geod = Geod(ellps='WGS84')
```

```
Requirement already satisfied: pyproj in /usr/local/lib/python3.6/dist-packages (2.1.3)
```

In [0]:
```
def distance(slat, slon, elat, elon):
    dist = 6371.01 * acos(sin(slat)*sin(elat) + cos(slat)*cos(elat)*cos(slon - elon))
    return dist

def Distance(lat1,lon1,lat2,lon2):
  az12,az21,dist = wgs84_geod.inv(lon1,lat1,lon2,lat2)
```

```
    return dist

def GetHomeFromDegrees(lat,lon):
    if (len(lat) <= 0):
        return (0,0)

    newX = sum(lat)/len(lat)
    newY = sum(lon)/len(lon)
    return (newX,newY)


def dict_sort_des(diction):
    sorted_d = sorted(diction.items(), key=operator.itemgetter(1),reverse=True)
    return sorted_d

def plot_frequency(list1, list2):
    data = [go.Bar(x=list1,
            y=list2)]

    return py.iplot(data, filename='jupyter-basic_bar')

def PrecisionGraph(thresh_holds, precision, x, y):
    plt.plot(thresh_holds, precision, label = y)
    plt.ylabel(y)
    plt.title(x + ' Vs '+ y)
    plt.xlabel(x)
    plt.show()
```

In [0]:
```
my_graph = nx.Graph()
edges = nx.read_edgelist(path+'/Gowalla_edges.txt')
my_graph.add_edges_from(edges.edges())
```

In [23]:
```
df = pd.read_csv(path+'/Gowalla_totalCheckins.txt', sep="\t", header=None, names=["user
df
```

Out[23]:

	user	time	lat	long	locid
0	0	2010-10-19T23:55:27Z	30.235909	-97.795140	22847
1	0	2010-10-18T22:17:43Z	30.269103	-97.749395	420315
2	0	2010-10-17T23:42:03Z	30.255731	-97.763386	316637
3	0	2010-10-17T19:26:05Z	30.263418	-97.757597	16516
4	0	2010-10-16T18:50:42Z	30.274292	-97.740523	5535878
5	0	2010-10-12T23:58:03Z	30.261599	-97.758581	15372
6	0	2010-10-12T22:02:11Z	30.267910	-97.749312	21714
7	0	2010-10-12T19:44:40Z	30.269103	-97.749395	420315
8	0	2010-10-12T15:57:20Z	30.281120	-97.745211	153505
9	0	2010-10-12T15:19:03Z	30.269103	-97.749395	420315
10	0	2010-10-12T00:21:28Z	40.643885	-73.782806	23261
11	0	2010-10-11T20:21:20Z	40.741374	-73.988105	16907

12	0	2010-10-11T20:20:42Z	40.741388	-73.989455	12973
13	0	2010-10-11T00:06:30Z	40.724910	-73.994621	341255
14	0	2010-10-10T22:00:37Z	40.729768	-73.998535	260957
15	0	2010-10-10T21:17:14Z	40.728527	-73.996868	1933724
16	0	2010-10-10T17:47:04Z	40.741747	-73.993421	105068
17	0	2010-10-09T23:51:10Z	40.734193	-74.004164	34817
18	0	2010-10-09T22:27:07Z	40.742512	-74.006031	27836
19	0	2010-10-09T21:39:26Z	40.742396	-74.007543	15079
20	0	2010-10-09T21:36:05Z	40.742396	-74.007543	15079
21	0	2010-10-09T21:05:23Z	40.735885	-74.004968	22806
22	0	2010-10-09T20:55:47Z	40.727525	-73.985399	1365909
23	0	2010-10-09T01:37:03Z	40.756880	-73.986225	11844
24	0	2010-10-08T21:48:37Z	40.707417	-74.011363	11742
25	0	2010-10-08T21:45:48Z	40.707173	-74.010545	19822
26	0	2010-10-08T21:43:52Z	40.707071	-74.011953	15169
27	0	2010-10-08T21:43:02Z	40.705823	-73.996696	11794
28	0	2010-10-08T19:28:36Z	40.769378	-73.963083	1567837
29	0	2010-10-08T17:24:27Z	40.780805	-73.976473	35513
...	...	...	...	...	...
6442862	196577	2010-03-20T13:50:44Z	51.748408	-0.457842	394036
6442863	196577	2010-03-13T15:01:31Z	50.796290	-1.104657	472762
6442864	196577	2010-03-10T20:46:33Z	51.747870	-0.488194	496276
6442865	196578	2010-06-26T11:31:25Z	51.712110	-0.050458	1341442
6442866	196578	2010-06-12T11:18:56Z	51.741916	-0.496729	1174322
6442867	196578	2010-06-12T10:47:18Z	51.743782	-0.495793	1160482
6442868	196578	2010-06-12T10:47:07Z	51.742029	-0.497377	594064
6442869	196578	2010-06-12T10:46:54Z	51.746925	-0.501147	627093
6442870	196578	2010-06-12T10:07:39Z	51.744149	-0.505390	899939
6442871	196578	2010-06-11T15:42:58Z	51.746712	-0.514305	467635
6442872	196578	2010-06-11T15:42:32Z	51.747791	-0.491863	1250178
6442873	196578	2010-06-11T15:42:20Z	51.746296	-0.487218	797460
6442874	196578	2010-06-11T15:42:09Z	51.746330	-0.486929	496521
6442875	196578	2010-06-11T15:41:59Z	51.749802	-0.501034	1072999
6442876	196578	2010-06-11T15:41:39Z	51.749672	-0.500684	1151842
6442877	196578	2010-06-11T15:41:08Z	51.749706	-0.500992	1151847
6442878	196578	2010-06-11T15:40:46Z	51.749478	-0.500603	635712
6442879	196578	2010-06-11T15:40:01Z	51.749451	-0.500988	697962
6442880	196578	2010-06-11T15:38:57Z	51.742029	-0.497377	594064
6442881	196578	2010-06-11T15:38:43Z	51.746925	-0.501147	627093
6442882	196578	2010-06-11T15:38:20Z	51.744149	-0.505390	899939
6442883	196578	2010-06-11T13:33:40Z	51.745652	-0.487572	964995
6442884	196578	2010-06-11T13:33:27Z	51.746004	-0.486102	797488
6442885	196578	2010-06-11T13:32:50Z	51.745659	-0.481369	616571
6442886	196578	2010-06-11T13:32:40Z	51.745971	-0.485233	965051
6442887	196578	2010-06-11T13:32:26Z	51.742988	-0.488065	906885
6442888	196578	2010-06-11T13:26:45Z	51.746492	-0.490780	965121
6442889	196578	2010-06-11T13:26:34Z	51.741916	-0.496729	1174322
6442890	196585	2010-10-08T21:01:49Z	50.105516	8.571525	471724

```
6442891  196585  2010-10-07T17:39:18Z  50.027812   8.785098  4555073

[6442892 rows x 5 columns]
```

```
In [84]: date_list = []
         for k in df['time']:
             date_list.append(datetime.datetime.strptime(k, "%Y-%m-%dT%H:%M:%SZ"))
         date_list
         df['time'] = date_list
         df.head()
```

Out[84]:

	user	time	lat	long	locid
0	0	2010-10-19 23:55:27	30.235909	-97.795140	22847
1	0	2010-10-18 22:17:43	30.269103	-97.749395	420315
2	0	2010-10-17 23:42:03	30.255731	-97.763386	316637
3	0	2010-10-17 19:26:05	30.263418	-97.757597	16516
4	0	2010-10-16 18:50:42	30.274292	-97.740523	5535878

```
In [0]: lat_list = []
        long_list = []
        for k in df['lat']:
            lat_list.append(float(k))
        for k in df['long']:
            long_list.append(float(k))
        df['lat'] = lat_list
        df['long'] = long_list
        df.head()
```

Out[0]:

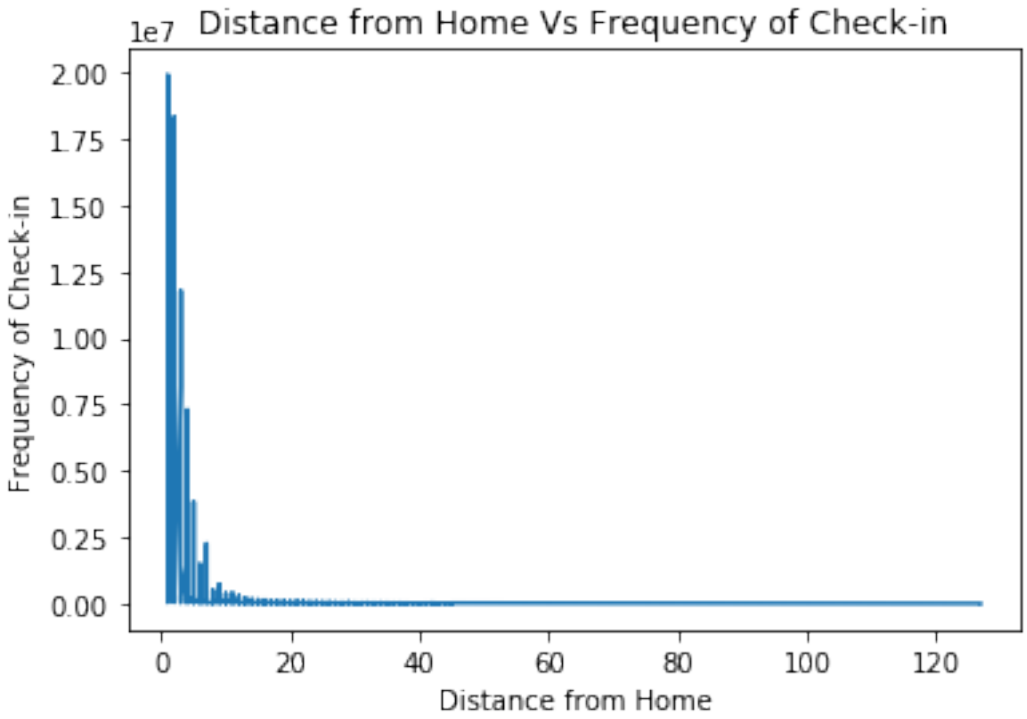
	user	time	lat	long	locid
0	0	2010-10-19T23:55:27Z	30.235909	-97.795140	22847
1	0	2010-10-18T22:17:43Z	30.269103	-97.749395	420315
2	0	2010-10-17T23:42:03Z	30.255731	-97.763386	316637
3	0	2010-10-17T19:26:05Z	30.263418	-97.757597	16516
4	0	2010-10-16T18:50:42Z	30.274292	-97.740523	5535878

```
In [0]: user_center = {}
        users = list(set(df['user']))
```

```
In [0]: # print(users)
        for k in users:
            df_user=df[(df['user']== k)]
        #     print(df_user)
            ulat_list = df_user['lat']
            ulong_list = df_user['long']
            m = GetHomeFromDegrees(ulat_list,ulong_list)
            user_center[k] = m
        #     print(m)
        user_center
```

Distance from home user tends to travel -> frequency of users vs Distance from home.

```
In [0]: user_distances = {}
        for k in users:
            df_user=df[(df['user']== k)]
            ulat_list = df_user['lat']
            ulong_list = df_user['long']
            user_distances[k] = []
            origins = user_center[k]
            for f, b in zip(ulat_list, ulong_list):
                user_distances[k].append(round(Distance(origins[0],origins[1], f,b), 4))

In [0]: user_distances = None
        with open(path+'/distanceee.pickle', 'rb') as handle:
            user_distances = pickle.load(handle)

In [0]: user_center = None
        with open(path+'/home.pickle', 'rb') as handle:
            user_center = pickle.load(handle)

In [163]: distances = []
          for k in user_distances.values():
            distances.extend(k)
          distances = list(set(distances))
          print(len(distances))
          distances = [x for x in distances if ~np.isnan(x)]
          print((distances[:50]))

3932660
[0.0, 15.8125, 30.375, 31.125, 32.75, 53.625, 61.9375, 65.375, 66.3089, 75.4339, 78.7464, 79.878


In [0]: distance_freq = {}
        for m in distances:
          if int(m) not in distance_freq.keys():
            distance_freq[int(m)] = 1
          else:
            distance_freq[int(m)] += 1

In [171]: ploting_list = []
          value_list = []
          for k in (dict_sort_des(distance_freq)):
              ploting_list.append(k[0])
              value_list.append(k[1])

          PrecisionGraph(ploting_list, value_list,'Distance from Home', 'Frequency of Check-in')
```




```
In [0]: userNumber = 0
        friends_of_user = []
        for k in my_graph.neighbors(str(users[userNumber])):
          if int(k) in user_center.keys():
            friends_of_user.append((k, user_center[int(k)]))
```

```
In [0]: distance_freq = {}
        distances = user_distances[userNumber]
        for m in distances:
          if int(m) not in distance_freq.keys():
            distance_freq[int(m)] = 1
          else:
            distance_freq[int(m)] += 1
```

```
In [169]: distance_friend_freq = {}
          df_user=df[(df['user']== users[userNumber])]
          ulat_list = df_user['lat']
          ulong_list = df_user['long']
          h = user_center[int(users[userNumber])]
          for f, b in zip(ulat_list, ulong_list):
            d = int(Distance(h[0],h[1], f,b))
            for k in friends_of_user:
              if (int(Distance(k[1][0],k[1][1], f,b))) <= 25000.0:
                if d not in distance_friend_freq.keys():
```

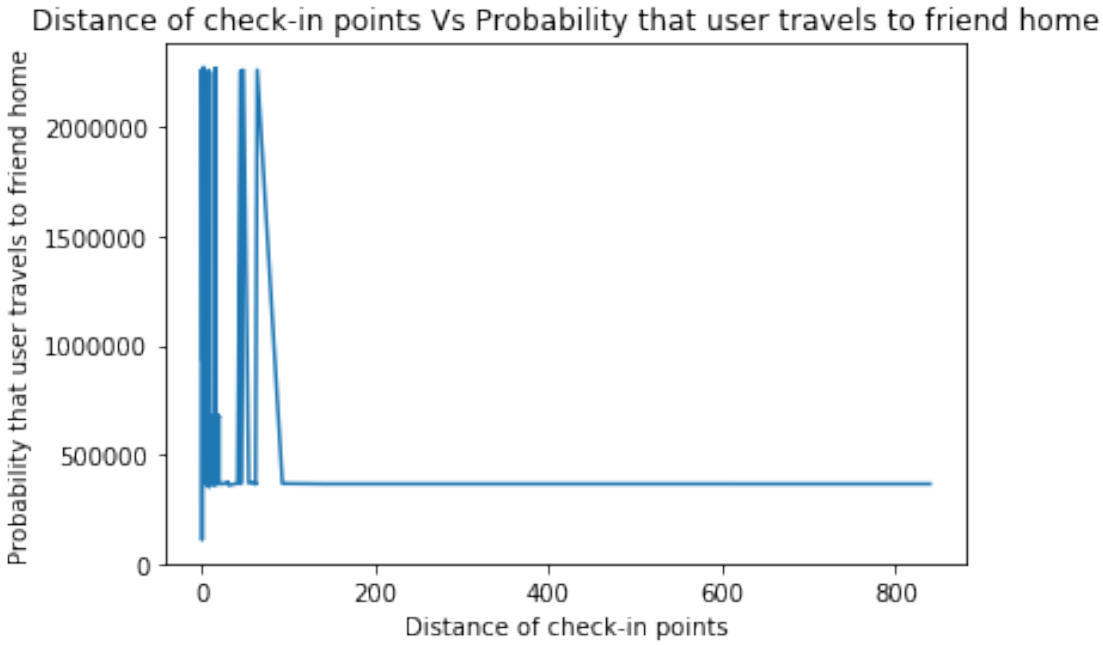
```
            distance_friend_freq[d] = 1
          else:
            distance_friend_freq[d] += 1
    c = 0
    for k in distance_friend_freq.keys():
      try:
        distance_friend_freq[k] /= (distance_freq[k])
      except:
        c +=1
        continue
    c
```

Out[169]: 0

In [167]:
```
types1 = [type(k) for k in distance_friend_freq.keys()]
types1
len(distance_friend_freq)
```

Out[167]: 127

In [170]:
```
ploting_list = []
value_list = []
for k in (dict_sort_des(distance_friend_freq)):
    ploting_list.append(k[0])
    value_list.append(k[1])

PrecisionGraph(value_list, ploting_list,'Distance of check-in points','Probability tha
```



```
In [85]: df['time'].head()

Out[85]: 0   2010-10-19 23:55:27
         1   2010-10-18 22:17:43
         2   2010-10-17 23:42:03
         3   2010-10-17 19:26:05
         4   2010-10-16 18:50:42
         Name: time, dtype: datetime64[ns]

In [92]: df['time'].iloc[[0]].iloc[0] > df['time'].iloc[[1]].iloc[0]

Out[92]: True

In [93]: df.head()

Out[93]:    user                time        lat       long    locid
         0     0 2010-10-19 23:55:27  30.235909 -97.795140    22847
         1     0 2010-10-18 22:17:43  30.269103 -97.749395   420315
         2     0 2010-10-17 23:42:03  30.255731 -97.763386   316637
         3     0 2010-10-17 19:26:05  30.263418 -97.757597    16516
         4     0 2010-10-16 18:50:42  30.274292 -97.740523  5535878

In [0]: userid = 0
        userdata = df.groupby('user').get_group(userid)

In [0]: df['lat-long'] = list(zip(df.lat, df.long))

In [108]: df.head()

Out[108]:    user                time        lat       long    locid  \
          0     0 2010-10-19 23:55:27  30.235909 -97.795140    22847
          1     0 2010-10-18 22:17:43  30.269103 -97.749395   420315
          2     0 2010-10-17 23:42:03  30.255731 -97.763386   316637
          3     0 2010-10-17 19:26:05  30.263418 -97.757597    16516
          4     0 2010-10-16 18:50:42  30.274292 -97.740523  5535878

                                      new_col                              lat-long
          0      (30.2359091167, -97.7951395833)      (30.2359091167, -97.7951395833)
          1      (30.2691029532, -97.7493953705)      (30.2691029532, -97.7493953705)
          2      (30.2557309927, -97.7633857727)      (30.2557309927, -97.7633857727)
          3      (30.2634181234, -97.7575966669)      (30.2634181234, -97.7575966669)
          4  (30.2742918584, -97.74052262309999)  (30.2742918584, -97.74052262309999)

In [111]: df.groupby('lat-long').get_group((30.2742918584, -97.74052262309999))
          df

Out[111]:    user                time        lat       long    locid  \
          0     0 2010-10-19 23:55:27  30.235909 -97.795140    22847
          1     0 2010-10-18 22:17:43  30.269103 -97.749395   420315
          2     0 2010-10-17 23:42:03  30.255731 -97.763386   316637
```

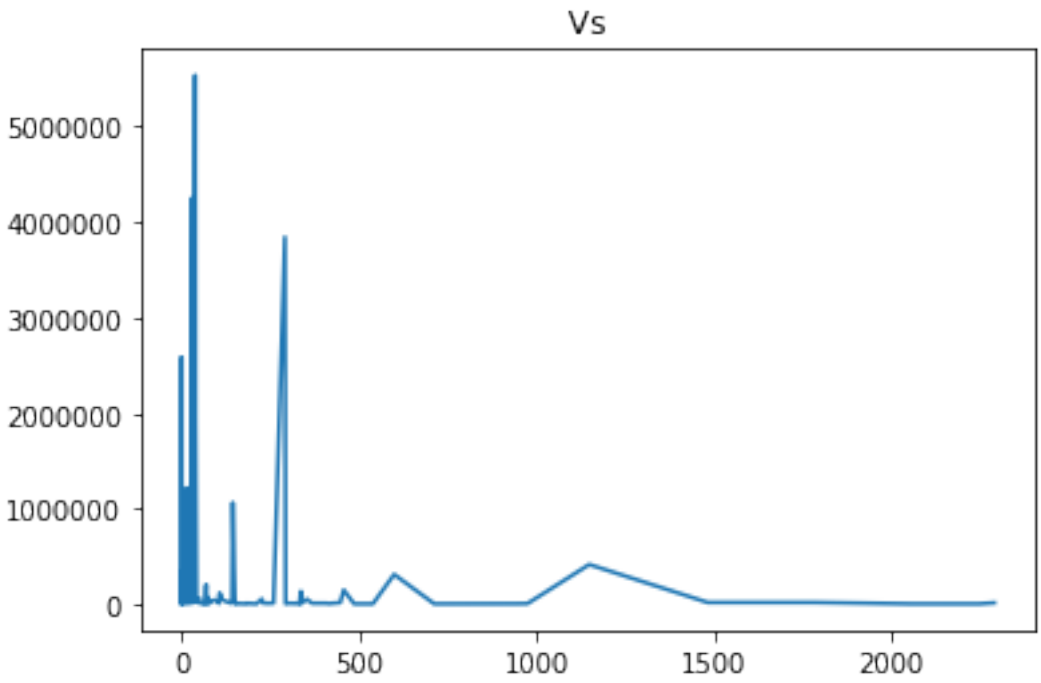
```
3     0 2010-10-17 19:26:05  30.263418 -97.757597    16516
4     0 2010-10-16 18:50:42  30.274292 -97.740523  5535878

                                  new_col                              lat-long
0      (30.2359091167, -97.7951395833)      (30.2359091167, -97.7951395833)
1      (30.2691029532, -97.7493953705)      (30.2691029532, -97.7493953705)
2      (30.2557309927, -97.7633857727)      (30.2557309927, -97.7633857727)
3      (30.2634181234, -97.7575966669)      (30.2634181234, -97.7575966669)
4  (30.2742918584, -97.74052262309999)  (30.2742918584, -97.74052262309999)
```

```
In [0]: check_in = []
        userid = 0
        for i in range(len(userdata)):
          user = userdata.iloc[[i]]['user'].iloc[0]
          time = userdata.iloc[[i]]['time'].iloc[0]
          lat = userdata.iloc[[i]]['lat'].iloc[0]
          long = userdata.iloc[[i]]['long'].iloc[0]
          locid = userdata.iloc[[i]]['locid'].iloc[0]
          count = 0
          data = df.groupby('lat-long').get_group((lat, long))
          for index in range(i, len(data), 1):
            if data.iloc[[index]]['user'].iloc[0] != user and data.iloc[[index]]['time'].iloc[0]
              count += 1
          check_in.append((locid, count))
```

```
In [0]: with open(path + '/trajectory.pickle', 'rb') as handle:
            check_in = pickle.load(handle)
```

```
In [0]: result = {}
        for val1, val2 in check_in:
          result[val1] = val2
```

```
In [178]: ploting_list = []
          value_list = []
          for k in (dict_sort_des(result)):
              ploting_list.append(k[0])
              value_list.append(k[1])

          PrecisionGraph(value_list, ploting_list, '', '')
```




```
In [0]: with open(path + '/trajectory.pickle', 'wb') as handle:
            pickle.dump(check_in,handle)
```

```
In [0]:
```