Capstone_Project_week4_After-school program

December 28, 2018

1 Capstone_Project: After-school program

2 Introduction

2.1 Introduction to the problem and background

Let's say one of my friends (living in Lansing Capital Area, Michigan State) plans to initialize an after-school program for elementary school students and middle-school students. He came to me and asked me for the suggestion on the location of the after-school program. In order to provide sound advice for him, we should consider the following factors:

- number of schools (public and private) in the neighbourhood.
- population in the neighbourhood.
- number of venues (stores and restaurants) in the neighbourhood.
- distance from the downtown

Definitely, the travel cost from the schools to the after-school spot is positively correlated to the distance between them. Moreover, there is a high probability that the more schools around the after-school spot, the more students will enroll the after school program. But one should also check if there already exist other after-school programs in the neighborhood. Besides, the number of stores and restraunts also has a positve impact on the enrollment.

2.2 Introduction to the data

To this end, we should collect the data of public and private schools, as well as the venues in the neighbourhoods. Here are the sources of each type of data:

- US zipcode can be found either from https://simplemaps.com/data/us-zips (recommended) or http://federalgovernmentzipcodes.us The population correspondign to each zipcode is also provided in the data.
- Geocodes for public schools are availe from https://nces.ed.gov/programs/edge/Geographic/SchoolLoca

The information of Latitude and Longitude is provided in all the files.

2.3 Introduction to the methodology

The python packages that we are going to use include (but not limited to):

- requests
- folium
- Nominatim
- pandas
- numpy

as well as foursquare API.
The procedure of preparing the data can be as follows:

- download/read all the datasets from websites.
- filter out all the schools in the area of interest.
- use Foursquare API to get all the venues (restraunts) in the area.
- visualize the location of the schools and venues with the folium.Map()
- use the groupby method to find out the number of schools and venues in each neighbourhood, which is defined based on the zipcode.
- find out the population of each neighbourhood.
- order the neighbourhoods based on the number of schools/venues and populations and use this ratio as a guideline

3 Data prepation and analysis

3.1 Import packages

```
In [326]: import requests
          from pandas.io.json import json_normalize
          import pandas as pd
          import numpy as np
          import folium
          import matplotlib.pyplot as plt
          import seaborn as sns
          from geopy.geocoders import Nominatim
```

3.2 Preparation of the data

download zipcode file from the website https://simplemaps.com/data/us-zips. Here we have already downloaded it into the local directory.

```
In [547]: path='uszipsv1.4.csv'

          US_zipcode=pd.read_csv(path)

          US_zipcode.head()
```

```
Out[547]:    zip      lat      lng         city state_id   state_name   zcta  \
          0  501  40.8133 -73.0476  Holtsville       NY     New York  False
```

```
1  544  40.8133 -73.0476  Holtsville       NY     New York  False
2  601  18.1800 -66.7522    Adjuntas       PR  Puerto Rico   True
3  602  18.3607 -67.1752      Aguada       PR  Puerto Rico   True
4  603  18.4544 -67.1220   Aguadilla       PR  Puerto Rico   True

   parent_zcta  population  county_fips county_name  \
0      11742.0         NaN          NaN         NaN
1      11742.0         NaN          NaN         NaN
2          NaN     18570.0      72001.0    Adjuntas
3          NaN     41520.0      72003.0      Aguada
4          NaN     54689.0      72005.0   Aguadilla

             all_county_weights  imprecise  military
0                           NaN       True     False
1                           NaN       True     False
2  {'72001':99.43,'72141':0.57}      False     False
3                {'72003':100}      False     False
4                {'72005':100}      False     False
```

We are only interested in the data in the Great Lansing Area. Therefore, we define a filter on both State and City names and pick those data out as a new dataframe.

```
In [548]: c0 =  US_zipcode['state_name'] =='Michigan'
          c1 =  US_zipcode['city'] =='Lansing'
          c2 =  US_zipcode['city'] =='Okemos'
          c3 =  US_zipcode['city'] =='Haslett'
          c4 =  US_zipcode['city'] =='Mason'
          c5 =  US_zipcode['city'] =='Holt'
          c6 =  US_zipcode['city'] =='East Lansing'

In [549]: Great_Lansing = US_zipcode[(c0) & ((c1) | (c2) | (c3) | (c4) | (c5) | (c6))]
          Great_Lansing.head()

Out[549]:          zip      lat      lng          city state_id state_name   zcta  \
          20914  48805  42.7082 -84.4144        Okemos       MI   Michigan  False
          20930  48823  42.7620 -84.4539  East Lansing       MI   Michigan   True
          20931  48824  42.7229 -84.4751  East Lansing       MI   Michigan  False
          20932  48825  42.7270 -84.4809  East Lansing       MI   Michigan   True
          20933  48826  42.7360 -84.4843  East Lansing       MI   Michigan  False

                 parent_zcta  population  county_fips county_name  \
          20914      48864.0         NaN          NaN         NaN
          20930          NaN     51302.0      26065.0      Ingham
          20931      48825.0         NaN          NaN         NaN
          20932          NaN     12596.0      26065.0      Ingham
          20933      48823.0         NaN          NaN         NaN

                        all_county_weights  imprecise  military
          20914                        NaN       True     False
```

```
20930  {'26037':14.5,'26065':85.5}      False     False
20931                          NaN      False     False
20932                {'26065':100}      False     False
20933                          NaN       True     False
```

Taking out the information that we need

```
In [550]: columns = ['zip','lat','lng','city','population']
          GL_population = Great_Lansing[columns]

In [551]: GL_population.rename(columns={'zip':'Zipcode','city':'City','lat':'Lat','lng':'Lon',
          GL_population.head()

/anaconda3/lib/python3.6/site-packages/pandas/core/frame.py:3778: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/indexing.html
  return super(DataFrame, self).rename(**kwargs)
```

Out[551]:

	Zipcode	Lat	Lon	City	Population
20914	48805	42.7082	-84.4144	Okemos	NaN
20930	48823	42.7620	-84.4539	East Lansing	51302.0
20931	48824	42.7229	-84.4751	East Lansing	NaN
20932	48825	42.7270	-84.4809	East Lansing	12596.0
20933	48826	42.7360	-84.4843	East Lansing	NaN

```
In [552]: print("There are {} neighbourhoods in the Great Lansing Area with {} different Latitu

There are 31 neighbourhoods in the Great Lansing Area with 20 different Latitudes.
```

Now let's prepare the data for schools:

- public schools
- private schools

We have already downloaded them into the local directory.

3.2.1 public schools

```
In [506]: public_path='EDGE_GEOCODE_PUBLICSCH_1617/EDGE_GEOCODE_PUBLICSCH_1617.xlsx'
          Public_Schools = pd.read_excel(public_path)
```

Again, we define filters to pick out the data that we are interested.

```
In [507]: c0 = Public_Schools['STATE'] == 'MI'
          c1 = Public_Schools['CITY'] =='LANSING'
          c2 = Public_Schools['CITY'] =='OKEMOS'
```

```
c3 = Public_Schools['CITY'] =='HASLETT'
c4 = Public_Schools['CITY'] =='EAST LANSING'
c5 = Public_Schools['CITY'] =='MASON'
c6 = Public_Schools['CITY'] =='HOLT'

GL_pub_schools = Public_Schools[(c0) & ((c1) | (c2) | (c3) | (c4) | (c5) | (c6))]
GL_pub_schools.head()
```

Out[507]:

	NCESSCH	NAME	OPSTFIPS	\
43329	260007900543	Cole Academy	26	
43330	260008000544	El-Hajj Malik El-Shabazz Academy	26	
43331	260008200546	Mid-Michigan Leadership Academy	26	
43419	260020301114	Windemere Park Charter Academy	26	
43565	260095908074	Lansing Charter Academy	26	

	STREET	CITY	STATE	ZIP	STFIP	CNTY	\
43329	1915 WEST MOUNT HOPE AVE	LANSING	MI	48910	26	26065	
43330	1028 WEST BARNES AVE	LANSING	MI	48910	26	26065	
43331	730 WEST MAPLE ST	LANSING	MI	48906	26	26065	
43419	3100 WEST SAGINAW ST	LANSING	MI	48917	26	26065	
43565	3300 EXPRESS CT	LANSING	MI	48910	26	26065	

	NMCNTY	...	NMCBSA	CBSATYPE	CSA	\
43329	Ingham County	...	Lansing-East Lansing, MI	1	330	
43330	Ingham County	...	Lansing-East Lansing, MI	1	330	
43331	Ingham County	...	Lansing-East Lansing, MI	1	330	
43419	Ingham County	...	Lansing-East Lansing, MI	1	330	
43565	Ingham County	...	Lansing-East Lansing, MI	1	330	

	NMCSA	NECTA	NMNECTA	CD	SLDL	SLDU	\
43329	Lansing-East Lansing-Owosso, MI	N	N	2608	26068	26023	
43330	Lansing-East Lansing-Owosso, MI	N	N	2608	26068	26023	
43331	Lansing-East Lansing-Owosso, MI	N	N	2608	26068	26023	
43419	Lansing-East Lansing-Owosso, MI	N	N	2608	26068	26023	
43565	Lansing-East Lansing-Owosso, MI	N	N	2608	26068	26023	

	SURVYEAR
43329	2016
43330	2016
43331	2016
43419	2016
43565	2016

[5 rows x 24 columns]

In [508]:
```
GL_pub_schools.columns
```

Out[508]:
```
Index(['NCESSCH', 'NAME', 'OPSTFIPS', 'STREET', 'CITY', 'STATE', 'ZIP',
       'STFIP', 'CNTY', 'NMCNTY', 'LOCALE', 'LAT', 'LON', 'CBSA', 'NMCBSA',
```

```
                'CBSATYPE', 'CSA', 'NMCSA', 'NECTA', 'NMNECTA', 'CD', 'SLDL', 'SLDU',
                'SURVYEAR'],
               dtype='object')
```

```
In [509]: columns = ['NAME','CITY','ZIP','LAT','LON']
          GL_pubs = GL_pub_schools[columns]
          GL_pubs.rename(columns={'NAME':'Name','CITY':'City','ZIP':'Zipcode','LAT':'Lat','LON
          GL_pubs.head()
```

```
/anaconda3/lib/python3.6/site-packages/pandas/core/frame.py:3778: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/indexing.html
  return super(DataFrame, self).rename(**kwargs)
```

```
Out[509]:                                  Name     City  Zipcode        Lat  \
          43329                   Cole Academy  LANSING    48910  42.711623
          43330  El-Hajj Malik El-Shabazz Academy  LANSING    48910  42.715258
          43331   Mid-Michigan Leadership Academy  LANSING    48906  42.746410
          43419    Windemere Park Charter Academy  LANSING    48917  42.741789
          43565           Lansing Charter Academy  LANSING    48910  42.699119

                       Lon
          43329 -84.578810
          43330 -84.566713
          43331 -84.563371
          43419 -84.591616
          43565 -84.575243
```

```
In [510]: print("There are {} public schools in the Great Lansing Area with {} different neighb
```

```
There are 69 public schools in the Great Lansing Area with 11 different neighbourhoods.
```

3.2.2 Private Schools

```
In [511]: private_schools = pd.read_excel('EDGE_GEOCODE_PRIVATESCH_15_16/EDGE_GEOCODE_PRIVATESC
          private_schools.head()
```

```
Out[511]:        PPIN                                          PINST  \
          0  A0100060                        CAMELLIA BAPTIST WEM
          1  A0900032              FIRST PRESBYTERIAN KINDERGARTEN
          2  00002722                           AUTAUGA ACADEMY
          3  K9300030                  FIRST BAPTIST KINDERGARTEN
          4  00002176  MARIETTA JOHNSON SCHOOL OF ORGANIC EDUCATION

                              PL_ADD      PL_CIT PL_STABB PL_ZIP PL_ZIP4  STFIP15  CNTY15  \
```

```
0    201 WOODVALE ROAD  PRATTVILLE       AL  36067    2713        1    1001
1    211 S CHESTNUT ST  PRATTVILLE       AL  36067    3023        1    1001
2        497 GOLSON RD  PRATTVILLE       AL  36067    9702        1    1001
3  138 S WASHINGTON ST  PRATTVILLE       AL  36067     NaN        1    1001
4        8 MARIETTA DR    FAIRHOPE       AL  36532    1653        1    1003

          NMCNTY15  ...    CBSA15                  NMCBSA15  CBSATYPE15 CSA15  \
0  Autauga County  ...     33860            Montgomery, AL           1     N
1  Autauga County  ...     33860            Montgomery, AL           1     N
2  Autauga County  ...     33860            Montgomery, AL           1     N
3  Autauga County  ...     33860            Montgomery, AL           1     N
4  Baldwin County  ...     19300  Daphne-Fairhope-Foley, AL           1   380

                       NMCSA15 NECTA15 NMNECTA15 CD15 SLDL15 SLDU15
0                            N       N         N  102     88     30
1                            N       N         N  102     88     30
2                            N       N         N  102     42     30
3                            N       N         N  102     88     30
4  Mobile-Daphne-Fairhope, AL       N         N  101     94     32

[5 rows x 23 columns]
```

In [512]:
```
c0 = private_schools['PL_STABB'] =='MI'
c1 = private_schools['PL_CIT'] =='LANSING'
c2 = private_schools['PL_CIT'] =='OKEMOS'
c3 = private_schools['PL_CIT'] =='HASLETT'
c4 = private_schools['PL_CIT'] =='EAST LANSING'
c5 = private_schools['PL_CIT'] =='HOLT'
c6 = private_schools['PL_CIT'] =='MASON'

GL_private_schools = private_schools[(c0) & ((c1) | (c2) | (c3) | (c4) | (c5) | (c6))]
GL_private_schools.head()
```

Out[512]:
```
           PPIN                                PINST                 PL_ADD  \
10007  A1502011  GREATER LANSING ADVENTIST SCHOOL       5330 W ST JOE HWY
10009  00642751        OUR SAVIOR LUTHERAN SCHOOL       7910 E ST JOE HWY
10013  00640197       ST GERARD ELEMENTARY SCHOOL       4433 W WILLOW HWY
10067  01610864       CAPITOL CITY BAPTIST SCHOOL      5100 WILLOUGHBY RD
10068  02037083        MONTESSORI CHILDRENS HOUSE  2100 W SAINT JOSEPH ST

        PL_CIT PL_STABB PL_ZIP PL_ZIP4  STFIP15  CNTY15       NMCNTY15  ...    \
10007  LANSING       MI  48917    4060       26   26045   Eaton County  ...
10009  LANSING       MI  48917    8871       26   26045   Eaton County  ...
10013  LANSING       MI  48917     NaN       26   26045   Eaton County  ...
10067     HOLT       MI  48842    1098       26   26065  Ingham County  ...
10068  LANSING       MI  48915    1175       26   26065  Ingham County  ...

       CBSA15                 NMCBSA15  CBSATYPE15 CSA15  \
```

```
10007   29620  Lansing-East Lansing, MI           1   330
10009   29620  Lansing-East Lansing, MI           1   330
10013   29620  Lansing-East Lansing, MI           1   330
10067   29620  Lansing-East Lansing, MI           1   330
10068   29620  Lansing-East Lansing, MI           1   330

                                  NMCSA15 NECTA15 NMNECTA15  CD15 SLDL15 SLDU15
10007  Lansing-East Lansing-Owosso, MI       N         N  2607     71     24
10009  Lansing-East Lansing-Owosso, MI       N         N  2607     71     24
10013  Lansing-East Lansing-Owosso, MI       N         N  2607     71     24
10067  Lansing-East Lansing-Owosso, MI       N         N  2608     67     23
10068  Lansing-East Lansing-Owosso, MI       N         N  2608     68     23

[5 rows x 23 columns]
```

In [513]:
```
#Private_Schools_MI_GL.rename(columns={'PL_ZIP':'ZIP','PL_CIT':'CITY'},inplace=True)
GL_private_schools.columns
```

Out[513]:
```
Index(['PPIN', 'PINST', 'PL_ADD', 'PL_CIT', 'PL_STABB', 'PL_ZIP', 'PL_ZIP4',
       'STFIP15', 'CNTY15', 'NMCNTY15', 'LOCALE15', 'LAT1516', 'LON1516',
       'CBSA15', 'NMCBSA15', 'CBSATYPE15', 'CSA15', 'NMCSA15', 'NECTA15',
       'NMNECTA15', 'CD15', 'SLDL15', 'SLDU15'],
      dtype='object')
```

In [514]:
```
columns = ['PINST','PL_CIT','PL_ZIP','LAT1516','LON1516']
GL_privates = GL_private_schools[columns]
GL_privates.rename(columns={'PINST':'Name','PL_CIT':'City','PL_ZIP':'Zipcode','LAT15
GL_privates.head()
```

```
/anaconda3/lib/python3.6/site-packages/pandas/core/frame.py:3778: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/indexing.html
  return super(DataFrame, self).rename(**kwargs)
```

Out[514]:

	Name	City	Zipcode	Lat	Lon
10007	GREATER LANSING ADVENTIST SCHOOL	LANSING	48917	42.726619	-84.624478
10009	OUR SAVIOR LUTHERAN SCHOOL	LANSING	48917	42.725150	-84.684151
10013	ST GERARD ELEMENTARY SCHOOL	LANSING	48917	42.747481	-84.611369
10067	CAPITOL CITY BAPTIST SCHOOL	HOLT	48842	42.653130	-84.550171
10068	MONTESSORI CHILDRENS HOUSE	LANSING	48915	42.727000	-84.580061

In [515]:
```
print("There are {} private schools in the Great Lansing Area with {} different neigh
```

```
There are 15 private schools in the Great Lansing Area with 7 different neighbourhoods.
```

3.3 A short summary

We have prepared three datasets for use - **GL_population** for populations - **GL_pubs** for public schools - **GL_privates** for private schools

3.4 Foursquare API

Next, we use the foursquare API to get venues for the area.

```
In [516]: CLIENT_ID = 'L0RMBCMNYHTS4DGW4DE2G0WWVXX5SNG1U4T1R4BTXG0Z0WJ5' # your Foursquare ID
          CLIENT_SECRET = '3NTSNQHDWPVKUDFHTLAA4FERGL0CBNOHCMIWEYTWFZG5UJFQ' # your Foursquare
          VERSION = '20180605'
          LIMIT = 100
          radius = 5000

          print('Your credentails:')
          print('CLIENT_ID: ' + CLIENT_ID)
          print('CLIENT_SECRET:' + CLIENT_SECRET)
```

```
Your credentails:
CLIENT_ID: L0RMBCMNYHTS4DGW4DE2G0WWVXX5SNG1U4T1R4BTXG0Z0WJ5
CLIENT_SECRET:3NTSNQHDWPVKUDFHTLAA4FERGL0CBNOHCMIWEYTWFZG5UJFQ
```

```
In [517]: # function that extracts the category of the venue
          def get_category_type(row):
              try:
                  categories_list = row['categories']
              except:
                  categories_list = row['venue.categories']

              if len(categories_list) == 0:
                  return None
              else:
                  return categories_list[0]['name']
```

```
In [518]: def getNearbyVenues(names, latitudes, longitudes, radius=500):

              venues_list=[]
              count_name = 0
              for name, lat, lng in zip(names, latitudes, longitudes):
                  count_name += 1
                  print(count_name,'zipcode/neighbourhood:', name)

                  # create the API request URL
                  url = 'https://api.foursquare.com/v2/venues/explore?&client_id={}&client_sec
                      CLIENT_ID,
                      CLIENT_SECRET,
                      VERSION,
```

```
                    lat,
                    lng,
                    radius,
                    LIMIT)

                # make the GET request
                results = requests.get(url).json()["response"]['groups'][0]['items']

                # return only relevant information for each nearby venue
                venues_list.append([(
                    name,
                    lat,
                    lng,
                    v['venue']['name'],
                    v['venue']['location']['lat'],
                    v['venue']['location']['lng'],
                    v['venue']['categories'][0]['name']) for v in results])

            nearby_venues = pd.DataFrame([item for venue_list in venues_list for item in venu
            nearby_venues.columns = ['Neighborhood',
                          'Neighborhood Latitude',
                          'Neighborhood Longitude',
                          'Venue',
                          'Venue Latitude',
                          'Venue Longitude',
                          'Venue Category']

            return(nearby_venues)
```

```
In [519]: df = GL_population
          Great_Lansing_venues = getNearbyVenues(names=df['Zipcode'],
                                                 latitudes=df['Lat'],
                                                 longitudes=df['Lon']
                                                )
```

```
1 zipcode/neighbourhood: 48805
2 zipcode/neighbourhood: 48823
3 zipcode/neighbourhood: 48824
4 zipcode/neighbourhood: 48825
5 zipcode/neighbourhood: 48826
6 zipcode/neighbourhood: 48840
7 zipcode/neighbourhood: 48842
8 zipcode/neighbourhood: 48854
9 zipcode/neighbourhood: 48864
10 zipcode/neighbourhood: 48901
11 zipcode/neighbourhood: 48906
12 zipcode/neighbourhood: 48908
13 zipcode/neighbourhood: 48909
```

```
14 zipcode/neighbourhood: 48910
15 zipcode/neighbourhood: 48911
16 zipcode/neighbourhood: 48912
17 zipcode/neighbourhood: 48913
18 zipcode/neighbourhood: 48915
19 zipcode/neighbourhood: 48916
20 zipcode/neighbourhood: 48917
21 zipcode/neighbourhood: 48918
22 zipcode/neighbourhood: 48919
23 zipcode/neighbourhood: 48922
24 zipcode/neighbourhood: 48924
25 zipcode/neighbourhood: 48929
26 zipcode/neighbourhood: 48930
27 zipcode/neighbourhood: 48933
28 zipcode/neighbourhood: 48937
29 zipcode/neighbourhood: 48951
30 zipcode/neighbourhood: 48956
31 zipcode/neighbourhood: 48980
```

In [520]:
```
print(Great_Lansing_venues.shape)

Great_Lansing_venues.head(10)
```

```
(255, 7)
```

Out[520]:

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude
0	48805	42.7082	-84.4144	Tacoma Hills Natural Area	42.707812	-84.414238
1	48805	42.7082	-84.4144	XFINITY Store by Comcast	42.705680	-84.416729
2	48805	42.7082	-84.4144	Golden Eagle Nature Trail	42.710777	-84.410447
3	48805	42.7082	-84.4144	Platinum Paint Coatings LLC Okemos	42.706187	-84.419868
4	48823	42.7620	-84.4539	Walnut Hills Golf Club	42.759651	-84.454663
5	48824	42.7229	-84.4751	MSU Horticulture Gardens	42.721251	-84.473551
6	48824	42.7229	-84.4751	MSU Dairy Store	42.724393	-84.478446
7	48824	42.7229	-84.4751	Wharton Center for Performing Arts	42.724205	-84.471024
8	48824	42.7229	-84.4751			
9	48824	42.7229	-84.4751			

```
8                  Abrams Planetarium       42.725554       -84.476291
9      Michigan 4-H Children's Garden       42.720839       -84.472827

     Venue Category
0             Trail
1  Business Service
2             Trail
3      Home Service
4       Golf Course
5            Garden
6    Ice Cream Shop
7           Theater
8       Planetarium
9            Garden
```

In [521]:
```
columns=['Neighborhood','Venue','Venue Latitude','Venue Longitude','Venue Category']
GL_venues_short = Great_Lansing_venues[columns]
```

In [522]:
```
GL_venues_short.head()
```

Out[522]:
```
   Neighborhood                                Venue  Venue Latitude  \
0         48805           Tacoma Hills Natural Area       42.707812
1         48805            XFINITY Store by Comcast       42.705680
2         48805           Golden Eagle Nature Trail       42.710777
3         48805  Platinum Paint Coatings LLC Okemos       42.706187
4         48823              Walnut Hills Golf Club       42.759651

   Venue Longitude    Venue Category
0       -84.414238             Trail
1       -84.416729  Business Service
2       -84.410447             Trail
3       -84.419868      Home Service
4       -84.454663       Golf Course
```

In [523]:
```
GL_venues=GL_venues_short.rename(columns={'Neighborhood':'Zipcode'})
```

In [524]:
```
GL_venues.head()
```

Out[524]:
```
   Zipcode                                Venue  Venue Latitude  \
0    48805           Tacoma Hills Natural Area       42.707812
1    48805            XFINITY Store by Comcast       42.705680
2    48805           Golden Eagle Nature Trail       42.710777
3    48805  Platinum Paint Coatings LLC Okemos       42.706187
4    48823              Walnut Hills Golf Club       42.759651

   Venue Longitude    Venue Category
0       -84.414238             Trail
1       -84.416729  Business Service
2       -84.410447             Trail
3       -84.419868      Home Service
4       -84.454663       Golf Course
```

4 Visualization of the data

```
In [525]: def get_latlon(address):
              geolocator = Nominatim()
              location   = geolocator.geocode(address)
              latitude   = location.latitude
              longitude  = location.longitude
              return latitude, longitude

In [526]: latitude, longitude = get_latlon("Lansing, MI")
          latitude, longitude
```

```
/anaconda3/lib/python3.6/site-packages/ipykernel_launcher.py:2: DeprecationWarning: Using Nomi
```

```
Out[526]: (42.7404617, -84.5468496)
```

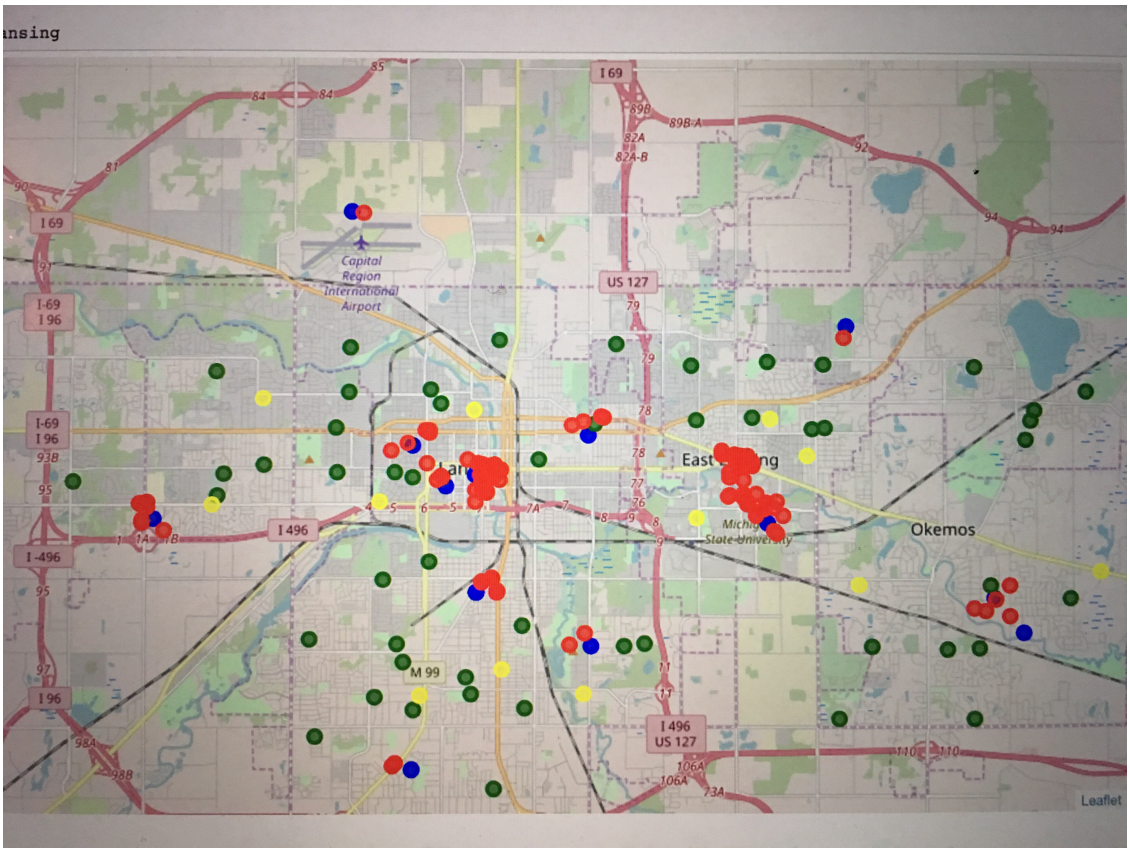
```
In [583]: map_Great_Lansing = folium.Map(location=[latitude, longitude], zoom_start=12)

          # population
          for lat, lng, zipcode, population in zip(GL_population['Lat'], GL_population['Lon'],
                                                   GL_population['Zipcode'], GL_population['Po
              labels = 'Zipcode:{}, Population: {}'.format(zipcode,population)
              label = folium.Popup(labels,parse_html=True)
              folium.CircleMarker(
                  [lat, lng],
                  radius=5,
                  color='blue',
                  popup=label,
                  fill=True,
                  #fill_color='#3186cc',
                  fill_opacity=0.7,
                  parse_html=False).add_to(map_Great_Lansing)

          map_Great_Lansing

          # add markers to map
          # public schools
          for lat, lng, name in zip(GL_pubs['Lat'], GL_pubs['Lon'], GL_pubs['Name']):
              labels = '{}'.format(name)
              label = folium.Popup(labels, parse_html=True)
              folium.CircleMarker(
                  [lat, lng],
                  radius=5,
                  color='green',
                  popup=label,
                  fill=True,
                  #fill_color='#3186cc',
```

```
                fill_opacity=0.7,
                parse_html=False).add_to(map_Great_Lansing)
            # private schools
        for lat, lng, name in zip(GL_privates['Lat'], GL_privates['Lon'], GL_privates['Name']
            labels = '{}'.format(name)
            label = folium.Popup(labels, parse_html=True)
            folium.CircleMarker(
                [lat, lng],
                radius=5,
                color='yellow',
                popup=label,
                fill=True,
                #fill_color='#3186cc',
                fill_opacity=0.7,
                parse_html=False).add_to(map_Great_Lansing)

            #Neighborhood Latitude        Neighborhood Longitude        Venue        Venue L
        for lat, lng, name in zip(GL_venues['Venue Latitude'],
                                  GL_venues['Venue Longitude'],
                                  GL_venues['Venue']):
            labels = '{}'.format(name)
            label = folium.Popup(labels, parse_html=True)
            folium.CircleMarker(
                [lat, lng],
                radius=5,
                color='red',
                popup=label,
                fill=True,
                #fill_color='#3186cc',
                fill_opacity=0.7,
                parse_html=False).add_to(map_Great_Lansing)



        map_Great_Lansing
```

Out[583]: <folium.folium.Map at 0x1a3ea0dc50>

```
In [585]: from IPython.display import Image
          Image('map1.JPG')
```

Out[585]:



4.1 Fig1: distribution of public schools (green), private schools (yellow), venues (red) and neighbourhoods (blue) in Great Lansing Area.

```
In [554]: print(GL_pubs.shape, GL_privates.shape)

(69, 5) (15, 5)


In [555]: GL_all_schools = pd.concat([GL_pubs,GL_privates],axis=0,join='outer')
          GL_all_schools.shape

Out[555]: (84, 5)

In [556]: GL_all_schools_summary=pd.DataFrame(GL_all_schools.groupby('Zipcode').count().sort_va
          GL_all_schools_summary.rename(columns={'Name':'School Name'},inplace=True)
          GL_all_schools_summary

Out[556]:          School Name  City  Lat  Lon
          Zipcode
          48910             12    12   12   12
          48842             10    10   10   10
```

```
48854              8     8    8    8
48917              8     8    8    8
48823              7     7    7    7
48864              7     7    7    7
48840              5     5    5    5
48910              3     3    3    3
48823              3     3    3    3
48915              3     3    3    3
48912              3     3    3    3
48911              3     3    3    3
48906              3     3    3    3
48917              3     3    3    3
48842              2     2    2    2
48864              2     2    2    2
48906              1     1    1    1
48915              1     1    1    1
```

In [557]:
```
GL_venues.head()
```

Out[557]:

	Zipcode	Venue	Venue Latitude	Venue Longitude	Venue Category
0	48805	Tacoma Hills Natural Area	42.707812	-84.414238	Trail
1	48805	XFINITY Store by Comcast	42.705680	-84.416729	Business Service
2	48805	Golden Eagle Nature Trail	42.710777	-84.410447	Trail
3	48805	Platinum Paint Coatings LLC Okemos	42.706187	-84.419868	Home Service
4	48823	Walnut Hills Golf Club	42.759651	-84.454663	Golf Course

In [558]:
```
GL_venues_summary = pd.DataFrame(GL_venues.groupby('Zipcode').count().sort_values(by=
GL_venues_summary
```

Out[558]:

Zipcode	Venue	Venue Latitude	Venue Longitude	Venue Category
48933	47	47	47	47
48826	46	46	46	46
48909	45	45	45	45
48825	14	14	14	14
48854	12	12	12	12
48917	9	9	9	9
48824	8	8	8	8
48915	6	6	6	6
48924	4	4	4	4
48919	4	4	4	4
48922	4	4	4	4

48805	4	4	4	4
48929	4	4	4	4
48930	4	4	4	4
48937	4	4	4	4
48956	4	4	4	4
48916	4	4	4	4
48912	4	4	4	4
48913	4	4	4	4
48908	4	4	4	4
48901	4	4	4	4
48980	4	4	4	4
48951	3	3	3	3
48911	2	2	2	2
48910	2	2	2	2
48823	1	1	1	1
48906	1	1	1	1
48864	1	1	1	1
48842	1	1	1	1
48840	1	1	1	1

In [559]:
```
GL_population2 = GL_population.set_index('Zipcode')
```

In [560]:
```
GL_population2
```

Out[560]:

Zipcode	Lat	Lon	City	Population
48805	42.7082	-84.4144	Okemos	NaN
48823	42.7620	-84.4539	East Lansing	51302.0
48824	42.7229	-84.4751	East Lansing	NaN
48825	42.7270	-84.4809	East Lansing	12596.0
48826	42.7360	-84.4843	East Lansing	NaN
48840	42.7690	-84.3707	Haslett	12501.0
48842	42.6338	-84.5387	Holt	20432.0
48854	42.5820	-84.4517	Mason	18598.0
48864	42.7013	-84.4067	Okemos	20148.0
48901	42.7091	-84.5540	Lansing	NaN
48906	42.7845	-84.5875	Lansing	26634.0
48908	42.7091	-84.5540	Lansing	NaN
48909	42.7311	-84.5526	Lansing	NaN
48910	42.6985	-84.5230	Lansing	34560.0
48911	42.6745	-84.5709	Lansing	40111.0
48912	42.7402	-84.5235	Lansing	17035.0
48913	42.7091	-84.5540	Lansing	NaN
48915	42.7383	-84.5710	Lansing	9218.0
48916	42.7091	-84.5540	Lansing	NaN
48917	42.7238	-84.6400	Lansing	32062.0
48918	40.2439	-87.1261	Lansing	NaN
48919	42.7091	-84.5540	Lansing	NaN

```
48922    42.7091 -84.5540       Lansing         NaN
48924    42.7091 -84.5540       Lansing         NaN
48929    42.7091 -84.5540       Lansing         NaN
48930    42.7091 -84.5540       Lansing         NaN
48933    42.7325 -84.5543       Lansing      2530.0
48937    42.7091 -84.5540       Lansing         NaN
48951    42.7300 -84.5622       Lansing         NaN
48956    42.7091 -84.5540       Lansing         NaN
48980    42.7091 -84.5540       Lansing         NaN
```

In [561]:
```
GL_all = pd.concat([GL_all_schools_summary,GL_venues_summary],axis=1,join='outer')

columns=['School Name','Venue']
GL_all_need = GL_all[columns]
GL_all_need.head()
```

Out[561]:

Zipcode	School Name	Venue
48910	12.0	2.0
48842	10.0	1.0
48854	8.0	12.0
48917	8.0	9.0
48823	7.0	1.0

In [562]:
```
GL_all_need_short = pd.concat([GL_all_need,GL_population2],axis=1,join='outer')
```

In [563]:
```
GL_all_need_short.fillna(GL_all_need_short.mean(), inplace=True)

GL_all_need_short.dropna(axis=0,inplace=True)
GL_all_need_short
```

Out[563]:

Zipcode	School Name	Venue	Lat	Lon	City	Population
48910	12.000000	2.0	42.6985	-84.5230	Lansing	34560.000000
48842	10.000000	1.0	42.6338	-84.5387	Holt	20432.000000
48854	8.000000	12.0	42.5820	-84.4517	Mason	18598.000000
48917	8.000000	9.0	42.7238	-84.6400	Lansing	32062.000000
48823	7.000000	1.0	42.7620	-84.4539	East Lansing	51302.000000
48864	7.000000	1.0	42.7013	-84.4067	Okemos	20148.000000
48840	5.000000	1.0	42.7690	-84.3707	Haslett	12501.000000
48915	3.000000	6.0	42.7383	-84.5710	Lansing	9218.000000
48912	3.000000	4.0	42.7402	-84.5235	Lansing	17035.000000
48911	3.000000	2.0	42.6745	-84.5709	Lansing	40111.000000
48906	3.000000	1.0	42.7845	-84.5875	Lansing	26634.000000
48933	4.666667	47.0	42.7325	-84.5543	Lansing	2530.000000
48826	4.666667	46.0	42.7360	-84.4843	East Lansing	22902.076923
48909	4.666667	45.0	42.7311	-84.5526	Lansing	22902.076923
48825	4.666667	14.0	42.7270	-84.4809	East Lansing	12596.000000
48824	4.666667	8.0	42.7229	-84.4751	East Lansing	22902.076923

```
48924       4.666667    4.0  42.7091 -84.5540       Lansing  22902.076923
48919       4.666667    4.0  42.7091 -84.5540       Lansing  22902.076923
48922       4.666667    4.0  42.7091 -84.5540       Lansing  22902.076923
48805       4.666667    4.0  42.7082 -84.4144        Okemos  22902.076923
48929       4.666667    4.0  42.7091 -84.5540       Lansing  22902.076923
48930       4.666667    4.0  42.7091 -84.5540       Lansing  22902.076923
48937       4.666667    4.0  42.7091 -84.5540       Lansing  22902.076923
48956       4.666667    4.0  42.7091 -84.5540       Lansing  22902.076923
48916       4.666667    4.0  42.7091 -84.5540       Lansing  22902.076923
48913       4.666667    4.0  42.7091 -84.5540       Lansing  22902.076923
48908       4.666667    4.0  42.7091 -84.5540       Lansing  22902.076923
48901       4.666667    4.0  42.7091 -84.5540       Lansing  22902.076923
48980       4.666667    4.0  42.7091 -84.5540       Lansing  22902.076923
48951       4.666667    3.0  42.7300 -84.5622       Lansing  22902.076923
48918       4.666667    8.5  40.2439 -87.1261       Lansing  22902.076923
```

In [564]:
```
GL_final=GL_all_need_short.sort_values(by=['School Name','Population','Venue'],ascen
```

In [565]:
```
GL_final.reset_index(inplace=True)
```

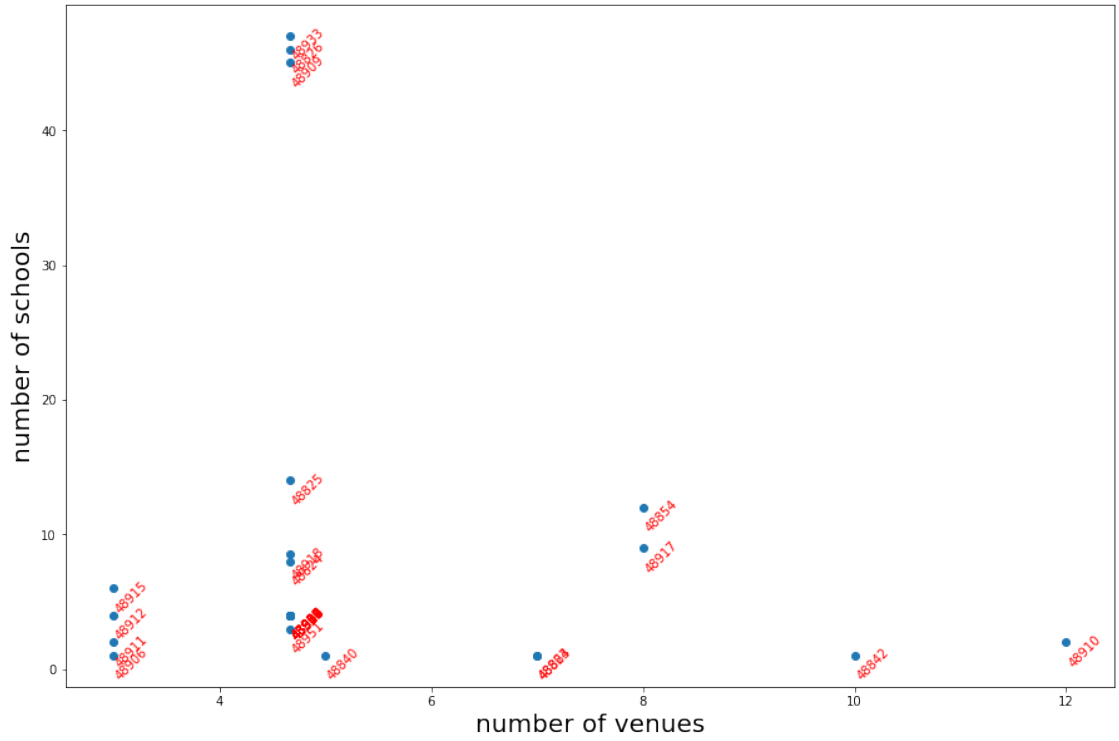
In [566]:
```
GL_final
```

Out[566]:

	Zipcode	School Name	Venue	Lat	Lon	City	Population
0	48910	12.000000	2.0	42.6985	-84.5230	Lansing	34560.000000
1	48842	10.000000	1.0	42.6338	-84.5387	Holt	20432.000000
2	48917	8.000000	9.0	42.7238	-84.6400	Lansing	32062.000000
3	48854	8.000000	12.0	42.5820	-84.4517	Mason	18598.000000
4	48823	7.000000	1.0	42.7620	-84.4539	East Lansing	51302.000000
5	48864	7.000000	1.0	42.7013	-84.4067	Okemos	20148.000000
6	48840	5.000000	1.0	42.7690	-84.3707	Haslett	12501.000000
7	48826	4.666667	46.0	42.7360	-84.4843	East Lansing	22902.076923
8	48909	4.666667	45.0	42.7311	-84.5526	Lansing	22902.076923
9	48918	4.666667	8.5	40.2439	-87.1261	Lansing	22902.076923
10	48824	4.666667	8.0	42.7229	-84.4751	East Lansing	22902.076923
11	48924	4.666667	4.0	42.7091	-84.5540	Lansing	22902.076923
12	48919	4.666667	4.0	42.7091	-84.5540	Lansing	22902.076923
13	48922	4.666667	4.0	42.7091	-84.5540	Lansing	22902.076923
14	48805	4.666667	4.0	42.7082	-84.4144	Okemos	22902.076923
15	48929	4.666667	4.0	42.7091	-84.5540	Lansing	22902.076923
16	48930	4.666667	4.0	42.7091	-84.5540	Lansing	22902.076923
17	48937	4.666667	4.0	42.7091	-84.5540	Lansing	22902.076923
18	48956	4.666667	4.0	42.7091	-84.5540	Lansing	22902.076923
19	48916	4.666667	4.0	42.7091	-84.5540	Lansing	22902.076923
20	48913	4.666667	4.0	42.7091	-84.5540	Lansing	22902.076923
21	48908	4.666667	4.0	42.7091	-84.5540	Lansing	22902.076923
22	48901	4.666667	4.0	42.7091	-84.5540	Lansing	22902.076923
23	48980	4.666667	4.0	42.7091	-84.5540	Lansing	22902.076923
24	48951	4.666667	3.0	42.7300	-84.5622	Lansing	22902.076923
25	48825	4.666667	14.0	42.7270	-84.4809	East Lansing	12596.000000

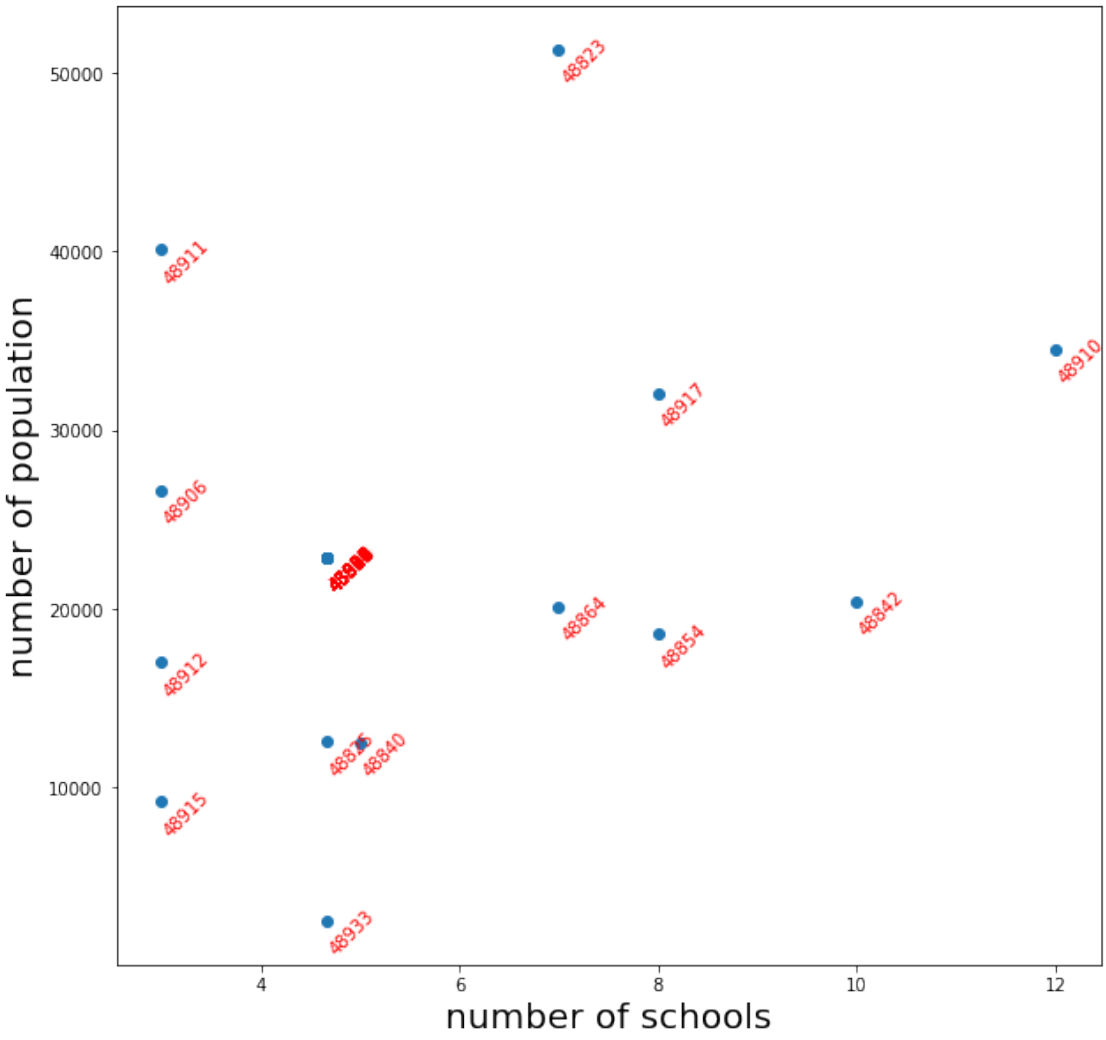
26	48933	4.666667	47.0	42.7325	-84.5543	Lansing	2530.000000
27	48911	3.000000	2.0	42.6745	-84.5709	Lansing	40111.000000
28	48906	3.000000	1.0	42.7845	-84.5875	Lansing	26634.000000
29	48912	3.000000	4.0	42.7402	-84.5235	Lansing	17035.000000
30	48915	3.000000	6.0	42.7383	-84.5710	Lansing	9218.000000

```
In [579]: fig, ax = plt.subplots(figsize=(15,10))
          ax.scatter(x=GL_final['School Name'],y=GL_final['Venue'])
          plt.ylabel('number of schools',fontsize=20)
          plt.xlabel('number of venues',fontsize=20)
          for i, txt in enumerate(GL_final['Zipcode']):
              ax.annotate(txt, (GL_final['School Name'][i],GL_final['Venue'][i]),color='red',r
```



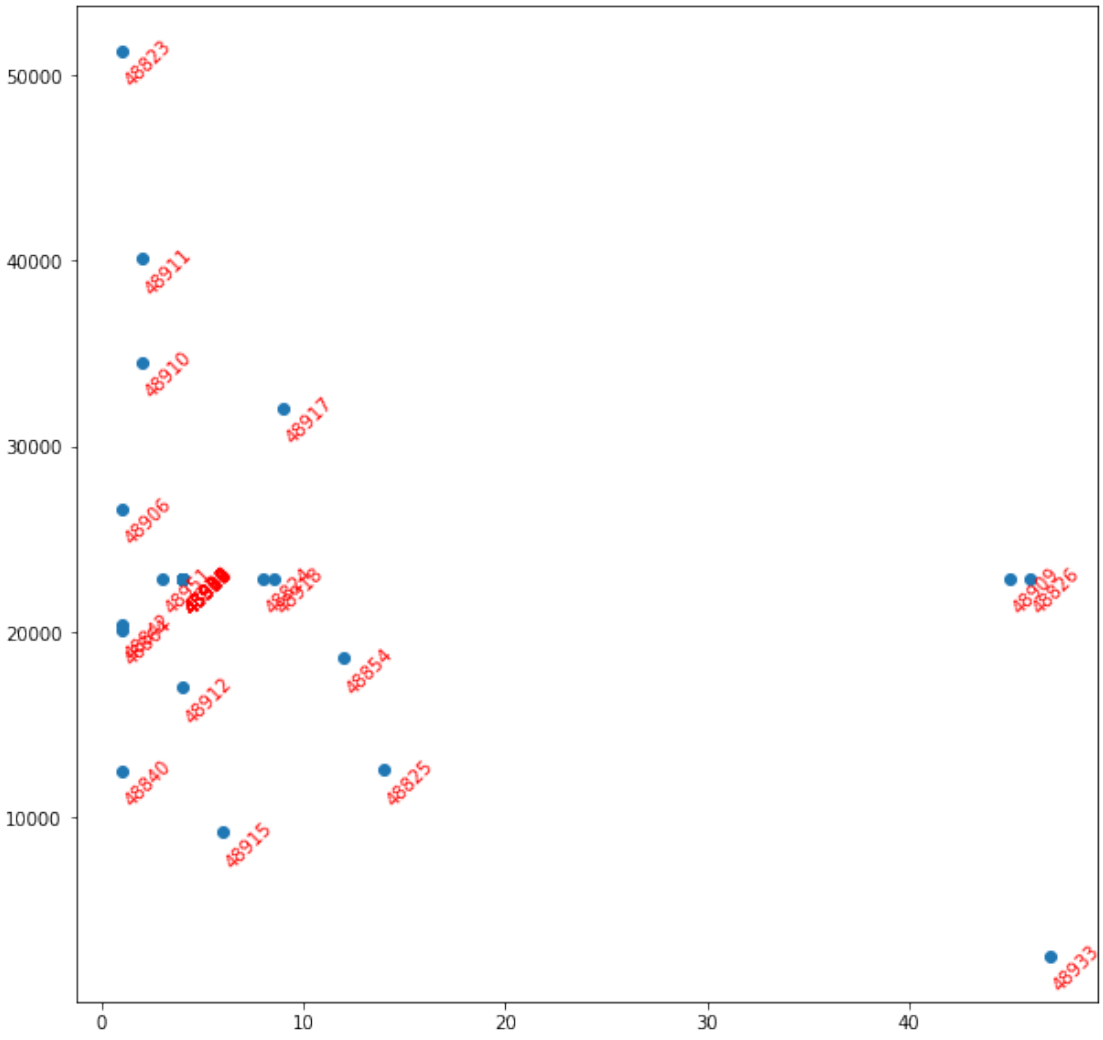
The above figure suggests the locations with zipcodes 48933, 48826,48909, 48917, 48854, 48825, 48864

```
In [491]: fig, ax = plt.subplots(figsize=(10,10))
          ax.scatter(x=GL_final['School Name'],y=GL_final['Population'])
          plt.ylabel('number of population',fontsize=20)
          plt.xlabel('number of schools',fontsize=20)
          for i, txt in enumerate(GL_final['Zipcode']):
              ax.annotate(txt, (GL_final['School Name'][i],GL_final['Population'][i]),rotation=
```



The above figure suggests the locations with zipcodes 48910, 48917, 48842, 48854, 48864

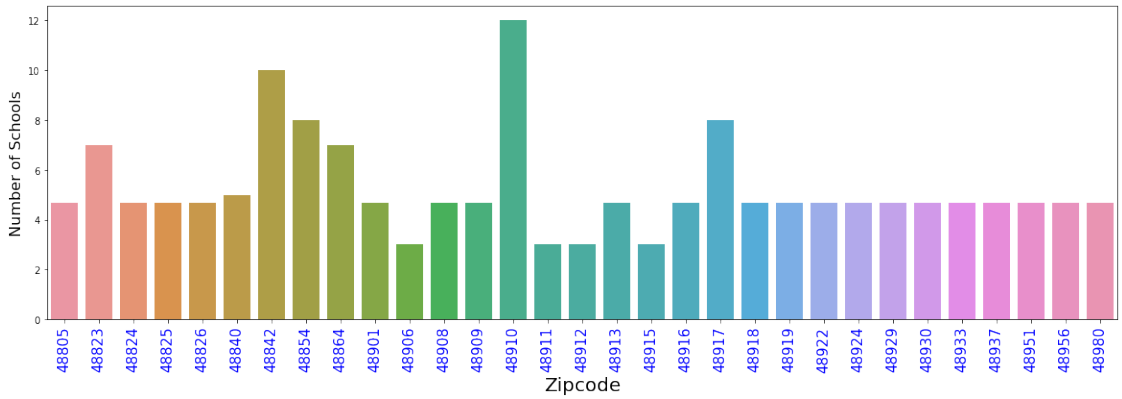
```
In [493]: fig, ax = plt.subplots(figsize=(10,10))
          ax.scatter(x=GL_final['Venue'],y=GL_final['Population'])
          for i, txt in enumerate(GL_final['Zipcode']):
              ax.annotate(txt, (GL_final['Venue'][i],GL_final['Population'][i]),rotation=45,co
```



*** The above figure suggests the locations with zipcodes 48909, 48826, 48825, 48854, 48917.***

```
In [495]: plt.figure(figsize=(20,6))
          fig=sns.barplot(x=GL_final['Zipcode'],y=GL_final['School Name'])
          plt.xlabel("Zipcode",fontsize=20)
          plt.ylabel("Number of Schools",fontsize=16)
          fig.set_xticklabels(fig.get_xticklabels(), rotation=90,color='blue',size=15)

Out[495]: [Text(0,0,'48805'),
           Text(0,0,'48823'),
           Text(0,0,'48824'),
           Text(0,0,'48825'),
           Text(0,0,'48826'),
           Text(0,0,'48840'),
           Text(0,0,'48842'),
           Text(0,0,'48854'),
```

```
Text(0,0,'48864'),
Text(0,0,'48901'),
Text(0,0,'48906'),
Text(0,0,'48908'),
Text(0,0,'48909'),
Text(0,0,'48910'),
Text(0,0,'48911'),
Text(0,0,'48912'),
Text(0,0,'48913'),
Text(0,0,'48915'),
Text(0,0,'48916'),
Text(0,0,'48917'),
Text(0,0,'48918'),
Text(0,0,'48919'),
Text(0,0,'48922'),
Text(0,0,'48924'),
Text(0,0,'48929'),
Text(0,0,'48930'),
Text(0,0,'48933'),
Text(0,0,'48937'),
Text(0,0,'48951'),
Text(0,0,'48956'),
Text(0,0,'48980')]
```



5 Discussion

The above analysis indicates that one should choose the location in one of the following neighbourhoods: 48826,48909, 48917, 48854, 48825, 48864.

```
In [580]: best = GL_final[(GL_final['Zipcode']==48864) | (GL_final['Zipcode']==48826) | (GL_fi
          best
```

```
Out[580]:     Zipcode  School Name  Venue      Lat      Lon          City    Population
          2     48917     8.000000    9.0  42.7238 -84.6400       Lansing  32062.000000
          3     48854     8.000000   12.0  42.5820 -84.4517         Mason  18598.000000
          5     48864     7.000000    1.0  42.7013 -84.4067        Okemos  20148.000000
          7     48826     4.666667   46.0  42.7360 -84.4843  East Lansing  22902.076923
          8     48909     4.666667   45.0  42.7311 -84.5526       Lansing  22902.076923
          25    48825     4.666667   14.0  42.7270 -84.4809  East Lansing  12596.000000
```

```
In [584]:  # final
          for lat, lng, zipcode, population in zip(best['Lat'], best['Lon'],
                                                   best['Zipcode'], best['Population']):
              labels = 'Zipcode:{}, Population: {}'.format(zipcode,population)
              label = folium.Popup(labels,parse_html=True)
              print(labels)
              folium.CircleMarker(
                  [lat, lng],
                  radius=10,
                  color='blue',
                  popup=label,
                  fill=True,
                  #fill_color='#3186cc',
                  #fill_opacity=0.7,
                  parse_html=False).add_to(map_Great_Lansing)

          map_Great_Lansing
```

```
Zipcode:48917, Population: 32062.0
Zipcode:48854, Population: 18598.0
Zipcode:48864, Population: 20148.0
Zipcode:48826, Population: 22902.076923076922
Zipcode:48909, Population: 22902.076923076922
Zipcode:48825, Population: 12596.0
```

```
Out[584]: <folium.folium.Map at 0x1a3ea0dc50>
```

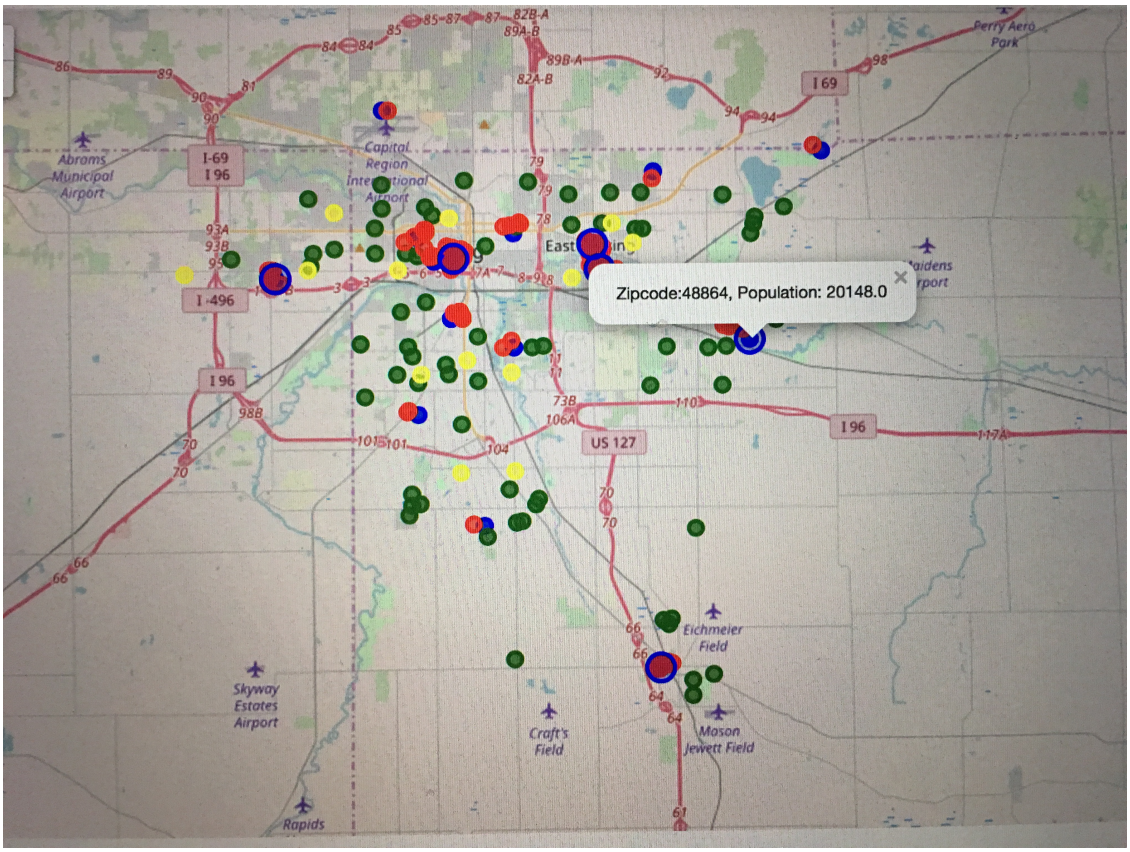
The above map shows that the neighbourhoods of 48917 and 48854 are far from the downtown. Even though the number of schools and population are large, I would not recommend these two places considering the travel cost.

6 Conclusion

** In short, based on all the three factors, I would suggest him to locate the after-school program in the neighbourhood with zipcode 48864 or 48826.**

```
In [586]: Image('map2.JPG')
```

```
Out[586]:
```


Zipcode:48864, Population: 20148.0
I-69
I 96
I-496
I 69
US 127
Capital Region International Airport
Abrams Municipal Airport
Perry Aero Park
Eichmeier Field
Skyway Estates Airport
Craft's Field
Mason Jewett Field
Rapids