Project Part 1: Understanding the Yelp data & Data Pre-processing

Preparation

In [ ]:
```
# Imports
import json
import typing
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from collections import Counter
from sklearn.feature_extraction.text import CountVectorizer
import folium
from folium import Choropleth, Circle, Marker
from folium.plugins import HeatMap, MarkerCluster

import seaborn as sns
import gc
from mpl_toolkits.basemap import Basemap
from wordcloud import WordCloud
import squarify
import nltk
from nltk.corpus import stopwords
from nltk.stem.porter import PorterStemmer
from nltk.stem.wordnet import WordNetLemmatizer
import string
import re
import gensim
from gensim import corpora

%matplotlib inline
plt.style.use('fivethirtyeight')
plt.style.use('bmh')
```

In [ ]:
```
def json_to_df(path):
    with open(path, encoding="utf8") as data_file:
        data = []
        for line in data_file:
            data.append(json.loads(line))
    df = pd.DataFrame(data)
    return df
```

1. Analysis of *yelp_academic_dataset_business.json*

In [ ]:
```
df_business = json_to_df("C:/Users/Francis Zhou/Desktop/Data Science & Machine Learning/Semester 1/DSA5104 Principles of Data Management and Retrieval/Project/yelp_academic_dataset_business.json")
df_business.head(6)
# print(df_business.shape)
```

Out[ ]:

	business_id	name	address	city	state	postal_code	latitude	longitude	stars	review_count	is_open	attributes	categories	hours
0	Pns2l4eNsfO8kk83dixA6A	Abby Rappoport, LAC, CMQ	1616 Chapala St, Ste 2	Santa Barbara	CA	93101	34.426679	-119.711197	5.0	7	0	{'ByAppointmentOnly': 'True'}	Doctors, Traditional Chinese Medicine, Naturop...	None
1	mpf3x-BjTdTEA3yCZrAYPw	The UPS Store	87 Grasso Plaza Shopping Center	Affton	MO	63123	38.551126	-90.335695	3.0	15	1	{'BusinessAcceptsCreditCards': 'True'}	Shipping Centers, Local Services, Notaries, Ma...	{'Monday': '0:0-0:0', 'Tuesday': '8:0-18:30', ...
2	tUFrWirKiKi_TAnsVWINQQ	Target	5255 E Broadway Blvd	Tucson	AZ	85711	32.223236	-110.880452	3.5	22	0	{'BikeParking': 'True', 'BusinessAcceptsCredit...	Department Stores, Shopping, Fashion, Home & G...	{'Monday': '8:0-22:0', 'Tuesday': '8:0-22:0', ...
3	MTSW4McQd7CbVtyjqoe9mw	St Honore Pastries	935 Race St	Philadelphia	PA	19107	39.955505	-75.155564	4.0	80	1	{'RestaurantsDelivery': 'False', 'OutdoorSeati...	Restaurants, Food, Bubble Tea, Coffee & Tea, B...	{'Monday': '7:0-20:0', 'Tuesday': '7:0-20:0', ...
4	mWMc6_wTdE0EUBKIGXDVfA	Perkiomen Valley Brewery	101 Walnut St	Green Lane	PA	18054	40.338183	-75.471659	4.5	13	1	{'BusinessAcceptsCreditCards': 'True', 'Wheelc...	Brewpubs, Breweries, Food	{'Wednesday': '14:0-22:0', 'Thursday': '16:0-2...
5	CF33F8-E6oudUQ46HnavjQ	Sonic Drive-In	615 S Main St	Ashland City	TN	37015	36.269593	-87.058943	2.0	6	1	{'BusinessParking': 'None', 'BusinessAcceptsCr...	Burgers, Fast Food, Sandwiches, Food, Ice Crea...	{'Monday': '0:0-0:0', 'Tuesday': '6:0-22:0', '...

In [ ]:
```
df_business.shape
```

Out[ ]:
```
(150346, 14)
```

1.1. Deal with the missing data

In [ ]:
```
# Count of missing data for each attribute
print("Missing values count: ")
```

```
print(df_business.isnull().sum())
print("")
```

```
Missing values count:
business_id         0
name                0
address             0
city                0
state               0
postal_code         0
latitude            0
longitude           0
stars               0
review_count        0
is_open             0
attributes      13744
categories        103
hours           23223
dtype: int64
```

In [ ]:
```
# df_business[df_business.isnull().any(axis=1)]
# print(df_business.shape)
business = df_business.dropna()
business
```

Out[ ]:

	business_id	name	address	city	state	postal_code	latitude	longitude	stars	review_count	is_open	attributes	categories	hours
1	mpf3x-BjTdTEA3yCZrAYPw	The UPS Store	87 Grasso Plaza Shopping Center	Affton	MO	63123	38.551126	-90.335695	3.0	15	1	{'BusinessAcceptsCreditCards': 'True'}	Shipping Centers, Local Services, Notaries, Ma...	{'Monday': '0:0-0:0', 'Tuesday': '8:0-18:30', ...
2	tUFrWirKiKi_TAnsVWINQQ	Target	5255 E Broadway Blvd	Tucson	AZ	85711	32.223236	-110.880452	3.5	22	0	{'BikeParking': 'True', 'BusinessAcceptsCredit...	Department Stores, Shopping, Fashion, Home & G...	{'Monday': '8:0-22:0', 'Tuesday': '8:0-22:0', ...
3	MTSW4McQd7CbVtyjqoe9mw	St Honore Pastries	935 Race St	Philadelphia	PA	19107	39.955505	-75.155564	4.0	80	1	{'RestaurantsDelivery': 'False', 'OutdoorSeati...	Restaurants, Food, Bubble Tea, Coffee & Tea, B...	{'Monday': '7:0-20:0', 'Tuesday': '7:0-20:0', ...
4	mWMc6_wTdE0EUBKIGXDVfA	Perkiomen Valley Brewery	101 Walnut St	Green Lane	PA	18054	40.338183	-75.471659	4.5	13	1	{'BusinessAcceptsCreditCards': 'True', 'Wheelc...	Brewpubs, Breweries, Food	{'Wednesday': '14:0-22:0', 'Thursday': '16:0-2...
5	CF33F8-E6oudUQ46HnavjQ	Sonic Drive-In	615 S Main St	Ashland City	TN	37015	36.269593	-87.058943	2.0	6	1	{'BusinessParking': 'None', 'BusinessAcceptsCr...	Burgers, Fast Food, Sandwiches, Food, Ice Crea...	{'Monday': '0:0-0:0', 'Tuesday': '6:0-22:0', '...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
150340	hn9Toz3s-Ei3uZPt7esExA	West Side Kebab House	2470 Guardian Road NW	Edmonton	AB	T5T 1K8	53.509649	-113.675999	4.5	18	0	{'Ambience': '{'touristy': False, 'hipster': F...	Middle Eastern, Restaurants	{'Monday': '11:0-22:0', 'Tuesday': '11:0-22:0'...
150341	lUQopTMmYQG-qRtBk-8QnA	Binh's Nails	3388 Gateway Blvd	Edmonton	AB	T6J 5H2	53.468419	-113.492054	3.0	13	1	{'ByAppointmentOnly': 'False', 'RestaurantsPri...	Nail Salons, Beauty & Spas	{'Monday': '10:0-19:30', 'Tuesday': '10:0-19:3...
150342	c8GjPICTGVmIemT7j5_SyQ	Wild Birds Unlimited	2813 Bransford Ave	Nashville	TN	37204	36.115118	-86.766925	4.0	5	1	{'BusinessAcceptsCreditCards': 'True', 'Restau...	Pets, Nurseries & Gardening, Pet Stores, Hobby...	{'Monday': '9:30-17:30', 'Tuesday': '9:30-17:3...
150344	mtGm22y5c2UHNXDfAjaPNw	Cyclery & Fitness Center	2472 Troy Rd	Edwardsville	IL	62025	38.782351	-89.950558	4.0	24	1	{'BusinessParking': '{'garage': False, 'street...	Fitness/Exercise Equipment, Eyewear & Optician...	{'Monday': '9:0-20:0', 'Tuesday': '9:0-20:0', ...
150345	jV_XOycEzSITx-65W906pg	Sic Ink	238 Apollo Beach Blvd	Apollo beach	FL	33572	27.771002	-82.394910	4.5	9	1	{'WheelchairAccessible': 'True', 'BusinessAcce...	Beauty & Spas, Permanent Makeup, Piercing, Tattoo	{'Tuesday': '12:0-19:0', 'Wednesday': '12:0-19...

117618 rows × 14 columns

1.2. Adjust data in each column

In [ ]:
```
business.dtypes
```

Out[ ]:
```
business_id      object
name             object
address          object
city             object
state            object
postal_code      object
latitude        float64
longitude       float64
stars           float64
review_count      int64
is_open           int64
attributes       object
categories       object
hours            object
dtype: object
```

Require *business_id* as **22 character unique string**, *state* as **2 character string**, *stars* as **rounded to half-stars.**

Adjust *business_id*

In [ ]:
```
business['business_id'] = business['business_id'].astype(str)

# Uniqueness check
print(np.unique(business['business_id']).size == len(business['business_id']))
# Or
print(business.business_id.is_unique)

# Any row in business_id not of string length 22?
print((business['business_id'].str.len() != 22).any())
```

```
True
True
False
```

```
C:\Users\Francis Zhou\AppData\Local\Temp\ipykernel_85100\1395647064.py:1: SettingWithCopyWarning:
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: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  business['business_id'] = business['business_id'].astype(str)
```

Adjust *state*

In [ ]:
```
business['state'] = business['state'].astype(str)

# Any row in business_id not of string length 2?
print((business['state'].str.len() != 2).any())
```

```
False
```

```
C:\Users\Francis Zhou\AppData\Local\Temp\ipykernel_85100\1327602327.py:1: SettingWithCopyWarning:
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: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  business['state'] = business['state'].astype(str)
```

Adjust *postal_code*

In [ ]:
```
business = business[business['postal_code'].apply(lambda x: str(x).isdigit())]
business.head(6)
```

Out[ ]:

	business_id	name	address	city	state	postal_code	latitude	longitude	stars	review_count	is_open	attributes	categories	hours
1	mpf3x-BjTdTEA3yCZrAYPw	The UPS Store	87 Grasso Plaza Shopping Center	Affton	MO	63123	38.551126	-90.335695	3.0	15	1	{'BusinessAcceptsCreditCards': 'True'}	Shipping Centers, Local Services, Notaries, Ma...	{'Monday': '0:0-0:0', 'Tuesday': '8:0-18:30', ...
2	tUFrWirKiKi_TAnsVWINQQ	Target	5255 E Broadway Blvd	Tucson	AZ	85711	32.223236	-110.880452	3.5	22	0	{'BikeParking': 'True', 'BusinessAcceptsCredit...	Department Stores, Shopping, Fashion, Home & G...	{'Monday': '8:0-22:0', 'Tuesday': '8:0-22:0', ...
3	MTSW4McQd7CbVtyjqoe9mw	St Honore Pastries	935 Race St	Philadelphia	PA	19107	39.955505	-75.155564	4.0	80	1	{'RestaurantsDelivery': 'False', 'OutdoorSeati...	Restaurants, Food, Bubble Tea, Coffee & Tea, B...	{'Monday': '7:0-20:0', 'Tuesday': '7:0-20:0', ...
4	mWMc6_wTdE0EUBKIGXDVfA	Perkiomen Valley Brewery	101 Walnut St	Green Lane	PA	18054	40.338183	-75.471659	4.5	13	1	{'BusinessAcceptsCreditCards': 'True', 'Wheelc...	Brewpubs, Breweries, Food	{'Wednesday': '14:0-22:0', 'Thursday': '16:0-2...
5	CF33F8-E6oudUQ46HnavjQ	Sonic Drive-In	615 S Main St	Ashland City	TN	37015	36.269593	-87.058943	2.0	6	1	{'BusinessParking': 'None', 'BusinessAcceptsCr...	Burgers, Fast Food, Sandwiches, Food, Ice Crea...	{'Monday': '0:0-0:0', 'Tuesday': '6:0-22:0', '...
6	n_0UpQx1hsNbnPUSlodU8w	Famous Footwear	8522 Eager Road, Dierbergs Brentwood Point	Brentwood	MO	63144	38.627695	-90.340465	2.5	13	1	{'BusinessAcceptsCreditCards': 'True', 'Restau...	Sporting Goods, Fashion, Shoe Stores, Shopping...	{'Monday': '0:0-0:0', 'Tuesday': '10:0-18:0', ...

Adjust *stars*

In [ ]:
```
business['stars'].value_counts().sort_index()
```

Out[ ]:
```
stars
1.0      819
1.5     3124
2.0     6440
2.5    10084
3.0    13536
3.5    20214
4.0    24591
4.5    21999
5.0    12684
Name: count, dtype: int64
```

In [ ]:
```
business['stars']
```

Out[ ]:
```
1         3.0
2         3.5
3         4.0
4         4.5
5         2.0
         ...
150338    4.0
150339    4.5
150342    4.0
150344    4.0
150345    4.5
Name: stars, Length: 113491, dtype: float64
```

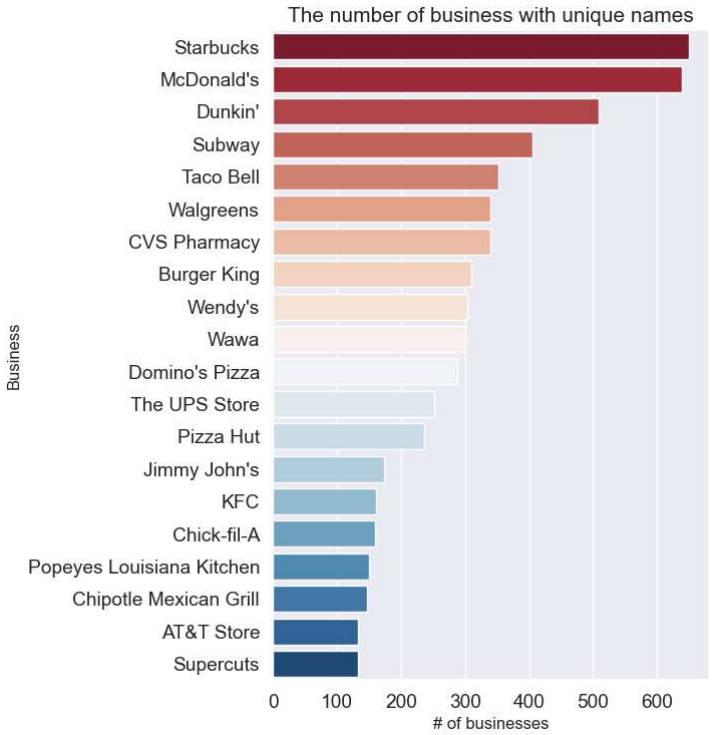
EDA of *business*

After data cleaning, we shall proceed with some EDA with the new dataset *business*.

Total number of businesses for each business name (utilize the attribute *name*)

In [ ]:
```
sns.set(font_scale=1.25)
ax1 = plt.figure(figsize=(5,8))
cnnt = business['name'].value_counts().to_frame()
cnt = pd.DataFrame(cnnt).reset_index()
cnt.columns = ['name', 'index']

print('Is the business name unique for each row of cnt?:', cnt.name.is_unique)
print('There are in total', cnt['name'].nunique(), 'unique businesses counted')
sns.barplot(x=cnt['index'].iloc[:20], y=cnt['name'].iloc[:20], data=cnt, palette = 'RdBu').set(title='The number of business with unique names')
plt.ylabel('Business', fontsize=12)
plt.xlabel('# of businesses', fontsize=12);
```

```
Is the business name unique for each row of cnt?: True
There are in total 86009 unique businesses counted
```



Observations:

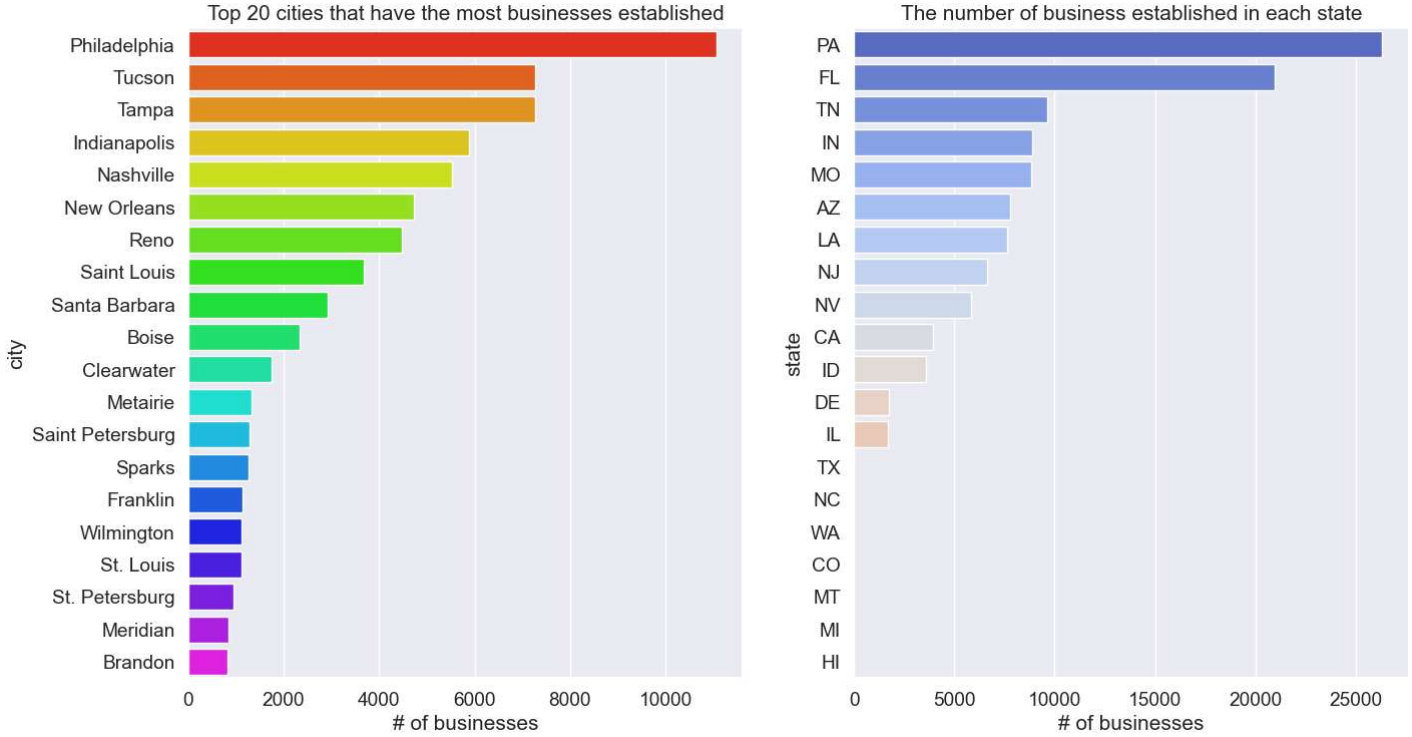
1. The number of names of unique businesses present in Yelp dataset is 86009;
2. *Starbucks* is top in list of total businesses counted;

3. Restaurant-related business is most popular business name (we shall check later with attribute *categories*).

Number of businesses in each city and each state (utilize attributes *city* & *state*)

In [ ]:
```
# City
print('Number of city listed is', business['city'].nunique())

sns.set(font_scale=1.25)
f,ax = plt.subplots(1,2, figsize=(14,8))
ax1,ax2, = ax.flatten()
cnnt = business['city'].value_counts().to_frame()
cnt = pd.DataFrame(cnnt).reset_index()
cnt.columns = ['city', 'index']

sns.barplot(x=cnt['index'].iloc[:20], y=cnt['city'].iloc[:20], data=cnt, palette = 'gist_rainbow', ax =ax1)
ax1.set_xlabel('# of businesses')
ax1.set_title('Top 20 cities that have the most businesses established')

# State
print('Number of state listed is', business['state'].nunique())
cnnt = business['state'].value_counts().to_frame()
cnt = pd.DataFrame(cnnt).reset_index()
cnt.columns = ['state', 'index']

sns.barplot(x=cnt['index'].iloc[:20], y=cnt['state'].iloc[:20], data=cnt, palette = 'coolwarm', ax =ax2)
ax2.set_xlabel('# of businesses')
ax2.set_title('The number of business established in each state');
```

```
Number of city listed is 1261
Number of state listed is 23
```

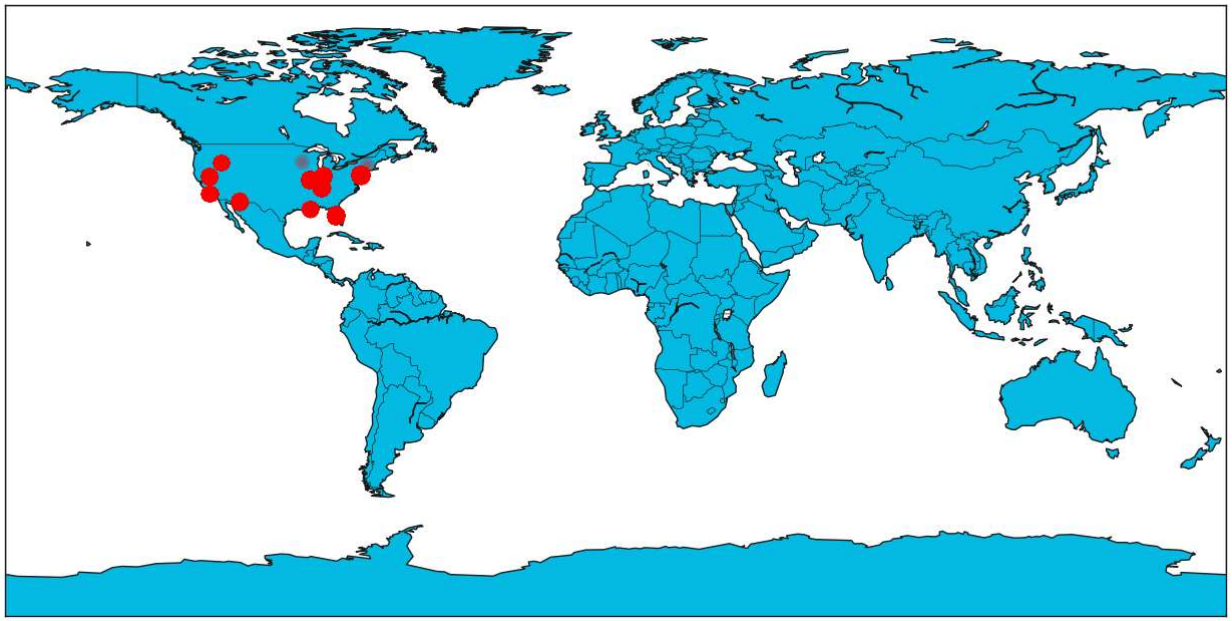


Observations:

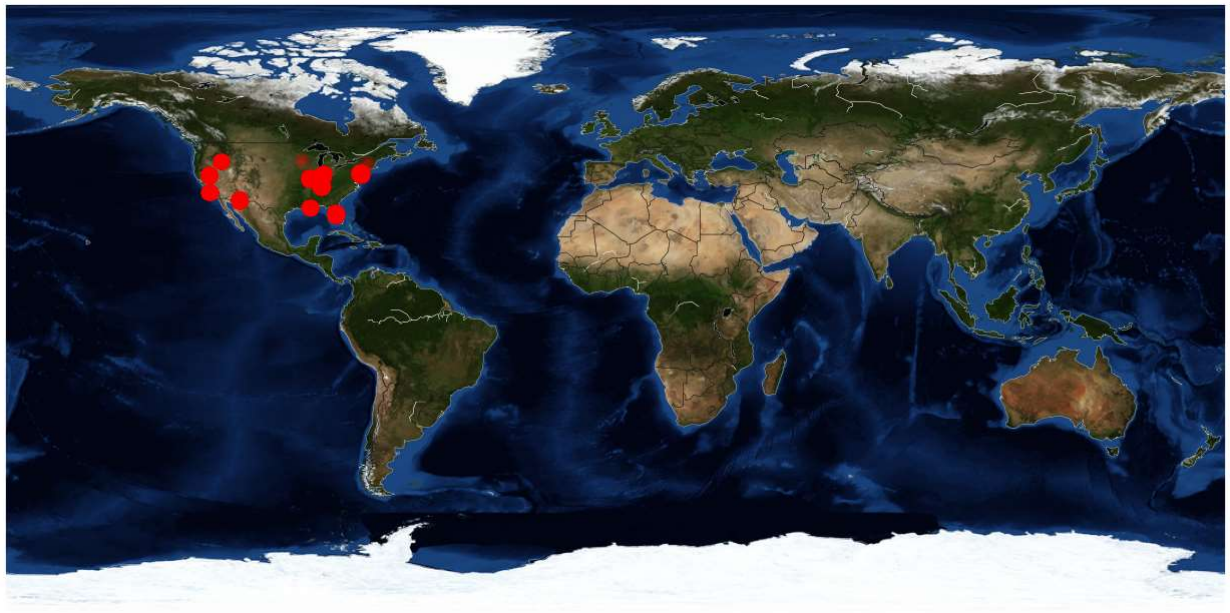
1. We see that there are 1261 city listed in Yelp dataset;
2. Philadelphia is top list in business listing in Yelp dataset followed by Tucson, Tampa etc.;
3. There are 23 state listed in Yelp dataset;
4. The state PA is top in the state list of Yelp dataset;
5. There are almost half of states having very few business listing.

Location distribution (utilize attributes *latitude* & *longtitude*)

In [ ]:
```
fig = plt.figure(figsize=(14, 10), edgecolor='w')
m = Basemap(projection='cyl',llcrnrlon= -180, urcrnrlon = 180, llcrnrlat = -90, urcrnrlat= 90, resolution='c', lat_ts = True)
m.drawcoastlines() # add coastlines
m.fillcontinents(color='#04BAE3',lake_color='#FFFFFF') # add continents lines
m.drawcountries() # add country border lines
m.drawmapboundary(fill_color='#FFFFFF') # add glabe borders

mloc = m(business['latitude'].tolist(),business['longitude'].tolist())
m.scatter(mloc[1],mloc[0],color ='red',lw=5,alpha=0.25,zorder=2.5);
```



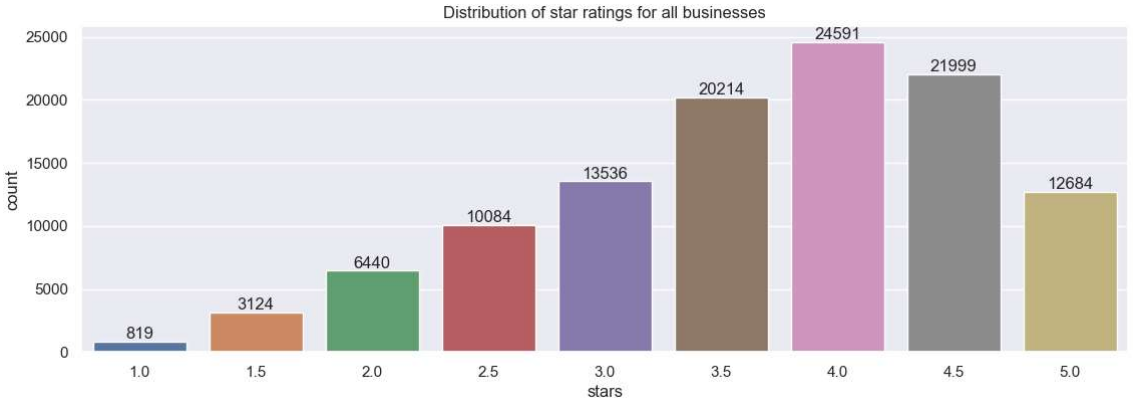
In [ ]:
```
fig = plt.figure(figsize=(14, 10), edgecolor='w')
m = Basemap(projection='cyl',llcrnrlon= -180, urcrnrlon = 180, llcrnrlat = -90, urcrnrlat= 90, resolution='c', lat_ts = True)
m.bluemarble(scale=0.2)   # full scale will be overkill
m.drawcoastlines(color='white', linewidth=0.2)  # add coastlines
m.drawcountries() # add country border lines

mloc = m(business['latitude'].tolist(),business['longitude'].tolist())
m.scatter(mloc[1],mloc[0],color ='red',lw=5,alpha=0.25,zorder=2.5);
```



We may select one of the above map representation.

Star ratings distribution (utilize the attribute *stars*)

In [ ]:
```
plt.figure(figsize=(12,4))
sns.set(font_scale=1)
ax = sns.countplot(business, x=business['stars'])
ax.bar_label(ax.containers[0], label_type='edge')
plt.title('Distribution of star ratings for all businesses');
```



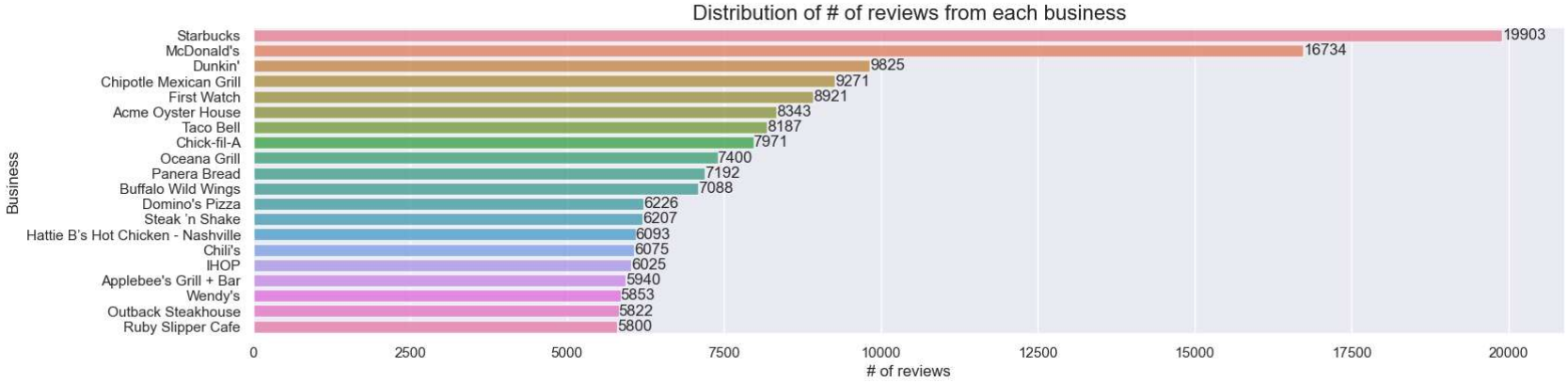
We see that most customers give 3.5, 4, and 4.5 stars to businesses.

Businesses that have most reviews counted (utilize attributes *name* and *review_count*)

In [ ]:
```
cnnt=business[['name', 'review_count']].sort_values(ascending=False, by="review_count")
cnnt=cnnt.groupby('name').sum()
cnt=pd.DataFrame(cnnt).reset_index()
cnt.columns = ['name', 'review_count']
cnt=cnt.sort_values(ascending=False, by="review_count")
```

```
print('Mean review count for all businesses is', cnt['review_count'].mean())
print('Median review count for all businesses is', cnt['review_count'].median())

#chart
plt.figure(figsize=(16,4))
sns.set(font_scale=1)
ax = sns.barplot(x=cnt['review_count'].iloc[0:20], y=cnt['name'].iloc[0:20], data=cnt, alpha=0.8, palette = 'husl')
ax.bar_label(ax.containers[0], label_type='edge')
plt.title("Distribution of # of reviews from each business", fontsize=16)
locs, labels = plt.xticks()
plt.setp(labels, rotation=0)
plt.ylabel('Business', fontsize=12)
plt.xlabel('# of reviews', fontsize=12)
plt.show()
```

```
Mean review count for all businesses is 71.37921612854468
Median review count for all businesses is 19.0
```

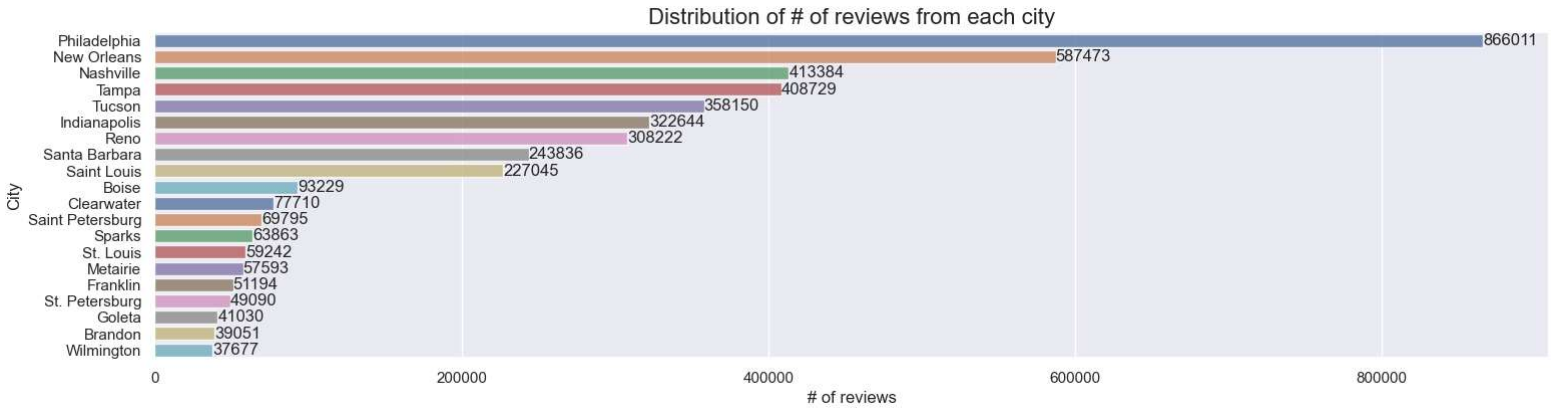


Cities that have most reviews counted (utilize attributes *city* and *review_count*)

In [ ]:

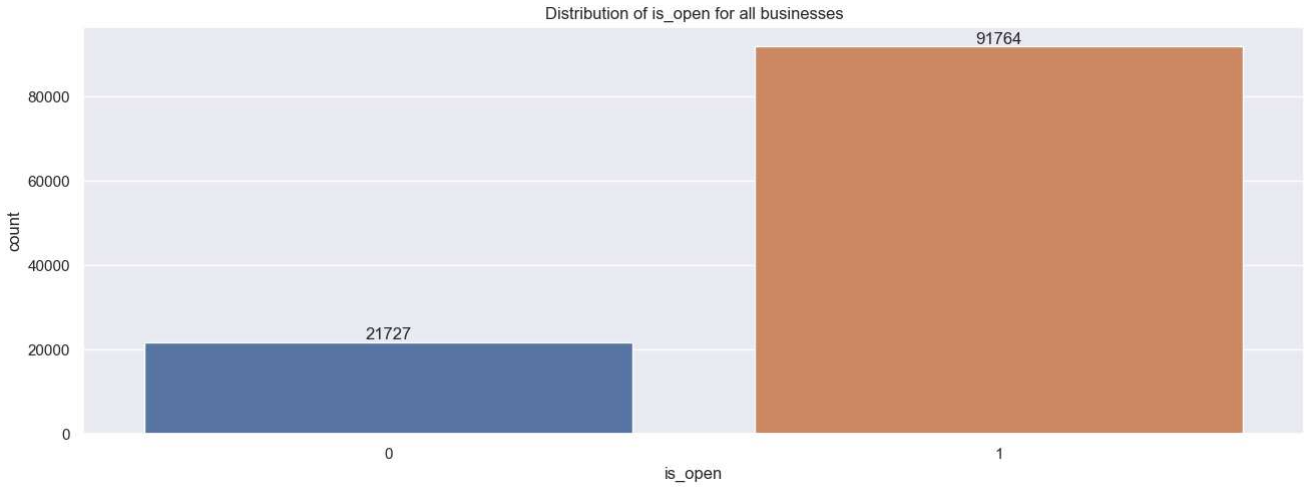
```
cnnt=business[['city', 'review_count']].sort_values(ascending=False, by="review_count")
cnnt=cnnt.groupby('city').sum()
cnt=pd.DataFrame(cnnt).reset_index()
cnt.columns = ['city', 'review_count']
cnt=cnt.sort_values(ascending=False, by="review_count")

print('Mean review count for all cities is', cnt['review_count'].mean())
print('Median review count for all cities is', cnt['review_count'].median())

#chart
plt.figure(figsize=(16,4))
sns.set(font_scale=1)
ax = sns.barplot(x=cnt['review_count'].iloc[0:20], y=cnt['city'].iloc[0:20], data=cnt, alpha=0.8, palette = 'deep')
ax.bar_label(ax.containers[0], label_type='edge')
plt.title("Distribution of # of reviews from each city", fontsize=16)
locs, labels = plt.xticks()
plt.setp(labels, rotation=0)
plt.ylabel('City', fontsize=12)
plt.xlabel('# of reviews', fontsize=12)
plt.show()
```

```
Mean review count for all cities is 4868.560666137986
Median review count for all cities is 88.0
```



Number of *is_open* distribution

In [ ]:
```
plt.figure(figsize=(14,5))
sns.set(font_scale=1)
ax = sns.countplot(business, x=business['is_open'])
ax.bar_label(ax.containers[0], label_type='edge')
plt.title('Distribution of is_open for all businesses');
```



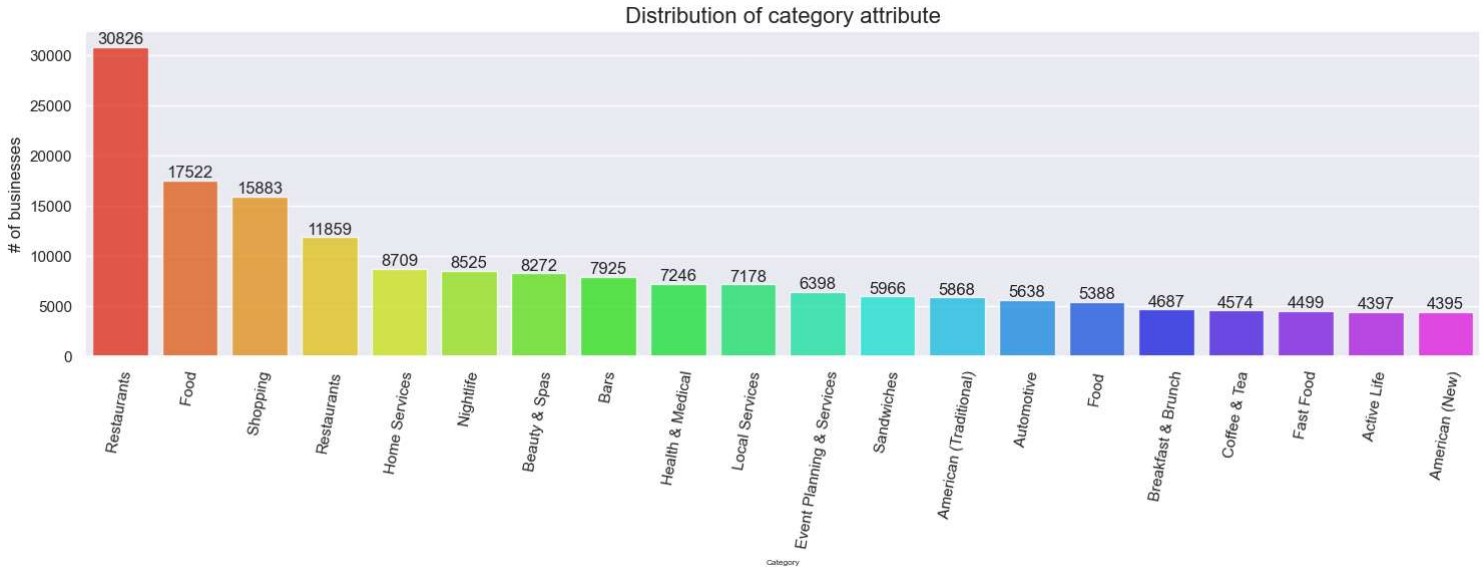
Observation: Most of business are still operating.

Analysis of *category* attribute

In [ ]:
```
business['categories'] += ','
business_cats = ''.join(business['categories'].astype('str'))
cats=pd.DataFrame(business_cats.split(','),columns=['categories'])
cats=cats[:-1]

#prep for chart
cnnt=cats.categories.value_counts()

cnnt=cnnt.sort_values(ascending=False)
cnt=cnnt.to_frame()
cnt=pd.DataFrame(cnt).reset_index()
cnt.columns = ['category', 'index']

print('Number of total unique categories listed is', cnt['category'].nunique())
```

```
#chart
plt.figure(figsize=(16,4))
sns.set(font_scale=1)
ax = sns.barplot(x=cnt['category'].iloc[0:20], y=cnt['index'].iloc[0:20], data=cnt, alpha=0.8, palette = 'gist_rainbow')
ax.bar_label(ax.containers[0], label_type='edge')
plt.title("Distribution of category attribute",fontsize=16)
locs, labels = plt.xticks()
plt.setp(labels, rotation=80)
plt.ylabel('# of businesses', fontsize=12)
plt.xlabel('Category', fontsize=6)
plt.show()
```

```
C:\Users\Francis Zhou\AppData\Local\Temp\ipykernel_85100\1015200423.py:1: SettingWithCopyWarning:
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: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  business['categories'] += ','
Number of total unique categories listed is 2383
```



In [ ]:
```
cloud = WordCloud(width=1440, height= 1080,max_words= 1000, background_color='white').generate(business_cats)
plt.figure(figsize=(14, 10))
plt.imshow(cloud)
plt.axis('off');
```

Export the cleaned *business* dataset to business.csv

In [ ]:
```
business.to_csv('business.csv', index=False)
```

In [ ]:
```
business.info()
```

2. Analysis of *yelp_academic_dataset_checkin.json*

In [ ]:
```
df_checkin = json_to_df("C:/Users/Francis Zhou/Desktop/Data Science & Machine Learning/Semester 1/DSA5104 Principles of Data Management and Retrieval/Project/yelp_academic_dataset_checkin.json")
df_checkin.head(6)
```

Out[ ]:

	business_id	date
0	---kPU91CF4Lq2-WlRu9Lw	2020-03-13 21:10:56, 2020-06-02 22:18:06, 2020...
1	--0iUa4sNDFiZFrAdIWhZQ	2010-09-13 21:43:09, 2011-05-04 23:08:15, 2011...
2	--30_8IhuyMHbSOcNWd6DQ	2013-06-14 23:29:17, 2014-08-13 23:20:22
3	--7PUidqRWpRSpXebiyxTg	2011-02-15 17:12:00, 2011-07-28 02:46:10, 2012...
4	--7jw19RH9JKXgFohspgQw	2014-04-21 20:42:11, 2014-04-28 21:04:46, 2014...
5	--8IbOsAAxjKRoYsBFL-FA	2015-06-06 01:03:19, 2015-07-29 16:50:58, 2015...

In [ ]:
```
df_checkin.shape
```

Out[ ]:
```
(131930, 2)
```

Deal with the missing data

In [ ]:
```
# Count of missing data for each attribute
print("Missing values count: ")
print(df_checkin.isnull().sum())
print("")
```

```
Missing values count:
business_id    0
date           0
dtype: int64
```

No missing value exists.

In [ ]:
```
checkin = df_checkin.dropna()
checkin['business_id'] = checkin['business_id'].astype(str)

# Uniqueness check
print(np.unique(checkin['business_id']).size == len(checkin['business_id']))
# Or
print(checkin.business_id.is_unique)

# Any row in business_id not of string length 22?
print((checkin['business_id'].str.len() != 22).any())
```

```
True
True
False
```

In [ ]:
```
checkin['date'] += ','
checkin_cats = ''.join(checkin['date'].astype('str'))
cats=pd.DataFrame(checkin_cats.split(','),columns=['date_time'])
cats=cats[:-1]
```

In [ ]:
```
cats
```

Out[ ]:

	date_time
0	2020-03-13 21:10:56
1	2020-06-02 22:18:06
2	2020-07-24 22:42:27
3	2020-10-24 21:36:13
4	2020-12-09 21:23:33
...	...
13356870	2013-12-11 00:52:49
13356871	2013-12-13 00:58:14
13356872	2016-12-03 23:33:26
13356873	2018-12-02 19:08:45
13356874	2015-01-06 17:51:53

13356875 rows × 1 columns

In [ ]:
```
# for ind in cats.index:
#     day=pd.to_datetime(cats["date_time"].iloc[ind]).strftime("%Y-%d-%m")
#     time=pd.to_datetime(cats["date_time"].iloc[ind]).strftime("%H:%M:%S")

# cats_day=pd.DataFrame(day,columns=['day'])
# cats_time=pd.DataFrame(time,columns=['time'])

# cats_day.head(6)
# cats_time.head(6)
```

In [ ]:
```
checkin.tail(25)
```

Out[ ]:

	business_id	date
131905	zz18xL0peOpD-ENMEF6hcQ	2013-04-25 23:26:44,
131906	zz3E7kmJI2r2JseE6LAnrw	2010-09-11 14:19:48, 2010-09-25 16:15:17, 2010...
131907	zz6_dk1S63QQNBSaq3iXEg	2016-01-27 16:15:09, 2016-01-28 15:17:29, 2016...
131908	zzFCdBSW27eKFg-xG7cqAg	2011-03-04 18:20:43, 2012-06-16 16:35:35, 2012...
131909	zzHtFjfM7NvuVM1HTsCLGA	2019-11-09 02:16:59, 2019-11-19 18:04:37, 2019...
131910	zzIF9qp2UoHN48EeZH_IDg	2013-07-15 01:36:36, 2016-02-19 23:31:08, 2017...
131911	zzKVqizyl3QCb3GZmg_cNg	2012-05-02 12:52:12, 2012-06-06 15:45:42, 2012...
131912	zzO2zgfqP9ANmEWt-EZFWg	2010-12-23 20:53:18, 2010-12-24 23:16:11, 2010...
131913	zzQWjZ_1Dr7kkDYIk17qRw	2018-08-12 04:20:39, 2018-09-24 08:05:08, 2018...
131914	zzRZMOmhjgUbzZSSWJT5aw	2011-08-14 15:49:56, 2011-10-22 18:54:06, 2012...
131915	zzW99n4VJr1Atte1Uhub1A	2011-05-06 00:06:41, 2014-04-28 16:17:00, 2014...
131916	zzXDi0Rdv0s84M-oQala_g	2010-02-27 16:16:13, 2010-10-23 20:04:39, 2011...
131917	zzXRdzrVhfNWPHD2MeyWeA	2019-06-28 23:00:57, 2019-07-12 23:55:18, 2019...
131918	zzbZtgPYZS8sTlWQH6DwEw	2010-08-13 07:51:27, 2010-08-14 06:35:15, 2010...
131919	zzbpcMZXHoZxUr9JZdH6wg	2013-07-10 19:11:12, 2013-07-12 15:51:59, 2014...
131920	zzfj1-iPfw0cwnOjY0yUgA	2015-07-26 17:15:58, 2015-10-01 16:30:40, 2016...
131921	zzg-ll9zxsaVXlCDrcG7hg	2015-03-28 17:22:29, 2015-05-16 20:10:42, 2016...
131922	zziDpuuJw-Km1J4BaGpBKA	2011-04-23 16:56:26, 2012-12-18 19:49:13, 2015...
131923	zzjCxn89a7RQo8keIOO_Ag	2011-01-04 17:09:15, 2011-09-01 18:50:09, 2012...
131924	zzjFdJwXuxBOGe9JeY_EMw	2015-01-14 19:21:48, 2015-06-26 17:16:54, 2015...
131925	zznJox6-nmXlGYNWgTDwQQ	2013-03-23 16:22:47, 2013-04-07 02:03:12, 2013...
131926	zznZqH9CiAznbkV6fXyHWA	2021-06-12 01:16:12,
131927	zzu6_r3DxBJuXcjnOYVdTw	2011-05-24 01:35:13, 2012-01-01 23:44:33, 2012...
131928	zzw66H6hVjXQEt0Js3Mo4A	2016-12-03 23:33:26, 2018-12-02 19:08:45,
131929	zzyx5x0Z7xXWWvWnZFuxlQ	2015-01-06 17:51:53,

In [ ]:
```
cats.tail(20)
```

Out[ ]:

	date_time
13356855	2012-07-21 01:52:39
13356856	2012-07-21 01:53:58
13356857	2012-08-25 01:35:33
13356858	2012-10-28 00:35:18
13356859	2013-01-31 18:22:55
13356860	2013-03-02 01:11:50
13356861	2013-04-03 23:23:34
13356862	2013-04-13 23:59:00
13356863	2013-04-14 00:54:53
13356864	2013-04-16 23:36:48
13356865	2013-05-09 23:59:54
13356866	2013-06-08 00:42:38
13356867	2013-06-09 18:00:03
13356868	2013-06-22 23:48:46
13356869	2013-07-14 00:29:38
13356870	2013-12-11 00:52:49
13356871	2013-12-13 00:58:14
13356872	2016-12-03 23:33:26
13356873	2018-12-02 19:08:45
13356874	2015-01-06 17:51:53

In [ ]:
```
cats[:-1]
```

Out[ ]:

	date_time
0	2020-03-13 21:10:56
1	2020-06-02 22:18:06
2	2020-07-24 22:42:27
3	2020-10-24 21:36:13
4	2020-12-09 21:23:33
...	...
13356869	2013-07-14 00:29:38
13356870	2013-12-11 00:52:49
13356871	2013-12-13 00:58:14
13356872	2016-12-03 23:33:26
13356873	2018-12-02 19:08:45

13356874 rows × 1 columns

Primary Key of *df_checkin* is **business_id.**

Export the cleaned *business* dataset to checkin.csv

In [ ]:
```
checkin.to_csv('checkin.csv', index=False)
```

In [ ]:
```
checkin.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 131930 entries, 0 to 131929
Data columns (total 2 columns):
 #   Column       Non-Null Count   Dtype 
---  ------       --------------   ----- 
 0   business_id  131930 non-null  object
 1   date         131930 non-null  object
dtypes: object(2)
memory usage: 2.0+ MB
```

3. Analysis of *yelp_academic_dataset_review.json*

In [ ]:
```
df_review = json_to_df("C:/Users/Francis Zhou/Desktop/Data Science & Machine Learning/Semester 1/DSA5104 Principles of Data Management and Retrieval/Project/yelp_academic_dataset_review.json")
df_review.head(6)
```

Out[ ]:

	review_id	user_id	business_id	stars	useful	funny	cool	text	date
0	KU_O5udG6zpxOg-VcAEodg	mh_-eMZ6K5RLWhZyISBhwA	XQfwVwDr-v0ZS3_CbbE5Xw	3.0	0	0	0	If you decide to eat here, just be aware it is...	2018-07-07 22:09:11
1	BiTunyQ73aT9WBnpR9DZGw	OyoGAe7OKpv6SyGZT5g77Q	7ATYjTIgM3jUlt4UM3IypQ	5.0	1	0	1	I've taken a lot of spin classes over the year...	2012-01-03 15:28:18
2	saUsX_uimxRlCVr67Z4Jig	8g_iMtfSiwikVnbP2etR0A	YjUWPpI6HXG530lwP-fb2A	3.0	0	0	0	Family diner. Had the buffet. Eclectic assortm...	2014-02-05 20:30:30
3	AqPFMleE6RsU23_auESxiA	_7bHUi9Uuf5__HHc_Q8guQ	kxX2SOes4o-D3ZQBkiMRfA	5.0	1	0	1	Wow! Yummy, different, delicious. Our favo...	2015-01-04 00:01:03
4	Sx8TMOWLNuJBWer-0pcmoA	bcjbaE6dDog4jkNY91ncLQ	e4Vwtrqf-wpJfwesgvdgxQ	4.0	1	0	1	Cute interior and owner (?) gave us tour of up...	2017-01-14 20:54:15
5	JrlxlS1TzJ-iCu79ul40cQ	eUta8W_HdHMXPzLBBZhL1A	04UD14gamNjLY0IDYVhHJg	1.0	1	2	1	I am a long term frequent customer of this est...	2015-09-23 23:10:31

In [ ]:
```
df_review.shape
```

Out[ ]:
```
(6990280, 9)
```

3.1. Deal with the missing data

In [ ]:
```
# Count of missing data for each attribute
print("Missing values count: ")
print(df_review.isnull().sum())
print("")
```

```
Missing values count:
review_id      0
user_id        0
business_id    0
stars          0
useful         0
funny          0
cool           0
text           0
date           0
dtype: int64
```

No missing value exists.

In [ ]:
```
review = df_review.dropna()
review
```

Out[ ]:

	review_id	user_id	business_id	stars	useful	funny	cool	text	date
0	KU_O5udG6zpxOg-VcAEodg	mh_-eMZ6K5RLWhZyISBhwA	XQfwVwDr-v0ZS3_CbbE5Xw	3.0	0	0	0	If you decide to eat here, just be aware it is...	2018-07-07 22:09:11
1	BiTunyQ73aT9WBnpR9DZGw	OyoGAe7OKpv6SyGZT5g77Q	7ATYjTIgM3jUlt4UM3IypQ	5.0	1	0	1	I've taken a lot of spin classes over the year...	2012-01-03 15:28:18
2	saUsX_uimxRlCVr67Z4Jig	8g_iMtfSiwikVnbP2etR0A	YjUWPpI6HXG530lwP-fb2A	3.0	0	0	0	Family diner. Had the buffet. Eclectic assortm...	2014-02-05 20:30:30
3	AqPFMleE6RsU23_auESxiA	_7bHUi9Uuf5__HHc_Q8guQ	kxX2SOes4o-D3ZQBkiMRfA	5.0	1	0	1	Wow! Yummy, different, delicious. Our favo...	2015-01-04 00:01:03
4	Sx8TMOWLNuJBWer-0pcmoA	bcjbaE6dDog4jkNY91ncLQ	e4Vwtrqf-wpJfwesgvdgxQ	4.0	1	0	1	Cute interior and owner (?) gave us tour of up...	2017-01-14 20:54:15
...	...	...	...	...	...	...	...	...	...
6990275	H0RlamZu0B0Ei0P4aeh3sQ	qskILQ3k0I_qcCMI-k6_QQ	jals67o91gcrD4DC81Vk6w	5.0	1	2	1	Latest addition to services from ICCU is Apple...	2014-12-17 21:45:20
6990276	shTPgbgdwTHSuU67mGCmZQ	Zo0th2m8Ez4gLSbHftiQvg	2vLksaMmSEcGbJl5gywpZA	5.0	2	1	2	This spot offers a great, affordable east week...	2021-03-31 16:55:10
6990277	YNfNhgZlaaCO5Q_YJR4rEw	mm6E4FbCMwJmb7kPDZ5v2Q	R1khUUxidqfaJmcpmGd4aw	4.0	1	0	0	This Home Depot won me over when I needed to g...	2019-12-30 03:56:30
6990278	i-I4ZOhoX70Nw5H0FwrQUA	YwAMC-jvZ1fvEUum6QkEkw	Rr9kKArrMhSLVE9a53q-aA	5.0	1	0	0	For when I'm feeling like ignoring my calorie-...	2022-01-19 18:59:27
6990279	RwcKOdEuLRHNJe4M9-qpqg	6JehEvdoCvZFJ_XlxnzIlw	VAeEXLbEcI9Emt9KGYq9aA	3.0	10	3	7	Located in the 'Walking District' in Nashville...	2018-01-02 22:50:47

6990280 rows × 9 columns

3.2. Adjust data in each column

In [ ]:
```
review.dtypes
```

Out[ ]:
```
review_id       object
user_id         object
business_id     object
stars          float64
useful           int64
funny            int64
cool             int64
text            object
date            object
dtype: object
```

Require *review_id* as **22 character unique string**, *user_id* as **22 character unique string**, *business_id* as **22 character unique string**, *stars* as **integer**.

In [ ]:
```
# review.id
review['review_id'] = review['review_id'].astype(str)

# Uniqueness check
print(np.unique(review['review_id']).size == len(review['review_id']))
# Or
print(review.review_id.is_unique)

# Any row in review_id not of string length 22?
print((review['review_id'].str.len() != 22).any())
```

```
True
True
False
```

In [ ]:
```
# user.id
review['user_id'] = review['user_id'].astype(str)

# Uniqueness check
print(np.unique(review['user_id']).size == len(review['user_id']))
# Or
print(review.user_id.is_unique)

# Any row in user_id not of string length 22?
print((review['user_id'].str.len() != 22).any())

print(np.unique(review['user_id']).size)
print(len(review['user_id']))
```

```
False
False
False
1987929
6990280
```

In [ ]:
```
# business.id
review['business_id'] = review['business_id'].astype(str)

# Uniqueness check
print(np.unique(review['business_id']).size == len(review['business_id']))
# Or
print(review.business_id.is_unique)

# Any row in user_id not of string length 22?
print((review['business_id'].str.len() != 22).any())

print(np.unique(review['business_id']).size)
print(len(review['business_id']))
```

```
False
False
False
150346
6990280
```

In [ ]:
```
# stars
review['stars'] = review['stars'].astype(int)
review['stars'].head(6)
```

Out[ ]:
```
0    3
1    5
2    3
3    5
4    4
5    1
Name: stars, dtype: int32
```

In [ ]:
```
review.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6990280 entries, 0 to 6990279
Data columns (total 9 columns):
 #   Column       Dtype 
---  ------       ----- 
 0   review_id    object
 1   user_id      object
 2   business_id  object
 3   stars        int32 
 4   useful       int64 
 5   funny        int64 
 6   cool         int64 
 7   text         object
 8   date         object
dtypes: int32(1), int64(3), object(5)
memory usage: 453.3+ MB
```

Primary key of *df_review* is **review_id.**

EDA on Review

In [ ]:
```
# Word cloud
cloud = WordCloud(width=1440, height= 1080, max_words= 200, background_color='white').generate(' '.join(review['text'].astype(str)))
plt.figure(figsize=(20, 15))
plt.imshow(cloud)
plt.axis('off');
```

Export the cleaned *review* dataset to review.csv

In [ ]:
```
review.to_csv('review.csv', index=False)
```

4. Analysis of *yelp_academic_dataset_tip.json*

In [ ]:
```
df_tip = json_to_df("C:/Users/Francis Zhou/Desktop/Data Science & Machine Learning/Semester 1/DSA5104 Principles of Data Management and Retrieval/Project/yelp_academic_dataset_tip.json")
df_tip.head(6)
```

Out[ ]:

	user_id	business_id	text	date	compliment_count
0	AGNUgVwnZUey3gcPCJ76iw	3uLgwr0qeCNMjKenHJwPGQ	Avengers time with the ladies.	2012-05-18 02:17:21	0
1	NBN4MgHP9D3cw--SnauTkA	QoezRbYQncpRqyrLH6Iqjg	They have lots of good deserts and tasty cuban...	2013-02-05 18:35:10	0
2	-copOvldyKh1qr-vzkDEvw	MYoRNLb5chwjQe3c_k37Gg	It's open even when you think it isn't	2013-08-18 00:56:08	0
3	FjMQVZjSqY8syIO-53KFKw	hV-bABTK-glh5wj31ps_Jw	Very decent fried chicken	2017-06-27 23:05:38	0
4	ld0AperBXk1h6UbqmM80zw	_uN0OudeJ3Zl_tf6nxg5ww	Appetizers.. platter special for lunch	2012-10-06 19:43:09	0
5	trf3Qcz8qvCDKXiTgjUcEg	7Rm9Ba50bw23KTA8RedZYg	Chili Cup + Single Cheeseburger with onion, pi...	2012-03-13 04:00:52	0

In [ ]:
```
df_tip.shape
```

Out[ ]:
```
(908915, 5)
```

4.1. Deal with the missing data

In [ ]:
```
# Count of missing data for each attribute
print("Missing values count: ")
print(df_tip.isnull().sum())
print("")
```

```
Missing values count:
user_id             0
business_id         0
text                0
date                0
compliment_count    0
dtype: int64
```

No missing data exists.

In [ ]:
```
tip = df_tip.dropna()
tip
```

Out[ ]:

	user_id	business_id	text	date	compliment_count
0	AGNUgVwnZUey3gcPCJ76iw	3uLgwr0qeCNMjKenHJwPGQ	Avengers time with the ladies.	2012-05-18 02:17:21	0
1	NBN4MgHP9D3cw--SnauTkA	QoezRbYQncpRqyrLH6Iqjg	They have lots of good deserts and tasty cuban...	2013-02-05 18:35:10	0
2	-copOvldyKh1qr-vzkDEvw	MYoRNLb5chwjQe3c_k37Gg	It's open even when you think it isn't	2013-08-18 00:56:08	0
3	FjMQVZjSqY8syIO-53KFKw	hV-bABTK-glh5wj31ps_Jw	Very decent fried chicken	2017-06-27 23:05:38	0
4	ld0AperBXk1h6UbqmM80zw	_uN0OudeJ3Zl_tf6nxg5ww	Appetizers.. platter special for lunch	2012-10-06 19:43:09	0
...	...	...	...	...	...
908910	eYodCTF8pkqKPzHkcxZs-Q	3lHTewuKFt5IImbXJoFeDQ	Disappointed in one of your managers.	2021-09-11 19:18:57	0
908911	1uxtQAuJ2T5Xwa_wp7kUnA	OaGf0Dp56ARhQwIDT90w_g	Great food and service.	2021-10-30 11:54:36	0
908912	v48Spe6WEpqehsF2xQADpg	hYnMeAO77RGyTtIzUSKYzQ	Love their Cubans!!	2021-11-05 13:18:56	0
908913	ckqKGM2hl7I9Chp5IpAhkw	s2eyoTuJrcP7I_XyjdhUHQ	Great pizza great price	2021-11-20 16:11:44	0
908914	4tF1CWdMxvvwpUIgGsDygA	_cb1Vg1NlWry8UA0jyuXnQ	Food is good value but a bit hot!	2021-12-07 22:30:00	0

908915 rows × 5 columns

In [ ]:
```
print(tip.duplicated().sum())
```

```
67
```

There are 67 duplicates in *tip*. Need to remove them. Which exactly are they?

In [ ]:
```
tip.loc[tip.duplicated(), :]
```

Out[ ]:

	user_id	business_id	text	date	compliment_count
29901	00Cz_vdInMHpTRjqbWjK5Q	ncacMQ9n_dSM1cR3c1vTQw	Miss saigon	2010-12-07 01:59:12	0
58887	47zMh_WgunwRDf7Cx2WyYw	J8vz_zwZaxzA585lV_k_vA	Com chien and mi are delish!	2011-07-23 17:22:58	0
99407	WQ8sh'm0ghNDz97BuHI1fA	Sv1MEZP-mMfp8SmE0hwYEA	love the crispy buns!	2017-10-18 23:29:03	0
126358	hGxVvX\g7IK4J2aTiGMSIQ	5RsVAkDnMrcSbErS6P1eew	Pricey, often crowded, and staff are not alway...	2017-10-20 22:08:25	0
129213	1gDoko0TrN0InQIMC2JtXw	06PmqoU3uY5Vb-BEaMPVfw	We ordered a pizza on New Year's Day, it never...	2014-02-20 04:09:37	0
...	...	...	...	...	...
793788	nnWFrvhO2jeq0KbG_CKCYA	jmG_QxXXfz2cnw9dQCXJLQ	Great place, great baked goods!	2019-06-08 17:06:50	0
794036	ajDPsSD77sxcVttPfftBRQ	DTxB12bQaZ1m-nLeXWX2rw	Good service and delicious food	2017-09-12 23:01:50	0
820290	wYo3aBVj-bRPT7E4RSj5Kg	W5SNps2JaT_RozLAI_TN1Q	Worker there are the best at serving me quick ...	2017-12-17 01:10:52	0
873070	TEjijSowDwJM4vCL-zn4ew	YPHDzg1h-PkaxfoppT-iJg	bleed blue	2011-09-26 00:03:49	0
903817	XJcb75c9CY0xX8spM0TQuw	UlGS2NxZSiph33E3nfovRw	Whiskey Kitchen is the perfect place for bar f...	2013-08-04 16:43:08	0

67 rows × 5 columns

Then, drop the duplicates in the original dataset *tip*

In [ ]:
```
tip.drop_duplicates(inplace=True)
print(tip.duplicated().sum())
```

```
0
```

4.2. Adjust data in each column

In [ ]:
```
tip.dtypes
```

Out[ ]:
```
user_id             object
business_id         object
text                object
date                object
compliment_count     int64
dtype: object
```

Require *business_id* as **22 character unique string**, *user_id* as **22 character unique string.**

In [ ]:
```
# business_id
tip['business_id'] = tip['business_id'].astype(str)

# Uniqueness check
print(np.unique(tip['business_id']).size == len(tip['business_id']))

# Any row in business_id not of string length 22?
print((tip['business_id'].str.len() != 22).any())

print(np.unique(tip['business_id']).size)
print(len(tip['business_id']))
```

```
False
False
106193
908848
```

In [ ]:
```
# user_id
tip['user_id'] = tip['user_id'].astype(str)

# Uniqueness check
print(np.unique(tip['user_id']).size == len(tip['user_id']))

# Any row in business_id not of string length 22?
print((tip['user_id'].str.len() != 22).any())

print(np.unique(tip['user_id']).size)
print(len(tip['user_id']))
```

```
False
False
301758
908848
```

In [ ]:
```
df_tip[df_tip["business_id"] == "3uLgwr0qeCNMjKenHJwPGQ"]
```

Out[ ]:

	user_id	business_id	text	date	compliment_count
0	AGNUgVwnZUey3gcPCJ76iw	3uLgwr0qeCNMjKenHJwPGQ	Avengers time with the ladies.	2012-05-18 02:17:21	0
15521	-PNOT-APcKKu9PFokhCtJA	3uLgwr0qeCNMjKenHJwPGQ	The Dark Knight Rises in XD! I don't know what...	2012-07-22 02:22:54	0
41035	wzX8UssOgIkwSDx8qob8zA	3uLgwr0qeCNMjKenHJwPGQ	Cleanliness matters....I just sat down to watc...	2018-04-28 17:33:05	0
65827	bQmEEqIobO4J0oasLUTX0Q	3uLgwr0qeCNMjKenHJwPGQ	Early bird gets the worm!	2011-10-30 19:10:34	0
79696	u2NnaNOcwOVCWDYeGQpoaA	3uLgwr0qeCNMjKenHJwPGQ	Brand new seats!	2015-03-22 18:12:37	0
83517	zdw1jwmw1TNLZgu_is_Seg	3uLgwr0qeCNMjKenHJwPGQ	Seeing the Amazing Spider Man. Loving this th...	2012-07-07 01:38:48	0
83705	ehgIycOK6qKj-CT9B36_oQ	3uLgwr0qeCNMjKenHJwPGQ	XD is awesome	2012-05-04 05:40:38	0
156322	wvNrdBUqj0K6FPccvO8SFA	3uLgwr0qeCNMjKenHJwPGQ	Captain America rocks!	2011-07-26 19:52:24	0
171757	juigu8XxwzLAeikeBzULbg	3uLgwr0qeCNMjKenHJwPGQ	Bully	2012-05-05 18:41:27	0
208063	pQG9KuaX5Rpd8Zdf_aiTXA	3uLgwr0qeCNMjKenHJwPGQ	MIBIII was dope!	2012-06-03 07:43:24	0
225280	vq9TI11JinsJuRVXhJZ4gw	3uLgwr0qeCNMjKenHJwPGQ	Avengers 3D!	2012-05-06 20:04:56	0
254908	pkP3z8r_3mmkHZ7EuiVahg	3uLgwr0qeCNMjKenHJwPGQ	Planet of the apes	2011-08-06 23:45:46	0
284656	w_CXUiqhP8hXZsBV77AMRg	3uLgwr0qeCNMjKenHJwPGQ	Anchorman2!	2013-12-21 03:29:41	0
362703	-PNOT-APcKKu9PFokhCtJA	3uLgwr0qeCNMjKenHJwPGQ	Avengers!	2012-05-05 01:04:16	0
392646	ehHDtBNAQ_5AopWiN-e4mA	3uLgwr0qeCNMjKenHJwPGQ	Buy a large refillable popcorn. Refill it befo...	2013-06-29 20:17:51	0
397734	wvNrdBUqj0K6FPccvO8SFA	3uLgwr0qeCNMjKenHJwPGQ	Gonna see "Act of Valor " with Eric.	2012-03-08 18:21:14	0
433184	JXjYnM5Kq1YboI-pJcojvA	3uLgwr0qeCNMjKenHJwPGQ	Late night movie time	2012-03-28 05:44:31	0
444313	JXjYnM5Kq1YboI-pJcojvA	3uLgwr0qeCNMjKenHJwPGQ	The Avengers!	2012-05-05 06:09:47	0
461938	3KtVXemEbIdELcs5eT24pA	3uLgwr0qeCNMjKenHJwPGQ	Bad grandpa movie	2013-10-26 20:51:56	0
464145	a01LsCP-lIWKCZ3P1VSy9w	3uLgwr0qeCNMjKenHJwPGQ	One of the few movie theaters in Tucson where ...	2013-12-30 23:11:57	0
471701	iz6amC-ytaz6Dt4RIYtcnw	3uLgwr0qeCNMjKenHJwPGQ	IPic in Scottsdale has RUINED me for any other...	2012-12-28 18:34:17	0
521865	sJprizZfXS0-g4sON33EDA	3uLgwr0qeCNMjKenHJwPGQ	Oblivion	2013-04-21 03:56:15	0
553578	JDFpVj-wb6ARF-_Fzjof_A	3uLgwr0qeCNMjKenHJwPGQ	Girl with Dragon Tattoo	2012-01-02 22:35:09	0
561454	VoKqa8DMkySsAV7PQCaHqw	3uLgwr0qeCNMjKenHJwPGQ	Batman!!!!	2012-07-23 02:15:03	0
569351	RKLDrXAhNWWBgEKiy2K5aQ	3uLgwr0qeCNMjKenHJwPGQ	Getting ready to watch Men in Black 3 with mom...	2012-06-02 17:18:17	0
572008	RKLDrXAhNWWBgEKiy2K5aQ	3uLgwr0qeCNMjKenHJwPGQ	Here to see Cowboys vs Aliens. Can't wait for...	2011-07-30 17:58:11	0
578870	t-1UITaxykxozm3sL9q81g	3uLgwr0qeCNMjKenHJwPGQ	I'm Thhhhor!!!	2012-05-04 06:11:43	0
643599	M59DnJEzaGtbRCi-wZkZbA	3uLgwr0qeCNMjKenHJwPGQ	Hangover III	2013-05-23 04:11:33	0
646524	PilmrBxF6veXLZHHfu4y_g	3uLgwr0qeCNMjKenHJwPGQ	$5.75 Tuesdays!	2016-08-03 05:10:04	0
648742	2rgIaO_X4Z07qrlu8xzGcA	3uLgwr0qeCNMjKenHJwPGQ	Tintin is just plain FUN. with Becca	2012-01-24 20:21:44	0
653404	2rgIaO_X4Z07qrlu8xzGcA	3uLgwr0qeCNMjKenHJwPGQ	Bob n Babe to see Hugo.	2012-01-29 19:14:59	0
657257	2rgIaO_X4Z07qrlu8xzGcA	3uLgwr0qeCNMjKenHJwPGQ	Albert Nobbs w/Nan, Bec, Bob. Good...but sad.	2012-01-27 21:06:42	0
658388	M59DnJEzaGtbRCi-wZkZbA	3uLgwr0qeCNMjKenHJwPGQ	Fast 6	2013-05-24 04:03:50	0
658585	t0OCaeUJ7ACn8J23l01bRg	3uLgwr0qeCNMjKenHJwPGQ	Watching Argo, have the t shirt	2012-11-04 00:47:52	0
675056	2rgIaO_X4Z07qrlu8xzGcA	3uLgwr0qeCNMjKenHJwPGQ	With Bob to FINALLY see "The Artist".	2012-01-14 18:02:40	0
715641	4u1hp8HfcO2A6gLkJEyMKg	3uLgwr0qeCNMjKenHJwPGQ	The Best Exotic Marigold Hotel	2012-05-27 04:09:13	0
755342	RdGX12xRj4tYHSBrr8cbpA	3uLgwr0qeCNMjKenHJwPGQ	American Reunion	2012-04-18 03:00:10	0
757363	RdGX12xRj4tYHSBrr8cbpA	3uLgwr0qeCNMjKenHJwPGQ	Chronicle...:-)	2012-02-10 22:39:05	0
766961	RdGX12xRj4tYHSBrr8cbpA	3uLgwr0qeCNMjKenHJwPGQ	Just saw Captain America in 3D. Can you say se...	2011-07-23 00:59:00	0
792337	RdGX12xRj4tYHSBrr8cbpA	3uLgwr0qeCNMjKenHJwPGQ	John Carter...:-)	2012-03-10 00:38:15	0
792650	RdGX12xRj4tYHSBrr8cbpA	3uLgwr0qeCNMjKenHJwPGQ	Hunger Games XD baby.	2012-03-23 22:30:42	0
793619	RdGX12xRj4tYHSBrr8cbpA	3uLgwr0qeCNMjKenHJwPGQ	3D Avengers...:-)	2012-05-04 19:45:42	0
810367	Otrbyr610UBKWZKLLgXm9Q	3uLgwr0qeCNMjKenHJwPGQ	Ice Age round 2:) aaand they have kettle corn:)	2012-08-02 01:51:06	0
818513	Otrbyr610UBKWZKLLgXm9Q	3uLgwr0qeCNMjKenHJwPGQ	Watching the Dark Night Rises marathon:)))))) v...	2012-07-20 00:42:39	0
842565	dJU014PIqteJouYx1u4lJA	3uLgwr0qeCNMjKenHJwPGQ	The Games of HUNGER!!!	2012-03-23 05:24:05	0
870878	22ufLQhlGDI5acX1jhnLxQ	3uLgwr0qeCNMjKenHJwPGQ	Going to see "The Batman"	2012-07-30 01:25:38	0

In [ ]:
```
table_tip_AGNUgVwnZUey3gcPCJ76iw = df_tip[df_tip["user_id"] == "AGNUgVwnZUey3gcPCJ76iw"]
table_tip_AGNUgVwnZUey3gcPCJ76iw[table_tip_AGNUgVwnZUey3gcPCJ76iw["business_id"] == "3uLgwr0qeCNMjKenHJwPGQ"]
```

Out[ ]:

	user_id	business_id	text	date	compliment_count	userbusiness_id
0	AGNUgVwnZUey3gcPCJ76iw	3uLgwr0qeCNMjKenHJwPGQ	Avengers time with the ladies.	2012-05-18 02:17:21	0	AGNUgVwnZUey3gcPCJ76iw3uLgwr0qeCNMjKenHJwPGQ

In [ ]:
```
df_tip["userbusiness_id"] = df_tip["user_id"] + df_tip["business_id"]
df_tip
```

Out[ ]:

	user_id	business_id	text	date	compliment_count	userbusiness_id
0	AGNUgVwnZUey3gcPCJ76iw	3uLgwr0qeCNMjKenHJwPGQ	Avengers time with the ladies.	2012-05-18 02:17:21	0	AGNUgVwnZUey3gcPCJ76iw3uLgwr0qeCNMjKenHJwPGQ
1	NBN4MgHP9D3cw--SnauTkA	QoezRbYQncpRqyrLH6Iqjg	They have lots of good deserts and tasty cuban...	2013-02-05 18:35:10	0	NBN4MgHP9D3cw--SnauTkAQoezRbYQncpRqyrLH6Iqjg
2	-copOvldyKh1qr-vzkDEvw	MYoRNLb5chwjQe3c_k37Gg	It's open even when you think it isn't	2013-08-18 00:56:08	0	-copOvldyKh1qr-vzkDEvwMYoRNLb5chwjQe3c_k37Gg
3	FjMQVZjSqY8syIO-53KFKw	hV-bABTK-glh5wj31ps_Jw	Very decent fried chicken	2017-06-27 23:05:38	0	FjMQVZjSqY8syIO-53KFKwhV-bABTK-glh5wj31ps_Jw
4	ld0AperBXk1h6UbqmM80zw	_uN0OudeJ3Zl_tf6nxg5ww	Appetizers.. platter special for lunch	2012-10-06 19:43:09	0	ld0AperBXk1h6UbqmM80zw_uN0OudeJ3Zl_tf6nxg5ww
...	...	...	...	...	...	...
908910	eYodCTF8pkqKPzHkcxZs-Q	3lHTewuKFt5IImbXJoFeDQ	Disappointed in one of your managers.	2021-09-11 19:18:57	0	eYodCTF8pkqKPzHkcxZs-Q3lHTewuKFt5IImbXJoFeDQ
908911	1uxtQAuJ2T5Xwa_wp7kUnA	OaGf0Dp56ARhQwIDT90w_g	Great food and service.	2021-10-30 11:54:36	0	1uxtQAuJ2T5Xwa_wp7kUnAOaGf0Dp56ARhQwIDT90w_g
908912	v48Spe6WEpqehsF2xQADpg	hYnMeAO77RGyTtlzUSKYzQ	Love their Cubans!!	2021-11-05 13:18:56	0	v48Spe6WEpqehsF2xQADpghYnMeAO77RGyTtlzUSKYzQ
908913	ckqKGM2hl7l9Chp5IpAhkw	s2eyoTuJrcP7l_XyjdhUHQ	Great pizza great price	2021-11-20 16:11:44	0	ckqKGM2hl7l9Chp5IpAhkws2eyoTuJrcP7l_XyjdhUHQ
908914	4tF1CWdMxvvwpUIgGsDygA	_cb1Vg1NIWry8UA0jyuXnQ	Food is good value but a bit hot!	2021-12-07 22:30:00	0	4tF1CWdMxvvwpUIgGsDygA_cb1Vg1NIWry8UA0jyuXnQ

908915 rows × 6 columns

In [ ]:
```
np.unique(df_tip["userbusiness_id"]).size
```

Out[ ]:
```
784784
```

In [ ]:
```
len(df_tip["userbusiness_id"])
```

Out[ ]:
```
908915
```

After removing all duplicates, there is no Primary Key for *tip*.

Export the cleaned *tip* dataset to tip.csv

In [ ]:
```
tip.to_csv('tip.csv', index=False)
```

5. Analysis of *yelp_academic_dataset_user.json*

In [ ]:
```
df_user = json_to_df("C:/Users/Francis Zhou/Desktop/Data Science & Machine Learning/Semester 1/DSA5104 Principles of Data Management and Retrieval/Project/yelp_academic_dataset_user.json")
df_user.head(6)
```

Out[ ]:

	user_id	name	review_count	yelping_since	useful	funny	cool	elite	friends	fans	...	compliment_more	compliment_profile	compliment_cute	compliment_list	compliment_note	com
0	qVc8ODYU5SZjKXVBgXdI7w	Walker	585	2007-01-25 16:47:26	7217	1259	5994	2007	NSCy54eWehBJyZdG2iE84w, pe42u7DcCH2QmI81NX-8qA...	267	...	65	55	56	18	232	
1	j14WgRoU_-2ZE1aw1dXrJg	Daniel	4333	2009-01-25 04:35:42	43091	13066	27281	2009,2010,2011,2012,2013,2014,2015,2016,2017,2...	ueRPE0CX75ePGMqOFVj6IQ, 52oH4DrRvzzl8wh5UXyU0A...	3138	...	264	184	157	251	1847	
2	2WnXYQFK0hXEoTxPtV2zvg	Steph	665	2008-07-25 10:41:00	2086	1010	1003	2009,2010,2011,2012,2013	LuO3Bn4f3rlhyHIaNfTlnA, j9B4XdHUhDfTKVecyWQgyA...	52	...	13	10	17	3	66	
3	SZDeASXq7o05mMNLshsdIA	Gwen	224	2005-11-29 04:38:33	512	330	299	2009,2010,2011	enx1vVPnfdNUdPho6PH_wg, 4wOcvMLtU6a9Lslggq74Vg...	28	...	4	1	6	2	12	
4	hA5lMy-EnncsH4JoR-hFGQ	Karen	79	2007-01-05 19:40:59	29	15	7		PBK4q9KEEBHhFvSXCUirIw, 3FWPpM7KU1gXeOM_ZbYMbA...	1	...	1	0	0	0	1	
5	q_QQ5kBBwlCcbL1s4NVK3g	Jane	1221	2005-03-14 20:26:35	14953	9940	11211	2006,2007,2008,2009,2010,2011,2012,2013,2014	xBDpTUbai0DXrvxCe3X16Q, 7GPNBO496aecrjJfW6UWtg...	1357	...	163	191	361	147	1212	

6 rows × 22 columns

In [ ]:
```
df_user.shape
```

Out[ ]:
```
(1987897, 22)
```

In [ ]:
```
print(len(np.unique(df_user["user_id"])) == len(df_user["user_id"]))
```

```
True
```

5.1. Deal with the missing data

In [ ]:
```
# Count of missing data for each attribute
print("Missing values count: ")
print(df_user.isnull().sum())
print("")
```

```
Missing values count:
user_id               0
name                  0
review_count          0
yelping_since         0
useful                0
funny                 0
cool                  0
elite                 0
friends               0
fans                  0
average_stars         0
compliment_hot        0
compliment_more       0
compliment_profile    0
compliment_cute       0
compliment_list       0
compliment_note       0
compliment_plain      0
compliment_cool       0
compliment_funny      0
compliment_writer     0
compliment_photos     0
dtype: int64
```

No missing value exists.

In [ ]:
```
user = df_user.dropna()
user
```

Out[ ]:

	user_id	name	review_count	yelping_since	useful	funny	cool	elite	friends	fans	...	compliment_more	compliment_profile	compliment_cute	compliment_list	compliment_no
0	qVc8ODYU5SZjKXVBgXdI7w	Walker	585	2007-01-25 16:47:26	7217	1259	5994	2007	NSCy54eWehBJyZdG2iE84w, pe42u7DcCH2Qml81NX-8qA...	267	...	65	55	56	18	2
1	j14WgRoU_-2ZE1aw1dXrJg	Daniel	4333	2009-01-25 04:35:42	43091	13066	27281	2009,2010,2011,2012,2013,2014,2015,2016,2017,2...	ueRPE0CX75ePGMqOFVj6IQ, 52oH4DrRvzzl8wh5UXyU0A...	3138	...	264	184	157	251	18
2	2WnXYQFK0hXEoTxPtV2zvg	Steph	665	2008-07-25 10:41:00	2086	1010	1003	2009,2010,2011,2012,2013	LuO3Bn4f3rlhyHIaNfTlnA, j9B4XdHUhDfTKVecyWQgyA...	52	...	13	10	17	3	
3	SZDeASXq7o05mMNLshsdIA	Gwen	224	2005-11-29 04:38:33	512	330	299	2009,2010,2011	enx1vVPnfdNUdPho6PH_wg, 4wOcvMLtU6a9Lslggq74Vg...	28	...	4	1	6	2	
4	hA5lMy-EnncsH4JoR-hFGQ	Karen	79	2007-01-05 19:40:59	29	15	7		PBK4q9KEEBHhFvSXCUirIw, 3FWPpM7KU1gXeOM_ZbYMbA...	1	...	1	0	0	0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
1987892	fB3jbHi3m0L2KgGOxBv6uw	Jerrold	23	2015-01-06 00:31:31	7	0	0		None	0	...	0	0	0	0	
1987893	68czcr4BxJyMQ9cJBm6C7Q	Jane	1	2016-06-14 07:20:52	0	0	0		None	0	...	0	0	0	0	
1987894	1x3KMskYxOuJCjRz70xOqQ	Shomari	4	2017-02-04 15:31:58	1	1	0		None	0	...	0	0	0	0	
1987895	ulfGl4tdbrH05xKzh5lnog	Susanne	2	2011-01-14 00:29:08	0	0	0		None	0	...	0	0	0	0	
1987896	wL5jPrLRVCK_Pmo4IM1zpA	Isa	2	2020-12-19 02:32:39	0	0	0		None	0	...	0	0	0	0	

1987897 rows × 22 columns

5.2. Adjust data in each column

In [ ]:
```
user.dtypes
```

Out[ ]:
```
user_id               object
name                  object
review_count           int64
yelping_since         object
useful                 int64
funny                  int64
cool                   int64
elite                 object
friends               object
fans                   int64
average_stars        float64
compliment_hot         int64
compliment_more        int64
compliment_profile     int64
compliment_cute        int64
compliment_list        int64
compliment_note        int64
compliment_plain       int64
compliment_cool        int64
compliment_funny       int64
compliment_writer      int64
compliment_photos      int64
dtype: object
```

Require *user_id* as 22 character unique string.

In [ ]:
```
user['user_id'] = user['user_id'].astype(str)

# Uniqueness check
print(np.unique(user['user_id']).size == len(user['user_id']))

# Any row in business_id not of string length 22?
print((user['user_id'].str.len() != 22).any())
```

```
True
False
False
```

Primary Key for *user.json* is *user_id*.

Export the cleaned *user* dataset to user.csv

In [ ]:
```
user.to_csv('user.csv', index=False)
```