CIS5200 Yelp Restaurants Big Data Analysis Project Tutorial

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Introduction

- The goal of this project is to take advantage of the Big Data analysis to capture some valuable insights about the restaurant industry from the 2017 Yelp challenge data set.
- Yelp is a social networking site that lets users post reviews and rate businesses.
- Since its inception in 2004, Yelp has collected a staggering 142 million reviews from users for local businesses. They have an average of 145 million unique visitors to their site every month.
- Restaurants is the 2nd largest business category on Yelp and can provide many interesting insights for analysis.

Objectives

The objective of this tutorial is to provide step-by-step instructions for Big Data Analysis of Restaurants in the 2017 Yelp challenge data set. In this tutorial you will learn how to:

- Download and extract the data set from Yelp
- Upload JSON files to HDFS using Ambari
- Install Rcongui SerDe
- Create tables and queries using HiveQL
- Export results and visualize them in Tableau

Step 1: Data Preparation

1) Download data and extract it.
   Data set URL and information about the data set: https://www.yelp.com/dataset
   Download **yelp_dataset.tar.gz** file from https://www.yelp.com/dataset/download to your computer. Please note that in order to download the data set from Yelp a registration is required on the provided link.

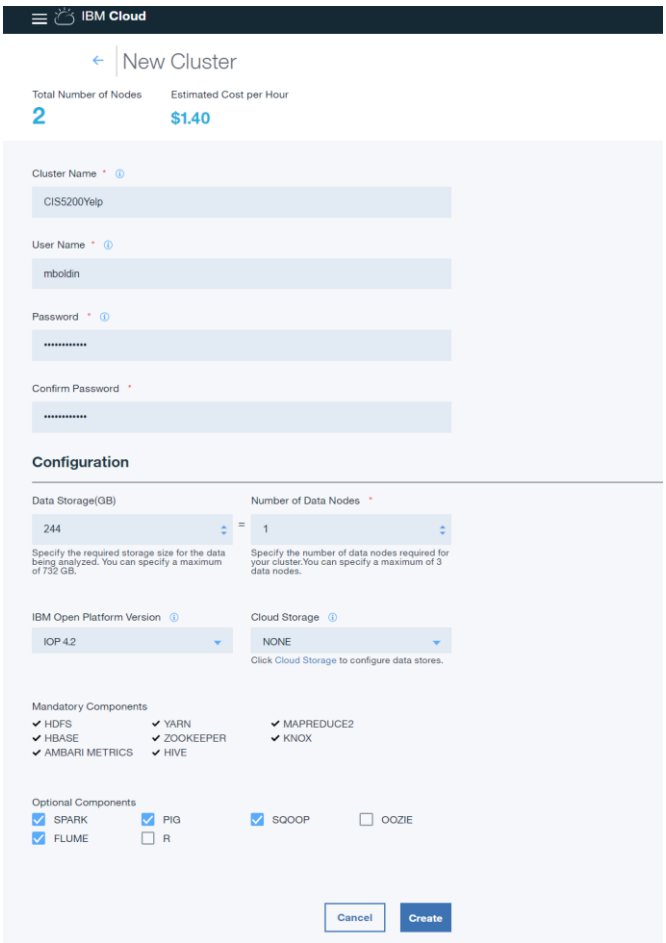
   Data set size:
   1 TAR file - 2.28 GB compressed
   6 JSON files - 5.79 GB uncompressed

The included files are: business, reviews, user, check-in, tip and photos.

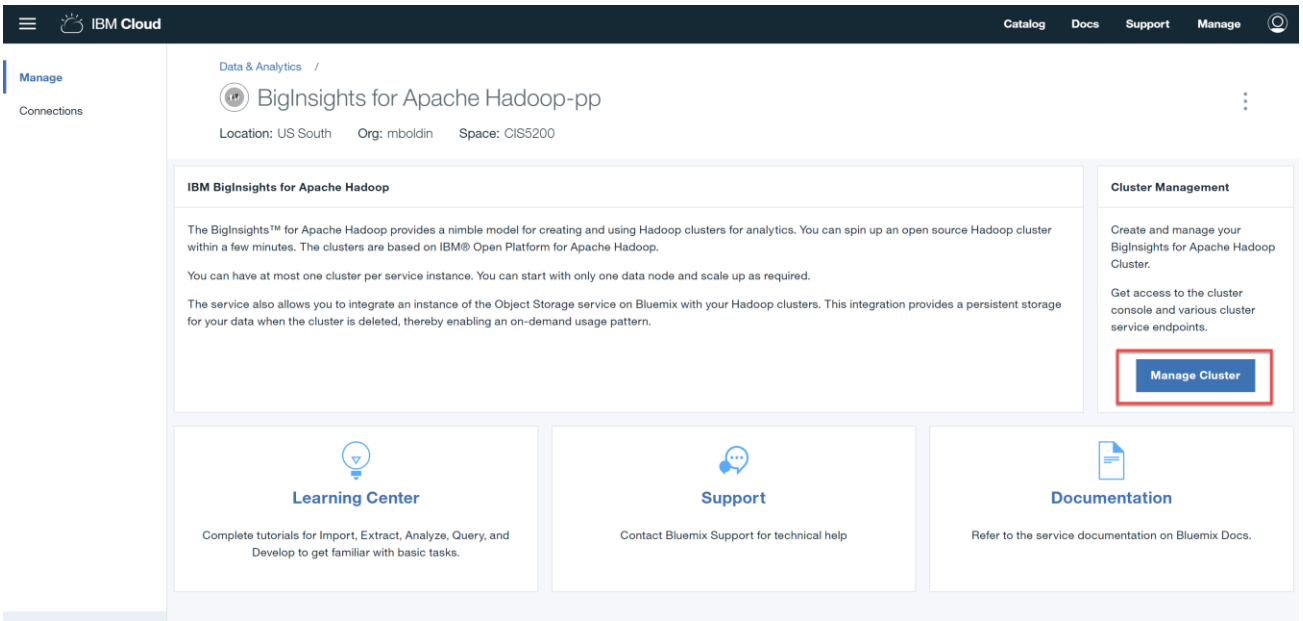
2) Use Winrar or other similar software to untar yelp_dataset.tar.gz file.
3) Since Yelp data set is of high quality it is not necessary to perform any data cleaning.

Step 2: Uploading Data to HDFS For Storage and Analysis

1. Sign into your IBM Bluemix account and select 'BigInsights for Apache Hadoop' under Data & Analytics.
2. Launch IBM BigInsights and click on Create Cluster.
3. Provide the cluster name, user name and password to create a new cluster.



4. Select your cluster from the dashboard and click on "Manage Cluster"



5. Open Putty and connect to your cluster via SSH.
6. From your BigInsight cluster launch Ambari.
7. Create Yelp folder in HDFS. You can use Ambari or HDFS.

```
hdfs dfs -mkdir /user/mboldin/yelp
```

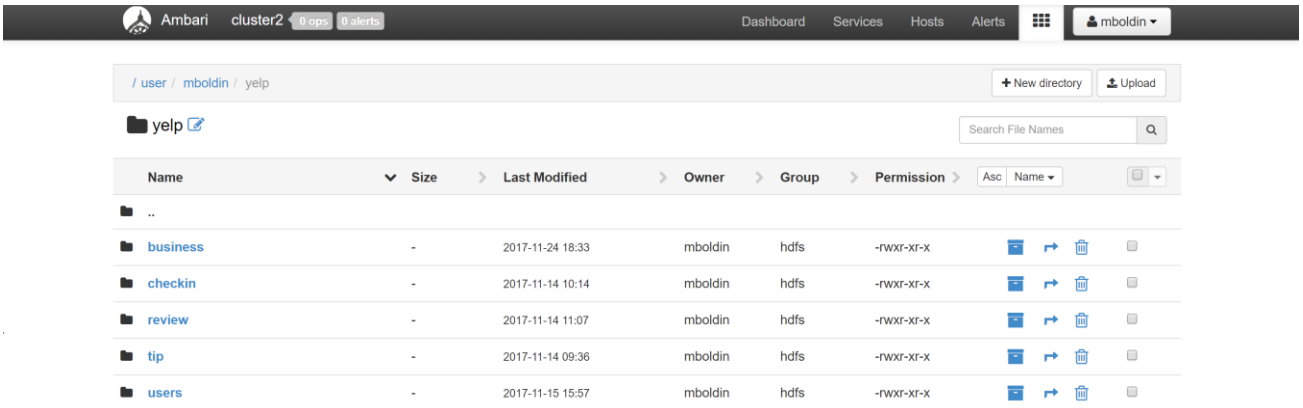
```
$ hdfs dfs -mkdir /user/mboldin/yelp
```

8. Create separate folders inside the Yelp directory for each JSON file:
   business
   review
   users
   tip
   checkin

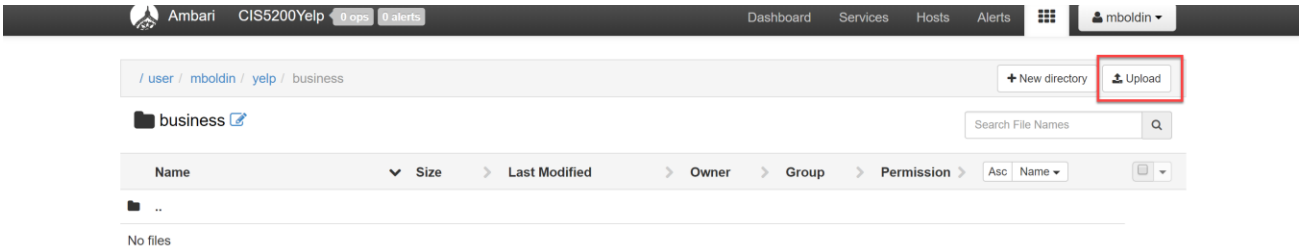
```
hdfs dfs -mkdir /user/mboldin/yelp/business

hdfs dfs -mkdir /user/mboldin/yelp/review

hdfs dfs -mkdir /user/mboldin/yelp/users

hdfs dfs -mkdir /user/mboldin/yelp/tip

hdfs dfs -mkdir /user/mboldin/yelp/checkin
```

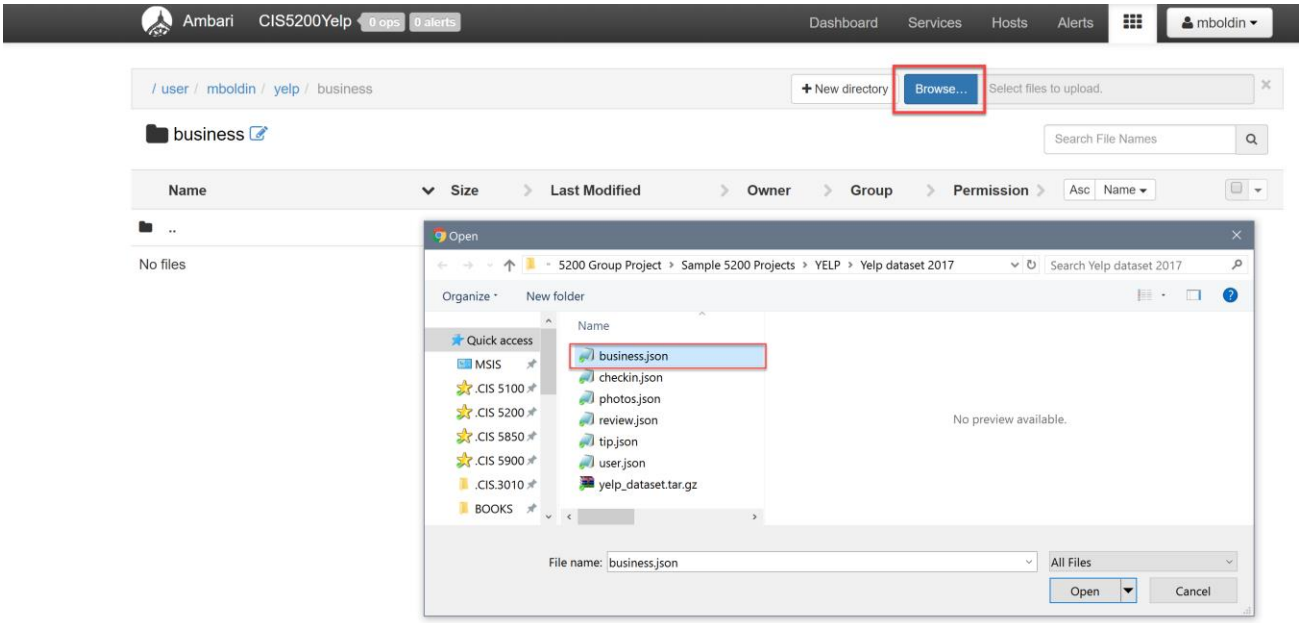
```
-bash-4.1$ hdfs dfs -mkdir /user/mboldin/yelp
-bash-4.1$ hdfs dfs -mkdir /user/mboldin/yelp/business
-bash-4.1$ hdfs dfs -mkdir /user/mboldin/yelp/review
-bash-4.1$ hdfs dfs -mkdir /user/mboldin/yelp/users
-bash-4.1$ hdfs dfs -mkdir /user/mboldin/yelp/tip
-bash-4.1$ hdfs dfs -mkdir /user/mboldin/yelp/checkin
-bash-4.1$
```

The folder structure should look as below:



9. Use upload button in AMBARI to upload each json file to its respective folder in HDFS. For example, create folder folder “business” and upload business.json to the folder. Repeat the same procedure for remaining JSON files.





Step 3: Adding RCONGUI JSON SerDe

RCONGUI JSON SerDe provides support for JSON arrays, maps and nested structures. Since our data set contains a lot of nested attributes, we will use Rcongui JSON SerDe to facilitate reading and writing data stored in JSON format.

1. Download two JAR files from http://www.congiu.net/hive-json-serde/ into your HDFS Cluster

wget -O json-serde-1.3.8-jar-with-dependencies.jar www.congiu.net/hive-json-serde/1.3.8/hdp23/json-serde-1.3.8-jar-with-dependencies.jar

wget -O json-udf-1.3.8-jar-with-dependencies.jar www.congiu.net/hive-json-serde/1.3.8/hdp23/json-udf-1.3.8-jar-with-dependencies.jar

If the files have successfully been uploaded you will see the following confirmation:

```
-bash-4.1$ wget -O json-serde-1.3.8-jar-with-dependencies.jar  www.congiu.net/hiv
e-json-serde/1.3.8/hdp23/json-serde-1.3.8-jar-with-dependencies.jar;
--2017-10-26 01:08:08--  http://www.congiu.net/hive-json-serde/1.3.8/hdp23/json-s
erde-1.3.8-jar-with-dependencies.jar
Resolving www.congiu.net... 64.90.44.101
Connecting to www.congiu.net|64.90.44.101|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 85492 (83K) [application/java-archive]
Saving to: "json-serde-1.3.8-jar-with-dependencies.jar"

100%[=====================================>] 85,492       330K/s   in 0.3s

2017-10-26 01:08:08 (330 KB/s) - "json-serde-1.3.8-jar-with-dependencies.jar" sav
ed [85492/85492]
```

```
-bash-4.1$ wget -O json-udf-1.3.8-jar-with-dependencies.jar www.congiu.net/hive-j
son-serde/1.3.8/hdp23/json-udf-1.3.8-jar-with-dependencies.jar
--2017-10-26 01:10:03--  http://www.congiu.net/hive-json-serde/1.3.8/hdp23/json-u
df-1.3.8-jar-with-dependencies.jar
Resolving www.congiu.net... 64.90.44.101
Connecting to www.congiu.net|64.90.44.101|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 2275 (2.2K) [application/java-archive]
Saving to: "json-udf-1.3.8-jar-with-dependencies.jar"

100%[=====================================>] 2,275       --.-K/s   in 0s

2017-10-26 01:10:03 (495 MB/s) - "json-udf-1.3.8-jar-with-dependencies.jar" saved
 [2275/2275]
```

2. Add the following in Putty at the beginning of each HIVE session:

ADD JAR json-serde-1.3.8-jar-with-dependencies.jar;
ADD JAR json-udf-1.3.8-jar-with-dependencies.jar;

```
hive> ADD JAR json-serde-1.3.8-jar-with-dependencies.jar;
Added [json-serde-1.3.8-jar-with-dependencies.jar] to class path
Added resources: [json-serde-1.3.8-jar-with-dependencies.jar]
hive>
```

You need to do this every HIVE session!!!! Otherwise the following error will be displayed:

```
FAILED: RuntimeException MetaException(message:java.lang.ClassNotFoundException
Class org.openx.data.jsonserde.JsonSerDe not found)
hive>
```

If you get any SerDe error, it is necessary to reenter these again, if you get out of HIVE, then you need to enter again when you start hive

3. Optionally you can enter the following in HIVE to see the query column names displayed

```
set hive.cli.print.header=true;
```

Step 4: Creating Tables in HIVE

The following Hive statements create external tables that allows Hive to query data stored in HDFS. Since we are using JSON Serde it is important to include the following format when creating each table:

ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'

Additionally, if you followed the instructions above and have your JSON data file in the respective folder the following statement will automatically load the data into your tables:

LOCATION '/user/your_username/yelp/folder_name';

Moreover, since the maximum JSON file size that can be uploaded directly to Tableau is 128MB and the files in our data set such as for example review.json and users.json files are 3.5GB and 1.5GB in size respectively, we will use HDFS to create smaller tables and queries and that can be exported to Tableau for visualizations.

I. Create Restaurants Table

Follow the following procedure to create Restaurants table from business.json file:

TABLE 1: Create initial BUSINESS table (with all categories and attributes included)

```
CREATE EXTERNAL TABLE business4 (

address string,

business_id string,

categories array<string>,

city string,

hours struct<friday:string, monday:string, saturday:string, sunday:string, thursday:string,
tuesday:string, wednesday:string>,

is_open int,

latitude double,
```

```
longitude double,
name string,
neighborhood string,
postal_code string,
review_count int,
stars double,
state string,
Attributes struct<
Accepts_Insurance:boolean,
Ages_Allowed:string,
Alcohol:string,
Bike_Parking:boolean,
Business_Accepts_Bitcoin:boolean,
Business_Accepts_Credit_Cards:boolean,
By_Appointment_Only:boolean,
Byob:boolean,
BYOB_Corkage:string,
Caters:boolean,
Coat_Check:boolean,
Corkage:boolean,
Dogs_Allowed:boolean,
Drive_Thru:boolean,
Good_For_Dancing:boolean,
Good_For_Kids:boolean,
Happy_Hour:boolean,
Has_TV:boolean,
Noise_Level:string,
Open24Hours:boolean,
Outdoor_Seating:boolean,
Restaurants_Attire:string,
Restaurants_Counter_Service:boolean,
```

Restaurants_Delivery:boolean,

Restaurants_Good_For_Groups:boolean,

Restaurants_Reservations:boolean,

Restaurants_Table_Service:boolean,

Restaurants_Take_Out:boolean,

Smoking:string,

WheelchairAccessible:boolean,

WiFi:string,

Ambience:struct<

Casual:boolean,

Classy:boolean,

Divey:boolean,

Hipster:boolean,

Intimate:boolean,

Romantic:boolean,

Touristy:boolean,

Trendy:boolean,

Upscale:boolean>,

BestNights:struct<

Friday1:boolean,

Monday1:boolean,

Saturday1:boolean,

Sunday1:boolean,

Thursday1:boolean,

Tuesday1:boolean,

Wednesday1:boolean>,

BusinessParking:struct<

Garage:boolean,

Lot:boolean,

Street:boolean,

Valet:boolean,

Validated:boolean>,

DietaryRestrictions:struct<

Dairy_Free:boolean,

Gluten_Free:boolean,

Halal:boolean,

Kosher:boolean,

Soy_Free:boolean,

Vegan:boolean,

Vegetarian:boolean>,

GoodForMeal:struct<

Breakfast:boolean,

Brunch:boolean,

Dessert:boolean,

Dinner:boolean,

Latenight:boolean,

Lunch:boolean>,

HairSpecializesIn:struct<

Africanamerican:boolean,

Asian:boolean,

Coloring:boolean,

Curly:boolean,

Extensions:boolean,

Kids:boolean,

Perms:boolean,

Straightperms:boolean>,

Music:struct<

BackgroundMusic:boolean,

Dj:boolean,

Jukebox:boolean,

Karaoke:boolean,

Live:boolean,

```
NoMusic:boolean,
Video:boolean>,
restaurantspricerange2:int>)
ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'
STORED AS TEXTFILE
LOCATION '/user/mboldin/yelp/business';
```

To verify that your table was created properly and data was loaded you can test your table as following:

1. Verify total number of businesses in the data set:

```
SELECT count(business_id) FROM business4;
```

```
OK
_c0
156639
Time taken: 43.331 seconds, Fetched: 1 row(s)
hive>
```

2. Take a look at your data

```
SELECT * FROM business4;
```

```
hive> select * from business4 limit 1;
OK
business4.address       business4.business_id   business4.categories    business
4.city  business4.hours business4.is_open       business4.latitude      business
4.longitude     business4.name  business4.neighborhood  business4.postal_code  b
usiness4.review_count   business4.stars business4.state business4.attributes
691 Richmond Rd YDf95gJZaq05wvo7hTQbbQ  ["Shopping","Shopping Centers"] Richmond
 Heights        {"friday":"10:00-21:00","monday":"10:00-21:00","saturday":"10:00
-21:00","sunday":"11:00-18:00","thursday":"10:00-21:00","tuesday":"10:00-21:00",
"wednesday":"10:00-21:00"}      1       41.5417162      -81.4931165     Richmond
 Town Square            44143   17      2.0     OH      {"accepts_insurance":nul
l,"ages_allowed":null,"alcohol":null,"bike_parking":null,"business_accepts_bitco
in":null,"business_accepts_credit_cards":null,"by_appointment_only":null,"byob":
null,"byob_corkage":null,"caters":null,"coat_check":null,"corkage":null,"dogs_al
lowed":null,"drive_thru":null,"good_for_dancing":null,"good_for_kids":null,"happ
y_hour":null,"has_tv":null,"noise_level":null,"open24hours":null,"outdoor_seatin
g":null,"restaurants_attire":null,"restaurants_counter_service":null,"restaurant
s_delivery":null,"restaurants_good_for_groups":null,"restaurants_reservations":n
ull,"restaurants_table_service":null,"restaurants_take_out":null,"smoking":null,
"wheelchairaccessible":true,"wifi":null,"ambience":null,"bestnights":null,"busin
essparking":{"garage":false,"lot":true,"street":false,"valet":false,"validated":
false},"dietaryrestrictions":null,"goodformeal":null,"hairspecializesin":null,"m
usic":null,"restaurantspricerange2":2}
Time taken: 0.227 seconds, Fetched: 1 row(s)
hive>
```

```
DESCRIBE business4;
```

```
hive> describe business4;
OK
col_name        data_type       comment
address                 string                  from deserializer
business_id             string                  from deserializer
categories              array<string>           from deserializer
city                    string                  from deserializer
hours                   struct<friday:string,monday:string,saturday:string,sunda
y:string,thursday:string,tuesday:string,wednesday:string>       from deserialize
r
is_open                 int                     from deserializer
latitude                double                  from deserializer
longitude               double                  from deserializer
name                    string                  from deserializer
neighborhood            string                  from deserializer
postal_code             string                  from deserializer
review_count            int                     from deserializer
stars                   double                  from deserializer
state                   string                  from deserializer
attributes              struct<accepts_insurance:boolean,ages_allowed:string,alc
ohol:string,bike_parking:boolean,business_accepts_bitcoin:boolean,business_accep
ts_credit_cards:boolean,by_appointment_only:boolean,byob:boolean,byob_corkage:st
ring,caters:boolean,coat_check:boolean,corkage:boolean,dogs_allowed:boolean,driv
e_thru:boolean,good_for_dancing:boolean,good_for_kids:boolean,happy_hour:boolean
,has_tv:boolean,noise_level:string,open24hours:boolean,outdoor_seating:boolean,r
estaurants_attire:string,restaurants_counter_service:boolean,restaurants_deliver
y:boolean,restaurants_good_for_groups:boolean,restaurants_reservations:boolean,r
estaurants_table_service:boolean,restaurants_take_out:boolean,smoking:string,whe
elchairaccessible:boolean,wifi:string,ambience:struct<casual:boolean,classy:bool
ean,divey:boolean,hipster:boolean,intimate:boolean,romantic:boolean,touristy:boo
lean,trendy:boolean,upscale:boolean>,bestnights:struct<friday1:boolean,monday1:b
oolean,saturday1:boolean,sunday1:boolean,thursday1:boolean,tuesday1:boolean,wedn
esday1:boolean>,businessparking:struct<garage:boolean,lot:boolean,street:boolean
,valet:boolean,validated:boolean>,dietaryrestrictions:struct<dairy_free:boolean,
gluten_free:boolean,halal:boolean,kosher:boolean,soy_free:boolean,vegan:boolean,
vegetarian:boolean>,goodformeal:struct<breakfast:boolean,brunch:boolean,dessert:
boolean,dinner:boolean,latenight:boolean,lunch:boolean>,hairspecializesin:struct
<africanamerican:boolean,asian:boolean,coloring:boolean,curly:boolean,extensions
:boolean,kids:boolean,perms:boolean,straightperms:boolean>,music:struct<backgrou
ndmusic:boolean,dj:boolean,jukebox:boolean,karaoke:boolean,live:boolean,nomusic:
boolean,video:boolean>,restaurantspricerange2:int>      from deserializer
Time taken: 0.086 seconds, Fetched: 15 row(s)
hive>
```

TABLE 2: Create EXPLODED table with flattened categories

Since our file contains an array of categories we need to flatten those categories in order to be able to query them easily. We use LATERAL VIEW explode function for this purpose as following:

```
CREATE TABLE exploded

ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'

STORED AS TEXTFILE

LOCATION '/user/mboldin/yelp/business/exploded'

AS
```

```
SELECT * FROM business4 LATERAL VIEW explode(categories) c AS cat_exploded;
```

1. To verify that your table was created properly and data was loaded you can test your table as following:

```
SELECT * FROM exploded LIMIT 1;
```

```
hive> select * from exploded limit 1;
OK
exploded.address        exploded.business_id    exploded.categories     exploded
.city   exploded.hours  exploded.is_open        exploded.latitude       exploded
.longitude      exploded.name   exploded.neighborhood   exploded.postal_code   e
xploded.review_count    exploded.stars  exploded.state  exploded.attributes    e
xploded.cat_exploded
691 Richmond Rd YDf95gJZaq05wvo7hTQbbQ  ["Shopping","Shopping Centers"] Richmond
 Heights        {"friday":"10:00-21:00","monday":"10:00-21:00","saturday":"10:00
-21:00","sunday":"11:00-18:00","thursday":"10:00-21:00","tuesday":"10:00-21:00",
"wednesday":"10:00-21:00"}      1       41.5417162      -81.4931165     Richmond
 Town Square            44143   17      2.0     OH      {"accepts_insurance":nul
l,"ages_allowed":null,"alcohol":null,"bike_parking":null,"business_accepts_bitco
in":null,"business_accepts_credit_cards":null,"by_appointment_only":null,"byob":
null,"byob_corkage":null,"caters":null,"coat_check":null,"corkage":null,"dogs_al
lowed":null,"drive_thru":null,"good_for_dancing":null,"good_for_kids":null,"happ
y_hour":null,"has_tv":null,"noise_level":null,"open24hours":null,"outdoor_seatin
g":null,"restaurants_attire":null,"restaurants_counter_service":null,"restaurant
s_delivery":null,"restaurants_good_for_groups":null,"restaurants_reservations":n
ull,"restaurants_table_service":null,"restaurants_take_out":null,"smoking":null,
"wheelchairaccessible":true,"wifi":null,"ambience":null,"bestnights":null,"busin
essparking":{"garage":false,"lot":true,"street":false,"valet":false,"validated":
false},"dietaryrestrictions":null,"goodformeal":null,"hairspecializesin":null,"m
usic":null,"restaurantspricerange2":2}  Shopping
Time taken: 0.362 seconds, Fetched: 1 row(s)
hive>
```

2. Verify that total number of businesses in the data set is the same as before:

```
SELECT count (DISTINCT business_id) number_businesses FROM exploded;
```

```
OK
number_businesses
156261
Time taken: 38.898 seconds, Fetched: 1 row(s)
hive>
```

3. To find the number of restaurants in the dataset:

```
SELECT count (business_id) number_restaurants FROM exploded

WHERE cat_exploded="Restaurants";
```

```
OK
number_restaurants
51613
Time taken: 35.564 seconds, Fetched: 1 row(s)
hive>
```

TABLE 3: Create RESTAURANTS table

This is our final table which contains only restaurants.

```
CREATE TABLE restaurants

ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'

STORED AS TEXTFILE

LOCATION '/user/mboldin/yelp/business/restaurants'

AS

SELECT * FROM exploded WHERE cat_exploded="Restaurants";
```

To verify that your restaurants table was created properly you can test your table as following:

```
SELECT name, review_count, stars, cat_exploded category FROM restaurants LIMIT 5;
```

```
hive> select name, review_count, stars, cat_exploded category from restaurants l
imit 5;
OK
name    review_count    stars   category
South Florida Style Chicken & Ribs      4       4.5     Restaurants
Blimpie 10      4.5     Restaurants
Applebee's      21      2.0     Restaurants
China Garden    3       3.0     Restaurants
Rocky's 15      3.0     Restaurants
Time taken: 0.103 seconds, Fetched: 5 row(s)
hive>
```

NOTE ON USING SerDe FOR QUERING NESTED DATA OBJECTS:

Since as mentioned before, our data set contains multiple nested attributes, you can use the following format to query them.

a) To select nested columns it works as following:

parent.child.grandchild

```
SELECT name, attributes.ambience.romantic FROM restaurants LIMIT 5;
```

```
hive> select name, attributes.ambience.romantic from restaurants limit 5;
OK
name    romantic
South Florida Style Chicken & Ribs      false
Blimpie false
Applebee's      false
China Garden    NULL
Rocky's false
Time taken: 0.102 seconds, Fetched: 5 row(s)
```

b) To query BOOLEAN values from nested objects:

```
SELECT name, state, city, attributes.ambience.romantic romantic FROM restaurants
WHERE attributes.ambience.romantic = true LIMIT 10;
```

```
hive> select name, state, city, attributes.ambience.romantic romantic  from re
aurants where attributes.ambience.romantic == true limit 10;
OK
name    state   city    romantic
Ristorante Beatrice     QC      Montreal        true
Verona Chophouse        AZ      Chandler        true
Bass Lake Taverne Inn   OH      Chardon true
Edulis  ON      Toronto true
Edge Steakhouse NV      Las Vegas       true
Caffe Boa Ahwatukee     AZ      Phoenix true
White Oaks      OH      Westlake        true
Latinada Tapas Restaurant       ON      Toronto true
Chez Chose      QC      Montréal        true
The Keg Steakhouse + Bar        AZ      Chandler        true
Time taken: 8.106 seconds, Fetched: 10 row(s)
```

II. Create Review Table

Table 4: Create Review Table

```
CREATE EXTERNAL TABLE review (
  business_id string,
  cool int,
  review_date string,
  funny int,
  review_id string,
  stars int,
  text string,
  useful int,
  user_id string)
ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'
STORED AS TEXTFILE
LOCATION '/user/mboldin/yelp/review';
```

```
    > CREATE EXTERNAL TABLE review (
    >   business_id string,
    >   cool int,
    >   review_date string,
    >   funny int,
    >   review_id string,
    >   stars int,
    >   text string,
    >   useful int,
    >   user_id string)
    > ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'
    > LOCATION '/user/mboldin/yelp/review';
OK
Time taken: 0.836 seconds
hive>
```

```
SELECT * FROM review LIMIT 1;
```

```
OK
review.business_id      review.cool     review.review_date      review.funny    r
eview.review_id review.stars    review.text     review.useful   review.user_id
uYHaNptLzDLoV_JZ_MuzUA  0       NULL    0       VfBHSwC5Vz_pbFluy07i9Q  5       M
y girlfriend and I stayed here for 3 nights and loved it. The location of this h
otel and very decent price makes this an amazing deal. When you walk out the fro
nt door Scott Monument and Princes street are right in front of you, Edinburgh C
astle and the Royal Mile is a 2 minute walk via a close right around the corner,
 and there are so many hidden gems nearby including Calton Hill and the newly op
ened Arches that made this location incredible.

The hotel itself was also very nice with a reasonably priced bar, very considera
te staff, and small but comfortable rooms with excellent bathrooms and showers.
Only two minor complaints are no telephones in room for room service (not a huge
 deal for us) and no AC in the room, but they have huge windows which can be ful
ly opened. The staff were incredible though, letting us borrow umbrellas for the
 rain, giving us maps and directions, and also when we had lost our only UK adap
ter for charging our phones gave us a very fancy one for free.

I would highly recommend this hotel to friends, and when I return to Edinburgh (
which I most definitely will) I will be staying here without any hesitation.   0
cjpdDjZyprfyDG3RlkVG3w
Time taken: 0.06 seconds, Fetched: 1 row(s)
hive>
```

To verify number of reviews in the data set:

```
SELECT count(*) FROM review;
```

```
OK
_c0
4736897
Time taken: 139.758 seconds, Fetched: 1 row(s)
hive>
```

Table 5: Create Review_Filtered Table

```
CREATE TABLE review_filtered

ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'

STORED AS TEXTFILE
```

```
LOCATION '/user/mboldin/yelp/review_filtered'
AS
SELECT re.business_id, r.stars,  r.user_id
FROM review r JOIN restaurants re
ON r.business_id = re.business_id;
```

To find the number of restaurant reviews:

```
SELECT count(*) FROM review_filtered;
```

```
hive> select count(*) from review_filtered;
OK
_c0
2927731
Time taken: 0.091 seconds, Fetched: 1 row(s)
hive>
```

III. Create Users Table

Table 6: Create Users Table

```
CREATE EXTERNAL TABLE users (
  average_stars double,
  compliment_cool int,
  compliment_cute int,
  compliment_funny int,
  compliment_hot int,
  compliment_list int,
  compliment_more int,
  compliment_note int,
  compliment_photos int,
  compliment_plain int,
  compliment_profile int,
  compliment_writer int,
  cool int,
  elite array<int>,
  fans int,
```

```
  friends array<string>,
  funny int,
  name string,
  review_count int,
  useful int,
  user_id string,
  yelping_since string)
ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'
LOCATION '/user/mboldin/yelp/users';
```

```
hive> CREATE EXTERNAL TABLE users (
    >   average_stars double,
    >   compliment_cool int,
    >   compliment_cute int,
    >   compliment_funny int,
    >   compliment_hot int,
    >   compliment_list int,
    >   compliment_more int,
    >   compliment_note int,
    >   compliment_photos int,
    >   compliment_plain int,
    >   compliment_profile int,
    >   compliment_writer int,
    >   cool int,
    >   elite array<int>,
    >   fans int,
    >   friends array<string>,
    >   funny int,
    >   name string,
    >   review_count int,
    >   useful int,
    >   user_id string,
    >   yelping_since string)
    > ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'
    > LOCATION '/user/mboldin/yelp/user';
OK
Time taken: 0.117 seconds
hive>
```

```
hive> select * from users limit 1;
OK
users.average_stars     users.compliment_cool   users.compliment_cute   users.co
mpliment_funny  users.compliment_hot    users.compliment_list   users.compliment
_more   users.compliment_note   users.compliment_photos users.compliment_plain u
sers.compliment_profile users.compliment_writer users.cool      users.elite    u
sers.fans       users.friends   users.funny     users.name      users.review_cou
nt      users.useful    users.user_id   users.yelping_since
3.8     5174    284     5174    5175    78      299     1435    7829    7397    5
69      1834    16856   [2014,2016,2013,2011,2012,2015,2010,2017]       209     [
"M19NwFwAXKRZzt8koF11hQ","QRcMZ8pJJBBZaKubHOoMDQ","uimsjcHoBnXz1MAKGvB26w","v325
XGF-l9da74ZMWEjyoA","vP5ajc1oGURsNvCXewsnDw","9nSutZOliE9Vg4XVGEx1HA","--2vR0DIs
mQ6WfcSzKWigw","LDJ51sk5SJXovRI2yQZimA","3R_dB9VQ_D3WPJEw7pmorA","8drMKNHWavs2g6
uf0pLtvg","wOGfOjBaP-lCS1NW_En2LQ","AK2-Pvb6E9vgeXWyY4Jxog","DbUSCSMQwD3eiAre0Ue
u8A","B_2qev6exPELs7ZnO4iljg","LQALTuDeCRLwR9NOxUWS5A","kSUU18CH2BRPLK1uUsz1Wg",
"M-HINGCHOnaQkKq8WDtRMA","9lWyDOySHcc6Jiqp2-EPUw","j2Eu9pE22Rp_DRoSp3KgQg","neuz
9oCcHiW4k-jltcC1BA","PRQxRp1IFHPBlbXeDwG3mA","t9vCxltuXJ941V8ppWVsVQ","pYK8JuByl
omxLIwwyv0Iyw","WTLPH3jIWOUTFMpD4o_7Vg","qAE5pJYa75gRbpC7bgI3Ow","7OxFrOWLP04hSC
GY_g3aUw","nRdfX_I0CaOq7lJunJMPpA","W81-CPVrM9c6F8XiNuEUvA","VaVkC537R46xRNpOucR
gvA","j8YxElKHhbg1ghQDSI1v3Q","sYLXiL6q8eiB-D4e3LfWaw","6ueSDFjnsnr-ypVR15WTRg",
"Mi1VEqRHfJ75ESxPuAV9MQ","itz3iIH8qPpm0RowHZ63cA","Wc5L6iuvSNF5WGBlqIO8nw","zb_8
3ib91kA6jBislfTSoQ","Pt1yV4SQUR_4LYmkynCGww","Nh_o4LibitBckghR1_8CBQ","vGr0B5weD
DNNmx0zQaQVhw","BujvYvqpupySiAD9ykhXqg","dOFyIGbyfB69VB4pnoKqQA","PSflctuopnjaIW
m-P_o7YQ","zGeG-yb2IDKAGeWSZW2Y1Q","nU5-DpWwid61hHtksA2DMQ","KOS4YIWIxYobnym0sn1
esQ","qNrHLZPurBWJzeAMkFLvvA","5YjvvIgBf-65In3AKXnNjw","Izm94TyF60xP4mPDg9oEBw",
"3ePYVkxiMxBBanReYIZuUw","fGQwLxFbo7RGnNoSDnI4Cw","5rDW0VrYEc9-XyuAU4aMHw","vTug
BdYg34rX4KvGpzBrNA","ebYpHPQWSKoxlzCPJFsFjA","a9x2BusJ-E7aG14LYQw3xw","r3XlOUy7F
UpX22Mi-Eo29Q","IXdmrbRu0veA-OuaP0URwQ","fCiXeYNwrwpM2MGilA1ViQ","_pBzBgtCTN9PNU
PfgPDI8A","hZKVx71GlTvg5AaWemQWIQ","4RKq0POQ5jpToRkiiUvJLg","tuIofXv7QuW0GFm-osF
aZA","L-5NjRMaE5KClXYJk8HVcA","o9XzWtzTuV2X9fyYevXmkw","qtUUQNbKlXy02Dr2TPrtZg",
"29XxHvrJAyvuRaPXu_h-QA","mlXIzLHZ2RAw3MMzpBsFlA","-gQm-IoK2_BMEMx9OgtQnw","qU7C
t1nJjLTtXc_J6YgsTA","s81VRLqYFEpXPIQtGx2mnw","418F_vnEiJMlU-sKpGttHA","RNChXr9iN
cYPP0G6zN4gYA","Cg7HLuddh8s6yKpq4SFpVg","zqXNpAw8zMcuNNPsRXxZ9Q","KB5ooQeFAivMFb
BavgH_kg","8U8b1EkLQ66djWVcNYyoRQ","n5wlyjHGoe8JTIJmDoGL9Q","u8WIVYVQxiAFJWLdjJN
kIQ","QuPACjm9M7dMqXbXrE9UWQ","YwaKGmRNnSa3R3N4Hf9jLw","P5wzujlAD8qz-SqpwcUaCQ",
"brqm9p7FMfolAqJgElqGHw","a-Ug_MFryz3utca-NaMkNQ","-UekDWg_Wy4FvxU8l38DIQ","PgKC
Yy3NYMSEIR2IZ1NQRw","OE7LvvZiQgLmNacHJNg-KA","yKNf3fxNiXnZr67FDTLQgw","7OvtYnfsc
IWBahX6hL2xkQ","bQ3BLXeuDtSdSyGNnLo9mA","pPCzUWTqoiAWUF3MyOXDvQ","xgI4uIQiCmM1yO
oJnHtzeA","WRTKHSPSum0sg6HDYM5prw","ajCBUlkRk7sdNqwIgvPh3Q","n6hHjOuv8NAWubj0U7L
FLA","eWLJMa7m_pHRdg1VANIK_Q","DONwuwg9iySZ7LFjtcHdCA","CLmvJN5a3l9KutC-nF6LzA",
"tufuEc5f9TWR05_yko46QQ","_ijx1PqANQVFLGNWCibdig","0bwmSWsi5WZfcDu61ZMGhg","IB0_
DRx-L8O1MtzwPF-lQw","6DC0wklyCCirKpglOOCyow","TwPlaNvnziaN2wB3lk_9Mw","NRRz3KbCS
```

To find the number of all users in dataset:

```
SELECT count(distinct user_id) FROM users;
```

```
OK
c0
1183362
Time taken: 68.755 seconds, Fetched: 1 row(s)
hive>
```

Table 7: Create Elite Users Table

This table allows us to separate elite users only

```
CREATE TABLE elite_users
ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'
STORED AS TEXTFILE
LOCATION '/user/mboldin/yelp/users/elite'
AS
SELECT * FROM users LATERAL VIEW explode(elite) c AS elite_year;
```

IV. Create Tip Table

Table 8: Create Tip Table

```
CREATE EXTERNAL TABLE tip (
text string,
date_tip string,
likes int,
business_id string,
user_id string)
ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'
STORED AS TEXTFILE
LOCATION '/user/mboldin/yelp/tip';
```

```
hive> CREATE EXTERNAL TABLE tip (
    > text string,
    > date_tip string,
    > likes int,
    > business_id string,
    > user_id string)
    > ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'
    > STORED AS TEXTFILE
    > LOCATION '/user/mboldin/yelp/tip';
OK
Time taken: 10.297 seconds
hive>
```

Step 4: Create tables and queries using HiveQL and visualize in Tableau

We can save the results of HIVE queries in HDFS in form of JSON files. Tableau works really well with the nested JSON files, making it easy to visualize the results of analysis.

To create visualizations in Tableau we have 2 options:

- If JSON file size is less than 128MB we can upload it directly to Tableau
- Otherwise, we can export just the results of the Hive query in form of JSON files to Tableau for visualization.

1) **Map of restaurants across United States**

```
SELECT state, count (business_id) number_restaurants
FROM restaurants
GROUP BY state
ORDER BY number_restaurants DESC LIMIT 20;
```

```
OK
state   number_restaurants
ON      12634
AZ      10219
NV      6883
QC      4567
OH      4513
NC      3625
PA      3435
BW      1759
WI      1486
EDH     1396
IL      598
SC      201
MLN     92
HLD     60
FIF     27
C       23
ELN     19
WLN     18
NYK     12
NY      11
Time taken: 51.587 seconds, Fetched: 20 row(s)
```

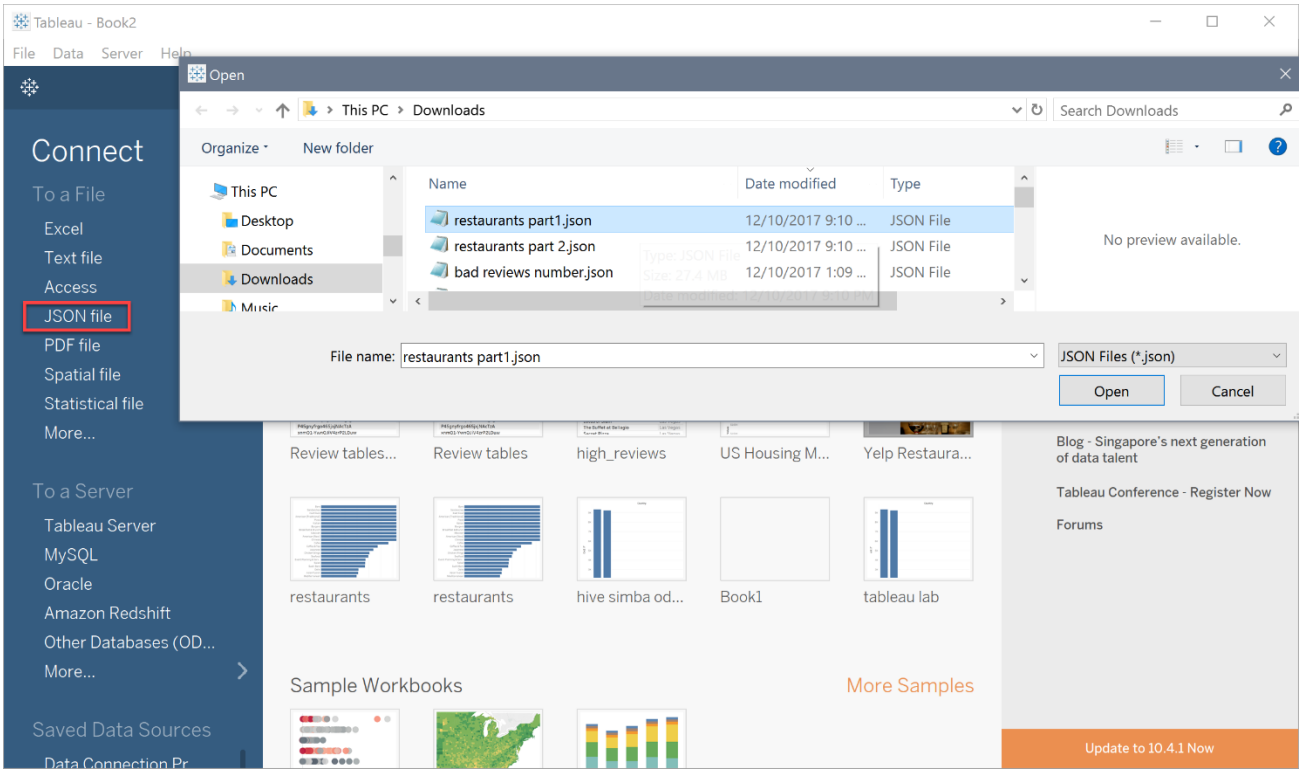
In order to visualize the results of queries in Tableau you should do the following:

a. Open Ambari. Download restaurants table to your computer by downloading two files 000000_0 and 000001_0 which are located in the business/restaurants folder in HDFS.

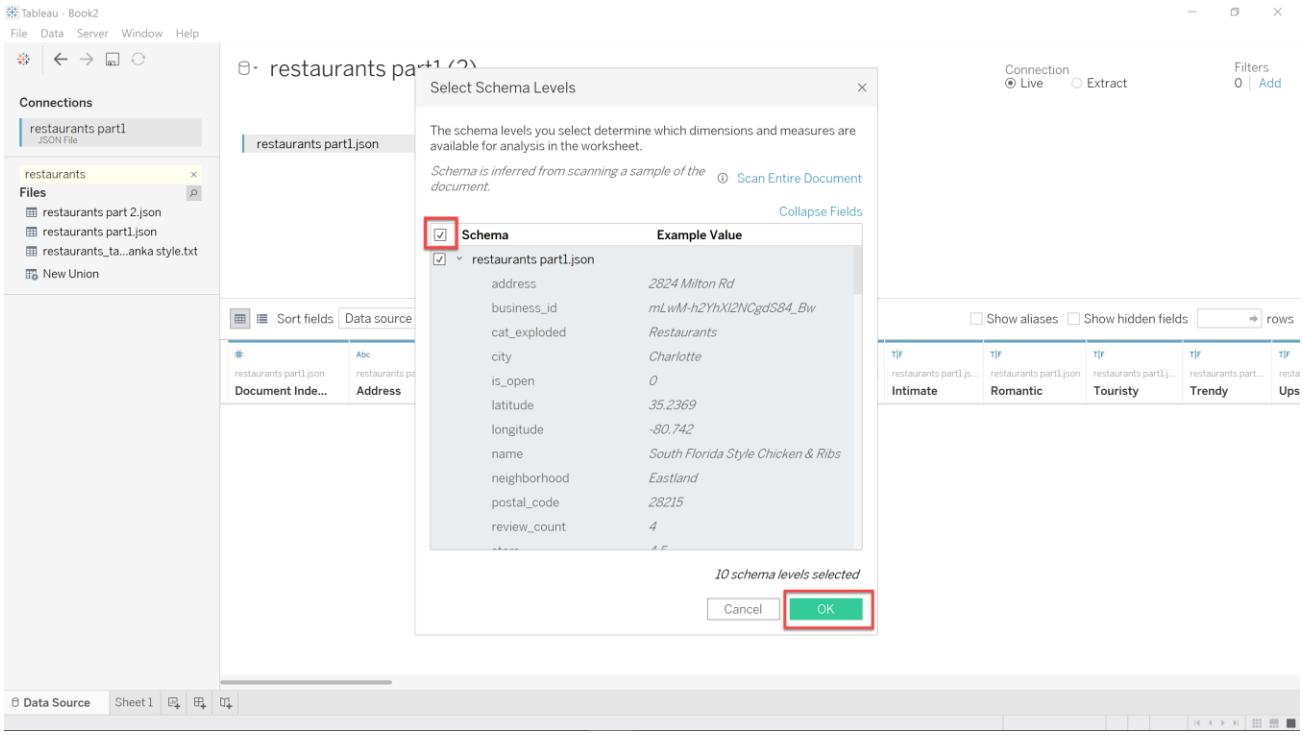
b. Click on the file, a pop-up preview window will open, then click on Download file. Repeat for the second file.

c. For ease of use, you can rename the files as restaurants part1.json and restaurants part2.json

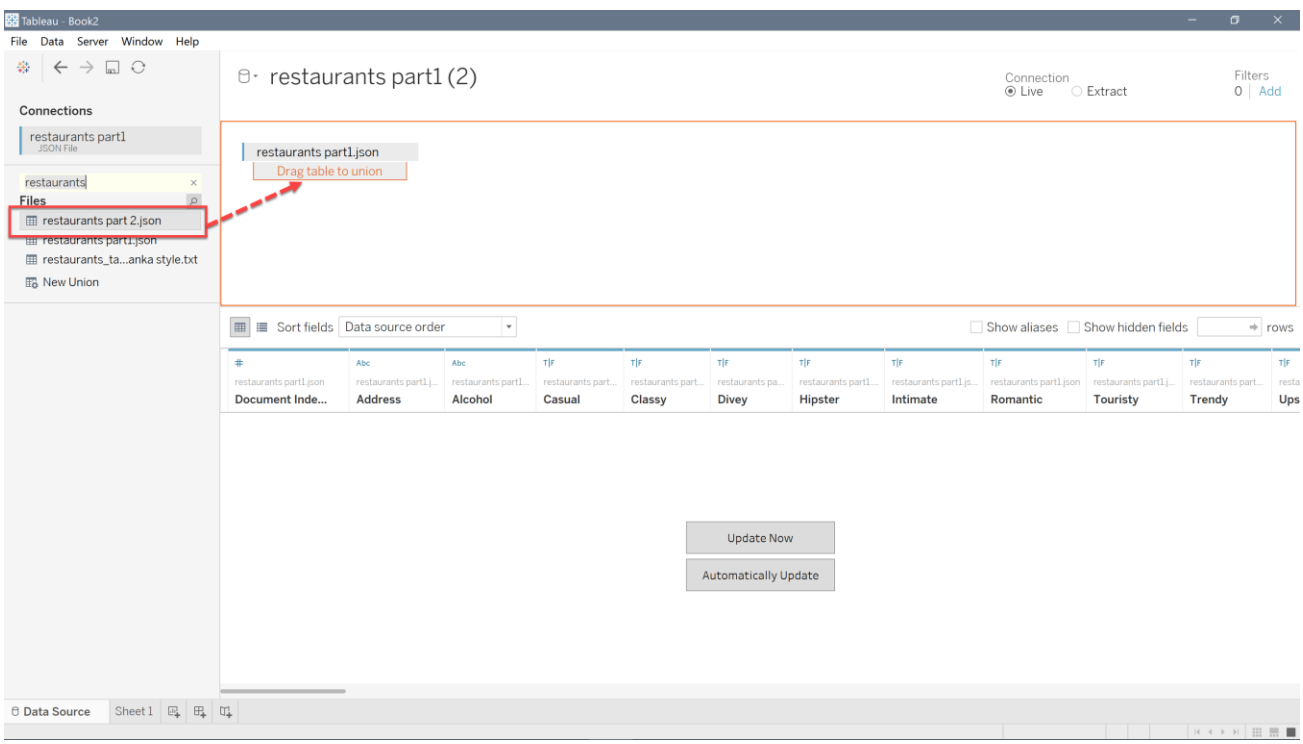
d. Open Tableau and connect JSON file as following:



e. Open the first file and select the Schema check mark as shown below.



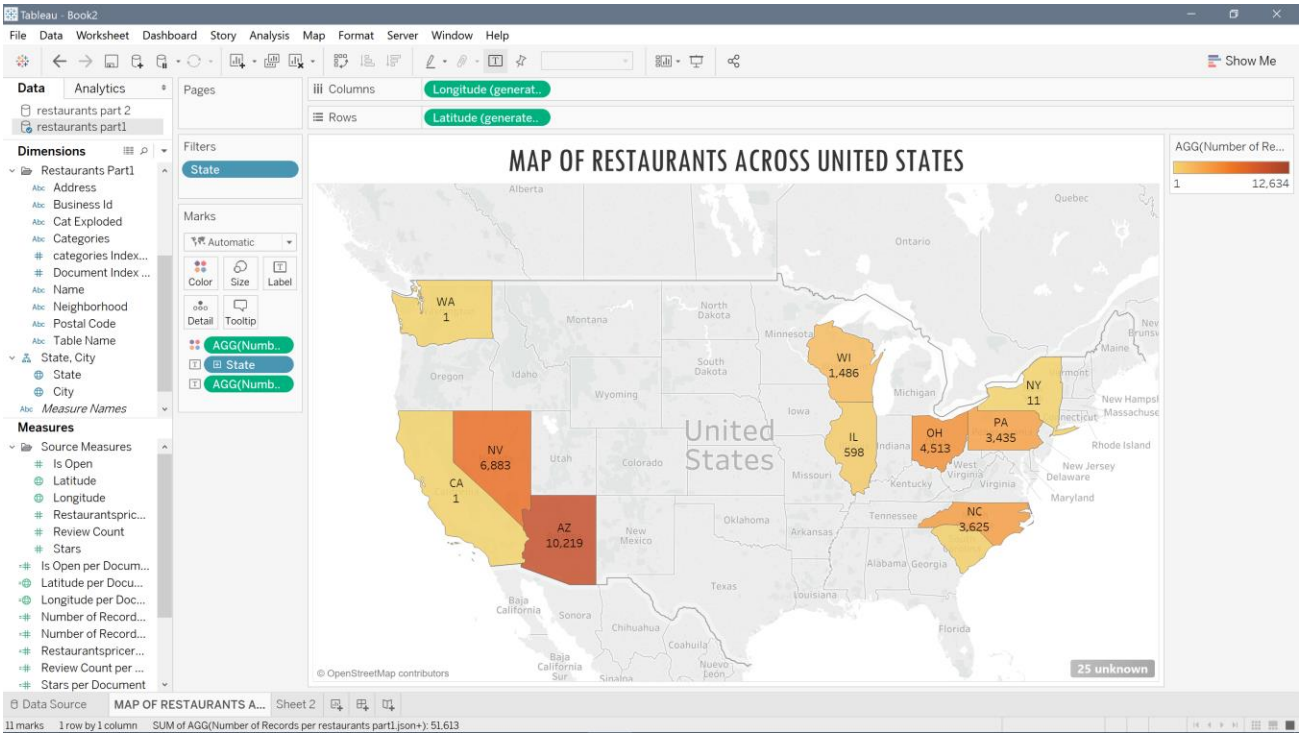
f. Since we have 2 files, we need to join them in Tableau as following:



g. To create the map visualization follow these instructions.

Click on Sheet 1, drag longtitude to columns, latitude to rows, number of records to color on Marks, number of records to label on Marks, state to label on Marks.

Click on color on the marks to adjust the colors to your choice. Click on title to change the title of the visualization. Your tableau worksheet should look like the image below:

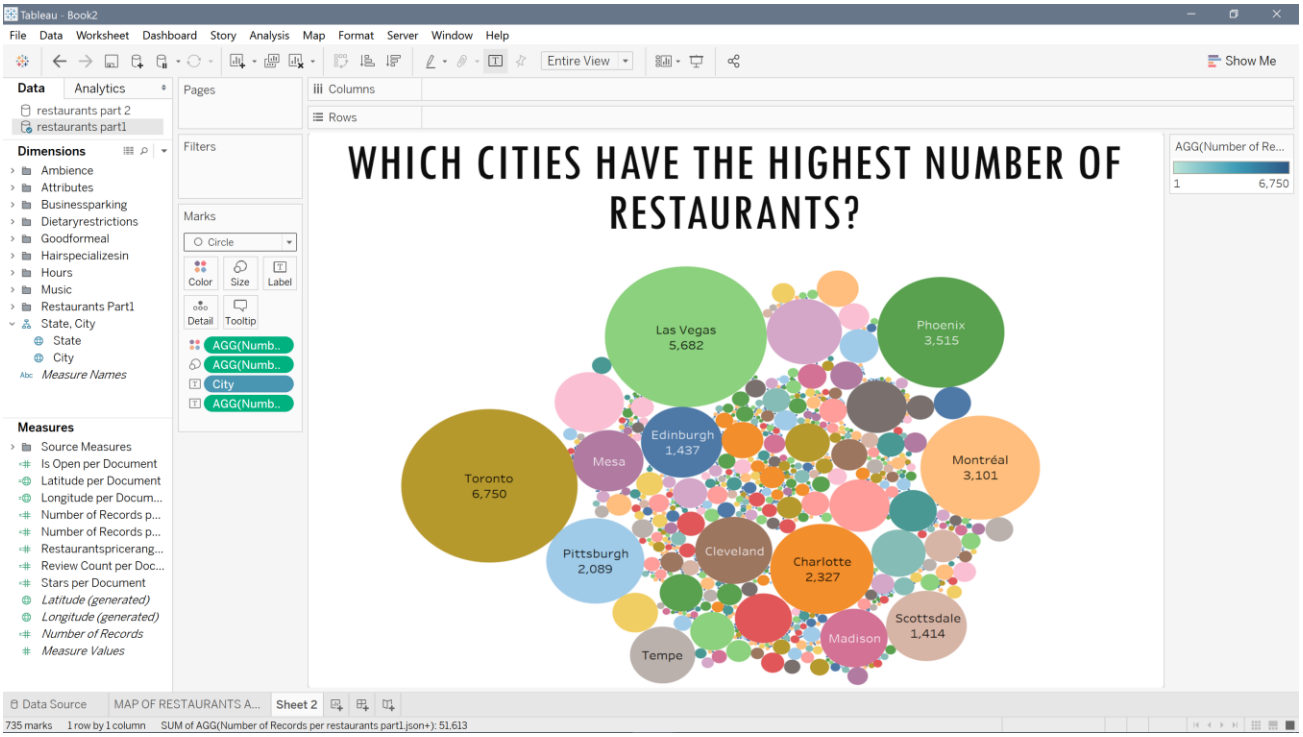


h. You can follow procedures described above to produce the rest of the visualizations in this tutorial.

2) **Which Cities Have The Highest Number Of Restaurants?**

```
SELECT city, count(business_id) number_city
FROM restaurants
GROUP BY city
ORDER BY number_city DESC LIMIT 20;
```

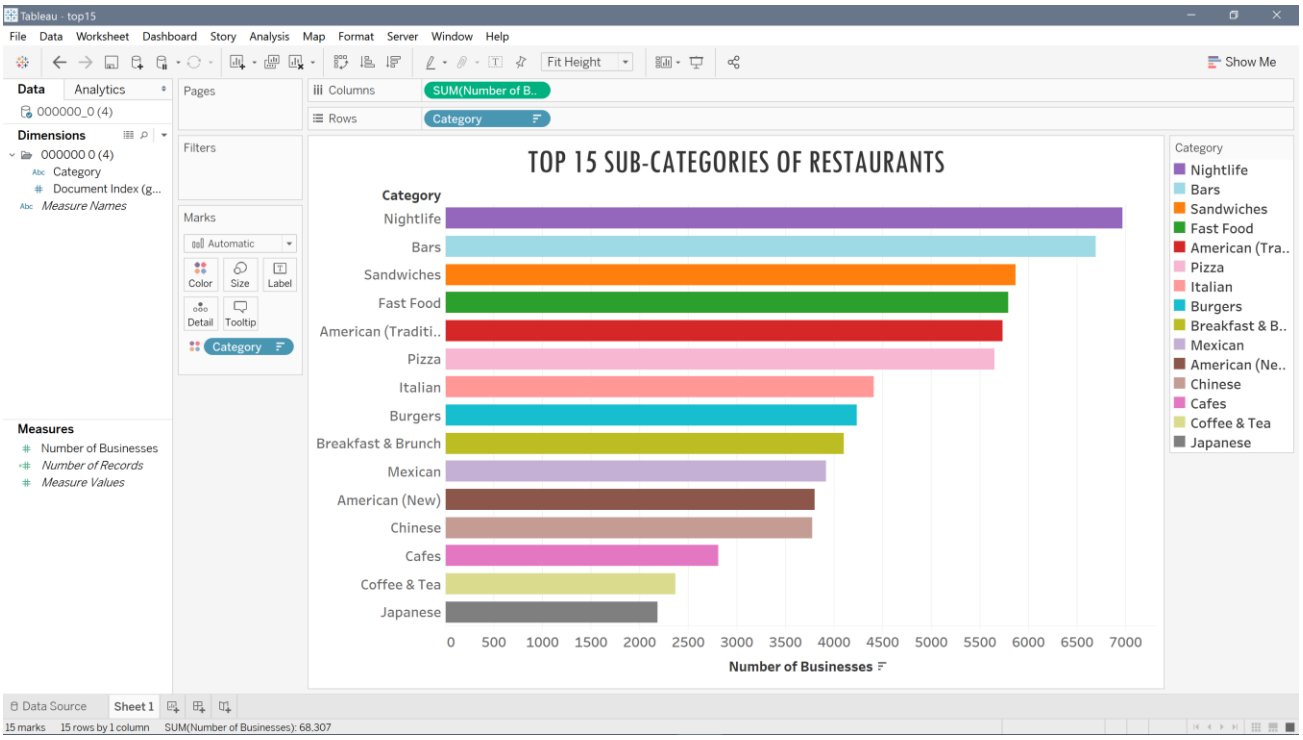
```
OK
city    number_city
Toronto 6750
Las Vegas       5682
Phoenix 3515
Montréal        3101
Charlotte       2327
Pittsburgh      2089
Edinburgh       1437
Scottsdale      1414
Cleveland       1292
Mississauga     1228
Mesa    1077
Stuttgart       1038
Madison 986
Tempe   926
Henderson       792
Chandler        789
Markham 708
```



3) **Top 15 Sub-Categories Of Restaurants**

```
CREATE TABLE top15
ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'
STORED AS TEXTFILE
LOCATION '/user/mboldin/yelp/business/top15'
AS
SELECT e.cat_exploded category, count(e.cat_exploded) number
FROM exploded e JOIN restaurants re
ON e.business_id = re.business_id
WHERE e.cat_exploded not in ("Restaurants","Food")
GROUP BY e.cat_exploded
ORDER BY number DESC LIMIT 15;
```

```
OK
e.cat_exploded  cate
Nightlife       6969
Bars    6690
Sandwiches      5864
Fast Food       5792
American (Traditional)  5737
Pizza   5652
Italian 4411
Burgers 4236
Breakfast & Brunch      4103
Mexican 3913
American (New)  3802
Chinese 3775
Cafes   2812
Coffee & Tea    2365
Japanese        2186
Time taken: 124.096 seconds, Fetched: 15 row(s)
hive>
```

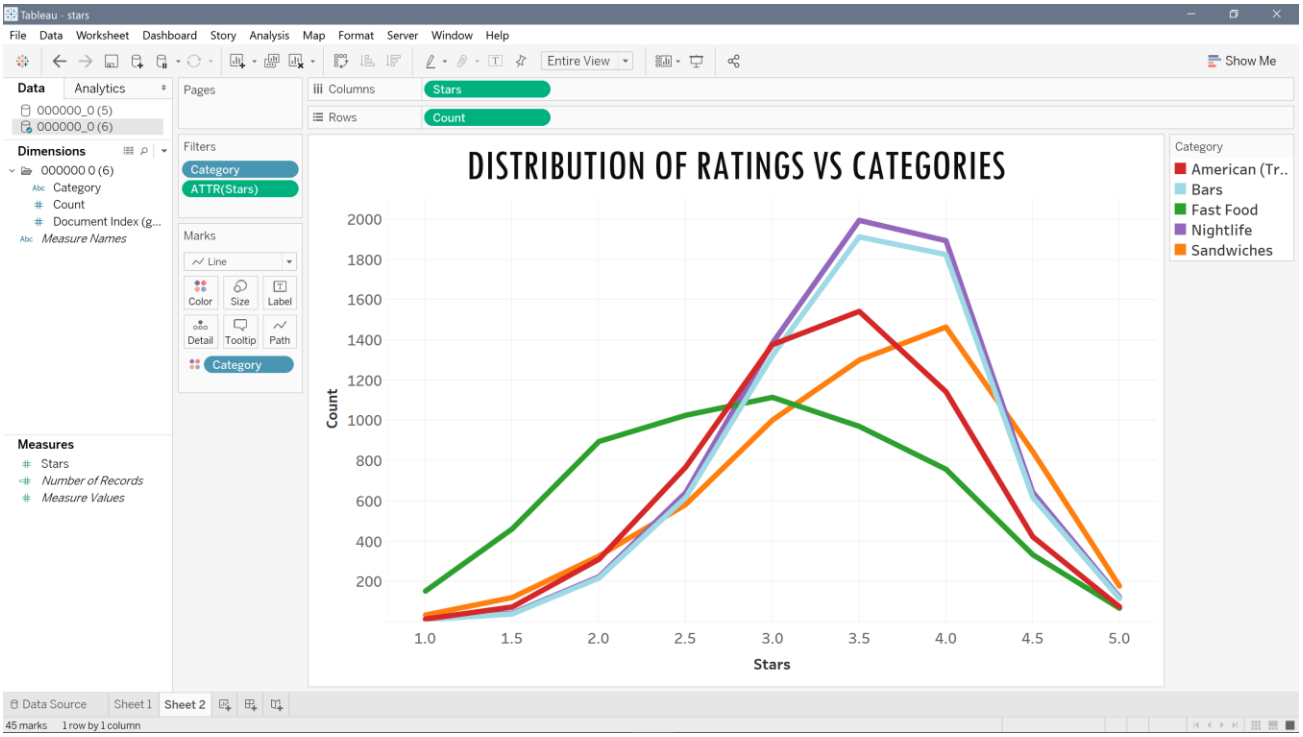


4) **Distribution of ratings vs categories**

```
CREATE TABLE ratings
ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'
STORED AS TEXTFILE
LOCATION '/user/mboldin/yelp/business/ratings'
AS
```

```
SELECT e.cat_exploded category, e.stars stars, count(e.cat_exploded) number

FROM exploded e JOIN restaurants re

ON e.business_id = re.business_id

WHERE e.cat_exploded in ("Nightlife","Bars", "Sandwiches", "Fast Food","American (Traditional)")

GROUP BY e.cat_exploded, e.stars

ORDER BY stars ASC;
```

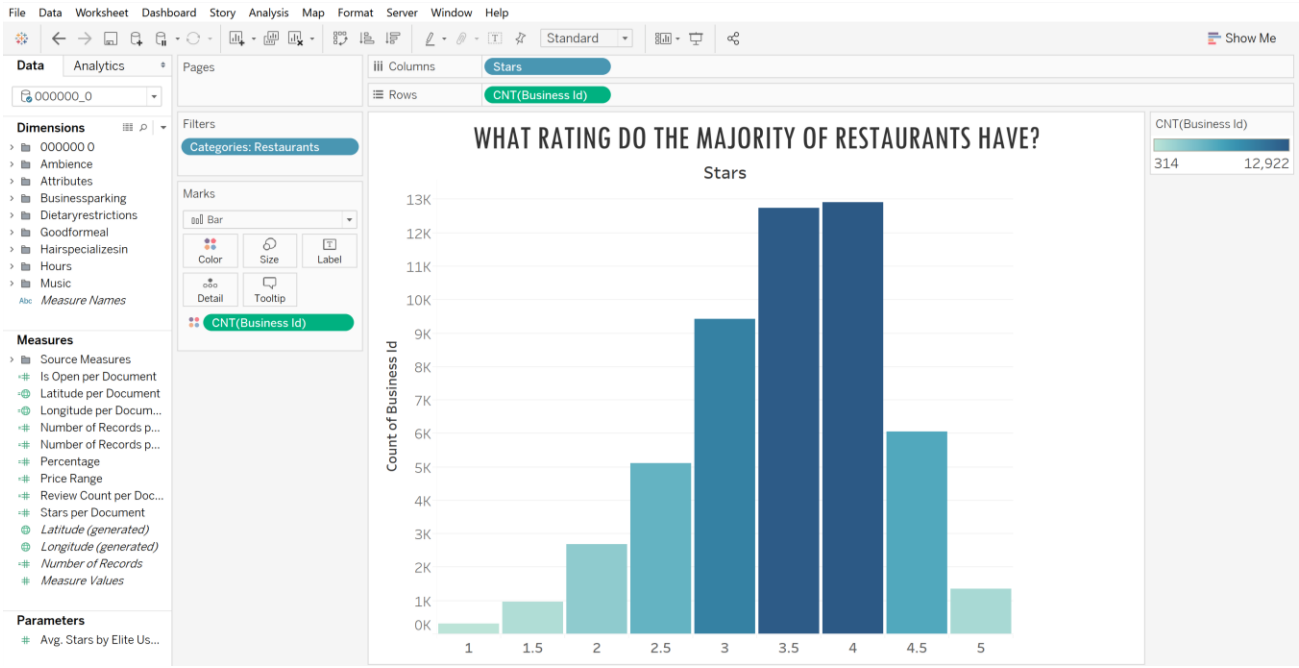
```
OK
category        stars   number
Bars    1.0     13
Sandwiches      1.0     35
American (Traditional)  1.0     15
Nightlife       1.0     13
Fast Food       1.0     154
Fast Food       1.5     463
American (Traditional)  1.5     75
Sandwiches      1.5     122
Bars    1.5     40
Nightlife       1.5     44
Bars    2.0     219
American (Traditional)  2.0     312
Nightlife       2.0     225
Fast Food       2.0     897
Sandwiches      2.0     328
Fast Food       2.5     1027
Bars    2.5     619
Nightlife       2.5     643
American (Traditional)  2.5     770
Sandwiches      2.5     584
Fast Food       3.0     1116
Sandwiches      3.0     1003
Nightlife       3.0     1386
Bars    3.0     1324
American (Traditional)  3.0     1378
Sandwiches      3.5     1301
American (Traditional)  3.5     1543
Bars    3.5     1913
Nightlife       3.5     1995
Fast Food       3.5     972
Fast Food       4.0     759
Bars    4.0     1825
American (Traditional)  4.0     1144
Sandwiches      4.0     1465
Nightlife       4.0     1894
Fast Food       4.5     335
Bars    4.5     620
Sandwiches      4.5     847
Nightlife       4.5     645
American (Traditional)  4.5     424
Sandwiches      5.0     179
American (Traditional)  5.0     76
Bars    5.0     117
Fast Food       5.0     69
Nightlife       5.0     124
```



5) **What ratings do the majority of restaurants have?**

```
SELECT stars, count (business_id) number_restaurants
FROM restaurants
GROUP BY stars;
```

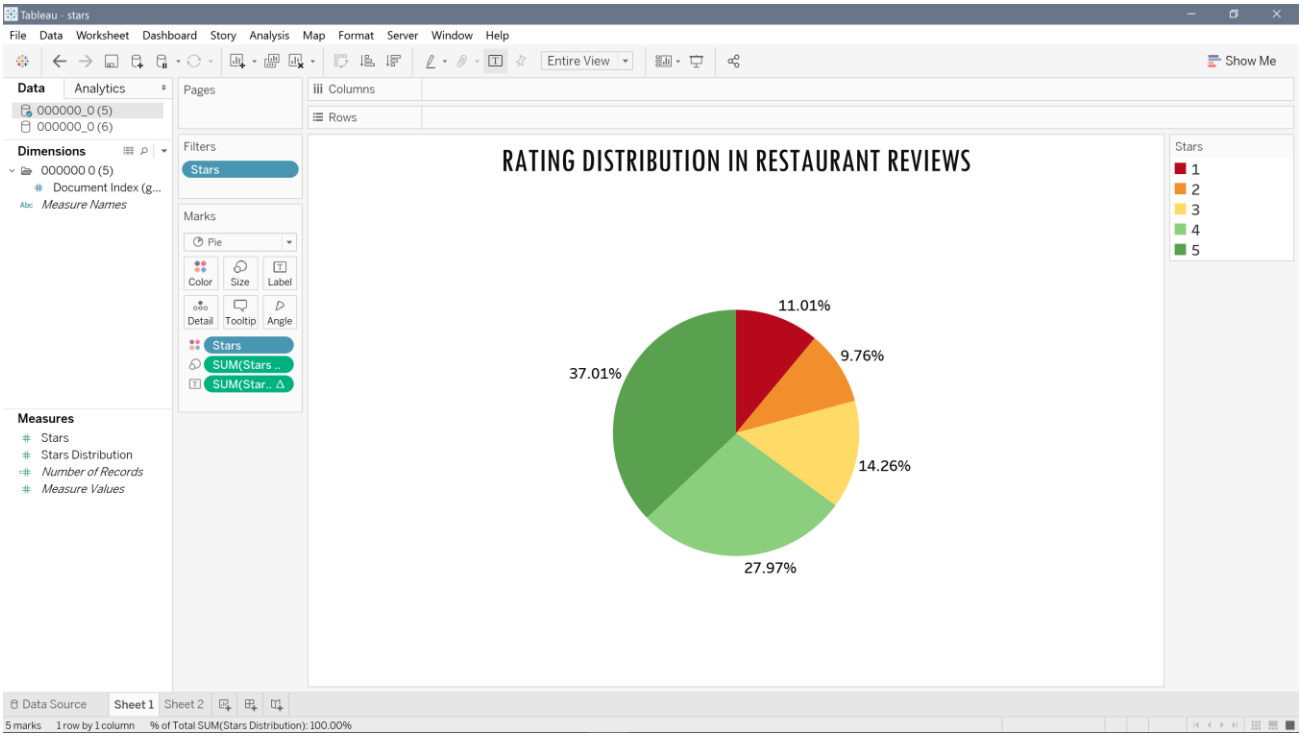
```
OK
stars    number_restaurants
1.0      314
1.5      969
2.0      2689
2.5      5108
3.0      9434
3.5      12747
4.0      12922
4.5      6064
5.0      1366
Time taken: 29.637 seconds, Fetched: 9 row(s)
hive>
```



6) **Rating distribution in restaurant reviews**

```
CREATE TABLE stars
ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'
STORED AS TEXTFILE
LOCATION '/user/mboldin/yelp/review/stars'
AS
SELECT stars, round(count(stars) * 100.0 / sum(count(stars)) over(),2) stars_distribution
FROM review_filtered
GROUP BY stars;
```

```
OK
stars   stars_distribution
5       37.01
4       27.97
3       14.26
2       9.76
1       11.01
Time taken: 57.602 seconds, Fetched: 5 row(s)
hive>
```



7) **Which restaurants get bad vs good reviews?**

Good reviews

```
CREATE TABLE good_reviews1
ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'
STORED AS TEXTFILE
LOCATION '/user/mboldin/yelp/business/good_reviews1'
AS
SELECT e.cat_exploded category, count(e.cat_exploded) good_reviews_number
FROM exploded e JOIN restaurants re
ON e.business_id = re.business_id
WHERE e.cat_exploded NOT IN ("Restaurants","Food") and re.stars>=4
GROUP BY e.cat_exploded
ORDER BY good_reviews_number DESC LIMIT 10;
```

```
OK
category        good_reviews_number
Nightlife       2663
Bars    2562
Sandwiches      2491
Pizza   2036
Italian 1898
Breakfast & Brunch      1826
Cafes   1664
American (Traditional)  1644
American (New)  1573
Mexican 1430
Time taken: 126.43 seconds, Fetched: 10 row(s)
hive>
```

Bad reviews

```
CREATE TABLE bad_reviews1

ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'

STORED AS TEXTFILE

LOCATION '/user/mboldin/yelp/business/bad_reviews1'

AS

SELECT e.cat_exploded category, count(e.cat_exploded) bad_reviews_number

FROM exploded e JOIN restaurants re

ON e.business_id = re.business_id

WHERE e.cat_exploded NOT IN ("Restaurants","Food") and re.stars<=2

GROUP BY e.cat_exploded

ORDER BY bad_reviews_number DESC LIMIT 10;
```

```
OK
category        bad_reviews_number
Fast Food       1514
Burgers 864
Pizza   600
Sandwiches      485
Chicken Wings   446
American (Traditional)  402
Nightlife       282
Italian 282
Bars    272
Mexican 267
Time taken: 121.578 seconds, Fetched: 10 row(s)
hive>
```

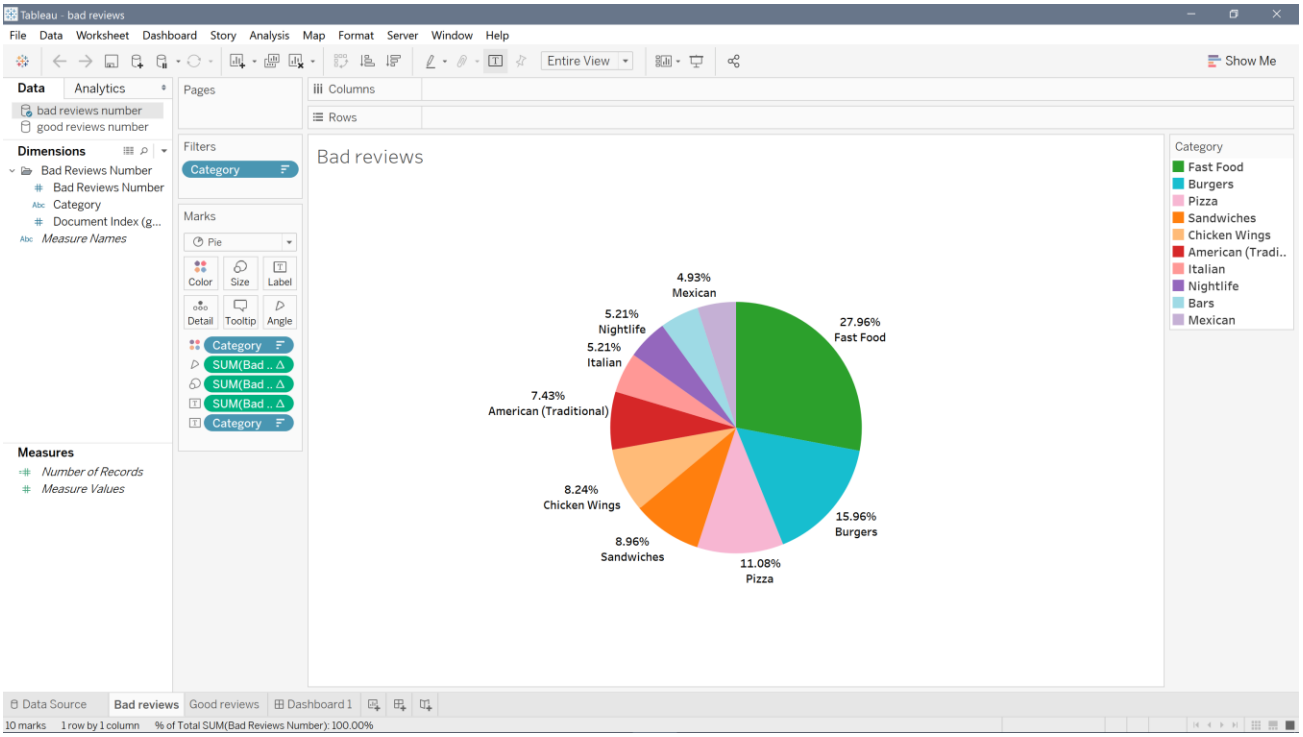


Tableau - bad reviews
File Data Worksheet Dashboard Story Analysis Map Format Server Window Help
Entire View
Show Me
Data
Analytics
bad reviews number
good reviews number
Dimensions
Bad Reviews Number
Bad Reviews Number
Category
Document Index (g...
Measure Names
Measures
Number of Records
Measure Values
Pages
Filters
Category
Marks
Pie
Color
Size
Label
Detail
Tooltip
Angle
Category
SUM(Bad .. Δ
SUM(Bad .. Δ
SUM(Bad .. Δ
Category
Columns
Rows
Bad reviews
4.93%
Mexican
27.96%
Fast Food
5.21%
Nightlife
5.21%
Italian
7.43%
American (Traditional)
8.24%
Chicken Wings
8.96%
Sandwiches
11.08%
Pizza
15.96%
Burgers
Category
Fast Food
Burgers
Pizza
Sandwiches
Chicken Wings
American (Tradi..
Italian
Nightlife
Bars
Mexican
Data Source
Bad reviews
Good reviews
Dashboard 1
10 marks
1 row by 1 column
% of Total SUM(Bad Reviews Number): 100.00%

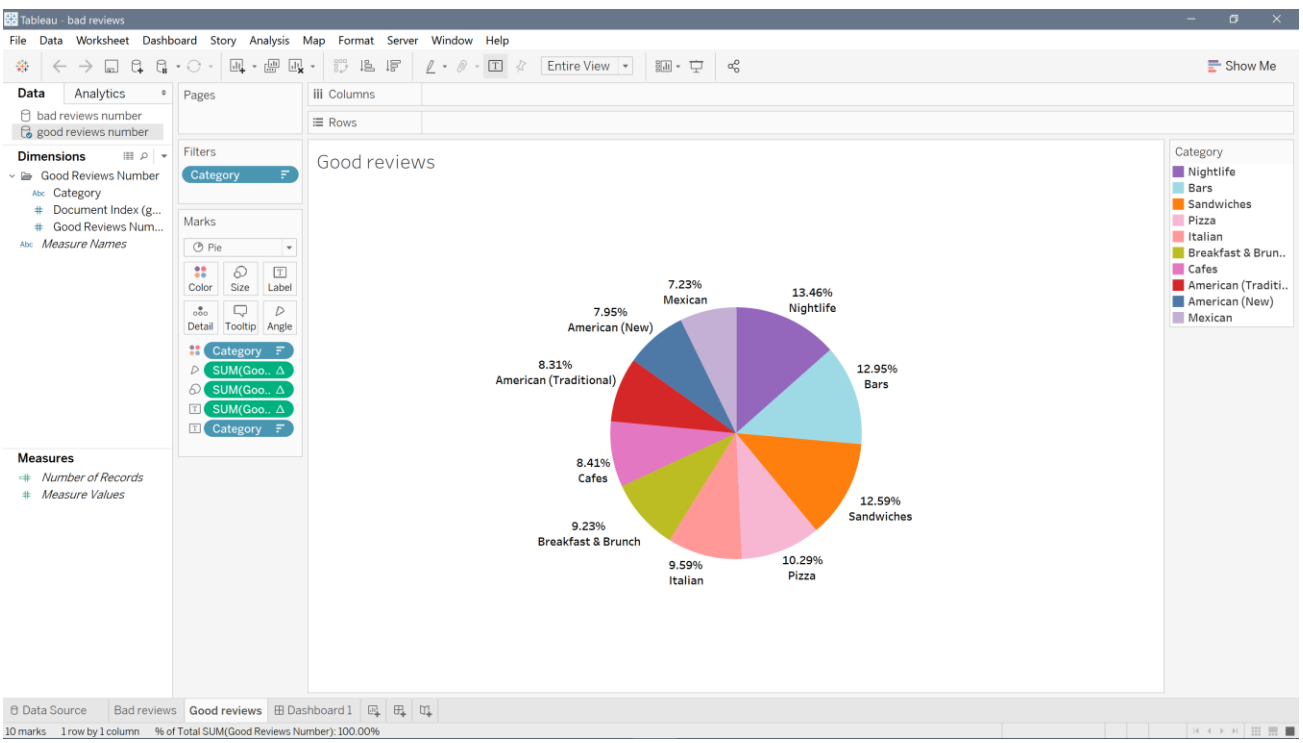
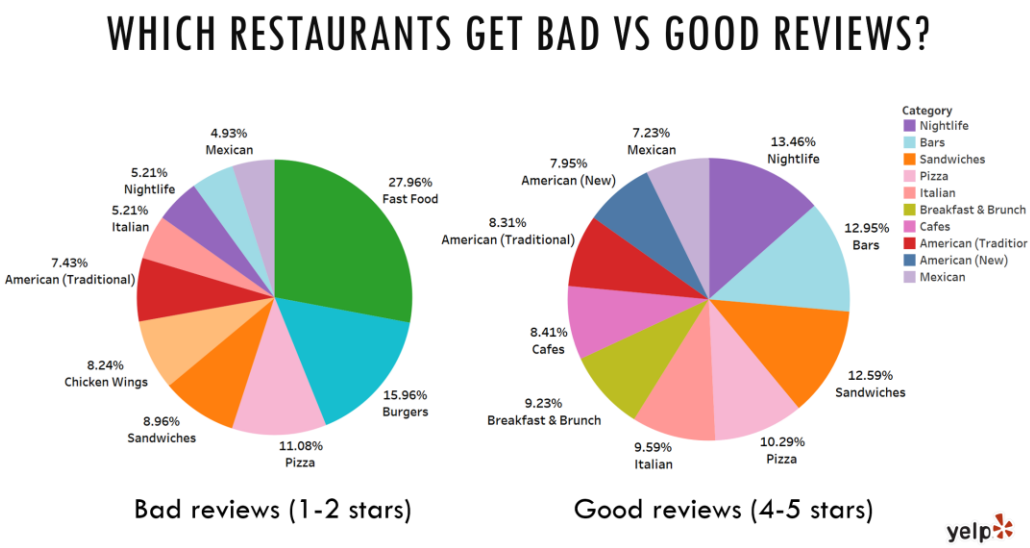


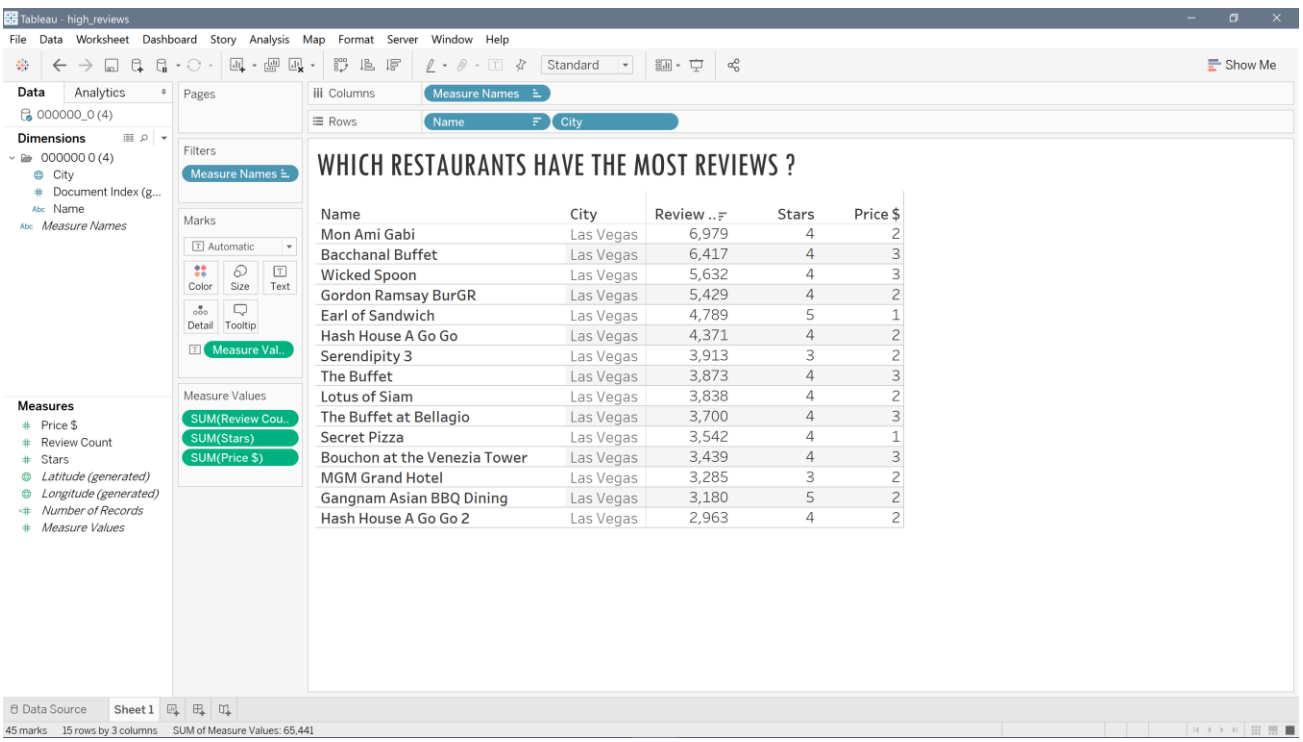
Tableau - bad reviews
File Data Worksheet Dashboard Story Analysis Map Format Server Window Help
Entire View
Show Me
Data
Analytics
bad reviews number
good reviews number
Dimensions
Good Reviews Number
Category
Document Index (g...
Good Reviews Num...
Measure Names
Measures
Number of Records
Measure Values
Pages
Filters
Category
Marks
Pie
Color
Size
Label
Detail
Tooltip
Angle
Category
SUM(Goo.. Δ
SUM(Goo.. Δ
SUM(Goo.. Δ
Category
Columns
Rows
Good reviews
7.23%
Mexican
13.46%
Nightlife
7.95%
American (New)
8.31%
American (Traditional)
12.95%
Bars
8.41%
Cafes
12.59%
Sandwiches
9.23%
Breakfast & Brunch
9.59%
Italian
10.29%
Pizza
Category
Nightlife
Bars
Sandwiches
Pizza
Italian
Breakfast & Brun..
Cafes
American (Traditi..
American (New)
Mexican
Data Source
Bad reviews
Good reviews
Dashboard 1
10 marks
1 row by 1 column
% of Total SUM(Good Reviews Number): 100.00%



8) **Which restaurants have the most reviews?**

```
CREATE TABLE high_reviews
ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'
STORED AS TEXTFILE
LOCATION '/user/mboldin/yelp/business/high_reviews'
AS
SELECT name, city, review_count, stars, attributes.restaurantspricerange2
FROM restaurants
WHERE review_count >= 1000
ORDER BY review_count
DESC LIMIT 15;
```

```
OK
name     city     review_count     stars    restaurantspricerange2
Mon Ami Gabi     Las Vegas        6979     4.0      2
Bacchanal Buffet         Las Vegas        6417     4.0      3
Wicked Spoon     Las Vegas        5632     3.5      3
Gordon Ramsay BurGR      Las Vegas        5429     4.0      2
Earl of Sandwich         Las Vegas        4789     4.5      1
Hash House A Go Go       Las Vegas        4371     4.0      2
Serendipity 3    Las Vegas        3913     3.0      2
The Buffet       Las Vegas        3873     3.5      3
Lotus of Siam    Las Vegas        3838     4.0      2
The Buffet at Bellagio  Las Vegas        3700     3.5      3
Secret Pizza     Las Vegas        3542     4.0      1
Bouchon at the Venezia Tower     Las Vegas        3439     4.0      3
MGM Grand Hotel Las Vegas        3285     3.0      2
Gangnam Asian BBQ Dining         Las Vegas        3180     4.5      2
Hash House A Go Go       Las Vegas        2963     4.0      2
Time taken: 29.245 seconds, Fetched: 15 row(s)
hive>
```



9) **What number of yelp users are elite?**
Do they rate differently than non-elite users?

<u>Average rating by all users</u>

```
SELECT round(avg(average_stars),2)

FROM users;
```

```
OK
_c0
3.71
Time taken: 63.016 seconds, Fetched: 1 row(s)
hive>
```

Average rating by elite users

```
SELECT round(avg(average_stars),2) avg_rating_elite
FROM elite_users;
```

```
OK
avg_rating_elite
3.81
Time taken: 57.563 seconds, Fetched: 1 row(s)
hive>
```

Count number of elite users by year:

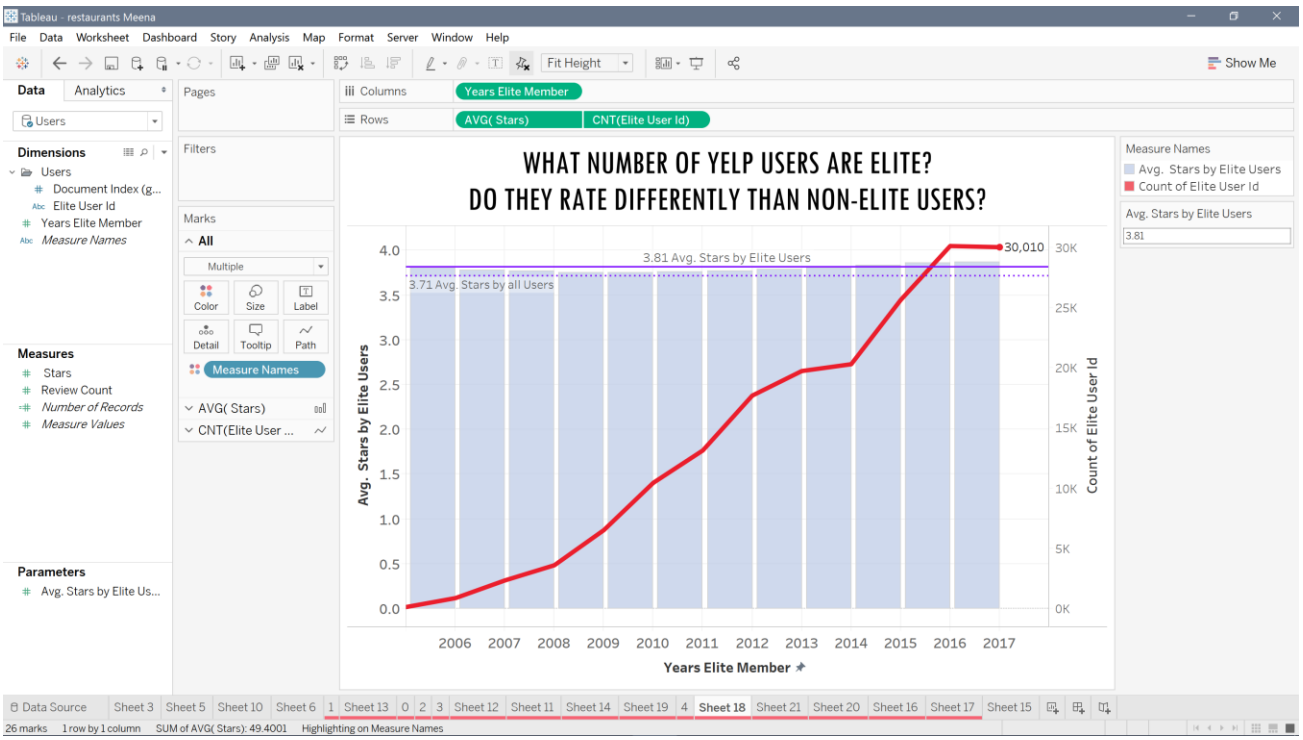
```
SELECT elite_year year, count(distinct user_id) elite_users
FROM elite_users
GROUP BY elite_year
ORDER BY elite_year ASC;
```

```
OK
year    elite_users
2005    140
2006    883
2007    2352
2008    3611
2009    6528
2010    10455
2011    13138
2012    17691
2013    19729
2014    20295
2015    25627
2016    30104
2017    30010
Time taken: 112.211 seconds, Fetched: 13 row(s)
hive>
```

Count average reviews by elite users by year

```
SELECT elite_year year, round(avg(average_stars),2) avg_rating
FROM elite_users
GROUP BY elite_year
ORDER BY elite_year ASC;
```

```
OK
year     _c1
2005     3.87
2006     3.81
2007     3.78
2008     3.76
2009     3.75
2010     3.75
2011     3.76
2012     3.77
2013     3.78
2014     3.8
2015     3.83
2016     3.86
2017     3.87
Time taken: 103.544 seconds, Fetched: 13 row(s)
hive>
```



REFERENCES

- Data set URL https://www.yelp.com/dataset
- Serde source https://github.com/rcongiu/Hive-JSON-Serde
- IBM Bluemix: https://console.bluemix.net/data/bic/
- Tableau https://www.tableau.com
- JSON with Tableau https://onlinehelp.tableau.com/current/pro/desktop/en-us/examples_json.html