In [332…
```
#We are using the Boston AirBNB open data set from data.world available at:
#    https://data.world/jerrys/boston-airbnb-open-data/workspace/file?filename=reviews.c
```

In [333…
```
#pandas provides DataFrame that is used to write data from and to files.
#it is also used to manipulate, filter and merge large datasets
import pandas as pd

#used for creating visualisations. it is used for basic plots and statistical plots
import matplotlib.pyplot as plt

#nltk comes with powerful text processing such as cleaning, stemmng, tokenization, etc
import nltk
from nltk.sentiment.vader import SentimentIntensityAnalyzer

# the vader lexicon is typically used for text which has both negative and positive emot
#used to quantify how much of a positive or negative emotion the text has and also the i

nltk.download('vader_lexicon')
```

```
[nltk_data] Downloading package vader_lexicon to
[nltk_data]     /Users/fizzausman/nltk_data...
[nltk_data]   Package vader_lexicon is already up-to-date!
```

Out[333]:
```
True
```

IMPORTING DATA AND CLEANING TEXT

In [334…
```
df = pd.read_csv('/Users/fizzausman/Desktop/reviewsdoc.csv')
```

In [335…
```
#since data is too big, we will be working with only first 300 rows
df.head(300).to_csv('/Users/fizzausman/Desktop/reviewsdoc2.csv')
df = pd.read_csv('/Users/fizzausman/Desktop/reviewsdoc2.csv')
```

In [336…
```
# over here there is adding of row_id field to the dataframe, which will be useful for j
#row_id column is made by incrementing the in-built index field.
#This row_id field serves as the unique key for this dataset to uniquely identify a row
df["row_id"] = df.index + 1
```

In [337…
```
#print the first 10 rows
print(df.head(10))
```

```
   Unnamed: 0  listing_id       id        date  reviewer_id reviewer_name  \
0           0     1178162  4724140  2013-05-21      4298113       Olivier
1           1     1178162  4869189  2013-05-29      6452964     Charlotte
2           2     1178162  5003196  2013-06-06      6449554     Sebastian
3           3     1178162  5150351  2013-06-15      2215611        Marine
4           4     1178162  5171140  2013-06-16      6848427        Andrew
5           5     1178162  5198929  2013-06-17      6663826         Arndt
6           6     1178162  6702817  2013-08-21      8099222       Maurice
7           7     1178162  6873023  2013-08-28      7671888        Elodie
8           8     1178162  7646702  2013-09-28      8197342     Arkadiusz
9           9     1178162  8094418  2013-10-15      9040491       Matthew

                                            comments  row_id
0  My stay at islam's place was really cool! Good...       1
1  Great location for both airport and city - gre...       2
2  We really enjoyed our stay at Islams house. Fr...       3
3  The room was nice and clean and so were the co...       4
4  Great location. Just 5 mins walk from the Airp...       5
5  A truely exeptional place to stay. The hosts a...       6
```

```
6  It was a really nice time in Boston - best pla...       7
7  Islam is a very nice guy ! Attentive, funny, h...       8
8  The place is really well furnished, pleasant a...       9
9  Our stay at Islam's place was fantastic. We co...      10
```

In [338…
```
#take row_id and comments and place them into a new dataframe
#this is the input required by the SentimentIntensityAnalyzer class

df_subset = df[['row_id','comments']].copy()
```

In [339…
```
df_subset
```

Out[339]:

	row_id	comments
0	1	My stay at islam's place was really cool! Good...
1	2	Great location for both airport and city - gre...
2	3	We really enjoyed our stay at Islams house. Fr...
3	4	The room was nice and clean and so were the co...
4	5	Great location. Just 5 mins walk from the Airp...
...	...	...
295	296	The apartment was as advertised. It was clean ...
296	297	Nice place in a lovely neighborhood. Dror and ...
297	298	We liked the apartment but not the three fligh...
298	299	Appartamento molto bello nel cuore del North E...
299	300	The location is great, with very nice Italian ...

300 rows × 2 columns

In [340…
```
#removing all the non-alphabets
df_subset['comments'] = df_subset['comments'].str.replace("[^a-zA-Z#]", " ")
```

```
/var/folders/h3/mpj_h6hd1x1_sbmvhjc1v7jw0000gn/T/ipykernel_34986/4217497895.py:2: FutureWarning: The default value of regex will change from True to False in a future version.
  df_subset['comments'] = df_subset['comments'].str.replace("[^a-zA-Z#]", " ")
```

In [341…
```
df_subset
```

Out[341]:

	row_id	comments
0	1	My stay at islam s place was really cool Good...
1	2	Great location for both airport and city gre...
2	3	We really enjoyed our stay at Islams house Fr...
3	4	The room was nice and clean and so were the co...
4	5	Great location Just mins walk from the Airp...
...	...	...
295	296	The apartment was as advertised It was clean ...
296	297	Nice place in a lovely neighborhood Dror and ...
297	298	We liked the apartment but not the three fligh...
298	299	Appartamento molto bello nel cuore del North E...
299	300	The location is great with very nice Italian ...

300 rows × 2 columns

In [342…
```
#convert to lower case
#The casefold() method returns a string where all the characters are lower case.
df_subset['comments']= df_subset['comments'].str.casefold()
```

In [343…
```
df_subset['comments'] = df_subset['comments'].apply(lambda comments: str(comments))
```

In [344…
```
print(df_subset.head(10))
```

```
   row_id                                           comments
0       1  my stay at islam s place was really cool  good...
1       2  great location for both airport and city   gre...
2       3  we really enjoyed our stay at islams house  fr...
3       4  the room was nice and clean and so were the co...
4       5  great location  just   mins walk from the airp...
5       6  a truely exeptional place to stay  the hosts a...
6       7  it was a really nice time in boston   best pla...
7       8  islam is a very nice guy   attentive  funny  h...
8       9  the place is really well furnished  pleasant a...
9      10  our stay at islam s place was fantastic  we co...
```

Generate sentiment polarity scores

In [345…
```
# polarity scores :-1 -0.9 -0.8 -0.7 -0.6 -0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5

# polarity score between -1 to -0.5 --> negative sentiment
# polarity score between -0.5 and +0.5 --> neutral sentiment
# polarity score between +0.5 and 1 --> positive sentiment

# creating an empty df to stage the output of SentimentIntensityAnalyzer.polarity_scores
#polarity_scores is a method which gives the following categories : positive, negative,
df1=pd.DataFrame()
```

In [346…
```
df1['row_id']=['99999999999']
```

In [347…
```
df1['sentiment_type']='NA999NA'
```

In [348…
```
df1['sentiment_score']=0
```

In [349…
```
print(df1.head(1))
```

```
        row_id sentiment_type  sentiment_score
0  99999999999        NA999NA                0
```

In [350…
```
# 1st for loop : iterate polarity_scores method over each row of df_subset
# 2nd for loop : within the 1st for loop, used to assign sentiment polarity to each sent

#at the end of the for loop, clean the output df by removing dummy data and removing dup
# we only keep rows for compound sentiment type because it gives accurate total polarity

print('Sentiment analysis is in Motion...')

sid = SentimentIntensityAnalyzer()
t_df = df1
for index, row in df_subset.iterrows():
    scores = sid.polarity_scores(row[1])
    for key, value in scores.items():
        temp = [key,value,row[0]]
        df1['row_id']=row[0]
```

```
        df1['sentiment_type']=key
        df1['sentiment_score']=value
        t_df = pd.concat([t_df,df1])

#remove dummy row with row_id = 99999999999
t_df_cleaned = t_df[t_df.row_id != '99999999999']
#remove duplicates if any exist
t_df_cleaned = t_df_cleaned.drop_duplicates()
# only keep rows where sentiment_type = compound
t_df_cleaned = t_df[t_df.sentiment_type == 'compound']
print(t_df_cleaned.head(25))
```

```
Sentiment analysis is in Motion...
   row_id sentiment_type  sentiment_score
0       1       compound           0.9390
0       2       compound           0.9061
0       3       compound           0.9650
0       4       compound           0.9267
0       5       compound           0.8658
0       6       compound           0.8221
0       7       compound           0.9923
0       8       compound           0.9269
0       9       compound           0.9758
0      10       compound           0.9705
0      11       compound           0.9807
0      12       compound           0.9657
0      13       compound          -0.2960
0      14       compound           0.8834
0      15       compound           0.9169
0      16       compound           0.7876
0      17       compound           0.9410
0      18       compound           0.7845
0      19       compound           0.8649
0      20       compound           0.9825
0      21       compound           0.1531
0      22       compound           0.8519
0      23       compound           0.9588
0      24       compound           0.7783
0      25       compound          -0.8338
```

Merge t_df_cleaned with input dataframe df

In [351…

```
#simple inner join on row_id
# resulting table should have listing_id, id, date, reviewer_id, reviewer_name, comments

df_output = pd.merge(df, t_df_cleaned, on='row_id', how='inner')
print(df_output.head(50))
```

```
    Unnamed: 0  listing_id        id        date  reviewer_id  reviewer_name  \
0            0     1178162   4724140  2013-05-21      4298113         Olivier
1            1     1178162   4869189  2013-05-29      6452964       Charlotte
2            2     1178162   5003196  2013-06-06      6449554       Sebastian
3            3     1178162   5150351  2013-06-15      2215611          Marine
4            4     1178162   5171140  2013-06-16      6848427          Andrew
5            5     1178162   5198929  2013-06-17      6663826           Arndt
6            6     1178162   6702817  2013-08-21      8099222         Maurice
7            7     1178162   6873023  2013-08-28      7671888          Elodie
8            8     1178162   7646702  2013-09-28      8197342       Arkadiusz
9            9     1178162   8094418  2013-10-15      9040491         Matthew
10          10     1178162   8174594  2013-10-19      9101576          Simona
11          11     1178162   8226316  2013-10-21       884407         Laurent
12          12     1178162   8372308  2013-10-28      8837991      Olga Maria
13          13     1178162   8414572  2013-10-29       478275             Kat
14          14     1178162   8523707  2013-11-04      8824032            Ivan
```

15	15	1178162	11069185	2014-03-18	10454265	Jeffrey
16	16	1178162	11159232	2014-03-23	9798322	Alexander
17	17	1178162	11420562	2014-04-01	6097987	Karthikram
18	18	1178162	11696317	2014-04-12	13599868	Paola
19	19	1178162	11766427	2014-04-14	5064941	Joe
20	20	1178162	11901870	2014-04-18	578962	Samir
21	21	1178162	12116711	2014-04-23	5051049	Oliver
22	22	1178162	12168229	2014-04-24	14421460	Ron
23	23	1178162	12243132	2014-04-27	10018866	Crystal
24	24	1178162	12753057	2014-05-10	14113353	Chris
25	25	1178162	13186169	2014-05-21	14192408	Alex
26	26	1178162	13514415	2014-05-29	14007556	Ósk
27	27	1178162	13586652	2014-05-31	419353	Phillip
28	28	1178162	13801287	2014-06-04	1636024	Fukuko
29	29	1178162	14000401	2014-06-09	16307906	Amber
30	30	1178162	14849457	2014-06-27	17001205	Sarah
31	31	1178162	14934841	2014-06-29	16598717	New
32	32	1178162	15125674	2014-07-02	13007001	Ali
33	33	1178162	15430473	2014-07-08	13616703	Cyril
34	34	1178162	15648106	2014-07-13	17376849	Emily
35	35	1178162	15728913	2014-07-14	11524242	Mika
36	36	1178162	15846810	2014-07-16	17826223	Raija
37	37	1178162	15895093	2014-07-17	18020631	Lucas
38	38	1178162	15982012	2014-07-19	7543714	Anne-Marie
39	39	1178162	16035159	2014-07-20	17287987	Shu-Ping
40	40	1178162	16221436	2014-07-23	2420725	Jessica
41	41	1178162	16730352	2014-08-01	7012629	Claudia
42	42	1178162	16789257	2014-08-02	17832793	Lydia
43	43	1178162	17176912	2014-08-08	857238	Tim & Charlie
44	44	1178162	18437695	2014-08-26	2789022	Gianluca
45	45	1178162	18561737	2014-08-28	19310647	Tamas
46	46	1178162	18696958	2014-08-30	15346724	Stephen
47	47	1178162	19087737	2014-09-06	13609481	Sarah
48	48	1178162	19282278	2014-09-09	20036237	Chris
49	49	1178162	19617260	2014-09-15	20104957	Nora

	comments	row_id	sentiment_type	\
0	My stay at islam's place was really cool! Good...	1	compound	
1	Great location for both airport and city - gre...	2	compound	
2	We really enjoyed our stay at Islams house. Fr...	3	compound	
3	The room was nice and clean and so were the co...	4	compound	
4	Great location. Just 5 mins walk from the Airp...	5	compound	
5	A truely exeptional place to stay. The hosts a...	6	compound	
6	It was a really nice time in Boston - best pla...	7	compound	
7	Islam is a very nice guy ! Attentive, funny, h...	8	compound	
8	The place is really well furnished, pleasant a...	9	compound	
9	Our stay at Islam's place was fantastic. We co...	10	compound	
10	Our stay at Islam's was very enjoyable, Islam ...	11	compound	
11	Communication with Islam and his brother was g...	12	compound	
12	Mi estadía en Boston aunque corta fue muy buen...	13	compound	
13	Well sized room for two people with the basic ...	14	compound	
14	GREAT SPACE, PERFECT LOCATION, AWESOME PEOPLE!...	15	compound	
15	The room was exactly as pictured, no frills, y...	16	compound	
16	The room was clean and very comfortable. Havin...	17	compound	
17	Izzy was great... had clear instructions and n...	18	compound	
18	The place was really good, it is like 10 minut...	19	compound	
19	The host wasn't there, but it was fine. He lef...	20	compound	
20	Izzy was a nice and helpful host with detailed...	21	compound	
21	We arrived late from the airport, so the locat...	22	compound	
22	Izzy was quick to reply to our request, and pr...	23	compound	
23	Everything is exactly as posted! super conveni...	24	compound	
24	We didn´t meet Izzy at all!!!! After we arrive...	25	compound	
25	I didn't get a chance to meet Izzy but I thoug...	26	compound	
26	Izzy's assistant was a nice and helpful person...	27	compound	
27	Host wasn't there, but instructions were clear...	28	compound	
28	Izzy's place was very convenient for getting t...	29	compound	

29	Well we were kind of annoyed to be honest. We ...	30	compound
30	We never met our host, but they were willing t...	31	compound
31	It was a great place to stay. Quiet, clean and...	32	compound
32	Overall a pleasing experience. We flew into B...	33	compound
33	Boston is one of the best city's I have ever b...	34	compound
34	Clear directions. Good neighborhood. Close to...	35	compound
35	The host actually gave us a place to sleep. It...	36	compound
36	OK stay. Perhaps best for those on the young/...	37	compound
37	Izzy was very helpful with directions and he w...	38	compound
38	This was ok it was easy with clear information...	39	compound
39	Izzy was out of the town when I stayed there. ...	40	compound
40	Unfortunately, we can't agree with the many po...	41	compound
41	East Boston is very nice place, well connected...	42	compound
42	We arrived late and left early in the morning ...	43	compound
43	Izzy's room is a great value for an airport re...	44	compound
44	Had a good experience overall. Short and sweet.	45	compound
45	It was a pleasant stay although we didn't meet...	46	compound
46	Izzy's home is conveniently located for anyone...	47	compound
47	Izzy's listing was as described, the room was ...	48	compound
48	It has a quiet, convenient and safe environmen...	49	compound
49	We had a great Time in Boston! We really enjoy...	50	compound

	sentiment_score
0	0.9390
1	0.9061
2	0.9650
3	0.9267
4	0.8658
5	0.8221
6	0.9923
7	0.9269
8	0.9758
9	0.9705
10	0.9807
11	0.9657
12	-0.2960
13	0.8834
14	0.9169
15	0.7876
16	0.9410
17	0.7845
18	0.8649
19	0.9825
20	0.1531
21	0.8519
22	0.9588
23	0.7783
24	-0.8338
25	0.9814
26	0.8660
27	0.8047
28	0.9493
29	0.1952
30	0.8246
31	0.8519
32	0.8074
33	0.9081
34	0.8979
35	0.5994
36	0.6589
37	0.9703
38	0.7880
39	0.7579
40	0.9939
41	0.9473
42	0.9517

```
43          0.9459
44          0.7096
45          0.8934
46          0.2500
47          0.8952
48          0.9109
49          0.9623
```

In [352…

```
#summary stats of sentiment_score
# min value is -0.984300 which tells that polarity of the most negative comment is stron
# max value is 0.995900 which tells that polarity of the most positive comment is highly
# we can see that the intensity of the most positive comment is slightly higher than the

# The mean value is +0.764561 which indicates the average polarity or intensity of senti
df_output[["sentiment_score"]].describe()
```

Out[352]:

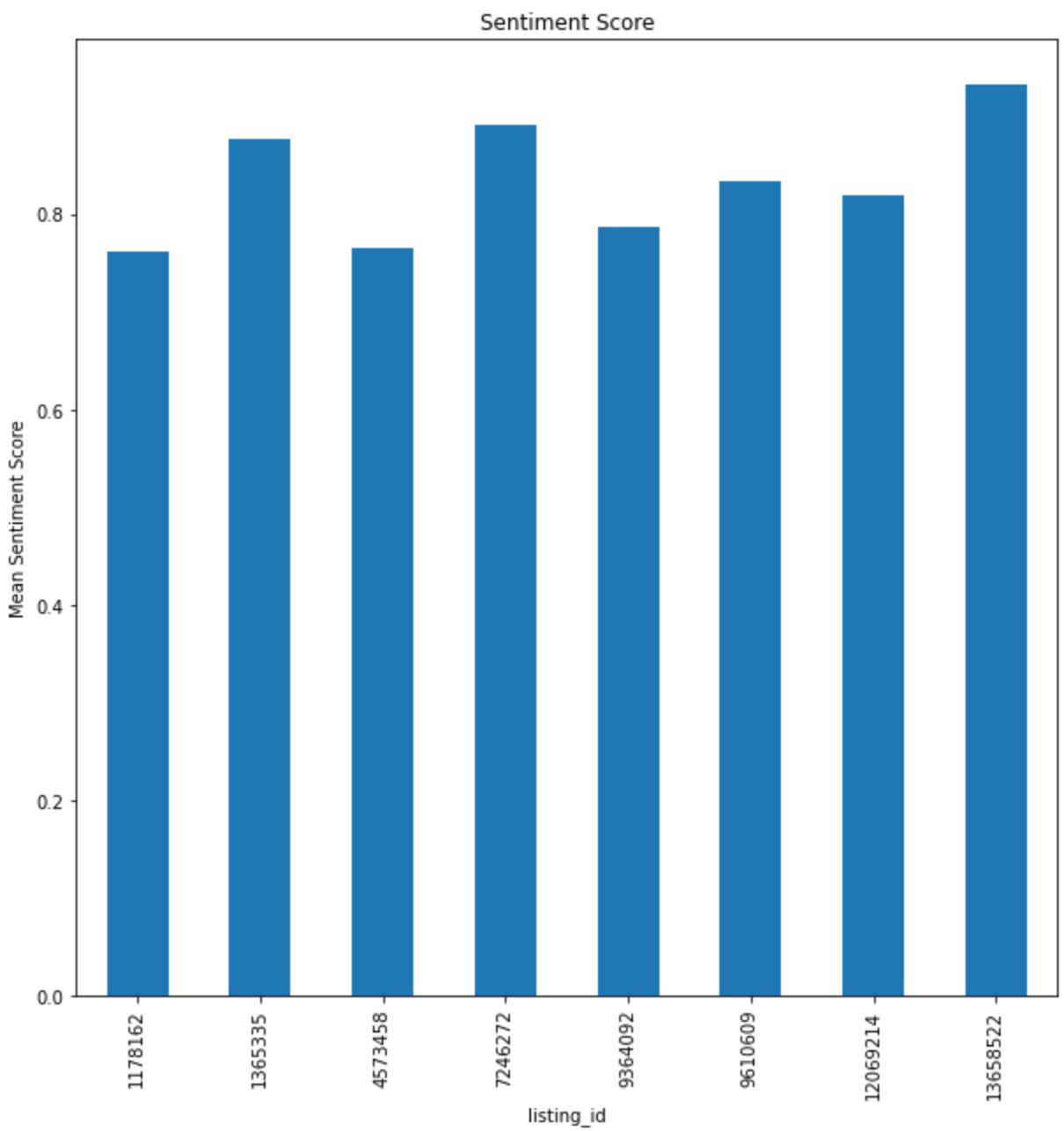
	sentiment_score
count	300.000000
mean	0.785833
std	0.318344
min	-0.943100
25%	0.796300
50%	0.909850
75%	0.964850
max	0.994700

In [353…

```
# use matplotlib to create charts to analyze sentiment scores by listing_id
# need to identify how mean sentiment score changes over the listings.
# keep listing_id on x axis and mean sentiment score on y axis

#generate mean of sentiment_score by period
dfg = df_output.groupby(['listing_id'])['sentiment_score'].mean()

#create a bar plot - figsize is the width and height of figure in inches

dfg.plot(kind='bar', title='Sentiment Score', ylabel='Mean Sentiment Score',xlabel='list
```

Out[353]:

```
<AxesSubplot:title={'center':'Sentiment Score'}, xlabel='listing_id', ylabel='Mean Sent
iment Score'>
```



In [354…

```
#This bar plot shows the mean sentiment score across reviewers for specific listings

#important observations:
#1. the score was almost the same for listings 1178162 and 4573458
#2. the highest score was for the listing 13658522
#3. the lowest score was for listing 1178162
#4. listings usually had scores above 0.5 indicating positive sentiment towards their se
#5. there was no drastic variability between listing sentiments


# The listing with the highest score could indicate that there are some hospitality stan
# there that customers really appreciate. It could be used to compare the services avail
# different AIRBNBs and their effectiveness.

#we need to make a boxplot - to study the spread and center of numerical data
# seaborn is used to create boxplot
```

In [355…

```
import seaborn as sns
#create seaborn boxplots by listings
sns.boxplot(x='listing_id', y='sentiment_score', notch = True,
            data=df_output, showfliers=False).set(title='Sentiment Score by Listing')
#modify axis labels
plt.xlabel('listing_id')
```

```
plt.ylabel('Sentiment Score')
plt.xticks(rotation=90)
```

Out[355]:
```
(array([0, 1, 2, 3, 4, 5, 6, 7]),
 [Text(0, 0, '1178162'),
  Text(1, 0, '1365335'),
  Text(2, 0, '4573458'),
  Text(3, 0, '7246272'),
  Text(4, 0, '9364092'),
  Text(5, 0, '9610609'),
  Text(6, 0, '12069214'),
  Text(7, 0, '13658522')])
```

In [356…
```
#The box for listing 1178162 is the tallest box, which indicates a wider spread in the s
#The manager of this listing might be able to use this deep-dive insight, along with the

#The box for listing 9364092 is shortest, indicating a narrow spread of sentiment scores
```

In [ ]:
```

```