Hotel Review Classification

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Importing Libraries

```
import pandas as pd
import numpy as np
from bs4 import BeautifulSoup
import requests
import csv
import time
import random
from collections import OrderedDict
import string
import re
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.offline as py
import plotly.graph_objs as go
import plotly.tools as tls
import plotly.express as px
import nltk
import random


py.init_notebook_mode(connected=True)


from nltk.stem import WordNetLemmatizer
from random import randint
from textblob import TextBlob
from time import sleep

color = sns.color_palette()
%matplotlib inline


from collections import Counter, defaultdict
from string import punctuation
from nltk.corpus import stopwords
from nltk.metrics import ConfusionMatrix
import plotly.io as pio

color = sns.color_palette()
%matplotlib inline
```

Retrieving Data from Website

```
hotel_page1 = ("https://www.tripadvisor.in/Hotels-g60750-San_Diego_California-Hotels.html")
hotel_page2 = ("https://www.tripadvisor.in/Hotels-g60750-oa30-San_Diego_California-Hotels.html")
hotel_page3 = ("https://www.tripadvisor.in/Hotels-g60750-oa60-San_Diego_California-Hotels.html")
hotel_page4 = ("https://www.tripadvisor.in/Hotels-g60750-oa90-San_Diego_California-Hotels.html")
hotel_page5 = ("https://www.tripadvisor.in/Hotels-g60750-oa120-San_Diego_California-Hotels.html")
hotel_page6 = ("https://www.tripadvisor.in/Hotels-g60750-oa150-San_Diego_California-Hotels.html")
hotel_page7 = ("https://www.tripadvisor.in/Hotels-g60750-oa180-San_Diego_California-Hotels.html")
hotel_page8 = ("https://www.tripadvisor.in/Hotels-g60750-oa210-San_Diego_California-Hotels.html")
hotel_page9 = ("https://www.tripadvisor.in/Hotels-g60750-oa240-San_Diego_California-Hotels.html")
hotel_page10 = ("https://www.tripadvisor.in/Hotels-g60750-oa270-San_Diego_California-Hotels.html")

user_agent = ( {'User-Agent': 'Mozilla/5.0 (Windows NT 10.0; Win64; x64) \ AppleWebKit/537.36 (KHTML, like Gecko) \ Chrome/90.0.4430.212 Safari/537.36',
                'Accept-Language': 'en-US, en'})


hp1= requests.get(hotel_page1, headers = user_agent)
hp2= requests.get(hotel_page2, headers = user_agent)
hp3= requests.get(hotel_page3, headers = user_agent)
hp4= requests.get(hotel_page4, headers = user_agent)
hp5= requests.get(hotel_page5, headers = user_agent)
hp6= requests.get(hotel_page6, headers = user_agent)
hp7= requests.get(hotel_page7, headers = user_agent)
hp8= requests.get(hotel_page8, headers = user_agent)
hp9= requests.get(hotel_page9, headers = user_agent)
hp10= requests.get(hotel_page10, headers = user_agent)
```

Extracting the Data

```
def extract(h_page, hotel_names, hotel_ratings, hotel_reviews, hotel_prices):

    h_content = BeautifulSoup(h_page.content, 'html.parser')

    for hotel_name in h_content.find_all('div', {'class': 'listing_title'}):
        hotel_names.append(hotel_name.text.strip())


    for hotel_rating in h_content.find_all('a', {'class': 'ui_bubble_rating'}):
        hotel_ratings.append(hotel_rating['alt'])

    for hotel_review in h_content.find_all('a', {'class': 'review_count'}):
        hotel_reviews.append(hotel_review.text.strip())

    for hotel_price in h_content.find_all('span', {'class': 'fwoto'}):
        print("In pricing")
        hotel_prices.append(hotel_price.span.text.replace('₹','').strip())


    return hotel_names, hotel_ratings, hotel_reviews, hotel_prices


def extract_test(hotel_names, hotel_ratings, hotel_reviews, hotel_prices):
    print("Lengths of Dataset Columns")
    print("Hotel Names: ", len(hotel_names))
    print("Hotel Ratings: ", len(hotel_ratings))
    print("Hotel Reviews: ", len(hotel_reviews))
    print("Hotel Prices: ", len(hotel_prices))
```

```
hotel_names = []
hotel_ratings = []
hotel_reviews = []
hotel_prices = []


hotel_names, hotel_ratings, hotel_reviews, hotel_prices = extract(hp1, hotel_names, hotel_ratings, hotel_reviews, hotel_prices)
hotel_names, hotel_ratings, hotel_reviews, hotel_prices = extract(hp2, hotel_names, hotel_ratings, hotel_reviews, hotel_prices)
hotel_names, hotel_ratings, hotel_reviews, hotel_prices = extract(hp3, hotel_names, hotel_ratings, hotel_reviews, hotel_prices)
hotel_names, hotel_ratings, hotel_reviews, hotel_prices = extract(hp4, hotel_names, hotel_ratings, hotel_reviews, hotel_prices)
hotel_names, hotel_ratings, hotel_reviews, hotel_prices = extract(hp5, hotel_names, hotel_ratings, hotel_reviews, hotel_prices)
hotel_names, hotel_ratings, hotel_reviews, hotel_prices = extract(hp6, hotel_names, hotel_ratings, hotel_reviews, hotel_prices)
hotel_names, hotel_ratings, hotel_reviews, hotel_prices = extract(hp7, hotel_names, hotel_ratings, hotel_reviews, hotel_prices)
hotel_names, hotel_ratings, hotel_reviews, hotel_prices = extract(hp8, hotel_names, hotel_ratings, hotel_reviews, hotel_prices)
hotel_names, hotel_ratings, hotel_reviews, hotel_prices = extract(hp9, hotel_names, hotel_ratings, hotel_reviews, hotel_prices)
hotel_names, hotel_ratings, hotel_reviews, hotel_prices = extract(hp10, hotel_names, hotel_ratings, hotel_reviews, hotel_prices)
```

```
extract_test(hotel_names, hotel_ratings, hotel_reviews, hotel_prices)
```

```
Lengths of Dataset Columns
Hotel Names:  600
Hotel Ratings:  300
Hotel Reviews:  300
Hotel Prices:  0
```

Data Preparation

```
def processing(hotel_names, hotel_ratings, hotel_reviews):
    hotel_names2 = []
    hotel_names3 = []
    hotel_names4 = []
    hotel_reviews2 = []
    hotel_reviews3 = []
    hotel_ratings2 = []
    hotel_ratings3 = []
    name_index = []
    num = 0
    temp = 0

    # removing duplicates of hotel names
    n = 0
    for i in hotel_names:
        if n % 2 == 0:
            n = n + 1
            hotel_names2.append(i)
        else:
            n = n + 1
            continue



    # remove "Sponsored" hotels

    for i in hotel_names2:
        #print(i)
        x = i.split(" ")
        if x[0] == "Sponsored":
            name_index.append(num)
            num = num + 1
            continue
        else:
            hotel_names3.append(" ".join(x))
            num = num + 1



    # removing numbers from hotel names

    for i in hotel_names3:
        x = i.split(" ")
        del x[0]
        hotel_names4.append(" ".join(x))



    # Removing word "reviews" from column values and converting to numerical

    for i in hotel_reviews:
        x = i.split(" ")
        for y in x:
            c = re.sub(r'[^\w\s]', '', y)
            if c.isdigit():
                hotel_reviews2.append(c)
            else:
                continue

    hotel_reviews2 = [eval(i) for i in hotel_reviews2]


    # Removing Sponsored hotel reviews


    for i in range(len(hotel_reviews2)):

        if i not in name_index:
                hotel_reviews3.append(hotel_reviews2[i])
        else:
            continue



    # Removing Sponsored hotel ratings


    for i in range(len(hotel_ratings)):

        if i not in name_index:
                hotel_ratings2.append(hotel_ratings[i])
        else:
            continue



    # Only taking rating and converting into numerical

    for i in hotel_ratings2:
        x = i.split(" ")
        hotel_ratings3.append(x[0])

    hotel_ratings3 = [eval(i) for i in hotel_ratings3]


    return hotel_names4, hotel_ratings3, hotel_reviews3, name_index



def processing_test(hotel_names3, hotel_ratings2, hotel_reviews2):
    print("Lengths of Dataset Columns")
    print("Hotel Names: ", len(hotel_names3))
    print("Hotel Ratings: ", len(hotel_ratings2))
    print("Hotel Reviews: ", len(hotel_reviews2))
```

```
hotel_names4, hotel_ratings3, hotel_reviews3, name_index = processing(hotel_names, hotel_ratings, hotel_reviews)
```

```
processing_test(hotel_names4, hotel_ratings3, hotel_reviews3)
```

```
Lengths of Dataset Columns
Hotel Names:  300
Hotel Ratings:  300
Hotel Reviews:  300
```

Loading Data

```
hotels_dict = {}

# Load data into dictionary

hotels_dict = {'names':hotel_names4, 'num_reviews':hotel_reviews3, 'ratings':hotel_ratings3}   #, 'costs':hotel_prices[:37]}


hotels_df = pd.DataFrame.from_dict(hotels_dict)
hotels_df.head(10)
```

	names	num_reviews	ratings
0	Bahia Resort Hotel	6359	4.5
1	Manchester Grand Hyatt San Diego	12628	4.5
2	Embassy Suites by Hilton San Diego Bay Downtown	3436	4.5
3	San Diego Mission Bay Resort	1356	4.0
4	Catamaran Resort Hotel and Spa	6745	4.5
5	San Diego Marriott La Jolla	1502	4.5
6	Paradise Point Resort & Spa	3187	4.0
7	Best Western Plus Island Palms Hotel & Marina	4852	4.5
8	Old Town Inn	2412	4.5
9	Urban Boutique Hotel	1333	4.5

Extracting Hotel Reviews

```
def extract_review(url):

    hotel_rev = []

    review_page= (url)

    user_agent = ( {'User-Agent': 'Mozilla/5.0 (Windows NT 10.0; Win64; x64) \ AppleWebKit/537.36 (KHTML, like Gecko) \ Chrome/90.0.4430.212 Safari/537.36',
                    'Accept-Language': 'en-US, en'})


    rp1= requests.get(review_page, headers = user_agent)

    h_content = BeautifulSoup(rp1.content, 'html.parser')

    for rp_1 in h_content.findAll('span', {'class':'QewHA H4 _a'}):
        hotel_rev.append(rp_1.span.text.strip())

    return hotel_rev



def extract_links(hotel_link, links):

    for review in hotel_link.findAll('a',{'class': 'review_count'}):
        a = review['href']
        a = 'https://www.tripadvisor.in'+ a

        a= a[:(a.find('Reviews')+7)] + '-or{}' + a[(a.find('Reviews')+7):]

        links.append(a)
    #return links
```

```
hotel_rev = BeautifulSoup(hp1.content, 'html.parser')
hotel_rev2 = BeautifulSoup(hp2.content, "html.parser")
hotel_rev3 = BeautifulSoup(hp3.content, "html.parser")
hotel_rev4 = BeautifulSoup(hp4.content, "html.parser")
hotel_rev5 = BeautifulSoup(hp5.content, "html.parser")
hotel_rev6 = BeautifulSoup(hp6.content, "html.parser")
hotel_rev7 = BeautifulSoup(hp7.content, "html.parser")
hotel_rev8 = BeautifulSoup(hp8.content, "html.parser")
hotel_rev9 = BeautifulSoup(hp9.content, "html.parser")
hotel_rev10 = BeautifulSoup(hp10.content, "html.parser")


links = []
links2 = []

extract_links(hotel_rev, links)
extract_links(hotel_rev2, links)
extract_links(hotel_rev3, links)
extract_links(hotel_rev4, links)
extract_links(hotel_rev5, links)
extract_links(hotel_rev6, links)
extract_links(hotel_rev7, links)
extract_links(hotel_rev8, links)
extract_links(hotel_rev9, links)
extract_links(hotel_rev10, links)



# removing links to reviews for sponsored hotels


for i in range(len(links)):

    if i not in name_index:
            links2.append(links[i])
    else:
        continue
```

```
reviews = []

for link in links2:
    reviews.append(extract_review(link))

#reviews
```

Loading Reviews into Data Frame

```
hotels_df["reviews"] = reviews

hotels_df.head(10)
```

	names	num_reviews	ratings	reviews
0	Bahia Resort Hotel	6359	4.5	[Karina, Ben, and Tim exceeded all expectation...
1	Manchester Grand Hyatt San Diego	12628	4.5	[I enjoyed a wonderful stay at the hotel. With...
2	Embassy Suites by Hilton San Diego Bay Downtown	3436	4.5	[The staff is super friendly and helpful, espe...
3	San Diego Mission Bay Resort	1356	4.0	[The grounds, facility and views were beautifu...
4	Catamaran Resort Hotel and Spa	6745	4.5	[We always have so much fun at this resort. Su...
5	San Diego Marriott La Jolla	1502	4.5	[We always appreciate extraordinary service an...
6	Paradise Point Resort & Spa	3187	4.0	[Excellent Service and friendly support in all...
7	Best Western Plus Island Palms Hotel & Marina	4852	4.5	[Very happy with this location. Quiet and peac...
8	Old Town Inn	2412	4.5	[Booked this for our San Diego trip. The sink ...
9	Urban Boutique Hotel	1333	4.5	[I can't think of anything that wasn't exempla...

```
print(len(hotels_df))
```

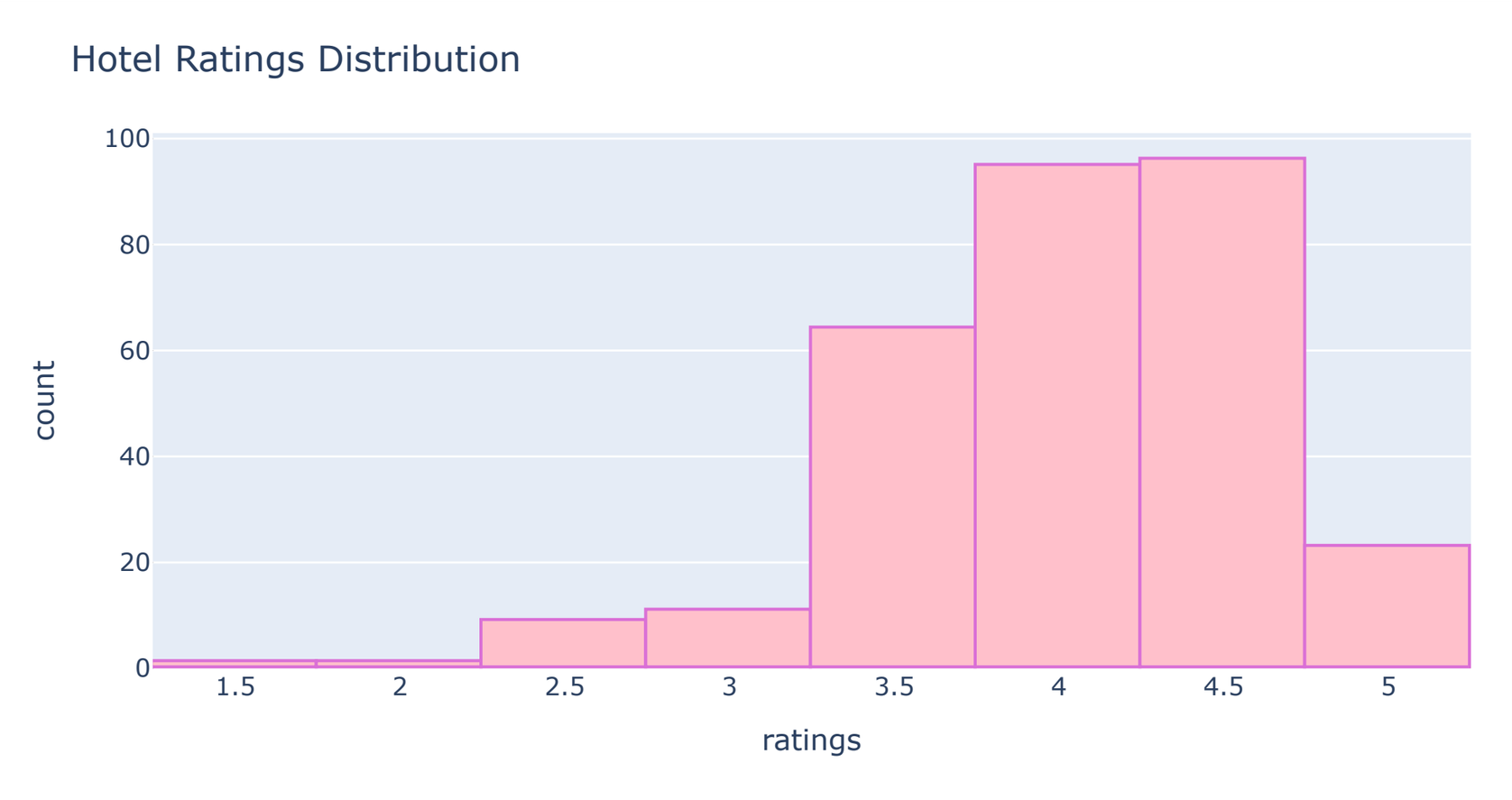
```
300
```

Exploratory Data Analysis

English Language Detection: Checking to see if there are any reviews that are not in English

Plotting the distribution of ratings scores:

```
color = sns.color_palette()
%matplotlib inline
fig = px.histogram(hotels_df, x="ratings",  width=800, height=400)
fig.update_traces(marker_color="pink",marker_line_color='orchid',
                  marker_line_width=1.5)
fig.update_layout(title_text='Hotel Ratings Distribution')
fig.show()
```



There are less hotels with a ratings score of less than 3. Majority of hotel guests that have written a review have a positive experience.

Data Cleaning & Processing

Functions for text cleaning & Tokenization:

```
#punctuation
punctuation = set(punctuation)
tw_punct = punctuation - {"#"}

#stopwords and null removal

sw = stopwords.words("english")
sw = sw + ['nan']

# Two useful regex
whitespace_pattern = re.compile(r"\s+")
hashtag_pattern = re.compile(r"^#[0-9a-zA-Z]+")


# and now our functions
def descriptive_stats(tokens, num_tokens = 5, verbose=True) :
    """
        Given a list of tokens, print number of tokens, number of unique tokens,
        number of characters, lexical diversity, and num_tokens most common
        tokens. Return a list of
    """

    num_tokens = len(tokens)
    num_unique_tokens = len(set(tokens))
    lexical_diversity = num_unique_tokens/num_tokens
    num_characters = sum(len(token) for token in tokens)

    if verbose :
        print(f"There are {num_tokens} tokens in the data.")
        print(f"There are {num_unique_tokens} unique tokens in the data.")
        print(f"There are {num_characters} characters in the data.")
        print(f"The lexical diversity is {lexical_diversity:.3f} in the data.")


    return([num_tokens, num_unique_tokens,
            lexical_diversity,
            num_characters])

# Function to remove stop words:

def remove_stop(tokens) :


    return[t for t in tokens if t not in sw]

def remove_punctuation(text, punct_set=tw_punct) :
    return("".join([ch for ch in text if ch not in punct_set]))

def tokenize(text) :
    """ Splitting on whitespace rather than the book's tokenize function. That
        function will drop tokens like '#hashtag' or '2A', which we need for Twitter. """

    return([item.lower() for item in whitespace_pattern.split(text)])


full_pipeline = [str.lower, remove_punctuation, tokenize, remove_stop]


def prepare(text, pipeline) :
    tokens = str(text)

    for transform in pipeline :
        tokens = transform(tokens)

    return(tokens)
```

Cleaning & tokenizing the text data:

```
hotels_df['tokens']= hotels_df['reviews'].apply(prepare, pipeline=full_pipeline)

hotels_df.head()
```

	names	num_reviews	ratings	reviews	tokens
0	Bahia Resort Hotel	6359	4.5	[Karina, Ben, and Tim exceeded all expectation...	[karina, ben, tim, exceeded, expectations, fri...
1	Manchester Grand Hyatt San Diego	12628	4.5	[I enjoyed a wonderful stay at the hotel. With...	[enjoyed, wonderful, stay, hotel, attention, d...
2	Embassy Suites by Hilton San Diego Bay Downtown	3436	4.5	[The staff is super friendly and helpful, espe...	[staff, super, friendly, helpful, especially, ...
3	San Diego Mission Bay Resort	1356	4.0	[The grounds, facility and views were beautifu...	[grounds, facility, views, beautiful, lush, cl...
4	Catamaran Resort Hotel and Spa	6745	4.5	[We always have so much fun at this resort. Su...	[always, much, fun, resort, super, family, pet...

Lemmatization of the text data:

```
def word_lemmatizer(text):
    lem_text = [WordNetLemmatizer().lemmatize(i) for i in text]
    return lem_text

hotels_df['tokens_lemma'] = hotels_df['tokens'].apply(lambda x: word_lemmatizer(x))
hotels_df.head()
```

	names	num_reviews	ratings	reviews	tokens	tokens_lemma
0	Bahia Resort Hotel	6359	4.5	[Karina, Ben, and Tim exceeded all expectation...	[karina, ben, tim, exceeded, expectations, fri...	[karina, ben, tim, exceeded, expectation, frie...
1	Manchester Grand Hyatt San Diego	12628	4.5	[I enjoyed a wonderful stay at the hotel. With...	[enjoyed, wonderful, stay, hotel, attention, d...	[enjoyed, wonderful, stay, hotel, attention, d...
2	Embassy Suites by Hilton San Diego Bay Downtown	3436	4.5	[The staff is super friendly and helpful, espe...	[staff, super, friendly, helpful, especially, ...	[staff, super, friendly, helpful, especially, ...
3	San Diego Mission Bay Resort	1356	4.0	[The grounds, facility and views were beautifu...	[grounds, facility, views, beautiful, lush, cl...	[ground, facility, view, beautiful, lush, clea...
4	Catamaran Resort Hotel and Spa	6745	4.5	[We always have so much fun at this resort. Su...	[always, much, fun, resort, super, family, pet...	[always, much, fun, resort, super, family, pet...

Descriptive statistics

Sentiment Analysis

```
#converting lemmatized data into string
hotels_df['lemma_str'] = [' '.join(map(str,l)) for l in hotels_df['tokens_lemma']]
hotels_df.head()
```

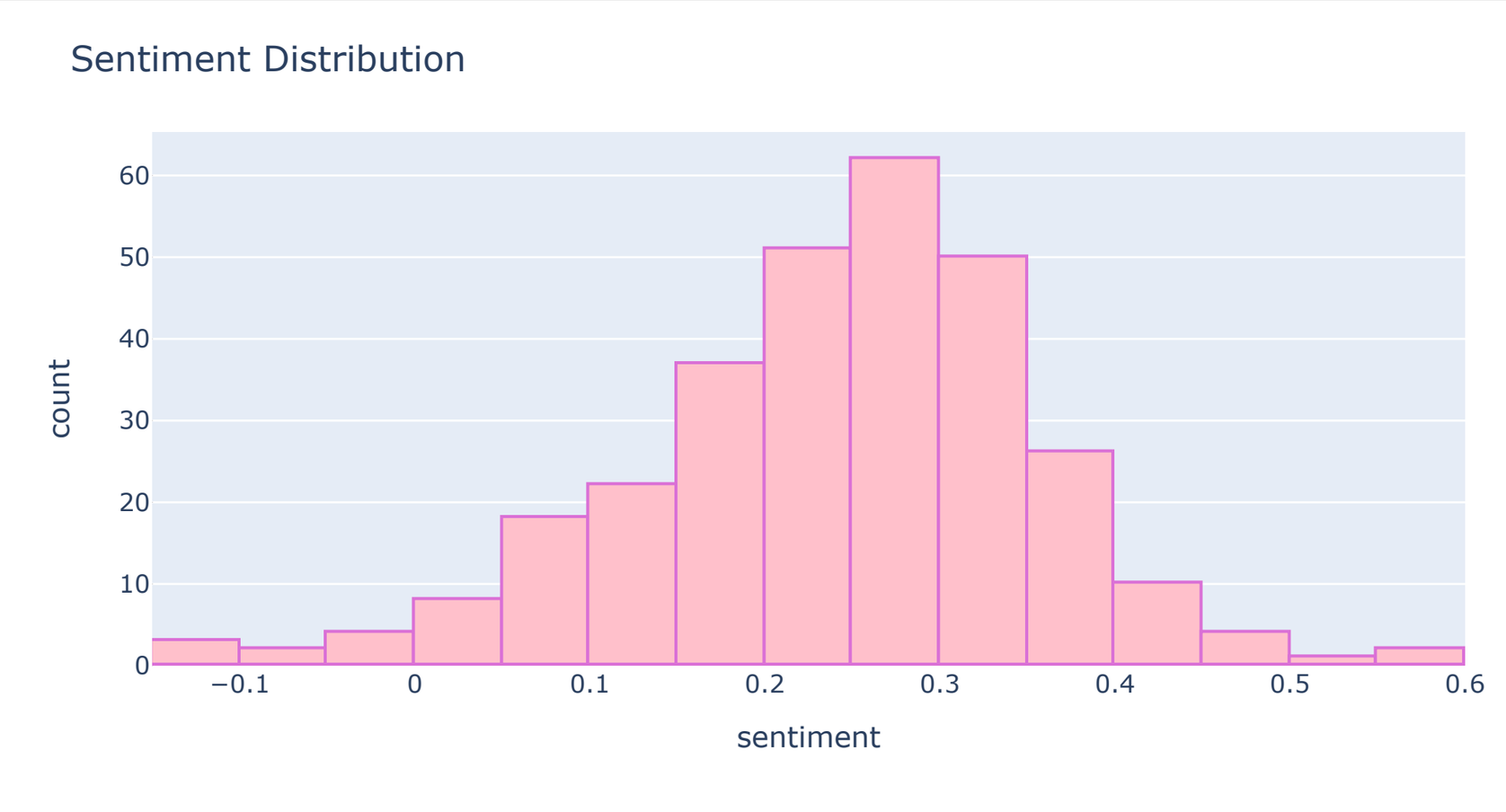
	names	num_reviews	ratings	reviews	tokens	tokens_lemma	lemma_str
0	Bahia Resort Hotel	6359	4.5	[Karina, Ben, and Tim exceeded all expectation...	[karina, ben, tim, exceeded, expectations, fri...	[karina, ben, tim, exceeded, expectation, frie...	karina ben tim exceeded expectation friendly a...
1	Manchester Grand Hyatt San Diego	12628	4.5	[I enjoyed a wonderful stay at the hotel. With...	[enjoyed, wonderful, stay, hotel, attention, d...	[enjoyed, wonderful, stay, hotel, attention, d...	enjoyed wonderful stay hotel attention detail ...
2	Embassy Suites by Hilton San Diego Bay Downtown	3436	4.5	[The staff is super friendly and helpful, espe...	[staff, super, friendly, helpful, especially, ...	[staff, super, friendly, helpful, especially, ...	staff super friendly helpful especially ida st...
3	San Diego Mission Bay Resort	1356	4.0	[The grounds, facility and views were beautifu...	[grounds, facility, views, beautiful, lush, cl...	[ground, facility, view, beautiful, lush, clea...	ground facility view beautiful lush clean gorg...
4	Catamaran Resort Hotel and Spa	6745	4.5	[We always have so much fun at this resort. Su...	[always, much, fun, resort, super, family, pet...	[always, much, fun, resort, super, family, pet...	always much fun resort super family pet friend...

```
hotels_df['sentiment'] = hotels_df['lemma_str'].apply(lambda x: TextBlob(x).sentiment.polarity)
hotels_df.head()
```

	names	num_reviews	ratings	reviews	tokens	tokens_lemma	lemma_str	sentiment
0	Bahia Resort Hotel	6359	4.5	[Karina, Ben, and Tim exceeded all expectation...	[karina, ben, tim, exceeded, expectations, fri...	[karina, ben, tim, exceeded, expectation, frie...	karina ben tim exceeded expectation friendly a...	0.293695
1	Manchester Grand Hyatt San Diego	12628	4.5	[I enjoyed a wonderful stay at the hotel. With...	[enjoyed, wonderful, stay, hotel, attention, d...	[enjoyed, wonderful, stay, hotel, attention, d...	enjoyed wonderful stay hotel attention detail ...	0.469873
2	Embassy Suites by Hilton San Diego Bay Downtown	3436	4.5	[The staff is super friendly and helpful, espe...	[staff, super, friendly, helpful, especially, ...	[staff, super, friendly, helpful, especially, ...	staff super friendly helpful especially ida st...	0.451384
3	San Diego Mission Bay Resort	1356	4.0	[The grounds, facility and views were beautifu...	[grounds, facility, views, beautiful, lush, cl...	[ground, facility, view, beautiful, lush, clea...	ground facility view beautiful lush clean gorg...	0.356973
4	Catamaran Resort Hotel and Spa	6745	4.5	[We always have so much fun at this resort. Su...	[always, much, fun, resort, super, family, pet...	[always, much, fun, resort, super, family, pet...	always much fun resort super family pet friend...	0.282974

Sentiment Distribution Plot:

```
%matplotlib inline
fig2 = px.histogram(hotels_df, x="sentiment",  width=800, height=400)
fig2.update_traces(marker_color="pink",marker_line_color='orchid',
                   marker_line_width=1.5)
fig2.update_layout(title_text='Sentiment Distribution')
fig2.show()
```



Sentiment distribution looks like normal

Looking at Words Frequency: