In [84]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
import warnings

import re
import nltk
from wordcloud import WordCloud
from nltk.corpus import stopwords
from nltk.stem.porter import PorterStemmer
from sklearn.metrics import confusion_matrix
from sklearn.preprocessing import MinMaxScaler
from sklearn.model_selection import GridSearchCV
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.feature_extraction.text import CountVectorizer

warnings.filterwarnings('ignore')
sns.set_style('darkgrid')
plt.rcParams['figure.figsize'] = (10, 6)
```

In [3]:
```
''' reading data '''
df = pd.read_csv('amazon_alexa.tsv', delimiter='\t')
```

In [4]:
```
''' displaying first 5 rows '''
df.head()
```

Out[4]:

	rating	date	variation	verified_reviews	feedback
0	5	31-Jul-18	Charcoal Fabric	Love my Echo!	1
1	5	31-Jul-18	Charcoal Fabric	Loved it!	1
2	4	31-Jul-18	Walnut Finish	Sometimes while playing a game, you can answer...	1
3	5	31-Jul-18	Charcoal Fabric	I have had a lot of fun with this thing. My 4 ...	1
4	5	31-Jul-18	Charcoal Fabric	Music	1

In [5]:
```
''' checking null values '''
df.isnull().sum()
```

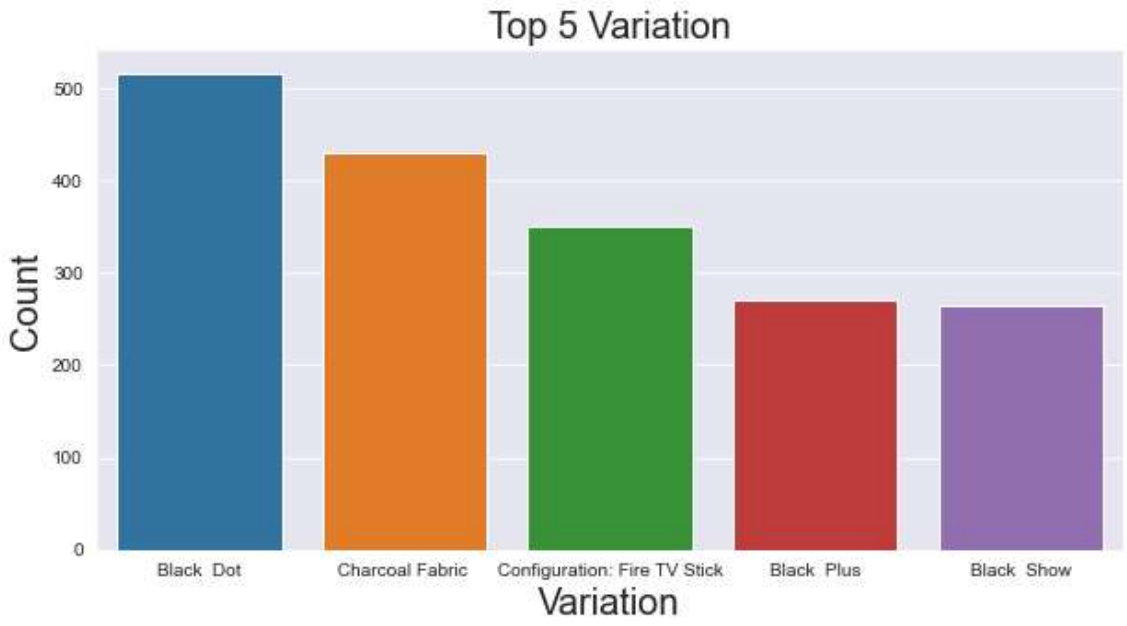
Out[5]:
```
rating              0
date                0
variation           0
verified_reviews    0
feedback            0
dtype: int64
```

In [6]:
```
''' checking info of data '''
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3150 entries, 0 to 3149
Data columns (total 5 columns):
 #   Column            Non-Null Count  Dtype 
---  ------            --------------  ----- 
 0   rating            3150 non-null   int64 
 1   date              3150 non-null   object
 2   variation         3150 non-null   object
 3   verified_reviews  3150 non-null   object
 4   feedback          3150 non-null   int64 
dtypes: int64(2), object(3)
memory usage: 123.2+ KB
```

In [14]:
```
''' value counts of variation '''
variation_label = df.variation.value_counts()[:5]
print(variation_label)

''' plotting top 5 variation '''
plt.figure(figsize=(10, 5))
sns.barplot(variation_label.index, variation_label);
plt.xlabel('Variation', fontsize=20)
plt.ylabel('Count', fontsize=20)
plt.title('Top 5 Variation', fontsize=20);
```

```
Black  Dot                      516
Charcoal Fabric                 430
Configuration: Fire TV Stick    350
Black  Plus                     270
Black  Show                     265
Name: variation, dtype: int64
```



In [15]:
```
''' shape of data '''
df.shape
```

Out[15]: (3150, 5)

In [16]:
```
''' adding a len column for analyzing the length of the reviews '''
df['len'] = df['verified_reviews'].map(len)
df['len']
```

Out[16]:
```
0        13
1         9
2       195
3       172
4         5
       ...
3145     50
3146    135
3147    441
3148    380
3149      4
Name: len, Length: 3150, dtype: int64
```

In [17]:
```
''' displaying data based on len '''
df.groupby('len').describe().sample(10)
```

Out[17]:

	rating								feed						
	count	mean	std	min	25%	50%	75%	max	count	mean	std	min	25%	50%	75%
len															
196	6.0	4.666667	0.516398	4.0	4.25	5.0	5.0	5.0	6.0	1.000000	0.000000	1.0	1.0	1.0	1.0
350	1.0	5.000000	NaN	5.0	5.00	5.0	5.0	5.0	1.0	1.000000	NaN	1.0	1.0	1.0	1.0
170	5.0	4.800000	0.447214	4.0	5.00	5.0	5.0	5.0	5.0	1.000000	0.000000	1.0	1.0	1.0	1.0
291	2.0	4.000000	1.414214	3.0	3.50	4.0	4.5	5.0	2.0	1.000000	0.000000	1.0	1.0	1.0	1.0
397	2.0	5.000000	0.000000	5.0	5.00	5.0	5.0	5.0	2.0	1.000000	0.000000	1.0	1.0	1.0	1.0
163	9.0	3.555556	1.509231	1.0	2.00	4.0	5.0	5.0	9.0	0.666667	0.500000	0.0	0.0	1.0	1.0
89	9.0	4.000000	1.732051	1.0	4.00	5.0	5.0	5.0	9.0	0.777778	0.440959	0.0	1.0	1.0	1.0
227	4.0	4.250000	0.957427	3.0	3.75	4.5	5.0	5.0	4.0	1.000000	0.000000	1.0	1.0	1.0	1.0
321	1.0	5.000000	NaN	5.0	5.00	5.0	5.0	5.0	1.0	1.000000	NaN	1.0	1.0	1.0	1.0
157	7.0	4.428571	0.975900	3.0	4.00	5.0	5.0	5.0	7.0	1.000000	0.000000	1.0	1.0	1.0	1.0

In [19]:
```
'''displaying the data according to the Ratings '''
df.groupby('rating').describe()
```

Out[19]:

	feedback														
	count	mean	std	min	25%	50%	75%	max	count	mean	std	min	25%	50%	7
rating															
1	161.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	161.0	195.000000	212.371226	1.0	36.00	120.0	284
2	96.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	96.0	249.187500	269.595303	1.0	78.75	163.0	309
3	152.0	1.0	0.0	1.0	1.0	1.0	1.0	1.0	152.0	207.296053	272.194706	1.0	54.00	130.0	284
4	455.0	1.0	0.0	1.0	1.0	1.0	1.0	1.0	455.0	178.520879	215.927849	1.0	34.00	99.0	241
5	2286.0	1.0	0.0	1.0	1.0	1.0	1.0	1.0	2286.0	108.444007	152.116387	1.0	26.00	64.0	135

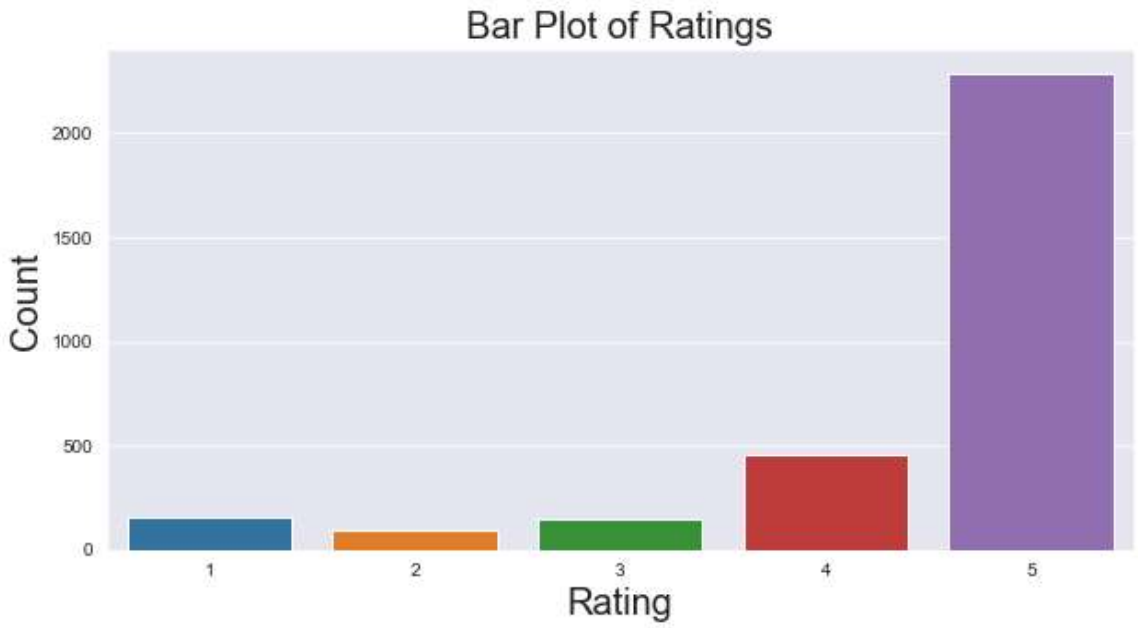
In [20]:
```
''' displaying data based according to the feedback '''
df.groupby('feedback').describe()
```

Out[20]:

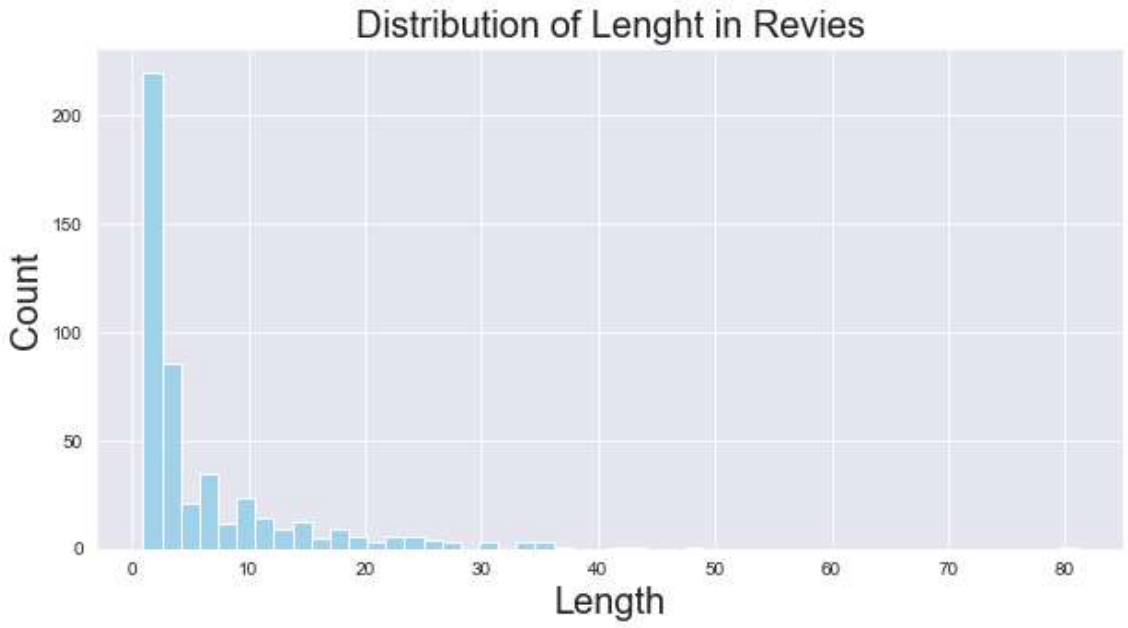
	rating												
	count	mean	std	min	25%	50%	75%	max	count	mean	std	min	25%
feedback													
0	257.0	1.373541	0.484688	1.0	1.0	1.0	2.0	2.0	257.0	215.241245	236.325955	1.0	53.0
1	2893.0	4.737643	0.546544	3.0	5.0	5.0	5.0	5.0	2893.0	124.659177	174.624491	1.0	29.0

In [25]:
```
''' visualization '''


''' value counts of rating '''
rating_label = df.rating.value_counts()
print(rating_label)

''' barplot '''
plt.figure(figsize=(10, 5))
sns.barplot(rating_label.index, rating_label);
plt.xlabel('Rating', fontsize=20)
plt.ylabel('Count', fontsize=20);
plt.title('Bar Plot of Ratings', fontsize=20);
```

```
5    2286
4     455
1     161
3     152
2      96
Name: rating, dtype: int64
```



In [35]:
```
''' histogram plot of len of reivews '''
len_label = df['len'].value_counts()
plt.figure(figsize=(10, 5))
sns.histplot(len_label, bins=50, color='skyblue');
plt.xlabel('Length', fontsize=20)
plt.ylabel('Count', fontsize=20);
plt.title('Distribution of Lenght in Revies', fontsize=20);
```



In [41]:
```
''' Let's Check some of the reviews according to thier lengths '''
df[df.len == 1]['verified_reviews'].iloc[0]
```

Out[41]: '😍'

In [43]:
```
df[df['len'] == 150]['verified_reviews'].iloc[0]
```

Out[43]: "Got this on Amazon prime with the ring pro. Work really great. Being the lazy guy I am I don't need to go see who at my door anymore while I'm gaming."

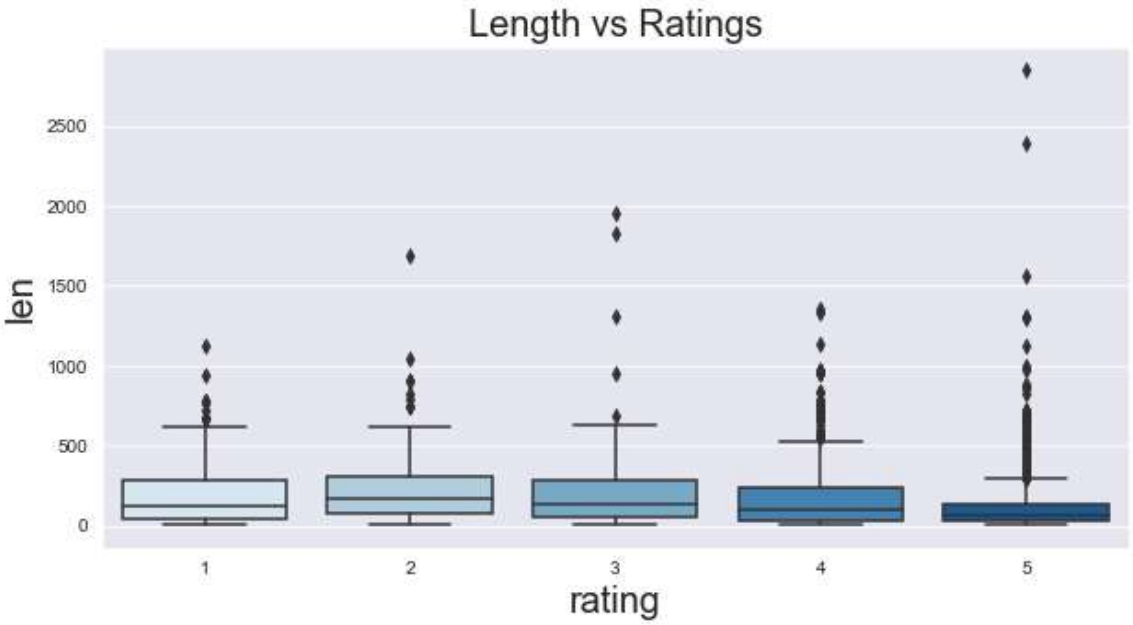
In [45]:
```
df[df['len'] == 50]['verified_reviews'].iloc[0]
```

Out[45]: 'Yet another Exho for our home and love them all!!!'

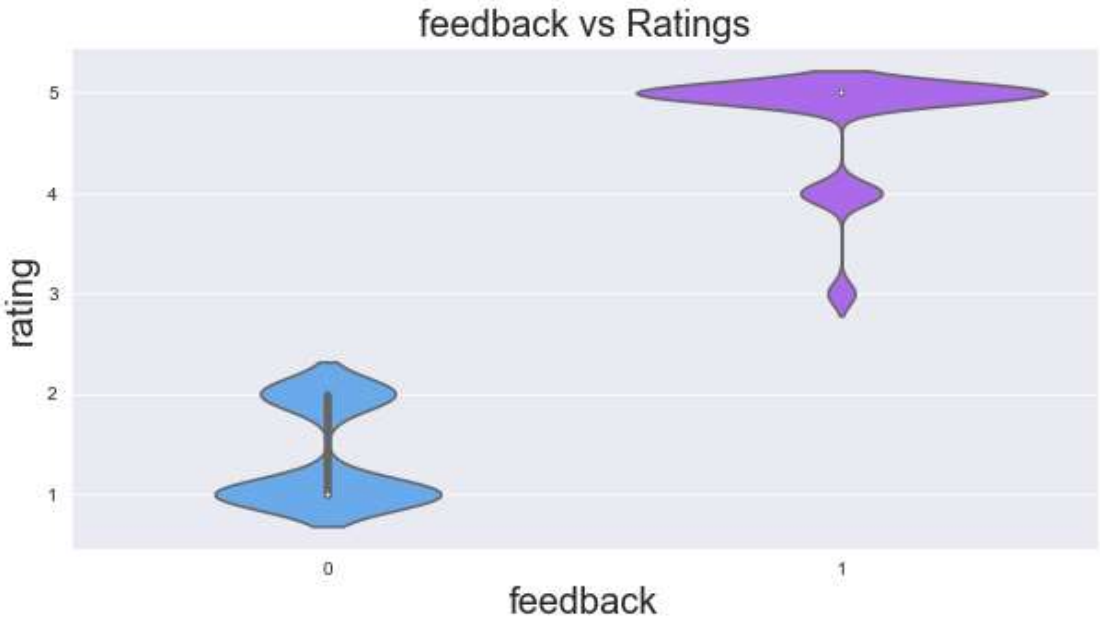
In [46]:
```
df[df['len'] == 25]['verified_reviews'].iloc[0]
```

Out[46]: 'I love it, wife hates it.'

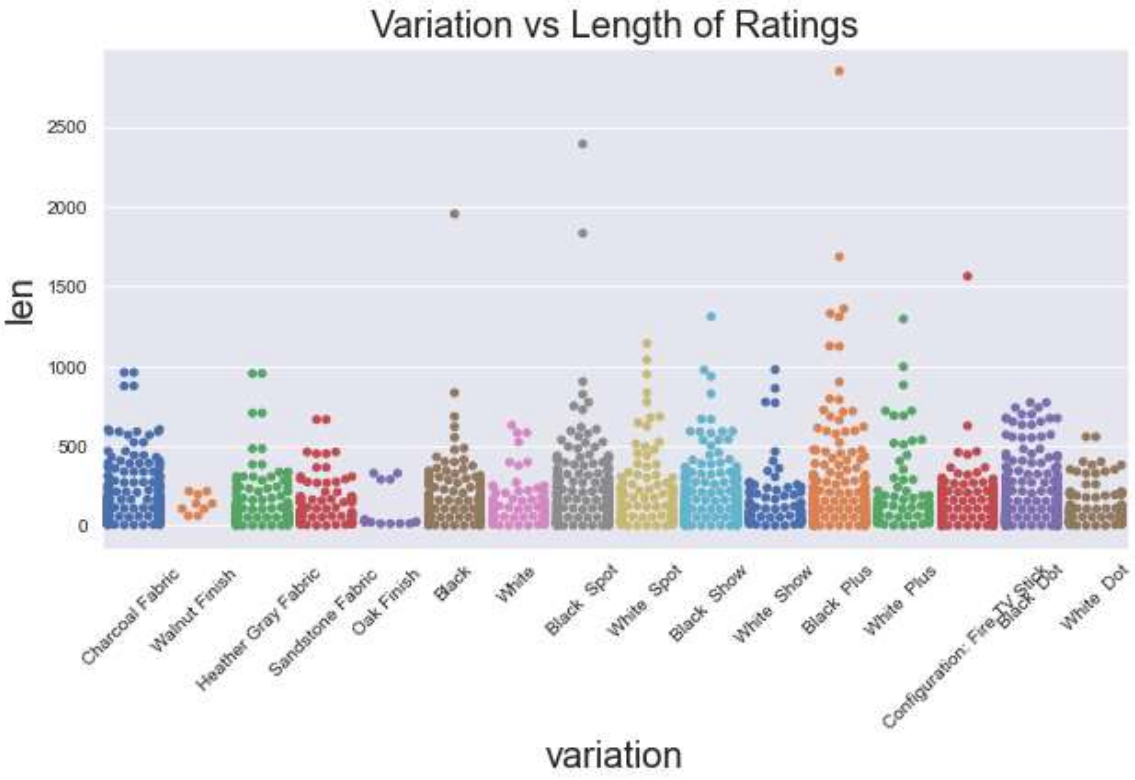
In [60]:
```
''' box plot '''
plt.figure(figsize=(10, 5))
sns.boxplot(df['rating'], df['len'], palette = 'Blues')
plt.title("Length vs Ratings", fontsize=20)
plt.xlabel('rating', fontsize=20)
plt.ylabel('len', fontsize=20);
```



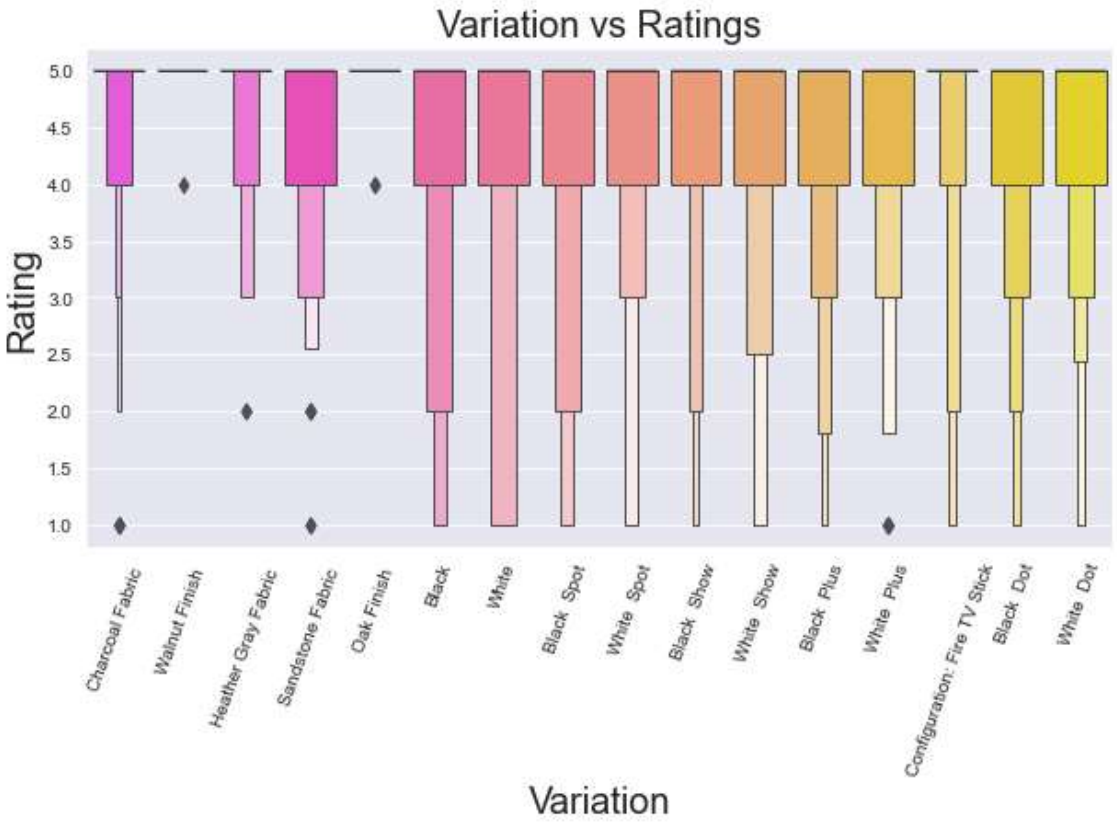
In [59]:
```
''' violin plot '''
plt.figure(figsize=(10, 5))
sns.violinplot(df['feedback'], df['rating'], palette = 'cool')
plt.title("feedback vs Ratings", fontsize=20)
plt.xlabel('feedback', fontsize=20)
plt.ylabel('rating', fontsize=20);
```



In [58]:
```
''' swarmplot '''
plt.figure(figsize=(10, 5))
sns.swarmplot(df['variation'], df['len'], palette = 'deep')
plt.title("Variation vs Length of Ratings", fontsize=20)
plt.xticks(rotation = 45);
plt.xlabel('variation', fontsize=20)
plt.ylabel('len', fontsize=20);
```

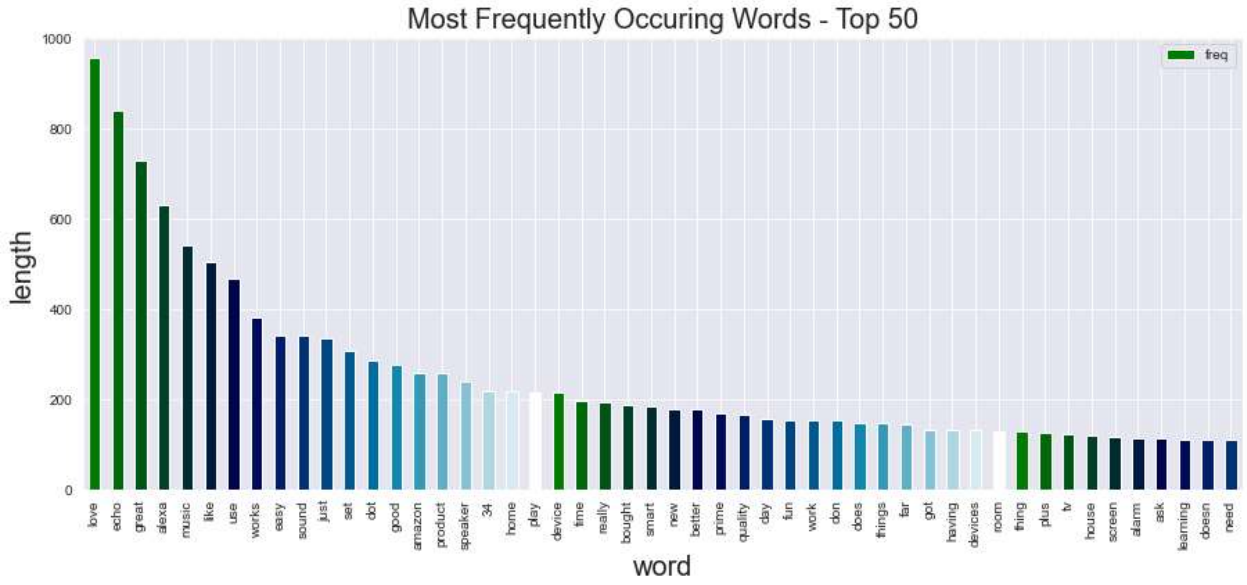


In [55]:
```
''' bivariate analysis '''
plt.figure(figsize=(10, 5))
sns.boxenplot(df['variation'], df['rating'], palette = 'spring')
plt.title("Variation vs Ratings", fontsize=20)
plt.xticks(rotation = 70);
plt.xlabel('Variation', fontsize=20)
plt.ylabel('Rating', fontsize=20);
```

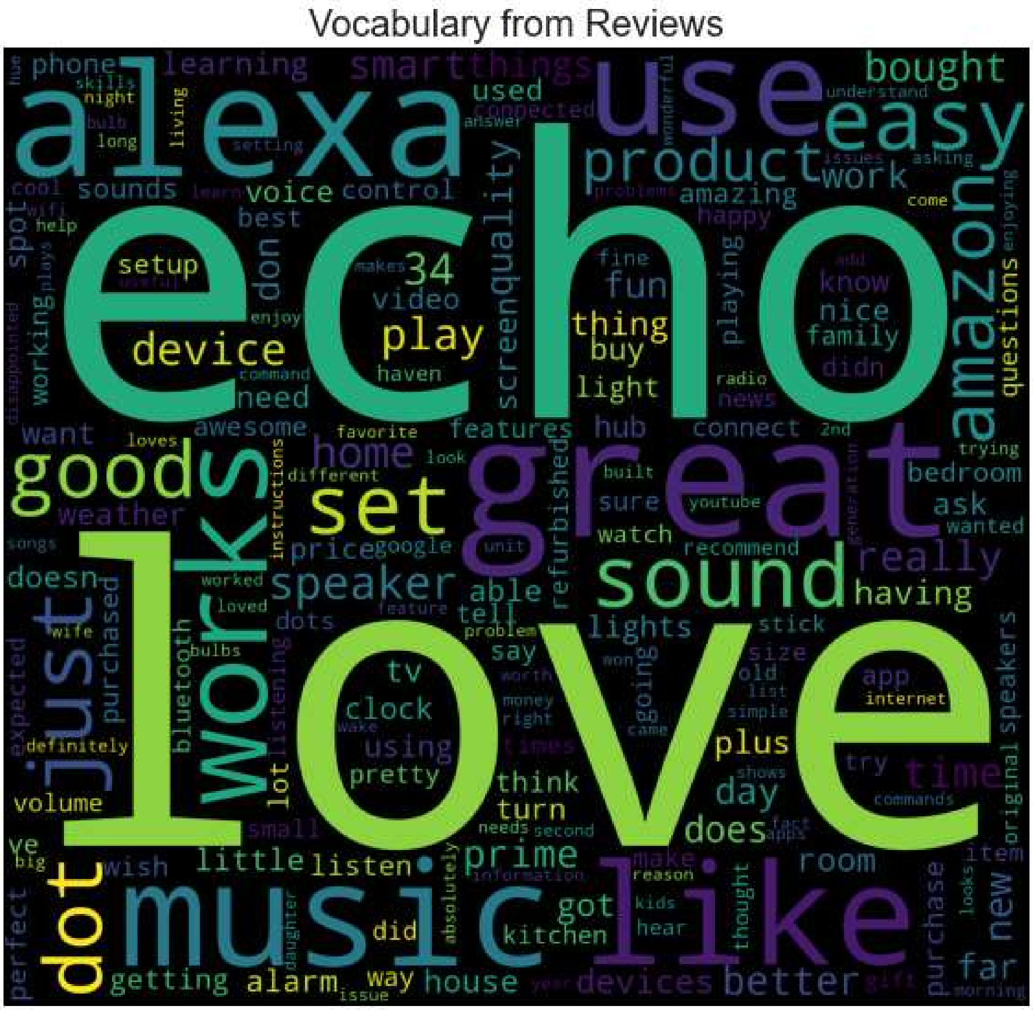


In [64]:
```
''' preprocessing of text '''

''' CountVectorrizer '''
count_vector = CountVectorizer(stop_words='english')

ws = count_vector.fit_transform(df.verified_reviews)
s_w = ws.sum(axis=0)
w_f = [(w, s_w[0, idx]) for w, idx in count_vector.vocabulary_.items()]
w_f = sorted(w_f, key = lambda x: x[1], reverse = True)

''' creating dataframe '''
freq = pd.DataFrame(w_f, columns=['word', 'freq'])
```

In [66]:
```
''' barplot of top 50 frequently occuring words '''
color = plt.cm.ocean(np.linspace(0, 1, 20))
freq.head(50).plot(x='word', y='freq', kind='bar', figsize=(15, 6), color = color)
plt.title("Most Frequently Occuring Words - Top 50", fontsize=20)
plt.xlabel('word', fontsize=20)
plt.ylabel('length', fontsize=20);
```



In [69]:
```
''' representing words on WordCloud '''
word_cloud = WordCloud(background_color='black', width=1500, height=1400).generate_from_f
plt.figure(figsize=(10, 10))
plt.axis('off')
plt.imshow(word_cloud)
plt.title("Vocabulary from Reviews", fontsize = 20);
```



In [76]:
```
''' preproecessing '''
c = []

for i in range(0, 3150):
    ''' removing characters except a-z and A-Z'''
    r = re.sub('[^a-zA-Z]', ' ', df['verified_reviews'][i])
    ''' converting every word into lower word'''
    r = r.lower()
    ''' splitting text '''
    r = r.split()
    ''' apllying Stemming '''
    ps = PorterStemmer()
    ''' removing stopwords '''
    sw = stopwords.words('english')
    sw.remove('not')
    r = [ps.stem(word) for word in r if not word in set(sw)]
    r = ' '.join(r)
    c.append(r)
```

In [78]:
```
''' count vectorizer '''
count_vector = CountVectorizer(max_features=2500)

''' independent and dependent variables '''
X = count_vector.fit_transform(c).toarray()
y = df.iloc[:, 4].values

''' checking shape '''
print(X.shape)
print(y.shape)
```

```
(3150, 2500)
(3150,)
```

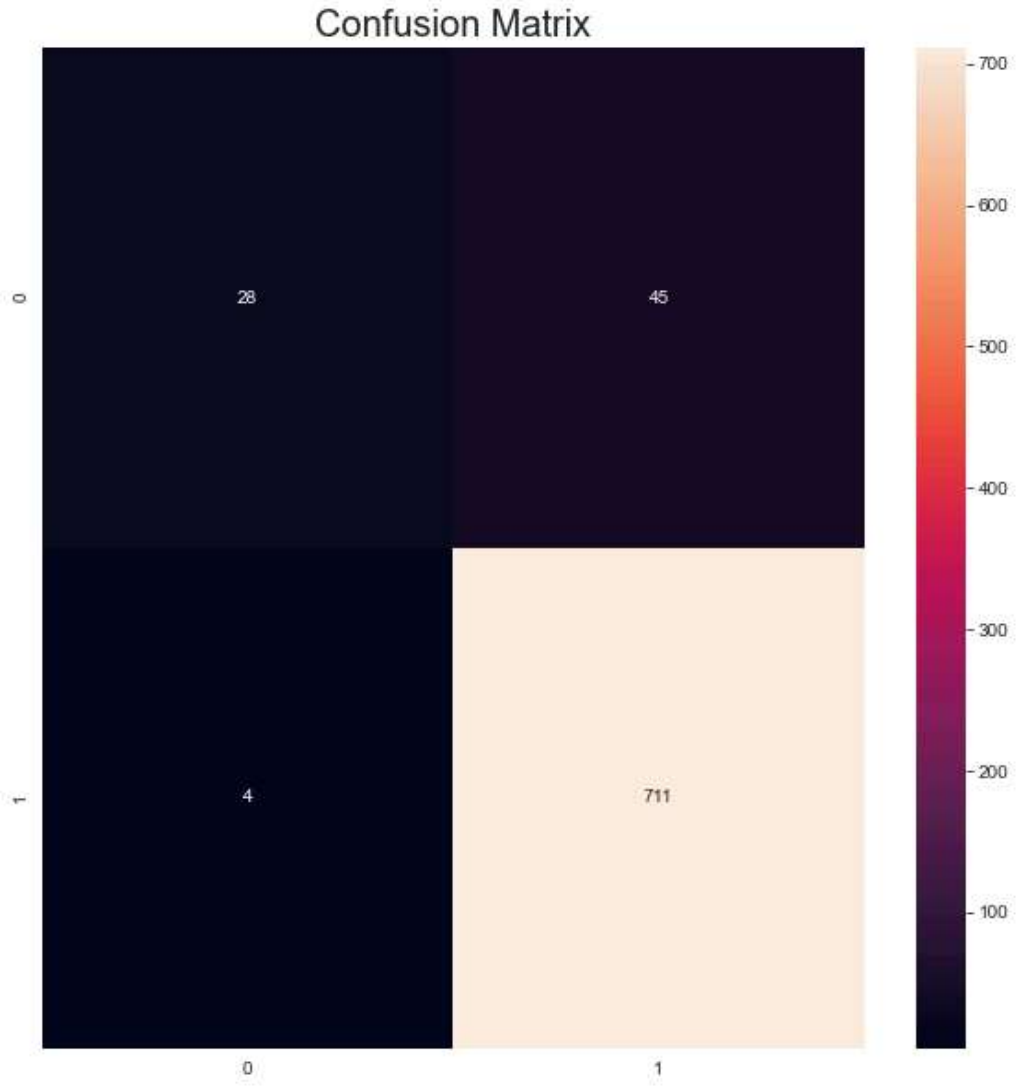
In [80]:
```
''' train test split '''
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.25, random_state=42
```

In [81]:
```
print("shape of X_train: ", X_train.shape)
print("shape of X_test: ", X_test.shape)
```

```
shape of X_train:  (2362, 2500)
shape of X_test:  (788, 2500)
```

In [83]:
```
''' Min Max Scaler '''
min_max_sc = MinMaxScaler()

X_train = min_max_sc.fit_transform(X_train)
X_test = min_max_sc.transform(X_test)
```

In [87]:
```
''' Random Forest Classifier '''
rf = RandomForestClassifier()

''' fit on data '''
rf.fit(X_train, y_train)

''' prediction '''
y_pred = rf.predict(X_test)

''' confusion matrix '''
plt.figure(figsize=(10, 10))
sns.heatmap(confusion_matrix(y_test, y_pred), annot=True, fmt='g');
plt.title('Confusion Matrix', fontsize=20);
```



In [88]:
```
''' Hyperparameter Tunning '''

p = {
    'bootstrap': [True],
    'max_depth': [80, 100],
    'min_samples_split': [8, 12],
    'n_estimators': [100, 300]
}

''' Grid Search CV '''
grid_cv = GridSearchCV(estimator=rf, param_grid=p, cv=10, verbose=0, scoring='accuracy',
                       return_train_score=True)
grid_cv.fit(X_train, y_train.ravel())
```

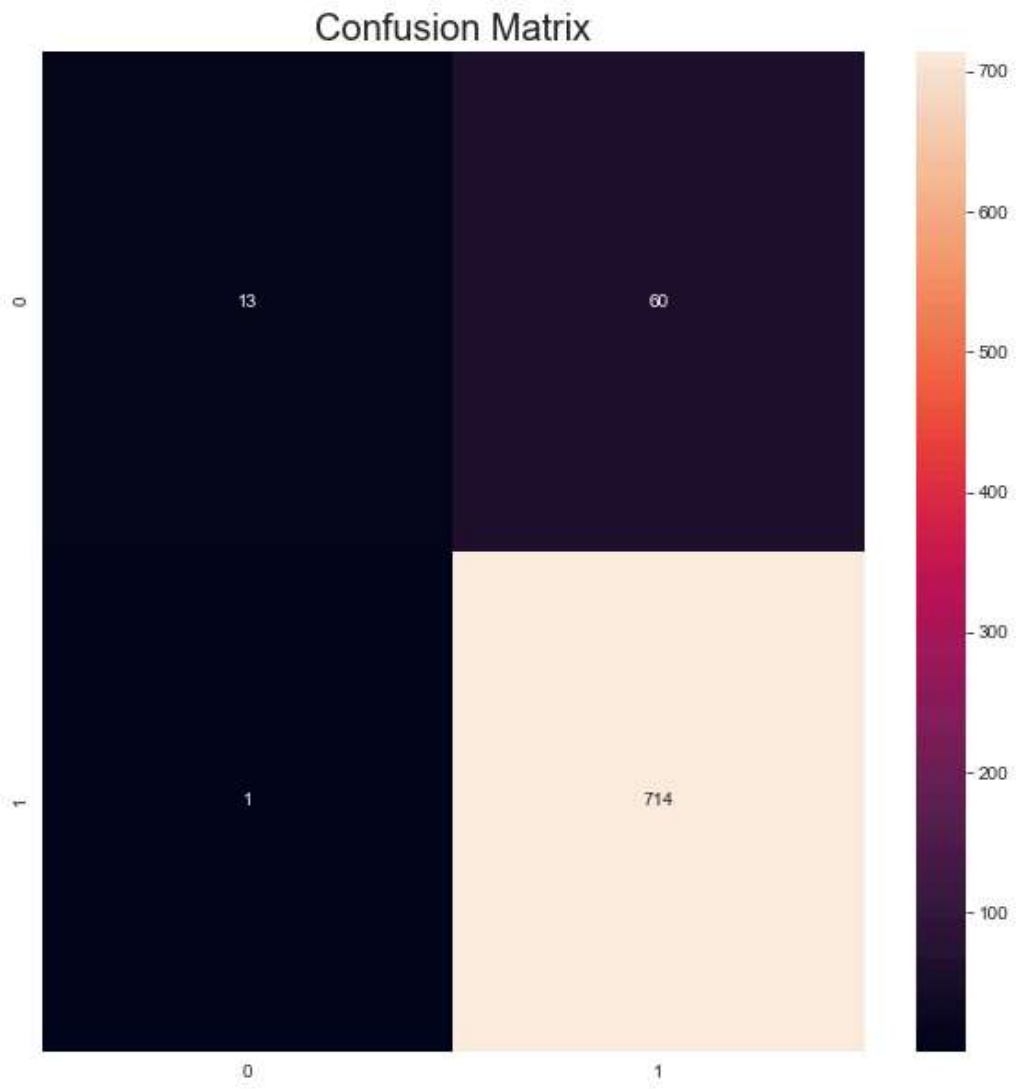
Out[88]:
```
GridSearchCV(cv=10, estimator=RandomForestClassifier(), n_jobs=-1,
             param_grid={'bootstrap': [True], 'max_depth': [80, 100],
                         'min_samples_split': [8, 12],
                         'n_estimators': [100, 300]},
             return_train_score=True, scoring='accuracy')
```

In [89]:
```
print("Best Parameter : {}".format(grid_cv.best_params_))
```

```
Best Parameter : {'bootstrap': True, 'max_depth': 80, 'min_samples_split': 8, 'n_estimat
ors': 300}
```

In [93]:
```
rf_cv = RandomForestClassifier(bootstrap=True, max_depth=80, min_samples_split=8, n_estim

''' fit on data '''
rf_cv.fit(X_train, y_train)

''' prediction '''
pred = rf_cv.predict(X_test)
```

In [94]:
```
''' confusion matrix '''
plt.figure(figsize=(10, 10))
sns.heatmap(confusion_matrix(y_test, pred), annot=True, fmt='g');
plt.title('Confusion Matrix', fontsize=20);
```



In [ ]: