Amazon Review Sentiment Analysis

In [2]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

import nltk
from nltk.stem.porter import PorterStemmer
nltk.download('stopwords')
from nltk.corpus import stopwords
STOPWORDS =   set(stopwords.words('english'))

from sklearn.model_selection import train_test_split
from sklearn.preprocessing import MinMaxScaler
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.model_selection import cross_val_score
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay
from sklearn.model_selection import GridSearchCV
from sklearn.model_selection import StratifiedKFold
from sklearn.metrics import accuracy_score
from wordcloud import WordCloud
from sklearn.tree import DecisionTreeClassifier
from xgboost import XGBClassifier
import pickle
import re
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.
```

In [3]:

```
data =pd.read_csv("/content/amazon_alexa.tsv" , delimiter='\t', quoting = 3)
print(f"Dataset Shape: {data.shape}")
print(f"Dataset Columns: {data.columns})")
```

```
Dataset Shape: (3150, 5)
Dataset Columns: Index(['rating', 'date', 'variation', 'verified_reviews', 'feedba
ck'], dtype='object'))
```

In [4]:

```
data.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 answe...	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]:

```
data.isnull().sum()
```

Out[5]:

	0
rating	0
date	0
variation	0
verified_reviews	1
feedback	0

dtype: int64

In [6]:

```
data[data['verified_reviews'].isna()==True]
```

Out[6]:

	rating	date	variation	verified_reviews	feedback
473	2	29-Jun-18	White	NaN	0

In [7]:

```
data.dropna(inplace=True)
```

In [8]:

```
data['length'] = data['verified_reviews'].apply(len)
```

In [9]:

```
data.head()
```

Out[9]:

	rating	date	variation	verified_reviews	feedback	length
0	5	31-Jul-18	Charcoal Fabric	Love my Echo!	1	13
1	5	31-Jul-18	Charcoal Fabric	Loved it!	1	9
2	4	31-Jul-18	Walnut Finish	"Sometimes while playing a game, you can answe...	1	197
3	5	31-Jul-18	Charcoal Fabric	"I have had a lot of fun with this thing. My 4...	1	174
4	5	31-Jul-18	Charcoal Fabric	Music	1	5

In [10]:

```
print(f"'verified_reviews' column val : {data.iloc[10]['verified_reviews']}")
print(f"Length of Review : {len(str(data.iloc[10]['verified_reviews']))}")
print(f"Length column val: {data.iloc[10]['length']}")
```

```
'verified_reviews' column val : "I sent it to my 85 year old Dad, and he talks to
it constantly."
Length of Review : 65
Length column val: 65
```

We can see the Lenth of review is same as the length conlum for the record

Data Types of the Features

In [11]:

```
data.dtypes
```

Out[11]:

	0
rating	int64
date	object
variation	object
verified_reviews	object
feedback	int64
length	int64

dtype: object

Analyze the Rating Column

In [12]:

```
data['rating'].value_counts()
```

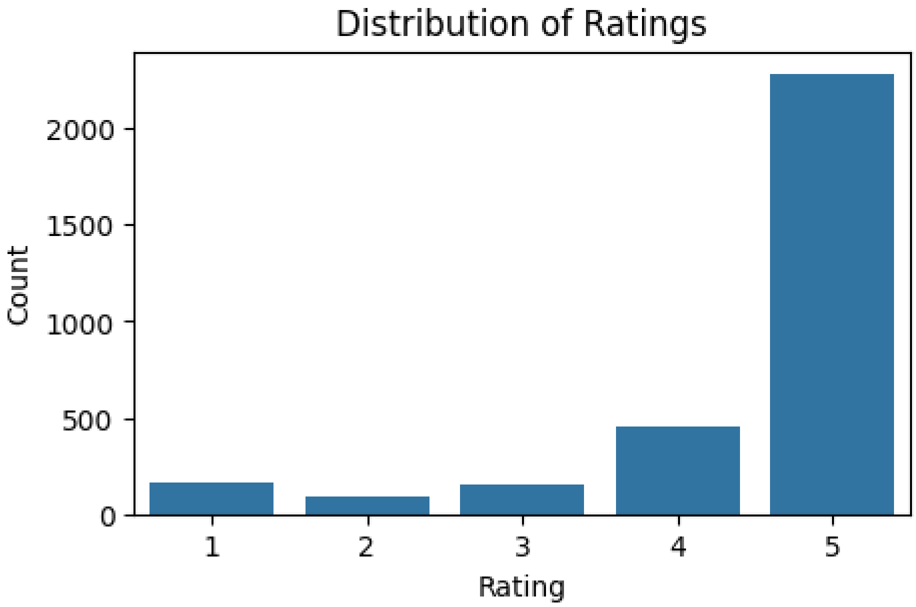
Out[12]:

	count
rating	
5	2286
4	455
1	161
3	152
2	95

dtype: int64

In [13]:

```
# prompt: create bar chart to visualize the rating clomun

# Bar chart to visualize the rating column
plt.figure(figsize=(5,3))
sns.countplot(x='rating', data=data)
plt.xlabel('Rating')
plt.ylabel('Count')
plt.title('Distribution of Ratings')
plt.show()
```



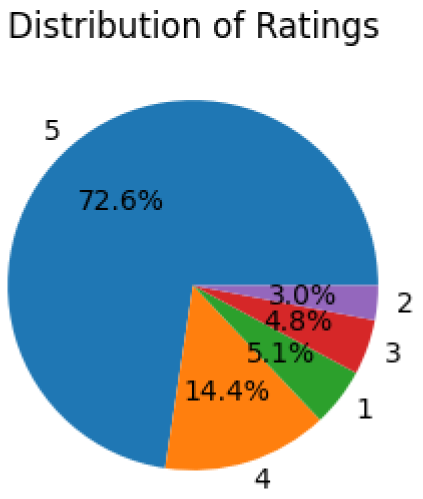
In [14]:
```
data['rating'].value_counts()/data.shape[0]*100
```

Out[14]:

rating	count
5	72.594474
4	14.449031
1	5.112734
3	4.826929
2	3.016831

dtype: float64

In [15]:
```
# prompt: create pie chart of rating colmn

# Pie chart to visualize the rating column
plt.figure(figsize=(3,3))
data['rating'].value_counts().plot(kind='pie', autopct='%1.1f%%')
plt.title('Distribution of Ratings')
plt.ylabel('')
plt.show()
```



Analyzing the Feedbak Column

In [16]:

```python
data['feedback'].value_counts()
```

Out[16]:

feedback	count
1	2893
0	256

dtype: int64

In [17]:

```python
data['feedback'].value_counts()/data.shape[0]*100
```

Out[17]:

feedback	count
1	91.870435
0	8.129565

dtype: float64

In [18]:

```python
review_0 = data[data['feedback'] == 0 ].iloc[1]['verified_reviews']
print(review_0)
review_1 = data[data['feedback'] == 1 ].iloc[1]['verified_reviews']
print(review_1)
```

```
Sound is terrible if u want good music too get a bose
Loved it!
```

0 == Neagative FB || 1 == Positve FB

In [19]:

```python
# Feedback = 0
data[data['feedback']== 0]['rating'].value_counts()
```

```
Out[19]:         count
        rating
             1     161
             2      95

        dtype: int64
```

```
In [20]: # Feedback = 0
         data[data['feedback']== 1]['rating'].value_counts()
```

```
Out[20]:         count
        rating
             5    2286
             4     455
             3     152

        dtype: int64
```

if review of rating is 1 or 2 then FB is 0 (negative) and if thw rating is 3, 4 or 5 then the feedback is 1 (positive)

Analyzing the 'Vatiation' Column

```
In [21]: data['variation'].value_counts()
```

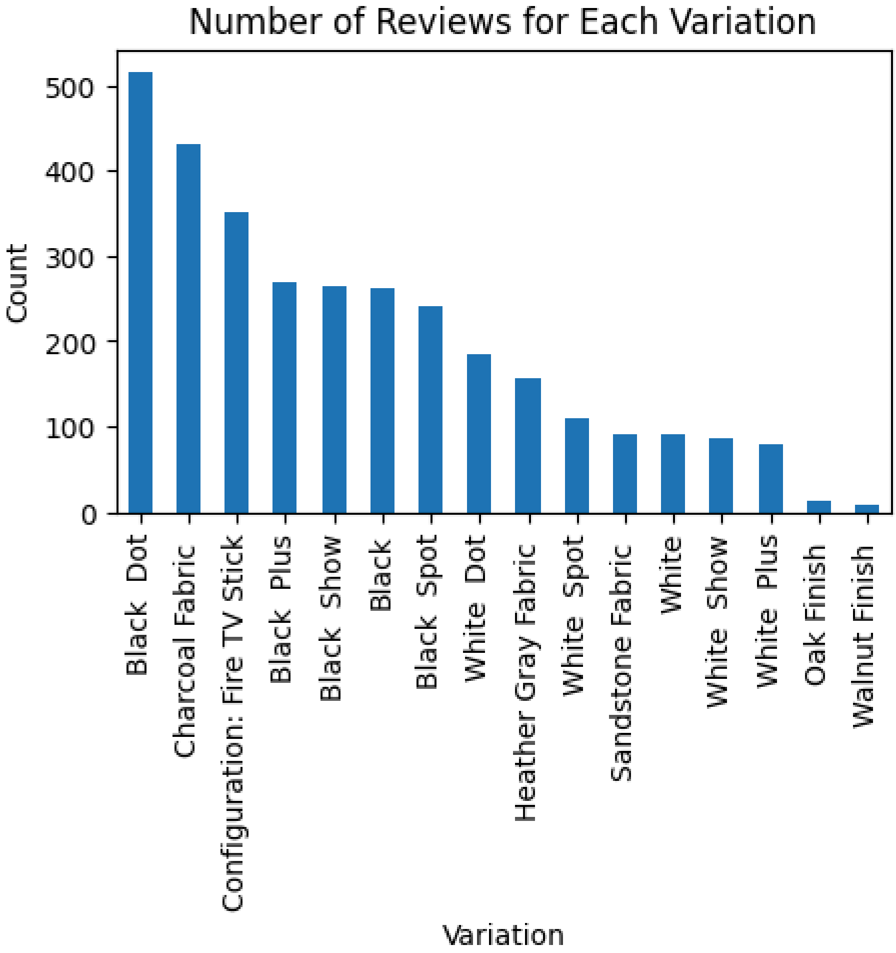
Out[21]:

	count
variation	
Black Dot	516
Charcoal Fabric	430
Configuration: Fire TV Stick	350
Black Plus	270
Black Show	265
Black	261
Black Spot	241
White Dot	184
Heather Gray Fabric	157
White Spot	109
Sandstone Fabric	90
White	90
White Show	85
White Plus	78
Oak Finish	14
Walnut Finish	9

dtype: int64

In [22]:

```python
# prompt: form the bar higghest to lowest graph of the variation value count

# Bar chart of variation counts sorted from highest to lowest
plt.figure(figsize=(5,3))
data['variation'].value_counts().plot(kind='bar')
plt.title('Number of Reviews for Each Variation')
plt.xlabel('Variation')
plt.ylabel('Count')
plt.show()
```



In [23]:
```
data.groupby('variation')['rating'].mean()
```

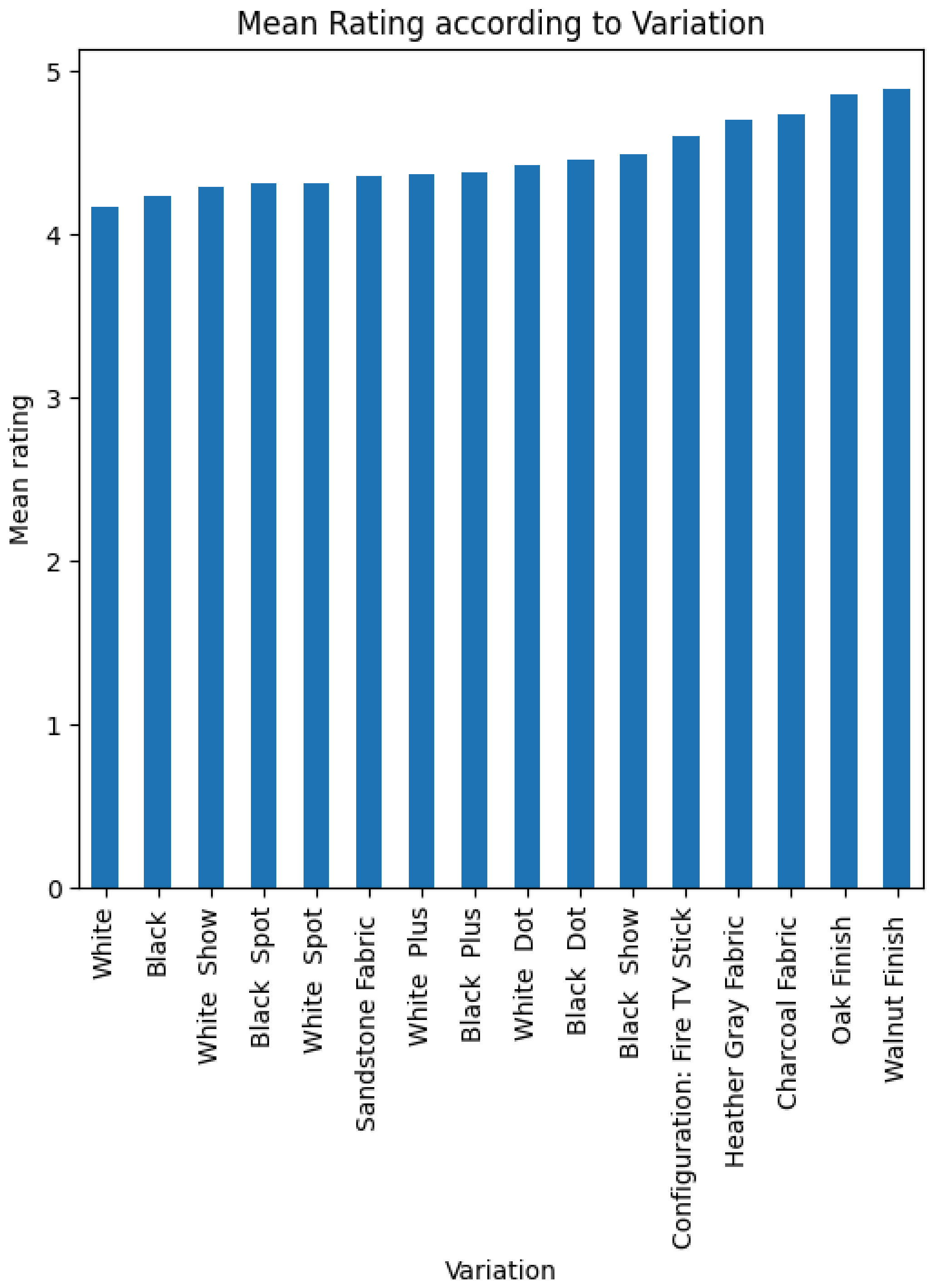
Out[23]:

variation	rating
Black	4.233716
Black Dot	4.453488
Black Plus	4.370370
Black Show	4.490566
Black Spot	4.311203
Charcoal Fabric	4.730233
Configuration: Fire TV Stick	4.591429
Heather Gray Fabric	4.694268
Oak Finish	4.857143
Sandstone Fabric	4.355556
Walnut Finish	4.888889
White	4.166667
White Dot	4.423913
White Plus	4.358974
White Show	4.282353
White Spot	4.311927

dtype: float64

In [24]:

```
# Bar chart of variation counts sorted from highest to lowest
plt.figure(figsize=(6,6))
data.groupby('variation')['rating'].mean().sort_values().plot(kind='bar')
plt.title('Mean Rating according to Variation')
plt.xlabel('Variation')
plt.ylabel('Mean rating')
plt.show()
```



Walnut Finish has Highest Rating and White has the lowest rating according to the data

Analyzing the Verified_Reviews Column

```
In [25]: data['length'].describe()
```

Out[25]:

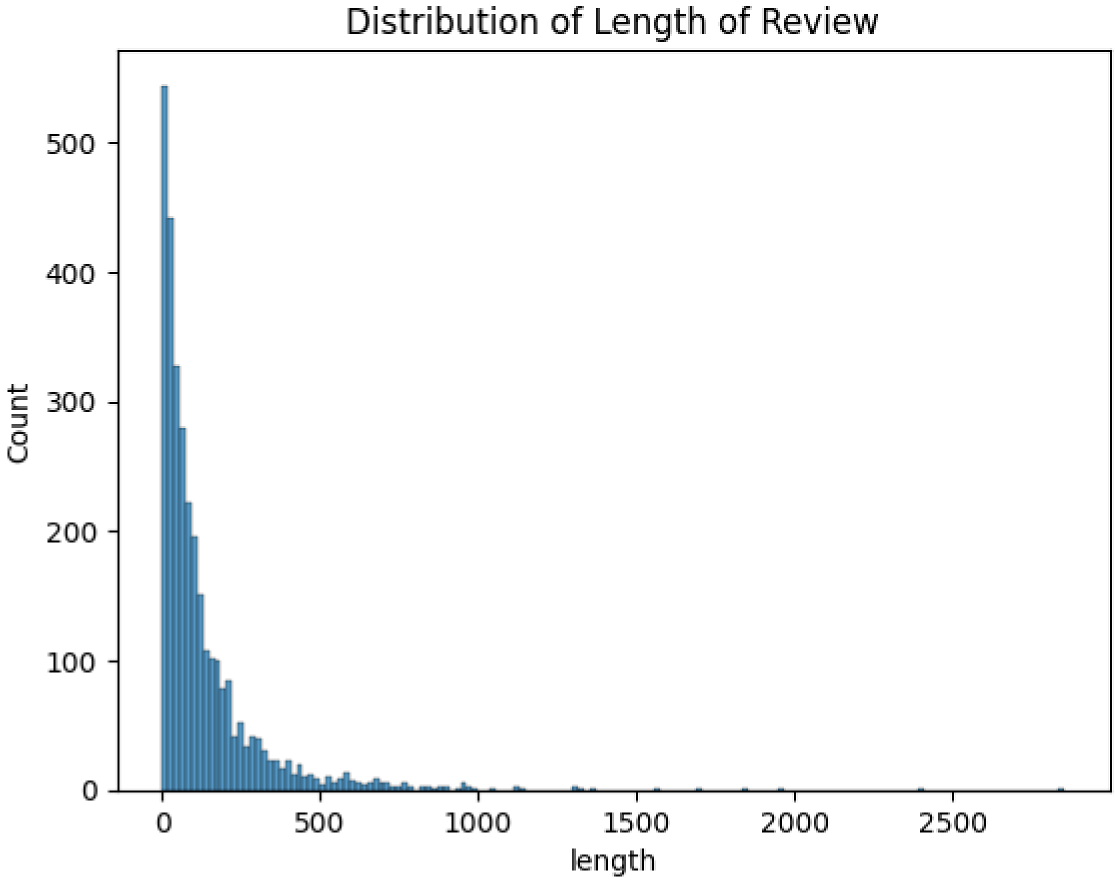
	length
count	3149.000000
mean	132.714513
std	182.541531
min	1.000000
25%	30.000000
50%	74.000000
75%	166.000000
max	2853.000000

dtype: float64

Length Analysis for Full Data Set

In [26]:
```
sns.histplot(data['length']).set(title ='Distribution of Length of Review')
```

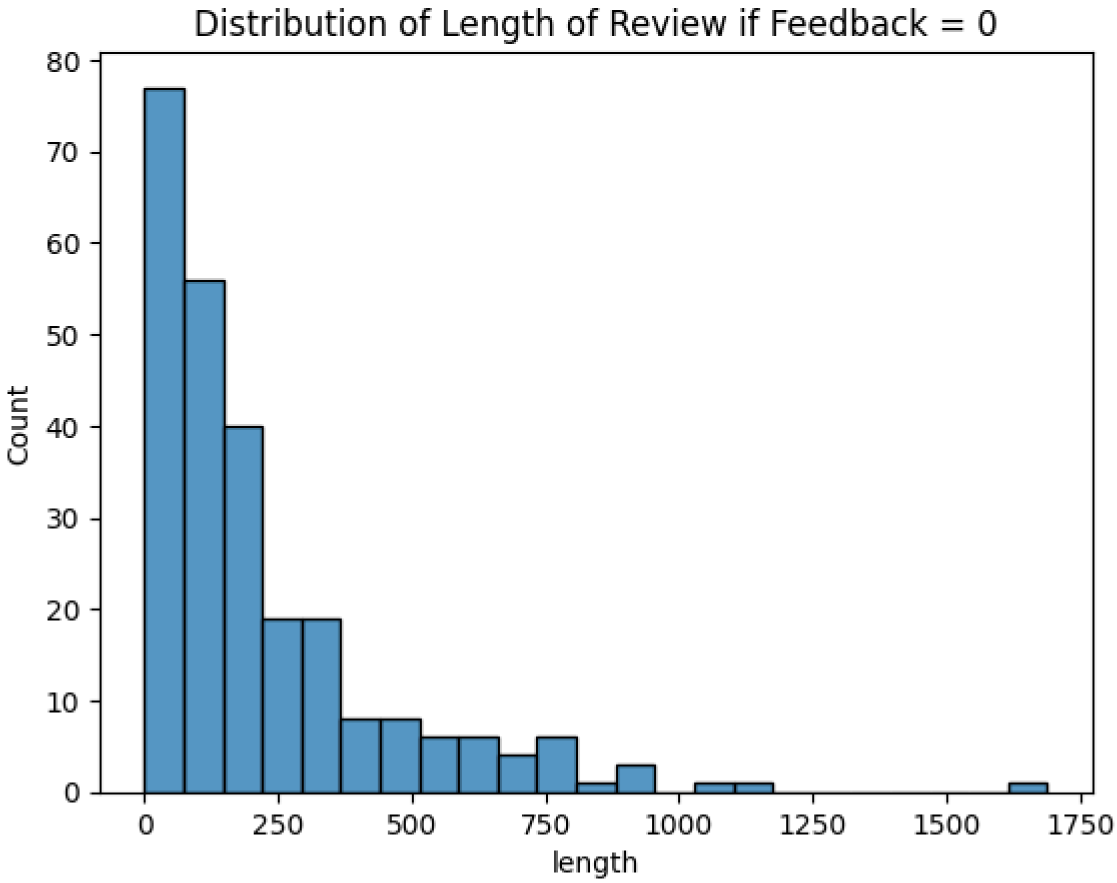
Out[26]:
```
[Text(0.5, 1.0, 'Distribution of Length of Review')]
```



Length Analysis when feedback is 0 (negative)

In [27]:
```
sns.histplot(data[data['feedback']==0]['length']).set(title ='Distribution of Lengt
```

Out[27]:
```
[Text(0.5, 1.0, 'Distribution of Length of Review if Feedback = 0')]
```



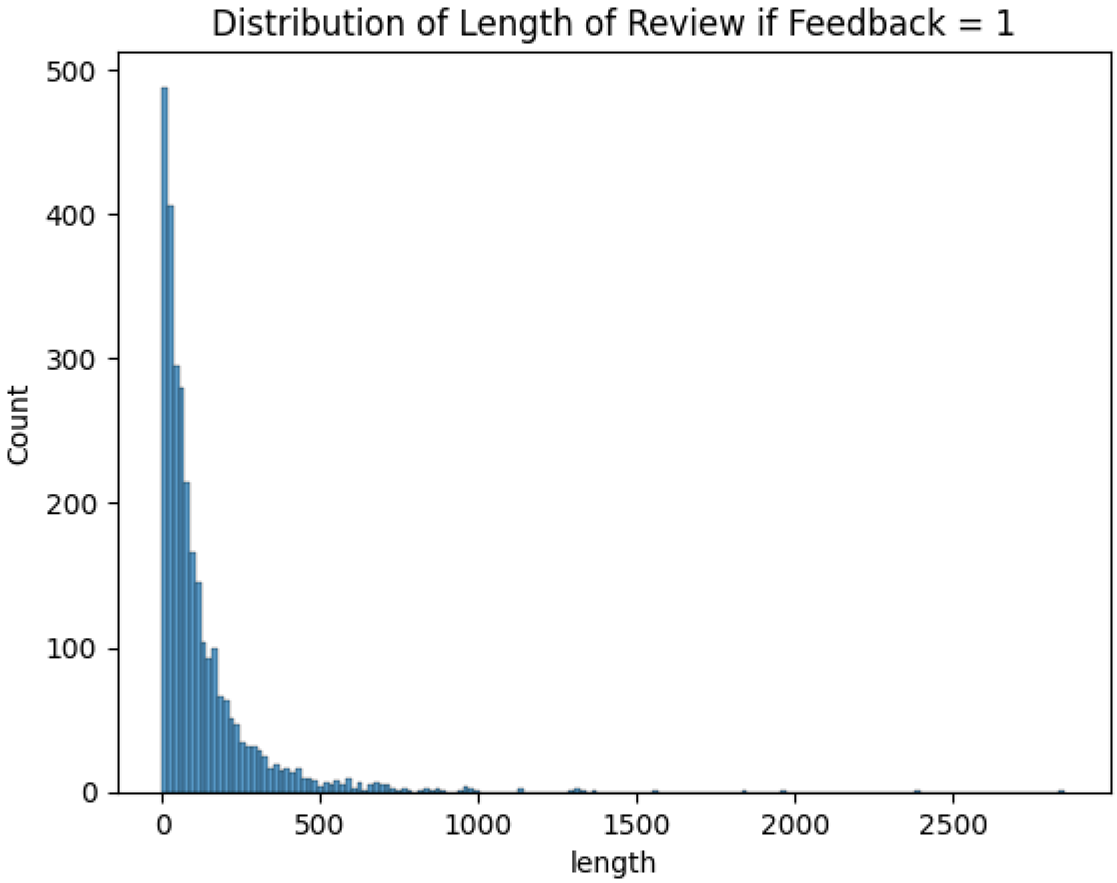
Length Analysis when feedback is 1(Positive)

In [28]:

```
sns.histplot(data[data['feedback']==1]['length']).set(title ='Distribution of Lengt
```

Out[28]:

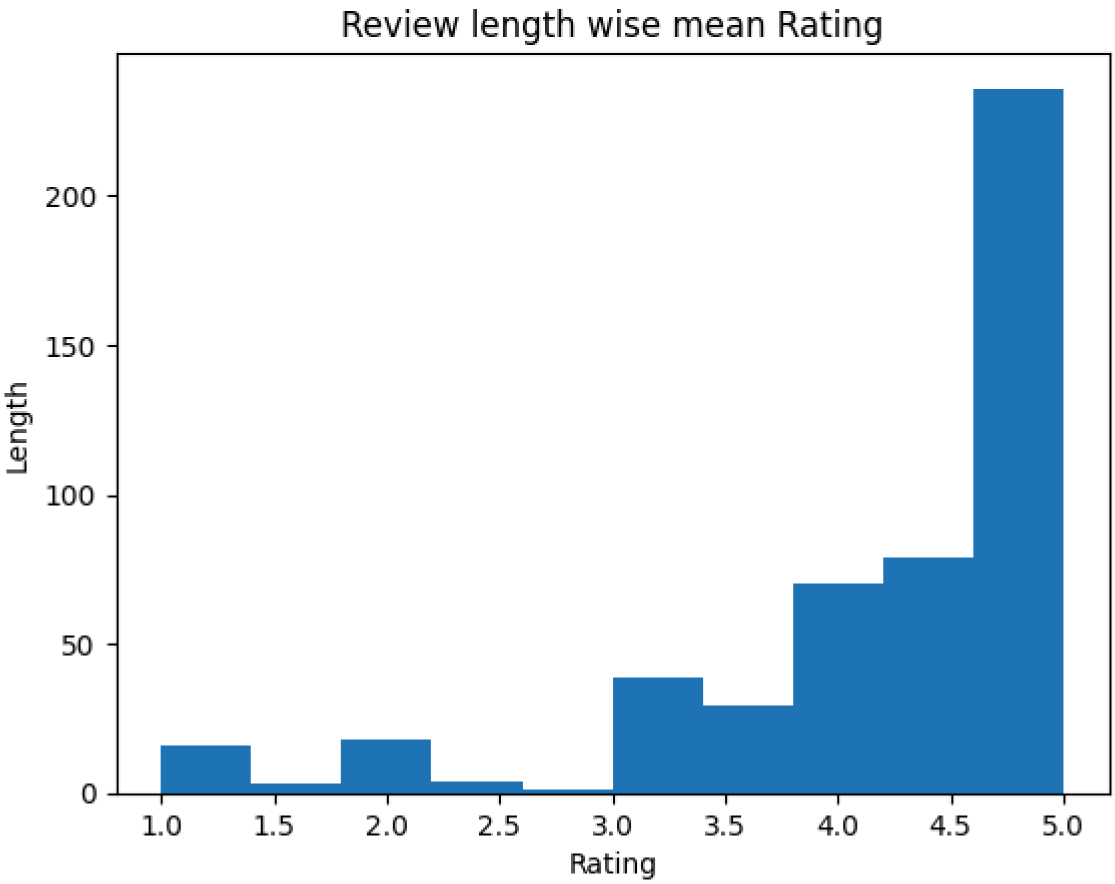
```
[Text(0.5, 1.0, 'Distribution of Length of Review if Feedback = 1')]
```



Length Mean rating

In [29]:
```
data.groupby('length')['rating'].mean().plot.hist()
plt.title('Review length wise mean Rating')
plt.xlabel('Rating')
plt.ylabel('Length')
```

Out[29]:
```
Text(0, 0.5, 'Length')
```

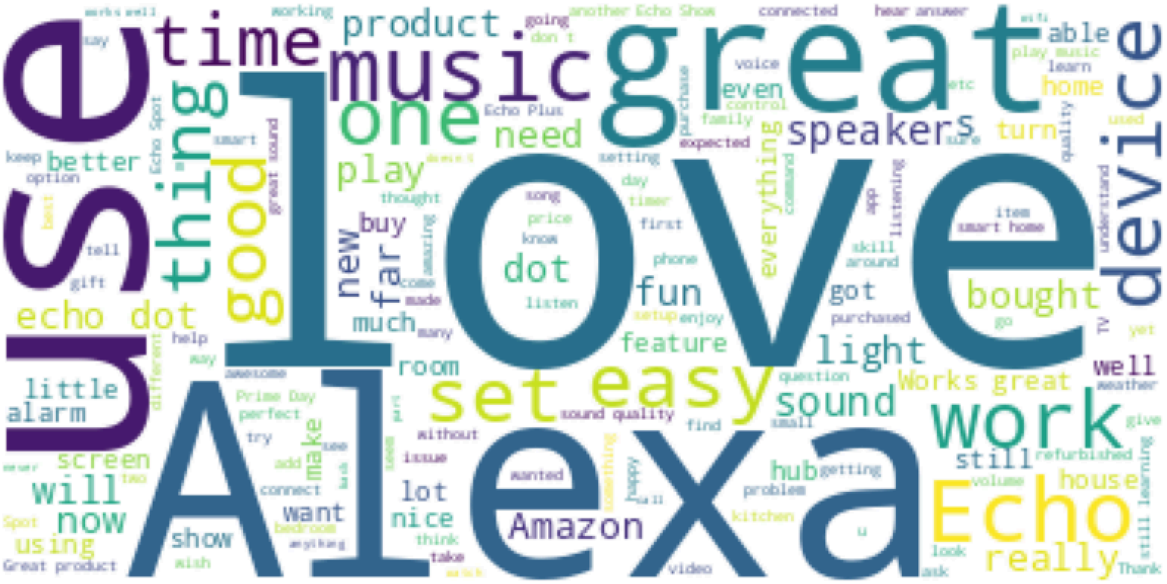


People who are giving more rating are writing the large good reviews so length for 5 stars is higher

In [30]:
```
cv = CountVectorizer(stop_words='english')
words = cv.fit_transform(data.verified_reviews)
```

In [31]:
```
reviews = " ".join([review for review in data['verified_reviews']]) # Remove extra

wc = WordCloud(background_color='white', max_words=500)

plt.figure(figsize=(10,8))
plt.imshow(wc.generate(reviews))
plt.title('Wordcloud for all reviews', fontsize=10)
plt.axis('off')
plt.show()
```

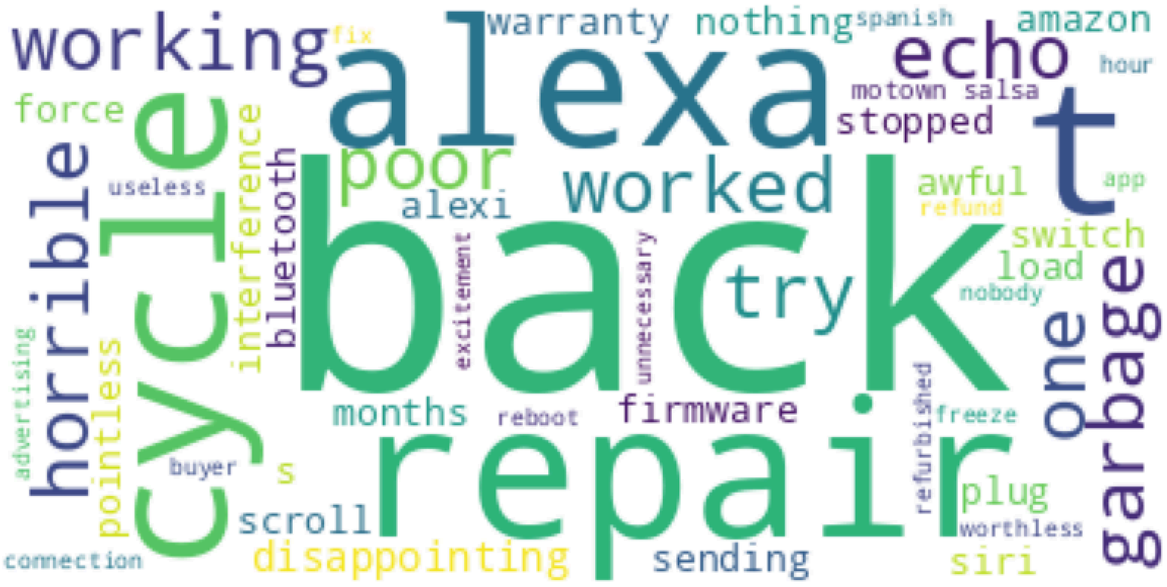
Wordcloud for all reviews



In [32]:
```
neg_reviews = " ".join([review for review in data[data['feedback']==0]['verified_re
neg_reviews = neg_reviews.lower().split()


pos_reviews = " ".join([review for review in data[data['feedback']==1]['verified_re
pos_reviews = pos_reviews.lower().split()

unique_neagtive = [x for x in neg_reviews if x not in pos_reviews]
unique_neagtive = " ".join(unique_neagtive)

unique_positive = [x for x in pos_reviews if x not in neg_reviews]
unique_positive = " ".join(unique_positive)
```

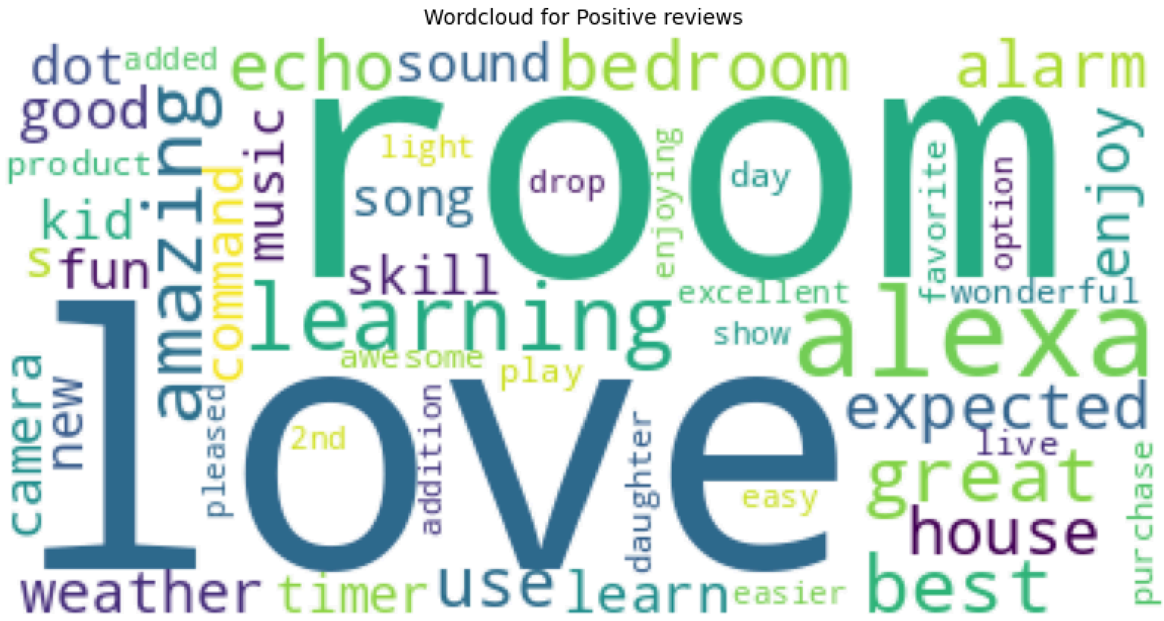
In [33]:
```
wc = WordCloud(background_color='white', max_words=50)

plt.figure(figsize=(10,8))
plt.imshow(wc.generate(unique_neagtive))
plt.title('Wordcloud for Negative reviews', fontsize=10)
plt.axis('off')
plt.show()
```

Wordcloud for Negative reviews



Neagative words can be seen : horrible, repair, back, echo, cycle,garbage, pointless, refund,

In [34]:
```
wc = WordCloud(background_color='white', max_words=50)

plt.figure(figsize=(10,8))
plt.imshow(wc.generate(unique_positive))
plt.title('Wordcloud for Positive reviews', fontsize=10)
plt.axis('off')
plt.show()
```



Positive words can be seen :Love, Learning, Expected, Awesome, great, skill, alarm

Preprocessing and Modelling

To build the corpus from the 'verified_reviews' we perfrom the following -

1. Replace any non alphabet characters with a space
2. Convert to lower case and split into words
3. Iterate over the Infividual words and if it is not a stopwords then add the stemmed from of the words to the corpus

In [35]:
```
corpus= []
stemmer = PorterStemmer()
for i in range (0,data.shape[0]):
  review = re.sub('[^a-zA-Z]', ' ', data.iloc[i]['verified_reviews'])
  review = review.lower().split()
  review = [stemmer.stem(word) for word in review if word not in STOPWORDS]
  review = ' '.join(review)
  corpus.append(review)
```

Using Count Vectorizer to creat bags of words

- Count vectorizer ; technique using in NLP to convert the textual language into the numeric data for feeding to the ML models

In [36]:

```
cv = CountVectorizer(max_features=2500)

# Storting independent and dependent variable in x and y
X = cv.fit_transform(corpus).toarray()
y = data['feedback'].values
```

In [37]:

```
# Saving the count vectorizer

pickle.dump(cv, open('countVectorizer.pkl', 'wb'))
```

Spliting data into train and test set with 30% data with testing

In [38]:

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_sta

print("X_train:" , X_train.shape)
print("X_test:", X_test.shape)
print("y_train:", y_train.shape)
print("y_test:", y_test.shape)
```

```
X_train: (2204, 2500)
X_test: (945, 2500)
y_train: (2204,)
y_test: (945,)
```

In [39]:

```
print("X train max val:", X_train.max())
print("X test max val:", X_test.max())
```

```
X train max val: 12
X test max val: 10
```

Will scale X_train and X_test so that all values are between 0 & 1

In [40]:

```
scaler = MinMaxScaler()

X_train_scl = scaler.fit_transform(X_train)
X_test_scl = scaler.transform(X_test)
```

In [41]:

```
# Saving the Scaler model

pickle.dump(scaler, open('scaler.pkl', 'wb'))
```

Random Forest

In [42]:

```
# fitting scaled x_train and y_train to Random forest classifier

model_rf = RandomForestClassifier()
model_rf.fit(X_train_scl, y_train)

print("Training Accuracy of RF :", model_rf.score(X_train_scl, y_train))
print("Testing Accuracy of RF :", model_rf.score(X_test_scl, y_test))
```

```
Training Accuracy of RF : 0.9941016333938294
Testing Accuracy of RF : 0.946031746031746
```

In [43]:

```
from xgboost import XGBClassifier # Correct class name

model_xgb = XGBClassifier()
model_xgb.fit(X_train_scl, y_train)

print("Training Accuracy of XGB :", model_xgb.score(X_train_scl, y_train))
print("Testing Accuracy of XGB :", model_xgb.score(X_test_scl, y_test))
```

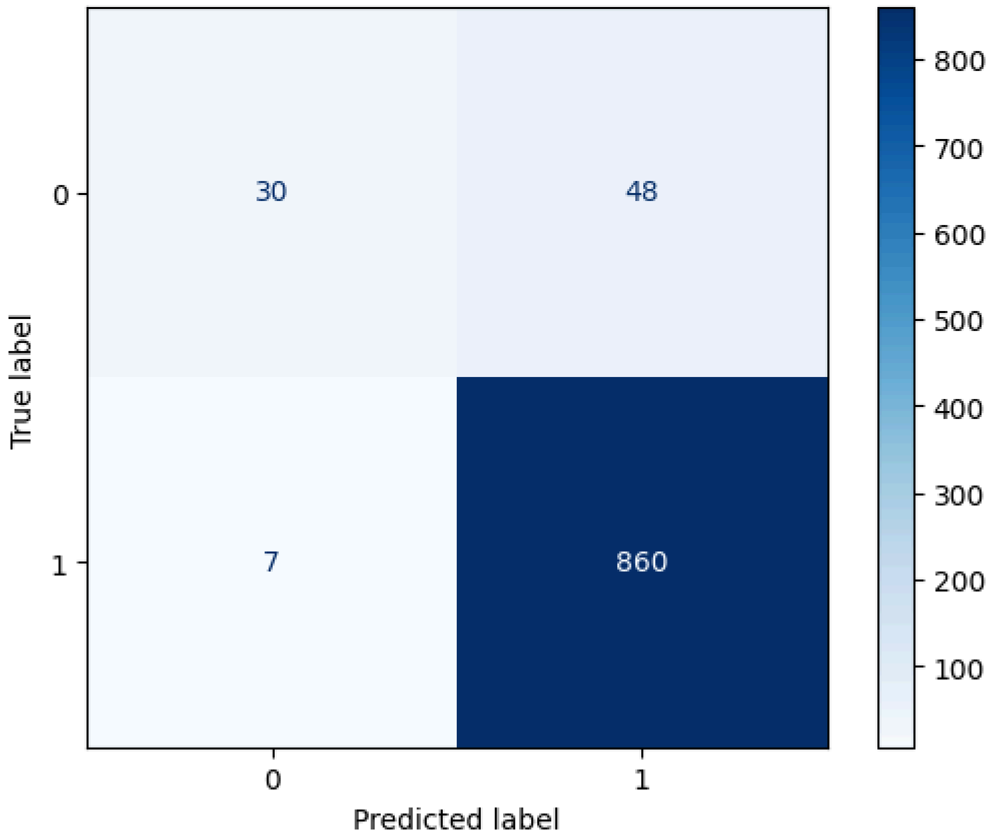
```
Training Accuracy of XGB : 0.971415607985481
Testing Accuracy of XGB : 0.9417989417989417
```

In [44]:

```
# Now predict using the rescaled X_test
y_pred = model_xgb.predict(X_test_scl)
```

In [45]:

```
from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay

# Assuming you have the true labels `y_true` and predicted labels `y_pred`
cm = confusion_matrix(y_test, y_pred)
disp = ConfusionMatrixDisplay(confusion_matrix=cm)

disp.plot(cmap=plt.cm.Blues)
plt.show()
```



In [46]:

```
cm = confusion_matrix(y_test, y_pred)
print(cm)
```

```
[[ 30  48]
 [  7 860]]
```

- True Negatives (TN): 30 (Top-left cell) - The number of negative instances that were correctly classified as negative.
- False Positives (FP): 48 (Top-right cell) - The number of negative instances that were incorrectly classified as positive.
- False Negatives (FN): 7 (Bottom-left cell) - The number of positive instances that were incorrectly classified as negative.
- True Positives (TP): 860 (Bottom-right cell) - The number of positive instances that were correctly classified as positive.

In [47]:

```
# Values from the confusion matrix
TN = 30
```

```
FP = 48
FN = 7
TP = 860

# Calculating the metrics
accuracy = (TP + TN) / (TP + TN + FP + FN)
precision = TP / (TP + FP)
recall = TP / (TP + FN)
f1_score = 2 * (precision * recall) / (precision + recall)
specificity = TN / (TN + FP)

print(f'Accuracy: {accuracy:.2f}')
print(f'Precision: {precision:.2f}')
print(f'Recall: {recall:.2f}')
print(f'F1 Score: {f1_score:.2f}')
print(f'Specificity: {specificity:.2f}')
```

```
Accuracy: 0.94
Precision: 0.95
Recall: 0.99
F1 Score: 0.97
Specificity: 0.38
```

In [48]:

```
#Saving the XGBoost classifier
pickle.dump(model_xgb, open('model_xgb.pkl', 'wb'))
```

In [49]:

```
import sklearn
from sklearn.feature_extraction.text import TfidfVectorizer

import pickle
with open('countVectorizer.pkl', 'rb') as f:
    vectorizer = pickle.load(f)

new_review = "I bought this product as a gift for my sister, and she was absolutely
new_review_vectorized = vectorizer.transform([new_review])
sentiment = model_xgb.predict(new_review_vectorized)

if sentiment == 1 :
  print(f"The sentiment of the review is: Positive")

elif sentiment == 0:
  print(f"The sentiment of the review is: Negative")

else :
  print(f"The sentiment of the review is: Neutral")
```

```
The sentiment of the review is: Positive
```