In [1]:
```
import pandas as pd
df1 = pd.read_csv('drugsComTest_raw.tsv',delimiter='\t')     # Read t
he files with the pandas dataFrame
df2 = pd.read_csv('drugsComTrain_raw.tsv', delimiter='\t')
```

In [2]:
```
df = pd.concat([df1,df2])
```

In [3]:
```
df.columns = ['Id','drugName','condition','review','rating','date','u
sefulCount']    #rename columns
```

In [4]:
```
df['date'] = pd.to_datetime(df['date'])
```

In [5]:
```
df2 = df[['Id','review','rating']].copy()
```

In [6]:
```
import nltk
nltk.download(['punkt','stopwords'])
```

```
[nltk_data] Downloading package punkt to /home/talha/nltk_data...
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package stopwords to /home/talha/nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
```

Out[6]:
```
True
```

In [7]:
```
from nltk.corpus import stopwords
stopwords = stopwords.words('english')
```

In [8]:
```
df2['cleanReview'] = df2['review'].apply(lambda x: ' '.join([item for
item in x.split() if item not in stopwords]))     # remove stopwords
 from review
```

In [9]:
```
import vaderSentiment
from vaderSentiment.vaderSentiment import SentimentIntensityAnalyzer
analyzer = SentimentIntensityAnalyzer()
```

In [11]:
```
df2['vaderReviewScore'] = df2['cleanReview'].apply(lambda x: analyzer
.polarity_scores(x)['compound'])
```

In [12]:
```
positive_num = len(df2[df2['vaderReviewScore'] >=0.05])
neutral_num = len(df2[(df2['vaderReviewScore'] >-0.05) & (df2['vaderR
eviewScore']<0.05)])
negative_num = len(df2[df2['vaderReviewScore']<=-0.05])
```

In [13]:
```
df2['vaderSentiment']= df2['vaderReviewScore'].map(lambda x:int(2) if
x>=0.05 else int(1) if x<=-0.05 else int(0) )
```

In [14]:
```
Total_vaderSentiment = positive_num + neutral_num + negative_num
```

In [15]:
```
df2.loc[df2['vaderReviewScore'] >=0.05,"vaderSentimentLabel"] ="posit
ive"
df2.loc[(df2['vaderReviewScore'] >-0.05) & (df2['vaderReviewScore']<
0.05),"vaderSentimentLabel"]= "neutral"
df2.loc[df2['vaderReviewScore']<=-0.05,"vaderSentimentLabel"] = "nega
tive"
```

In [16]:
```
positive_rating = len(df2[df2['rating'] >=7.0])
neutral_rating = len(df2[(df2['rating'] >=4) & (df2['rating']<7)])
negative_rating = len(df2[df2['rating']<=3])
```

In [17]:
```
Total_rating = positive_rating+neutral_rating+negative_rating
```

In [18]:
```
df2['ratingSentiment']= df2['rating'].map(lambda x:int(2) if x>=7 els
e int(1) if x<=3 else int(0) )
```

In [19]:
```
df2.loc[df2['rating'] >=7.0,"ratingSentimentLabel"] ="positive"
df2.loc[(df2['rating'] >=4.0) & (df2['rating']<7.0),"ratingSentimentL
abel"]= "neutral"
df2.loc[df2['rating']<=3.0,"ratingSentimentLabel"] = "negative"
```

In [20]:
```
df2 = df2[['Id','review','cleanReview','rating','ratingSentiment','ra
tingSentimentLabel','vaderReviewScore','vaderSentiment','vaderSentime
ntLabel']]
```

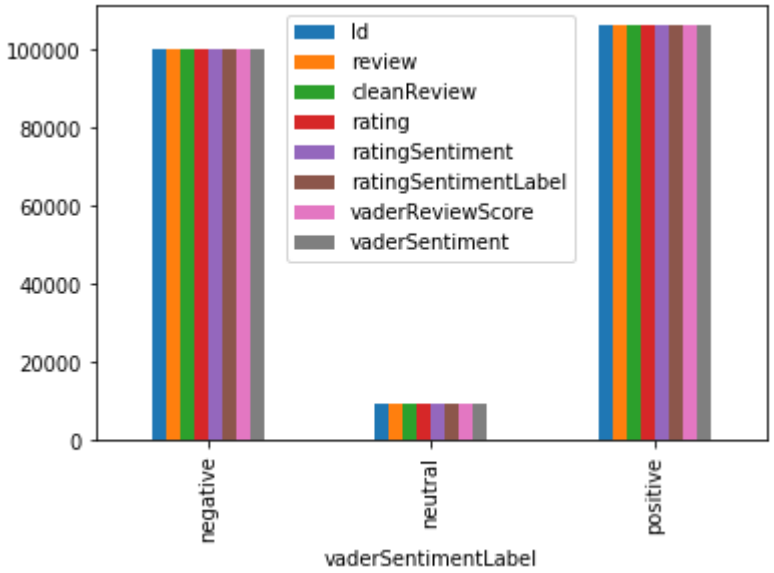
In [21]:
```
df2.to_csv('processed.csv')
```

In [22]:
```
df = pd.read_csv('processed.csv')
```

In [23]:
```
df = df.drop(columns=df.columns[0])
```

In [24]:
```
import matplotlib.pyplot as plt
```

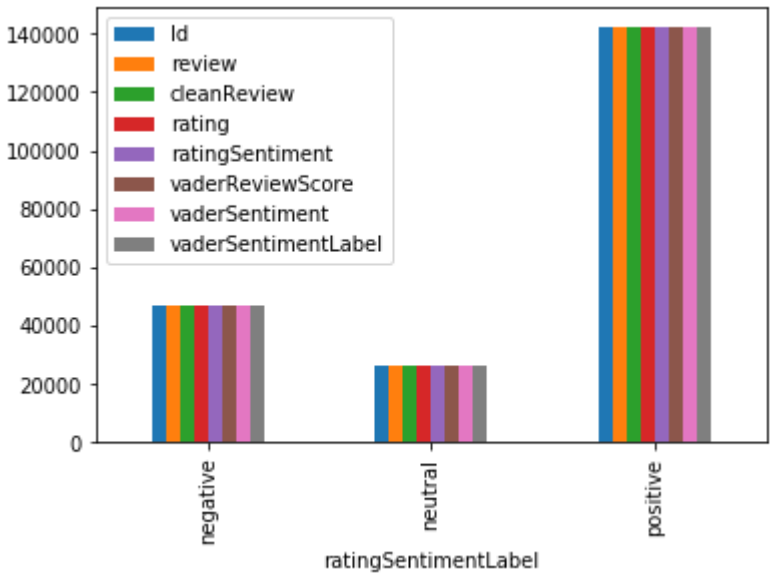
In [25]:
```
df.groupby('vaderSentimentLabel').count().plot.bar()
plt.show()
```



In [26]:
```
df.groupby('ratingSentimentLabel').size()
```

Out[26]:
```
ratingSentimentLabel
negative     46901
neutral      25856
positive    142306
dtype: int64
```

In [27]:
```
df.groupby('ratingSentimentLabel').count().plot.bar()
plt.show()
```

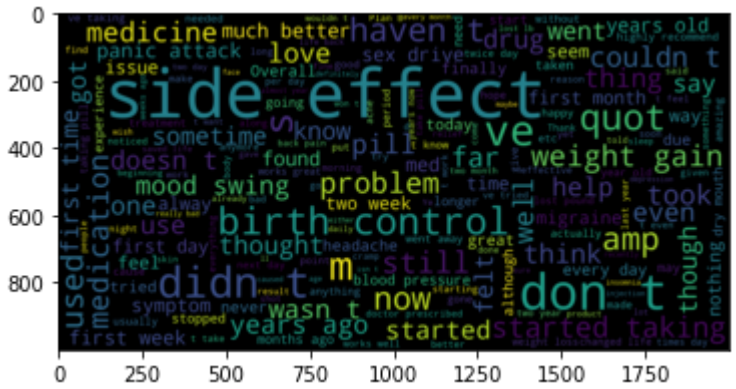


In [28]:
```
df.groupby('ratingSentiment').size()
```

Out[28]:
```
ratingSentiment
0     25856
1     46901
2    142306
dtype: int64
```

In [29]:
```
positive_vader_sentiments = df[df.ratingSentiment == 2]
positive_string = []
for s in positive_vader_sentiments.cleanReview:
  positive_string.append(s)
positive_string = pd.Series(positive_string).str.cat(sep=' ')
```

In [30]:
```
from wordcloud import WordCloud
wordcloud = WordCloud(width=2000,height=1000,max_font_size=200).gener
ate(positive_string)
plt.imshow(wordcloud,interpolation='bilinear')
plt.show()
```

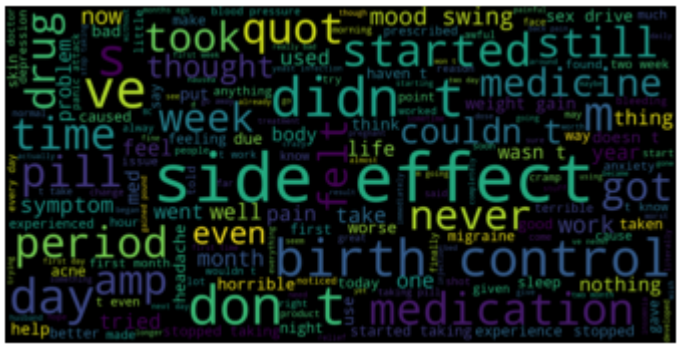


In [31]:
```
for s in positive_vader_sentiments.cleanReview[:20]:
  if 'side effect' in s:
    print(s)
```

```
"I&#039;ve tried antidepressants years (citalopram, fluoxetine, amitr
iptyline), none helped depression, insomnia &amp;amp; anxiety. My doctor
suggested changed onto 45mg mirtazapine medicine saved life. Thankful
ly I side effects especially common - weight gain, I&#039;ve actually
lost alot weight. I still suicidal thoughts mirtazapine saved me."
"My son Crohn&#039;s disease done well Asacol. He complaints shows si
de effects. He taken many nine tablets per day one time. I&#039;ve ha
ppy results, reducing bouts diarrhea drastically."
"I birth control one cycle. After reading reviews type similar birth
controls I bit apprehensive start. Im giving birth control 9 10 I lon
g enough 10. So far I love birth control! My side effects minimal lik
e Im even birth control! I experienced mild headaches nausea ive feel
ing great! I got period cue third day inactive pills I idea coming I
zero pms! My period light I barely cramping! I unprotected sex first
month obviously didn&#039;t get pregnant I&#039;m pleased! Highly rec
ommend"
"This drug pretty amazing. I&#039;ve hyperhydrosis palms, soles under
arms since hitting puberty. I skeptic since I&#039;ve previously trie
d botox, iontophoresis drysol limited results. However, three days ta
king oxybutynin (5mg 3x day) I 95% sweat-free. My negative things say
drug side effects. I gotten fairly dizzy/spaced times, I experience d
ry mouth pretty often. However, that&#039;s bad comparison acne I&#03
9;ve gotten. I used get pimples around month, however I ones lasting
&lt;6 wks, varying size/colour. I constantly groups acne face. Does a
nyone remedies? I&#039;ve tried acne masks, cleansers tea tree oil."
"2.75g x 2 every night five years. Deeper sleep dreaming infrequent.
No side effects whatsoever. I&#039;ve gotten used salt added manufact
ure."
```

In [32]:
```
negative_vader_sentiments = df[df.ratingSentiment == 1]
negative_string = []
for s in negative_vader_sentiments.cleanReview:
  negative_string.append(s)
negative_string = pd.Series(negative_string).str.cat(sep=' ')
```

In [33]:
```
from wordcloud import WordCloud
wordcloud = WordCloud(width=2000,height=1000,max_font_size=200).generate(negative_string)
plt.imshow(wordcloud,interpolation='bilinear')
plt.axis('off')
plt.show()
```



In [34]:
```
for s in negative_vader_sentiments.cleanReview[:20]:
  if 'side effect' in s:
    print(s)
```

"About two months ago I switch LoLestrin Fe microgestin due insurance pharmacy. Since starting microgestin I've noticed insane bloating nausea weird discharge. While lolestrin, periods consisted spotting average side effects, nothing serious, one month micro I got period heavy cramping painful I leave class. I've also noticed I've developed bad depression mood swings intense. My anxiety bad sex drive low nonexistent anymore. It helped acne I'm lot paranoid getting pregnant I lolestrin. I'm going talking doctor possibly getting shot."
"I 12 year survivor mirapex/Pramepexole. It miracle begin with. I slept 4hrs night enormous energy never tired. That lasted nine years. But time I lost bladder control, impulse disorders, loss concentration, myalgia neuropathy, falling asleep driving, many augmentation. I .5 mg. Detoxing med free med horrendous! After detox side effects cleared up. But I still issues memory concentration. This med I took reg bases health good. Im still suffering side effects Withdrawl it. Studies longer 12 weeks."
"I started nifedipine/Procardia morning. About 4 hours later rare side effects kicked in. Heart palpitations, dizziness, headache, I FREEZING. Even 43 I still call mommy. She wasn't thrilled I going take anyway since I perfect blood pressure. But recommended laying left side. That help even take awhile get warm again. The headache still lingering."

In [35]:
```
neutral_vader_sentiments = df[df.ratingSentiment == 0]
neutral_string = []
for s in neutral_vader_sentiments.cleanReview:
  neutral_string.append(s)
neutral_string = pd.Series(neutral_string).str.cat(sep=' ')
```

In [36]:
```
from wordcloud import WordCloud
wordcloud = WordCloud(width=2000,height=1000,max_font_size=200).gener
ate(neutral_string)
plt.imshow(wordcloud,interpolation='bilinear')
plt.axis('off')
plt.show()
```

In [37]:
```
for s in neutral_vader_sentiments.cleanReview[:20]:
  if 'side effect' in s:
    print(s)
```

```
"Have Actos almost year, gained 24 pounds swelling hands feet retaini
ng lot water thighs. My sugar levels good. My doctor lowered dosage 3
0 mg 15 mg refused take off. Will get second opinion side effects muc
h."
"I&#039;d never birth control months ago, I given Ortho Tri-Cyclen Lo
starter, I want much hormones. I went two whole packs decided switch
extremely low sex drive, extreme mood swings increased appetite (I wo
uld eat full meal two hours later stomach would growling again). My r
elationship began suffer due side effects I stopped taking back norma
l. However, pill DID pros: I didn&#039;t get pregnant, regulated peri
od caused breakouts acne. But wary weight gain, decreased libido mood
swings."
```

In [38]:
```
from sklearn.feature_extraction.text import TfidfVectorizer
```

In [39]:
```
tfidf = TfidfVectorizer(stop_words='english',ngram_range=(1,2))
features = tfidf.fit_transform(df.cleanReview)
labels   = df.vaderSentiment
```

In [40]:
```
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn.naive_bayes import MultinomialNB
```

In [41]:
```
x_train,x_test,y_train,y_test = train_test_split(df['cleanReview'],df
['ratingSentimentLabel'],random_state=0)
```

In [42]:
```
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import LinearSVC
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import cross_val_score
from sklearn.preprocessing import StandardScaler
```

In [43]:
```
models = [RandomForestClassifier(n_estimators=200,max_depth=3,random_
state=0),LinearSVC(),MultinomialNB(),LogisticRegression(random_state=
0,solver='lbfgs',max_iter=2000,multi_class='auto')]
CV = 5
cv_df = pd.DataFrame(index=range(CV * len(models)))
entries = []
for model in models:
  model_name = model.__class__.__name__
  accuracies = cross_val_score(model,features,labels,scoring='accurac
y',cv=CV)
  for fold_idx,accuracy in enumerate(accuracies):
    entries.append((model_name,fold_idx,accuracy))
cv_df = pd.DataFrame(entries,columns=['model_name','fold_idx','accura
cy'])
```

In [44]:
```
cv_df
```

Out[44]:

	model_name	fold_idx	accuracy
0	RandomForestClassifier	0	0.494362
1	RandomForestClassifier	1	0.494316
2	RandomForestClassifier	2	0.493897
3	RandomForestClassifier	3	0.493955
4	RandomForestClassifier	4	0.494257
5	LinearSVC	0	0.941948
6	LinearSVC	1	0.943343
7	LinearSVC	2	0.945598
8	LinearSVC	3	0.947968
9	LinearSVC	4	0.945597
10	MultinomialNB	0	0.834864
11	MultinomialNB	1	0.829191
12	MultinomialNB	2	0.832771
13	MultinomialNB	3	0.833023
14	MultinomialNB	4	0.834046
15	LogisticRegression	0	0.901541
16	LogisticRegression	1	0.901518
17	LogisticRegression	2	0.903378
18	LogisticRegression	3	0.904097
19	LogisticRegression	4	0.903562

In [45]:
```
cv_df.groupby('model_name').accuracy.mean()
```

Out[45]:
```
model_name
LinearSVC                 0.944891
LogisticRegression        0.902819
MultinomialNB             0.832779
RandomForestClassifier    0.494158
Name: accuracy, dtype: float64
```

In [46]:
```
from sklearn.preprocessing import Normalizer
```

In [47]:
```
model = LinearSVC('l2')
x_train,x_test,y_train,y_test = train_test_split(features,labels,test
_size=0.25,random_state=0)
normalize = Normalizer()
x_train = normalize.fit_transform(x_train)
x_test = normalize.transform(x_test)
model.fit(x_train,y_train)
y_pred = model.predict(x_test)
```

In [48]:
```
from sklearn.metrics import accuracy_score
print(accuracy_score(y_test, y_pred))
```

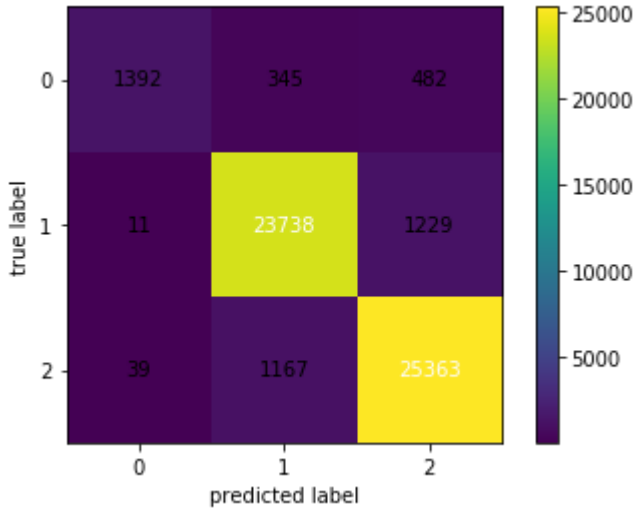
```
0.9391250976453521
```

In [49]:
```
from sklearn.metrics import confusion_matrix
conf_mat = confusion_matrix(y_test,y_pred)
conf_mat
```

Out[49]:
```
array([[ 1392,   345,   482],
       [   11, 23738,  1229],
       [   39,  1167, 25363]])
```

In [50]:
```
from mlxtend.plotting import plot_confusion_matrix
```

In [51]:
```
fig,ax = plot_confusion_matrix(conf_mat=conf_mat,colorbar=True,show_absolute=True,cmap='viridis')
```



In [52]:
```
from  sklearn.metrics import classification_report
print(classification_report(y_test,y_pred,target_names= df['ratingSentimentLabel'].unique()))
```

```
              precision    recall  f1-score   support

    positive       0.97      0.63      0.76      2219
     neutral       0.94      0.95      0.95     24978
    negative       0.94      0.95      0.95     26569

    accuracy                           0.94     53766
   macro avg       0.95      0.84      0.88     53766
weighted avg       0.94      0.94      0.94     53766
```

In [ ]: