Week8_6_LDA_project

May 31, 2021

LDA Project

Import Libraries

```
[1]: import numpy as np
     import pandas as pd
     import glob
     import matplotlib.pyplot as plt
     import seaborn as sns
     import warnings
     warnings.filterwarnings('ignore')
```

Load and display Dataset

```
[2]: dataset = pd.read_csv('/Users/preethamvignesh/Desktop/Work/ML_EIT/Data/
      ↪sport_garden.csv')
     dataset.head()
```

```
[2]:                                          Description      label
     0  This is how I pictured Rachel Lind's house in …  gardening
     1                    Came here to say exactly this!   gardening
     2                     Rachel Lind's house? Really??   gardening
     3  Of course, she would have nothing but the best…  gardening
     4                 Let's be kindred spirits, please.   gardening
```

Initial Data cleaning

```
[3]: # drop columns that aren't going to be used
     cleaned_dataset = dataset.drop(['label'], axis=1)
     # remove useless text parts
     cleaned_dataset['Description'] = cleaned_dataset['Description'].
      ↪replace(to_replace='xx/xx/\d{4}|XX/XX/\d{4}|\d\d/\d\d/\d{4}|xx/xx/\d{2}|XX/
      ↪XX/\d{2}|\d\d/\d\d/\d{2}|xx+|XX+|{|}|\$\d+(\.\d+)?', value='', regex=True)
     # replace consecutive spaces by only one space
     cleaned_dataset['Description'] = cleaned_dataset['Description'].
      ↪replace(to_replace='\s\s+', value=' ', regex=True)
```

```
[4]: cols = ['Description']
     ids = []
```

```
label_to_id = []
id_to_label = []

count = 0
for c in cols:
    one_hot_encoding = pd.get_dummies(cleaned_dataset[c], prefix = c)
    cleaned_dataset = pd.concat([cleaned_dataset, one_hot_encoding], axis = 1)

    cleaned_dataset[c + ' id'] = cleaned_dataset[c].factorize()[0]
    ids.append(cleaned_dataset[[c, c + ' id']].drop_duplicates().sort_values(c␣
 ↪+ ' id'))
    label_to_id.append(dict(ids[count].values))
    id_to_label.append(dict(ids[count][[c + ' id', c]].values))
    count += 1
```

[5]:

```
import nltk
nltk.download('stopwords')
nltk.download('punkt')
nltk.download('wordnet')
```

```
[nltk_data] Downloading package stopwords to
[nltk_data]     /Users/preethamvignesh/nltk_data…
[nltk_data]   Package stopwords is already up-to-date!
[nltk_data] Downloading package punkt to
[nltk_data]     /Users/preethamvignesh/nltk_data…
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package wordnet to
[nltk_data]     /Users/preethamvignesh/nltk_data…
[nltk_data]   Package wordnet is already up-to-date!
```

[5]:

```
True
```

Data cleaning by removing symbols, short words, stopwords and by stemming words to their dictionary form by using a lemmatizer.

[6]:

```
import re
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
from nltk.stem import WordNetLemmatizer
stop_words = set(stopwords.words('english'))
lemma = WordNetLemmatizer()

def clean_col(col):
    cleaned_col = []
    for r in range(0,len(col)):
        row = str(col[r])
        row = row.lower()
        row = re.sub('[^a-zA-Z]',' ', row)
        row = re.sub(r'\b\w{1}\b', '', row)

        word_tokens = word_tokenize(row)

        row = [w for w in word_tokens if w not in stop_words]
        row = ' '.join(row)
        row = [lemma.lemmatize(w) for w in word_tokenize(str(row).lower())]
        row = ' '.join(row)
        cleaned_col.append(row)
    return cleaned_col
```

[7]:

```
%%time

cleaned_dataset['Description'] = clean_col(cleaned_dataset['Description'])
```

```
CPU times: user 4.43 s, sys: 77.8 ms, total: 4.51 s
Wall time: 4.53 s
```

[8]:

```
show_n_rows = 5

pd.set_option('display.max_colwidth', None)
pd.options.display.max_rows = show_n_rows

cleaned_dataset['Description'].head(show_n_rows)
```

[8]:

```
0                                pictured rachel lind house anne green gable
1                                                           came say exactly
2                                                   rachel lind house really
3    course would nothing best kept garden imagined style similar anne house
4                                                  let kindred spirit please
Name: Description, dtype: object
```

Train a Doc2Vec model.

[9]:

```
from gensim.models.doc2vec import Doc2Vec, TaggedDocument
from nltk.tokenize import word_tokenize

X = cleaned_dataset['Description']
Y = [[i] for i in range(len(X))]
tagged_data  = [TaggedDocument(X[i], Y[i]) for i in range(len(X))]


model = Doc2Vec(
    vector_size=50,
    alpha=0.025,
    min_alpha=0.00025,
    min_count=2,
    sample=0.00001,
#     window=25,
#     negative=5,
    dm=1
)

model.build_vocab(tagged_data)
model.train(tagged_data, total_examples=model.corpus_count, epochs=model.epochs)


filename = "doc2vec_model"
model.save(filename)
print("Model Saved (" + filename + ")")
```

```
Model Saved (doc2vec_model)
```

Vectorize the whole dataset with the trained model

[10]:

```
from gensim.models.doc2vec import Doc2Vec

fname = "doc2vec_model"
model = Doc2Vec.load(fname)
X = cleaned_dataset['Description']

vectorized_complaints = []
for x in X[:]:
    vectorized_complaints.append(model.infer_vector(list(x)))
```

Perform PCA on the vectorized dataset for outlier detection

[11]:

```
from sklearn.decomposition import PCA

pca = PCA(n_components=2).fit(vectorized_complaints)
pca_vectorized_complaints = pca.transform(vectorized_complaints)
```

Perform SVD on the vectorized dataset for outlier detection

[12]:

```
from sklearn.decomposition import TruncatedSVD

svd = TruncatedSVD(n_components=2)
svd_vectorized_complaints = svd.fit_transform(vectorized_complaints)
```

Function to detect outliers with 4 different algorithms.

[13]:

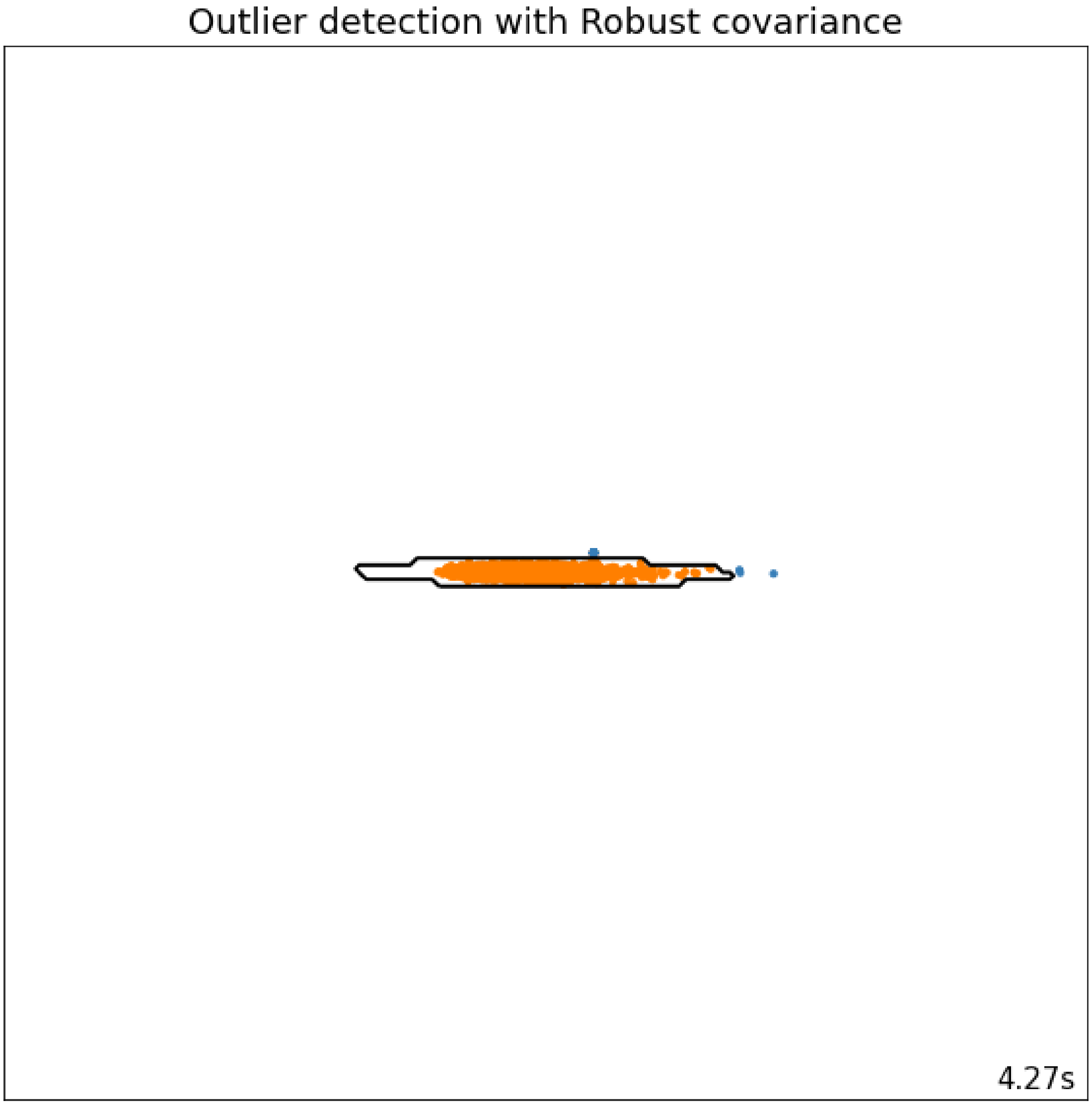
```
import time

import matplotlib
import matplotlib.pyplot as plt
matplotlib.rcParams['contour.negative_linestyle'] = 'solid'
```

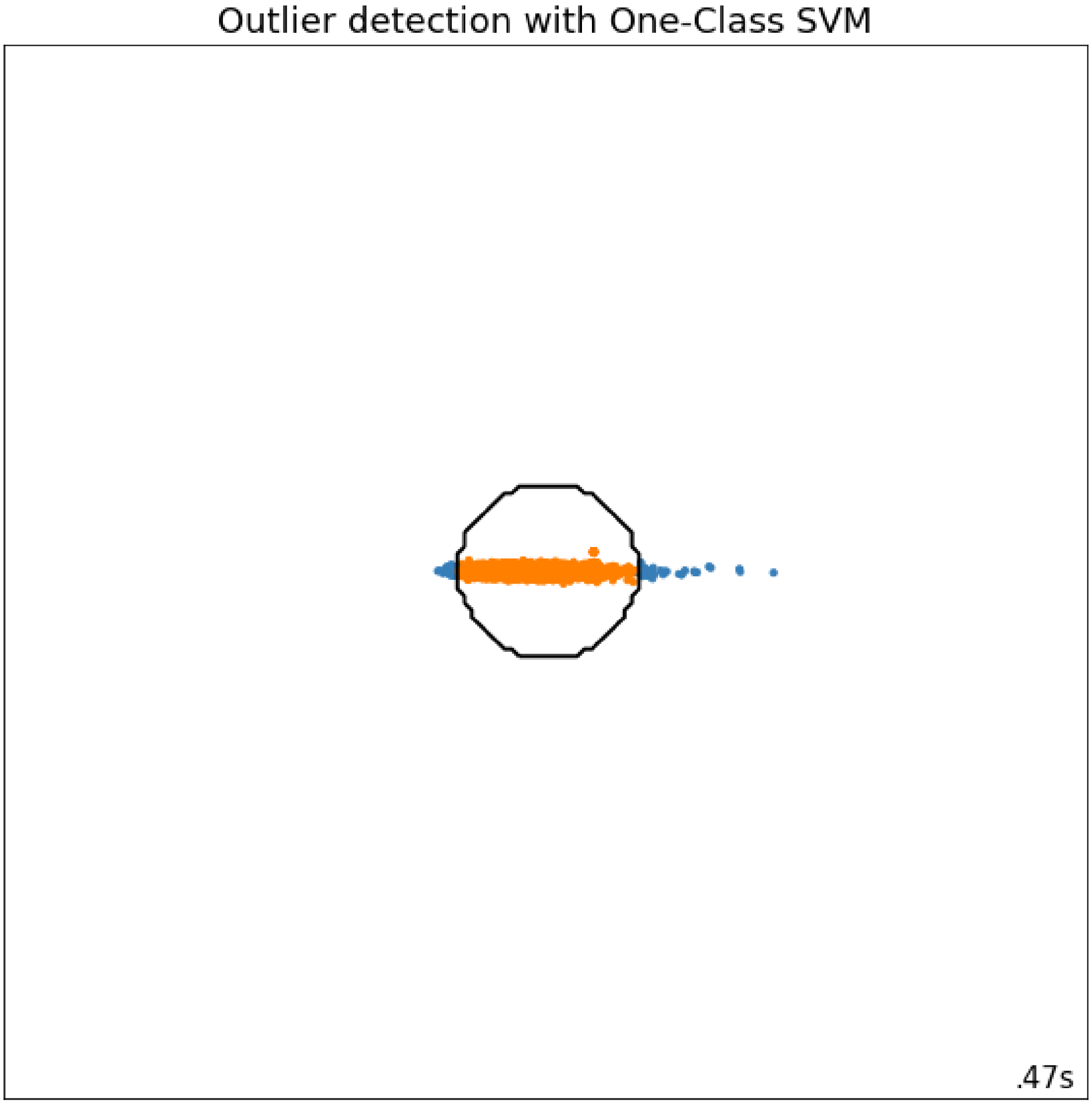
```
from sklearn import svm
from sklearn.covariance import EllipticEnvelope
from sklearn.ensemble import IsolationForest
from sklearn.neighbors import LocalOutlierFactor

def compute_and_plot_outliers(data, outliers_fraction=0.01):
    anomaly_algorithms = [
        ("Robust covariance",␣
 ↪EllipticEnvelope(contamination=outliers_fraction)),
        ("One-Class SVM", svm.OneClassSVM(nu=outliers_fraction, kernel="rbf",␣
 ↪gamma=0.1)),
        ("Isolation Forest", IsolationForest(contamination=outliers_fraction)),
        ("Local Outlier Factor", LocalOutlierFactor(n_neighbors=35,␣
 ↪contamination=outliers_fraction))
    ]

    xx, yy = np.meshgrid(np.linspace(-1, 1, 150), np.linspace(-1, 1, 150))

    y_preds = []

    for name, algorithm in anomaly_algorithms:
        t0 = time.time()

        algorithm.fit(data)

        plt.figure(figsize=(10, 10))
        plt.title("Outlier detection with " + name, size=18)

        if name == "Local Outlier Factor":
            y_pred = algorithm.fit_predict(data)
        else:
            y_pred = algorithm.fit(data).predict(data)

        y_preds.append(y_pred)

        if name != "Local Outlier Factor":
            Z = algorithm.predict(np.c_[xx.ravel(), yy.ravel()])
            Z = Z.reshape(xx.shape)
            plt.contour(xx, yy, Z, levels=[0], linewidths=2, colors='black')

        t1 = time.time()

        colors = np.array(['#377eb8', '#ff7f00'])
        plt.scatter(data[:, 0], data[:, 1], s=10, color=colors[(y_pred + 1) //␣
 ↪2])
```

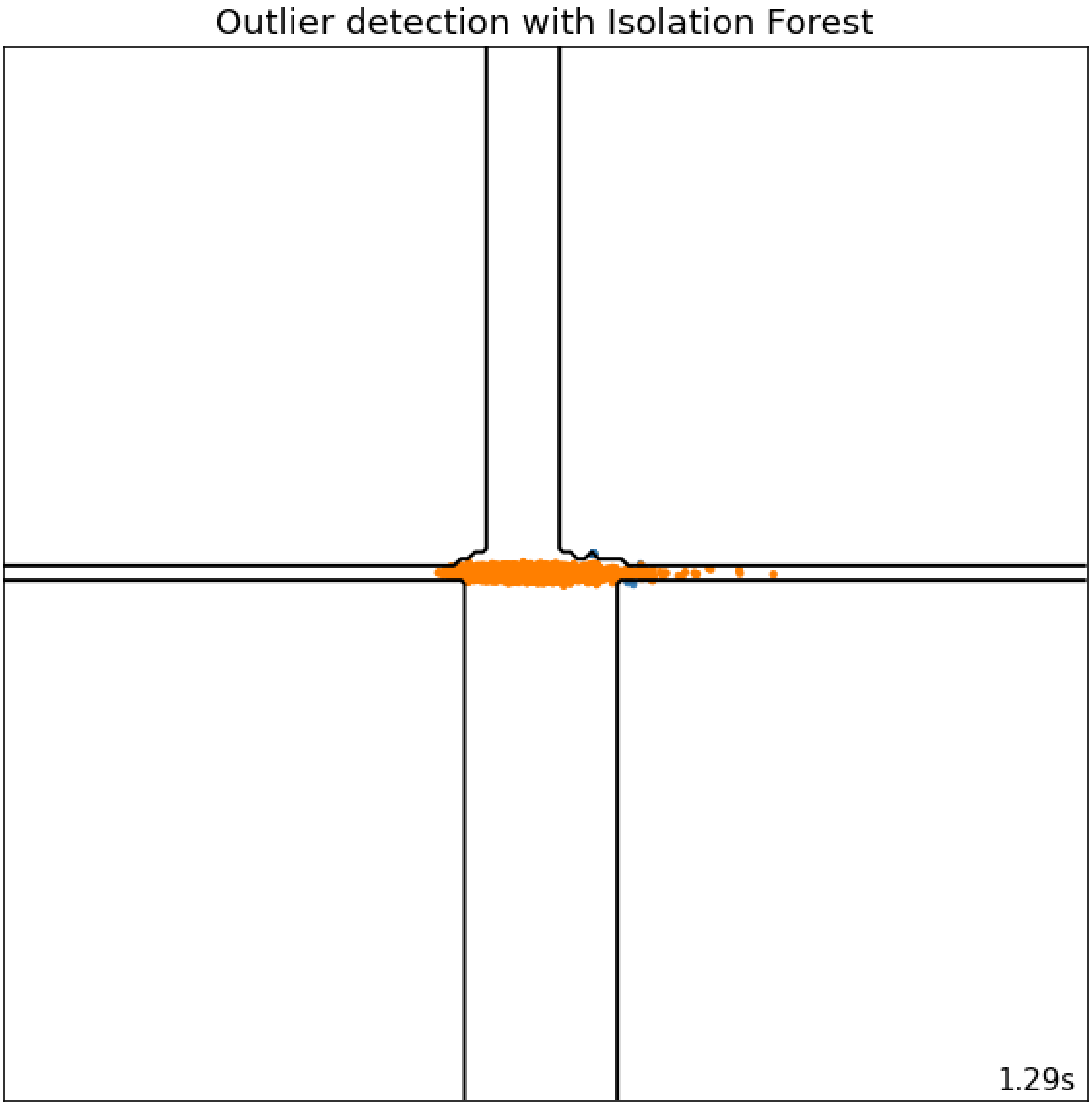
```
        plt.xlim(-1, 1)
        plt.ylim(-1, 1)
        plt.xticks(())
        plt.yticks(())
        plt.text(.99, .01, ('%.2fs' % (t1 - t0)).lstrip('0'), transform=plt.
 ↪gca().transAxes, size=15, horizontalalignment='right')

        plt.show()

    return y_preds
```

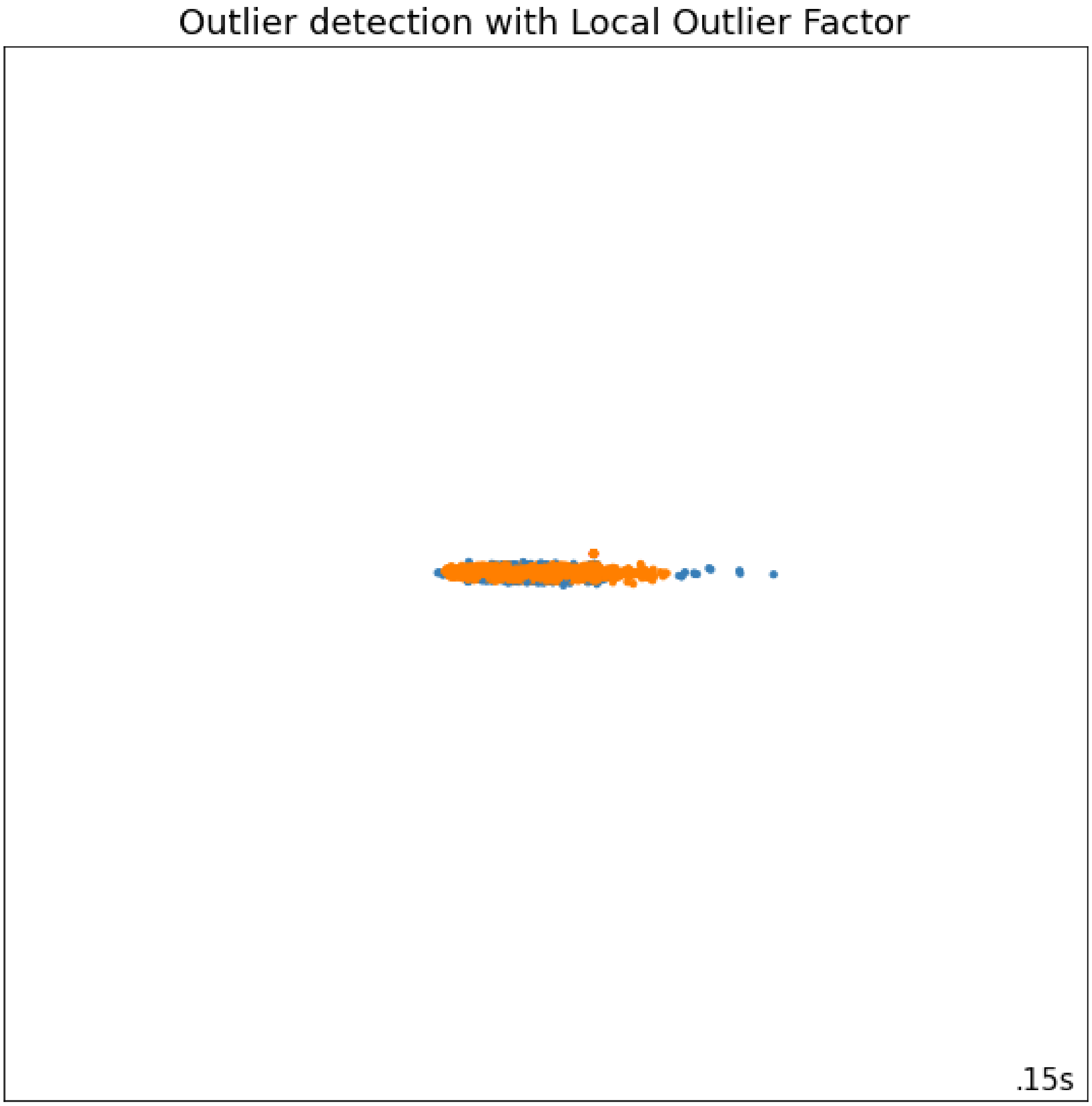
Detect outliers both by using PCA and SVD

```
[14]: pca_y_preds = compute_and_plot_outliers(pca_vectorized_complaints)
```




Outlier detection with One-Class SVM
.47s


Outlier detection with Isolation Forest
1.29s



Get all complaint ids that are labelled as outliers.

```
[15]: def get_outlier_ids(y_pred):
          outlier_ids = []

          for id in range(0, len(y_pred)):
              if y_pred[id] == -1:
                  outlier_ids.append(id)

          return outlier_ids
```

Get all outliers per algorithm (PCA)

```
[16]: pca_outlier_ids = []
      for o in range(0, len(pca_y_preds)):
          outliers = get_outlier_ids(pca_y_preds[o])
          pca_outlier_ids.append(outliers)

          print('#outliers:', len(outliers))
```

```
#outliers: 84
#outliers: 84
#outliers: 84
#outliers: 84
```

```
[17]: print('# of complaints in cleaned_dataset:', cleaned_dataset.shape[0])
```

```
# of complaints in cleaned_dataset: 8360
```

```
[18]: dataset_excluding_outliers = dataset.drop(dataset.index[pca_outlier_ids[0]])
      print('# of complaints in cleaned_dataset_excluding_outliers:',␣
       ↪dataset_excluding_outliers.shape[0])
```

```
# of complaints in cleaned_dataset_excluding_outliers: 8276
```

Use pickle to save the dataset without outliers to a file

```
[19]: filename = 'dataset_excluding_outliers.csv'
      dataset_excluding_outliers.to_csv(filename, index=False)
```

```
[20]: import pandas as pd

      filename = 'dataset_excluding_outliers.csv'
      dataset_excluding_outliers = pd.read_csv(filename)
```

```
[21]: print('# of complaints in vectorized_complaints:', len(vectorized_complaints))
```

```
# of complaints in vectorized_complaints: 8360
```

```
[22]: vectorized_complaints_cleaned = []

      for index in range(0, len(vectorized_complaints)):
          if index not in pca_outlier_ids[0]:
              vectorized_complaints_cleaned.append(vectorized_complaints[index])

      print('# of complaints in vectorized_complaints_cleaned:',␣
       ↪len(vectorized_complaints_cleaned))
```

```
# of complaints in vectorized_complaints_cleaned: 8276
```

Use pickle to save the cleaned vectorized complaints to a file.

[23]:
```python
import pickle

filename = 'vectorized_complaints_cleaned.pkl'
data = vectorized_complaints_cleaned
output = open(filename, 'wb')
pickle.dump(data, output)
output.close()
```

[24]:
```python
import pickle

filename = 'vectorized_complaints_cleaned.pkl'
pkl_file = open(filename, 'rb')
data = pickle.load(pkl_file)
pkl_file.close()
```

Clustering

[25]:
```python
import pandas as pd

filename = 'dataset_excluding_outliers.csv'
cleaned_dataset_excluding_outliers = pd.read_csv(filename)
```

[26]:
```python
import re

# drop columns that aren't going to be used
cleaned_dataset_excluding_outliers = cleaned_dataset_excluding_outliers.
 ↪drop(['label'], axis=1)
# remove useless text parts
cleaned_dataset_excluding_outliers['Description'] =␣
 ↪cleaned_dataset_excluding_outliers['Description'].replace(to_replace='xx/xx/
 ↪\d{4}|XX/XX/\d{4}|\d\d/\d\d/\d{4}|xx/xx/\d{2}|XX/XX/\d{2}|\d\d/\d\d/
 ↪\d{2}|xx+|XX+|{|}|\$\d+(\.\d+)?', value='', regex=True)
# replace consecutive spaces by only one space
cleaned_dataset_excluding_outliers['Description'] =␣
 ↪cleaned_dataset_excluding_outliers['Description'].
 ↪replace(to_replace='\s\s+', value=' ', regex=True)
```

[27]:
```python
%%time

cleaned_dataset_excluding_outliers['Description'] =␣
 ↪clean_col(cleaned_dataset_excluding_outliers['Description'])
```

```
CPU times: user 2.95 s, sys: 9.5 ms, total: 2.96 s
Wall time: 2.97 s
```

[28]:
```python
doc_sample = cleaned_dataset_excluding_outliers['Description']
processed_docs = doc_sample.tolist()
```

```
extra_stopwords = [
    'told', 'still', 'one', 'said', 'asked', 'sent', 'call', 'amount',␣
 ↪'received', 'would',
    'could', 'day', 'since', 'never', 'also', 'time', 'back', 'year', 'get',␣
 ↪'even',
    'paid', 'month', 'pay', 'money', 'bank', 'however', 'made', 'due', 'email',␣
 ↪'stated',
    'name', 'date', 'want', 'need', 'first', 'know'
]

processed_docs = map(lambda x: x.split(), processed_docs)
processed_docs = map(lambda x: list(filter(lambda y: y not in extra_stopwords,␣
 ↪x)) , processed_docs)
```

[29]:

```
processed_docs = list(processed_docs)
```

The next step is to compute frequent bigrams from the documents

[30]:

```
import gensim

bigram = gensim.models.Phrases(processed_docs, min_count=5, threshold=100)
bigram_mod = gensim.models.phrases.Phraser(bigram)
```

[31]:

```
def make_bigrams(texts):
    return [bigram_mod[doc] for doc in texts]
```

[32]:

```
processed_docs_bigrams = make_bigrams(processed_docs)
```

[33]:

```
import gensim

dictionary = gensim.corpora.Dictionary(processed_docs_bigrams)
dictionary.filter_extremes(no_below=100, no_above=0.4, keep_n=10000)
bow_corpus = [dictionary.doc2bow(doc) for doc in processed_docs_bigrams]
```

[34]:

```
print(len(dictionary))
```

```
103
```

[35]:

```
from gensim.models import CoherenceModel

def compute_coherence_values(corpus, dictionary, k, a, b):
    lda_model = gensim.models.LdaMulticore(corpus=corpus,
                                           id2word=dictionary,
                                           num_topics=k,
                                           random_state=100,
                                           chunksize=1000,
                                           passes=2,
                                           alpha=a,
                                           eta=b,
                                           per_word_topics=True)

    coherence_model_lda = CoherenceModel(model=lda_model, texts=processed_docs,␣
 ↪dictionary=dictionary, coherence='c_v')

    return coherence_model_lda.get_coherence()
```

[ ]:

```
https://github.com/bijoyandas/Hands-On-Natural-Language-Processing-with-Python
https://github.com/kavgan/nlp-in-practice
```

[ ]:

```
https://github.com/EdjeElectronics/
 ↪TensorFlow-Object-Detection-API-Tutorial-Train-Multiple-Objects-Windows-10
```