Discriptive Statistics and Models

October 24, 2022

[1]:

```
#!pip install openpyxl --upgrade --pre
```

[2]:

```
import os
import regex as re
import emoji
import pandas as pd
import numpy as np

from collections import Counter, defaultdict
from nltk.corpus import stopwords
from string import punctuation

sw = stopwords.words("english")
import openpyxl

from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import confusion_matrix,␣
 ↪accuracy_score,classification_report
from sklearn.linear_model import LogisticRegression
import seaborn as sns
import matplotlib.pyplot as plt
import warnings
warnings.filterwarnings('ignore')

import string
from nltk.tokenize import word_tokenize

# Gensim
import gensim
import gensim.corpora as corpora
from gensim.utils import simple_preprocess
from gensim.models import CoherenceModel
from pprint import pprint

# Plotting tools
```

```
import pyLDAvis
import pyLDAvis.gensim_models as gensimvis

import wordcloud
from wordcloud import WordCloud
```

```
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/pandas/core/computation/expressions.py:21: UserWarning: Pandas requires
version '2.7.3' or newer of 'numexpr' (version '2.7.1' currently installed).
  from pandas.core.computation.check import NUMEXPR_INSTALLED
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/past/builtins/misc.py:45: DeprecationWarning: the imp module is
deprecated in favour of importlib; see the module's documentation for
alternative uses
  from imp import reload
```

[3]:

```
# Add any additional import statements you need here
import html
from textacy import preprocessing
import string
import nltk

stop_words = set(stopwords.words("english"))
```

```
/Users/travis/opt/anaconda3/lib/python3.8/site-packages/h5py/__init__.py:46:
DeprecationWarning: `np.typeDict` is a deprecated alias for `np.sctypeDict`.
  from ._conv import register_converters as _register_converters
```

[4]:

```
df = pd.read_excel('reddit-data.xlsx')
df
```

[4]:

```
      Unnamed: 0        subreddit  \
0              0  personalfinance
1              1  personalfinance
2              2  personalfinance
3              3  personalfinance
4              4  personalfinance
…            …                …
4768         895            story
4769         896            story
4770         897            story
4771         898            story
4772         899            story

                                                   text
0     # Welcome!  Before making a post, please check…
1     ### If you need help, please check the [PF Wik…
2     Haven't been churning so much lately; but foun…
```

```
3     **TL;DR** my question is: If I set up a 529 Sa…
4     I've lived in my house in VA since 2009, and a…
…                                                 …
4768  Do you ever make up stories that are so absurd…
4769  So up until about 2019, I was unable to watch …
4770  I had to shit at the airport (I couldn't shit …
4771  This morning as I was grabbing my right shoe, …
4772       **True peace is only won by peaceful means**

[4773 rows x 3 columns]
```

[5]:
```
print(df['text'])
```

```
0       # Welcome!  Before making a post, please check…
1       ### If you need help, please check the [PF Wik…
2       Haven't been churning so much lately; but foun…
3       **TL;DR** my question is: If I set up a 529 Sa…
4       I've lived in my house in VA since 2009, and a…
                              …
4768    Do you ever make up stories that are so absurd…
4769    So up until about 2019, I was unable to watch …
4770    I had to shit at the airport (I couldn't shit …
4771    This morning as I was grabbing my right shoe, …
4772         **True peace is only won by peaceful means**
Name: text, Length: 4773, dtype: object
```

[6]:
```
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 (https://en.wikipedia.org/wiki/
↪Lexical_diversity),
        and num_tokens most common tokens. Return a list with the number of␣
↪tokens, number
        of unique tokens, lexical diversity, and number of characters.

    """

    # Fill in the correct values here.
    num_tokens = len(tokens)
    num_unique_tokens = len(set(tokens))
    lexical_diversity = num_unique_tokens/num_tokens
    num_characters = 0
    for i in tokens:
        num_characters += len(i)
    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.")

        # print the five most common tokens

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

[7]:

```
text = "here is some example text with other example text here in this text".
 ↪split()
assert(descriptive_stats(text, verbose=True)[0] == 13)
assert(descriptive_stats(text, verbose=False)[1] == 9)
assert(abs(descriptive_stats(text, verbose=False)[2] - 0.69) < 0.02)
assert(descriptive_stats(text, verbose=False)[3] == 55)
```

```
There are 13 tokens in the data.
There are 9 unique tokens in the data.
There are 55 characters in the data.
The lexical diversity is 0.692 in the data.
```

[8]:

```
# create your clean twitter data here

## This calculates the impurity in an instance of tokens, used to find␣
 ↪characters worth removing
RE_SUSPICIOUS = re.compile(r'[&#<>{}\[\]\\]')
def impurity(text, min_len=10):
    """returns the share of suspicious characters in a text"""
    if text == None or len(text) < min_len:
        return 0
    else:
        return len(RE_SUSPICIOUS.findall(text))/len(text)
    print(impurity(text))

## Function to clean the text by removing matches on the regex rules
def clean(text):
    # convert html escapes like &amp; to characters.
    text = html.unescape(text)
    # tags like <tab>
    text = re.sub(r'<[^<>]*>', ' ', text)
    # markdown URLs like [Some text](https://....)
    text = re.sub(r'\[([^\[\]]*)\]\([^\(\)]*\)', r'\1', text)
    # text or code in brackets like [0]
    text = re.sub(r'\[[^\[\]]*\]', ' ', text)
    # standalone sequences of specials, matches &# but not #cool
    text = re.sub(r'(?:^|\s)[&#<>{}\[\]+|\\:-]{1,}(?:\s|$)', ' ', text) #␣
↪standalone sequences of hyphens like --- or ==
    text = re.sub(r'(?:^|\s)[\-=\+]{2,}(?:\s|$)', ' ', text)
    # sequences of white spaces
    text = re.sub(r'\s+', ' ', text)
    text = re.sub(r'##',' ',text)
    text = re.sub(r'{{_}}',' ',text)
    text = re.sub(r'/\/',' ',text)
    text = re.sub(r'//\\',' ',text)
    text = re.sub(r'\\',' ',text)
    #Remove punctuation
    text = re.sub(r'[^\w\s]', ' ', text)
    return text.strip()

def normalize(text):
    text = preprocessing.normalize.hyphenated_words(text)
    text = preprocessing.normalize.quotation_marks(text)
    text = preprocessing.normalize.unicode(text)
    text = preprocessing.remove.accents(text)
    return text


def tokenize(text):
    return re.findall(r'[\w-]*\p{L}[\w-]*', text)

def remove_stop(tokens):
    return [t for t in tokens if t.lower() not in stop_words]

pipeline = [str.lower, tokenize, remove_stop]

def prepare(text, pipeline):
    tokens = text
    for transform in pipeline:
        tokens = transform(tokens)
    return tokens
```

[9]:
```
df['text'] = df['text'].astype('string')
```

[10]:
```
df['text'] = df['text'].fillna('')
```

[11]:
```
df['clean_text'] = df['text'].map(clean)
df['clean_text'] = df['clean_text'].astype('string')
df['clean_text'] = df['clean_text'].map(normalize)
df['tokens'] = df['clean_text'].apply(prepare, pipeline=pipeline)
df.head()
```

[11]:
```
   Unnamed: 0      subreddit  \
0           0  personalfinance
1           1  personalfinance
2           2  personalfinance
3           3  personalfinance
4           4  personalfinance

                                                text  \
0  # Welcome!  Before making a post, please check…
1  ### If you need help, please check the [PF Wik…
2  Haven't been churning so much lately; but foun…
3  **TL;DR** my question is: If I set up a 529 Sa…
4  I've lived in my house in VA since 2009, and a…

                                          clean_text  \
0  Welcome  Before making a post  please check ou…
1  If you need help  please check the PF Wiki to …
2  Haven t been churning so much lately  but foun…
3  TL DR   my question is  If I set up a 529 Savi…
4  I ve lived in my house in VA since 2009  and a…

                                              tokens
0  [welcome, making, post, please, check, great, …
1  [need, help, please, check, pf, wiki, see, que…
2  [churning, much, lately, found, make, mortgage…
3  [tl, dr, question, set, savings, account, niec…
4  [lived, house, va, since, along, years, house,…
```

[12]:
```python
posts = []
for description in df["clean_text"]:
    posts.extend(description.split())
```

[13]:
```python
print('Subreddit Descriptive Statistics')
print(descriptive_stats(posts))
```

```
Subreddit Descriptive Statistics
There are 1042337 tokens in the data.
There are 35401 unique tokens in the data.
There are 4201232 characters in the data.
The lexical diversity is 0.034 in the data.
[1042337, 35401, 0.0339631040632732, 4201232]
```

[14]:
```python
if 'Unnamed: 0' in df:
    df.drop('Unnamed: 0',axis=1,inplace=True)
```

[15]:
```python
df
```

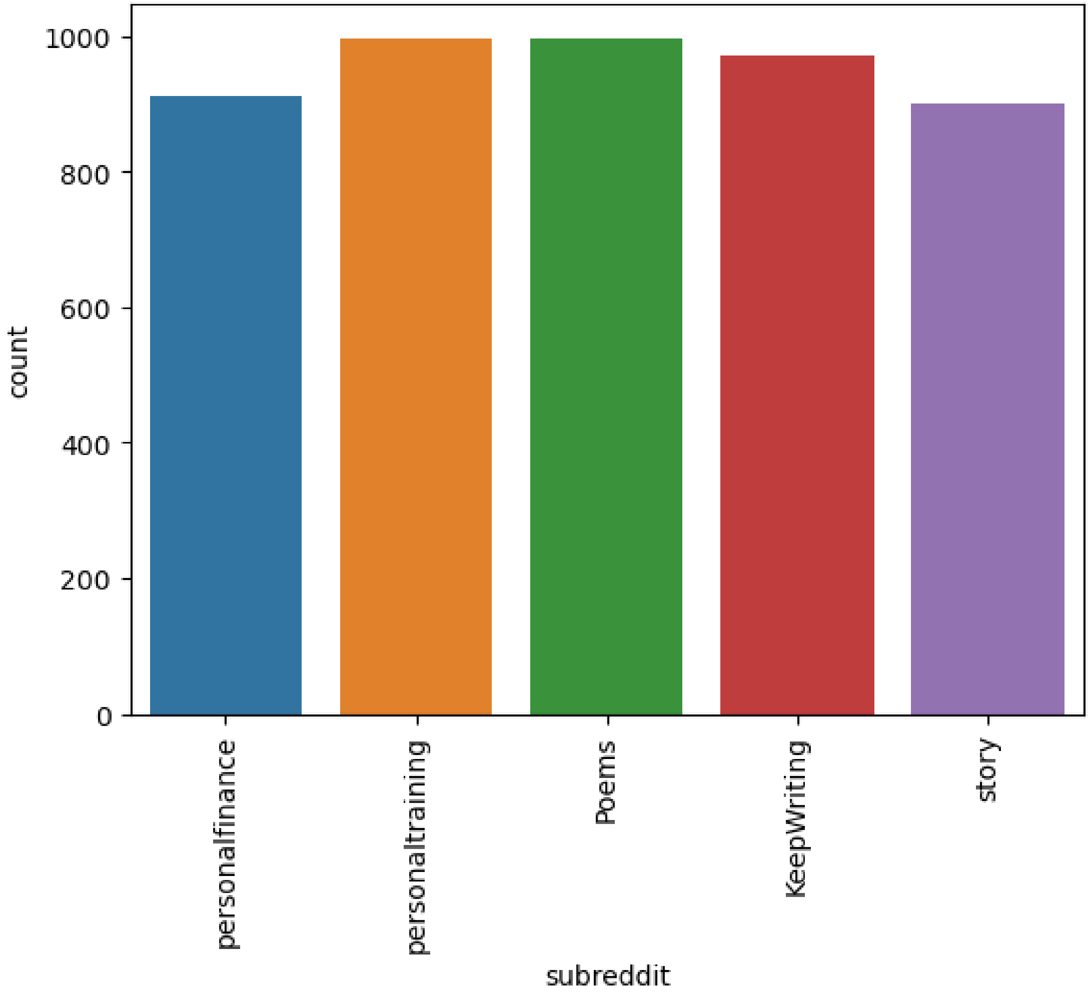
[15]:

```
            subreddit                                               text  \
0     personalfinance  # Welcome!  Before making a post, please check…
1     personalfinance  ### If you need help, please check the [PF Wik…
2     personalfinance  Haven't been churning so much lately; but foun…
3     personalfinance  **TL;DR** my question is: If I set up a 529 Sa…
4     personalfinance  I've lived in my house in VA since 2009, and a…
…                 …                                               …
4768            story  Do you ever make up stories that are so absurd…
4769            story  So up until about 2019, I was unable to watch …
4770            story  I had to shit at the airport (I couldn't shit …
4771            story  This morning as I was grabbing my right shoe, …
4772            story       **True peace is only won by peaceful means**

                                             clean_text  \
0     Welcome  Before making a post  please check ou…
1     If you need help  please check the PF Wiki to …
2     Haven t been churning so much lately  but foun…
3     TL DR   my question is  If I set up a 529 Savi…
4     I ve lived in my house in VA since 2009  and a…
…                                                  …
4768  Do you ever make up stories that are so absurd…
4769  So up until about 2019  I was unable to watch …
4770  I had to shit at the airport  I couldn t shit …
4771  This morning as I was grabbing my right shoe  …
4772           True peace is only won by peaceful means

                                                 tokens
0     [welcome, making, post, please, check, great, …
1     [need, help, please, check, pf, wiki, see, que…
2     [churning, much, lately, found, make, mortgage…
3     [tl, dr, question, set, savings, account, niec…
4     [lived, house, va, since, along, years, house,…
…                                                  …
4768  [ever, make, stories, absurd, tell, people, be…
4769  [unable, watch, movie, every, time, watched, i…
4770  [shit, airport, shit, anywhere, nervous, choic…
4771  [morning, grabbing, right, shoe, noticed, damp…
4772                         [true, peace, peaceful, means]

[4773 rows x 4 columns]
```

1 Models

[16]:

```python
sns.countplot(df['subreddit'])
plt.xticks(rotation=90)
plt.show()
```



[17]:
```
labels = ['Poems', 'personaltraining', 'KeepWriting', 'personalfinance',␣
 ↪'story']

def plot_cm(confusion_mat):
    df_cm = pd.DataFrame(confusion_mat, index = labels,
                         columns = labels)
    plt.figure(figsize = (10,7))
    sns.heatmap(df_cm, annot=True)
    plt.xticks(rotation=90)
    plt.yticks(rotation=0)
    plt.show()
```

1.1 Implement CountVectorizer to convert text to vectors

[18]:
```
df['tokens_joined'] = df['tokens'].apply(lambda x: ' '.join(x))
```

[19]:
```
X = df['tokens_joined']
y = df['subreddit']
```

[20]:
```
# train test split
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size =0.25,␣
 ↪random_state = 40)
```

[21]:
```
cv = CountVectorizer(ngram_range =(2,2), max_features = 20000)
X_train_cv = cv.fit_transform(X_train).toarray()
X_test_cv = cv.transform(X_test)
X_train_cv
```

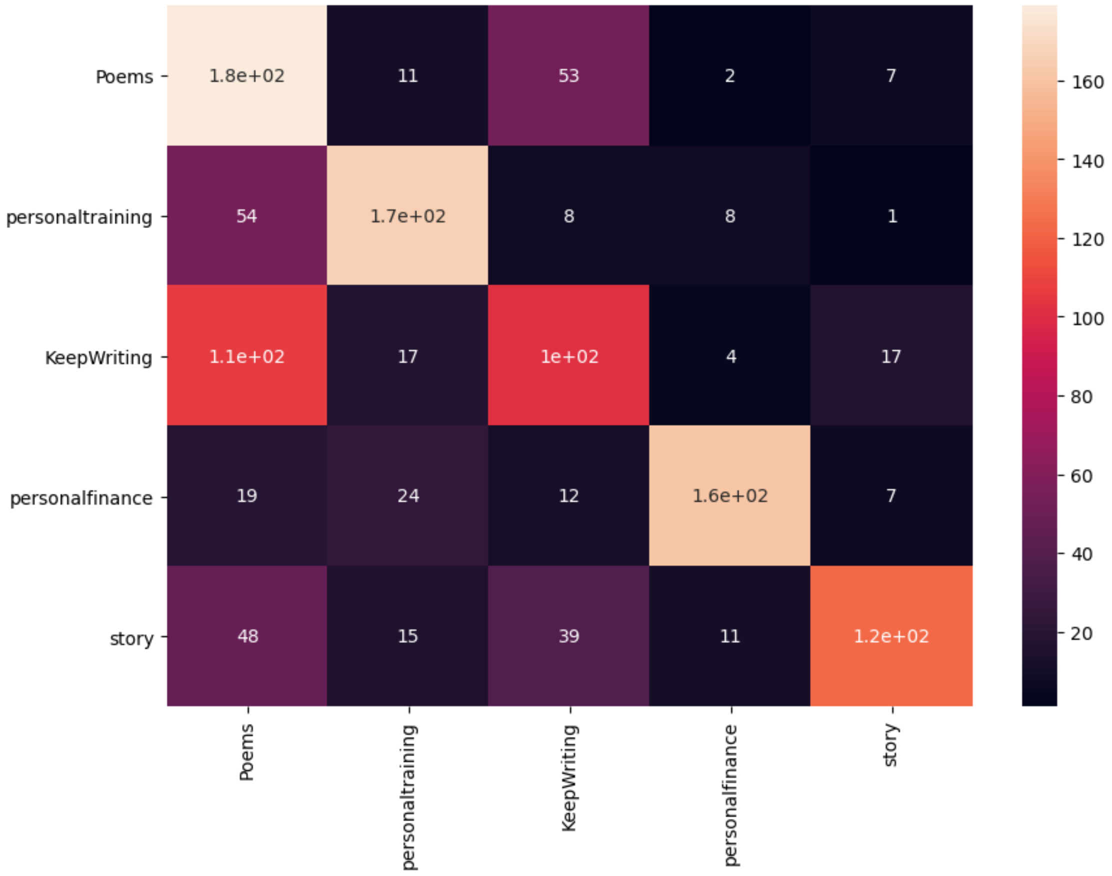
[21]:
```
array([[0, 0, 0, …, 0, 0, 0],
       [0, 0, 0, …, 0, 0, 0],
       [0, 0, 0, …, 0, 0, 0],
       …,
       [0, 0, 0, …, 0, 0, 0],
       [0, 0, 0, …, 0, 0, 0],
       [0, 0, 0, …, 0, 0, 0]])
```

1.2 Logistic Regression

[22]:
```
lr_classifier = LogisticRegression(n_jobs=-1)
lr_classifier.fit(X_train_cv, y_train)
```

[22]:
```
LogisticRegression(n_jobs=-1)
```

[23]:
```
lr_y_pred = lr_classifier.predict(X_test_cv)
confusion_mat = confusion_matrix(y_test, lr_y_pred,labels=labels)
plot_cm(confusion_mat)
```



```
[24]: print(classification_report(y_test,lr_y_pred))
```

```
                 precision    recall  f1-score   support

     KeepWriting       0.48      0.41      0.44       246
           Poems       0.44      0.71      0.54       252
 personalfinance       0.87      0.72      0.79       223
personaltraining       0.71      0.70      0.71       237
           story       0.79      0.52      0.63       236

        accuracy                           0.61      1194
       macro avg       0.66      0.61      0.62      1194
    weighted avg       0.65      0.61      0.62      1194
```

```
[25]: print(accuracy_score(y_test,lr_y_pred))
```

```
0.6122278056951423
```

1.3 Random Forest Classifier

[26]:

```
rf_classifier = RandomForestClassifier(n_jobs=-1,verbose=2,n_estimators=20)
rf_classifier.fit(X_train_cv, y_train)
```

```
[Parallel(n_jobs=-1)]: Using backend ThreadingBackend with 16 concurrent
workers.
```

```
building tree 1 of 20building tree 2 of 20

building tree 3 of 20
building tree 4 of 20
building tree 5 of 20
building tree 6 of 20
building tree 7 of 20
building tree 8 of 20
building tree 9 of 20
building tree 10 of 20
building tree 11 of 20
building tree 12 of 20
building tree 13 of 20
building tree 14 of 20
building tree 15 of 20
building tree 16 of 20
building tree 17 of 20
building tree 18 of 20
building tree 19 of 20
building tree 20 of 20
```

```
[Parallel(n_jobs=-1)]: Done  11 out of  20 | elapsed:    5.6s remaining:    4.6s
[Parallel(n_jobs=-1)]: Done  20 out of  20 | elapsed:    7.9s finished
```

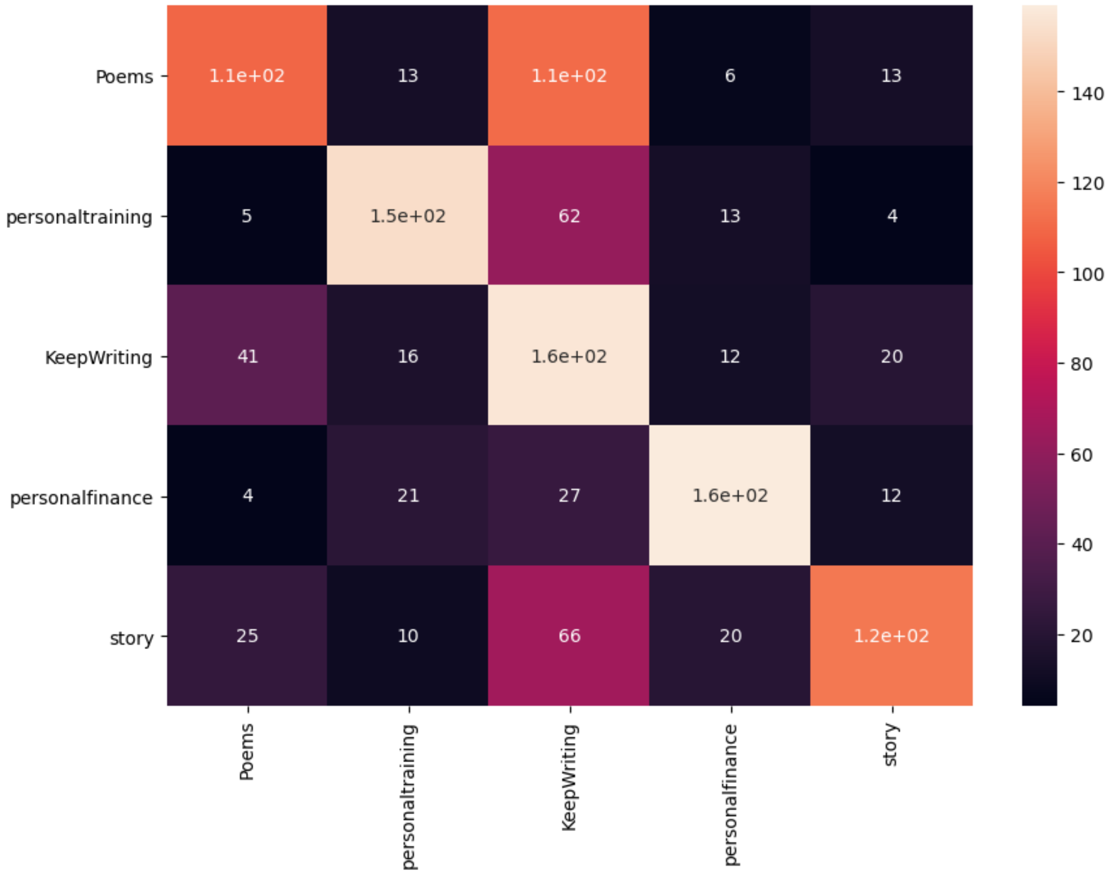
[26]:

```
RandomForestClassifier(n_estimators=20, n_jobs=-1, verbose=2)
```

[27]:

```
rf_y_pred = rf_classifier.predict(X_test_cv)
confusion_mat = confusion_matrix(y_test, rf_y_pred,labels=labels)
plot_cm(confusion_mat)
```

```
[Parallel(n_jobs=16)]: Using backend ThreadingBackend with 16 concurrent
workers.
[Parallel(n_jobs=16)]: Done  11 out of  20 | elapsed:    0.0s remaining:    0.0s
[Parallel(n_jobs=16)]: Done  20 out of  20 | elapsed:    0.0s finished
```



[28]:
```
print(classification_report(y_test,rf_y_pred))
```

```
                  precision    recall  f1-score   support

     KeepWriting       0.37      0.64      0.47       246
           Poems       0.59      0.43      0.50       252
 personalfinance       0.76      0.71      0.73       223
personaltraining       0.72      0.65      0.68       237
           story       0.70      0.49      0.57       236

        accuracy                           0.58      1194
       macro avg       0.63      0.58      0.59      1194
    weighted avg       0.62      0.58      0.59      1194
```

[29]:
```
print(accuracy_score(y_test,rf_y_pred))
```

```
0.5804020100502513
```

1.4 Implement TfIdfVectorizer to convert text tovector

[30]:

```
tfidf = TfidfVectorizer(ngram_range =(2,2))
X_train_tfidf = tfidf.fit_transform(X_train).toarray()
X_test_tfidf = tfidf.transform(X_test)
X_train_tfidf
```

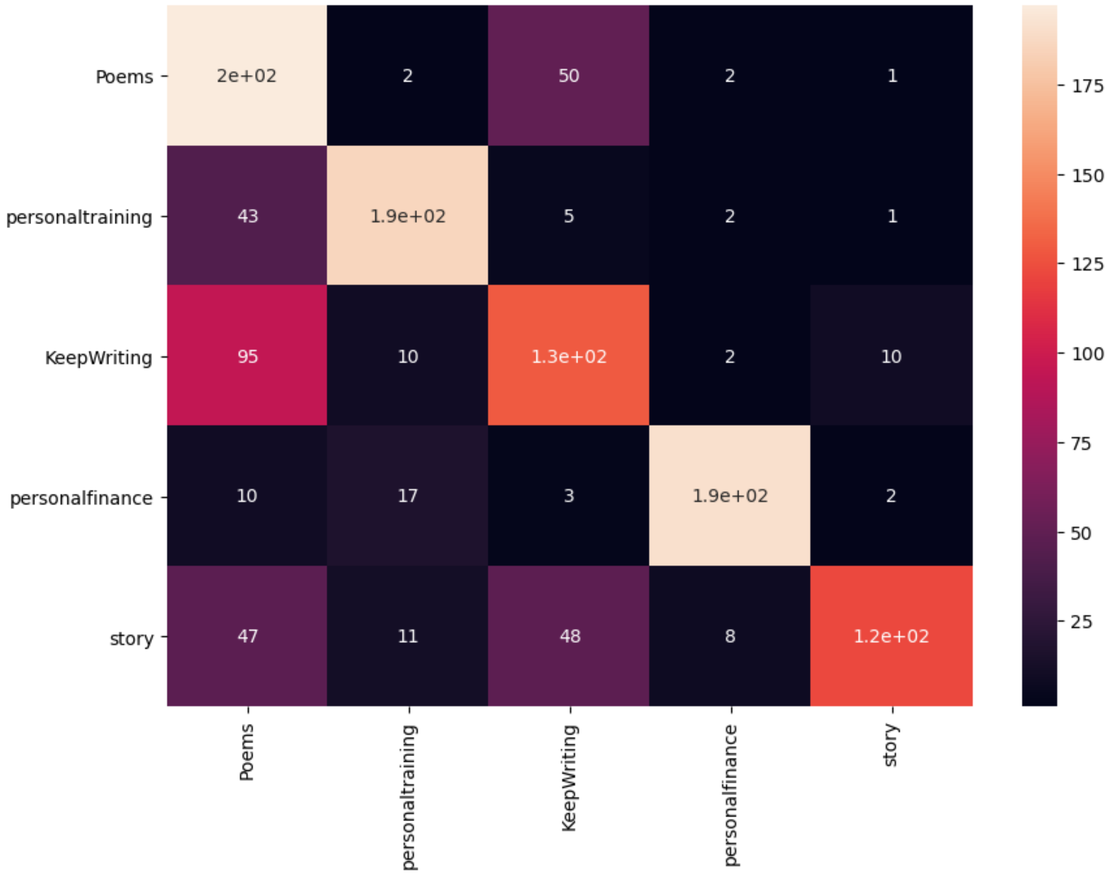
[30]:

```
array([[0., 0., 0., …, 0., 0., 0.],
       [0., 0., 0., …, 0., 0., 0.],
       [0., 0., 0., …, 0., 0., 0.],
       …,
       [0., 0., 0., …, 0., 0., 0.],
       [0., 0., 0., …, 0., 0., 0.],
       [0., 0., 0., …, 0., 0., 0.]])
```

1.5 Logistic Regression

[31]:

```
lr_classifier = LogisticRegression()
lr_classifier.fit(X_train_tfidf, y_train)

lr_y_pred = lr_classifier.predict(X_test_tfidf)
confusion_mat = confusion_matrix(y_test, lr_y_pred,labels=labels)
plot_cm(confusion_mat)
```



[32]:
```
print(classification_report(y_test,lr_y_pred))
```

```
                  precision    recall  f1-score   support

     KeepWriting       0.55      0.52      0.54       246
           Poems       0.50      0.78      0.61       252
 personalfinance       0.93      0.86      0.89       223
personaltraining       0.82      0.78      0.80       237
           story       0.90      0.52      0.66       236

        accuracy                           0.69      1194
       macro avg       0.74      0.69      0.70      1194
    weighted avg       0.73      0.69      0.70      1194
```

[33]:
```
print(accuracy_score(y_test,lr_y_pred))
```

```
0.6909547738693468
```

1.6 Random Forest Classifier

[34]:

```
rf_classifier = RandomForestClassifier(n_jobs=-1,verbose=2,n_estimators=20)
rf_classifier.fit(X_train_tfidf, y_train)
```

```
[Parallel(n_jobs=-1)]: Using backend ThreadingBackend with 16 concurrent
workers.
```

```
building tree 1 of 20building tree 2 of 20
building tree 3 of 20

building tree 4 of 20
building tree 5 of 20
building tree 6 of 20
building tree 7 of 20
building tree 8 of 20
building tree 9 of 20
building tree 10 of 20
building tree 11 of 20
building tree 12 of 20
building tree 13 of 20
building tree 14 of 20
building tree 15 of 20
building tree 16 of 20
building tree 17 of 20
building tree 18 of 20
building tree 19 of 20
building tree 20 of 20
```

```
[Parallel(n_jobs=-1)]: Done  11 out of  20 | elapsed:   44.9s remaining:   36.7s
[Parallel(n_jobs=-1)]: Done  20 out of  20 | elapsed:  1.0min finished
```

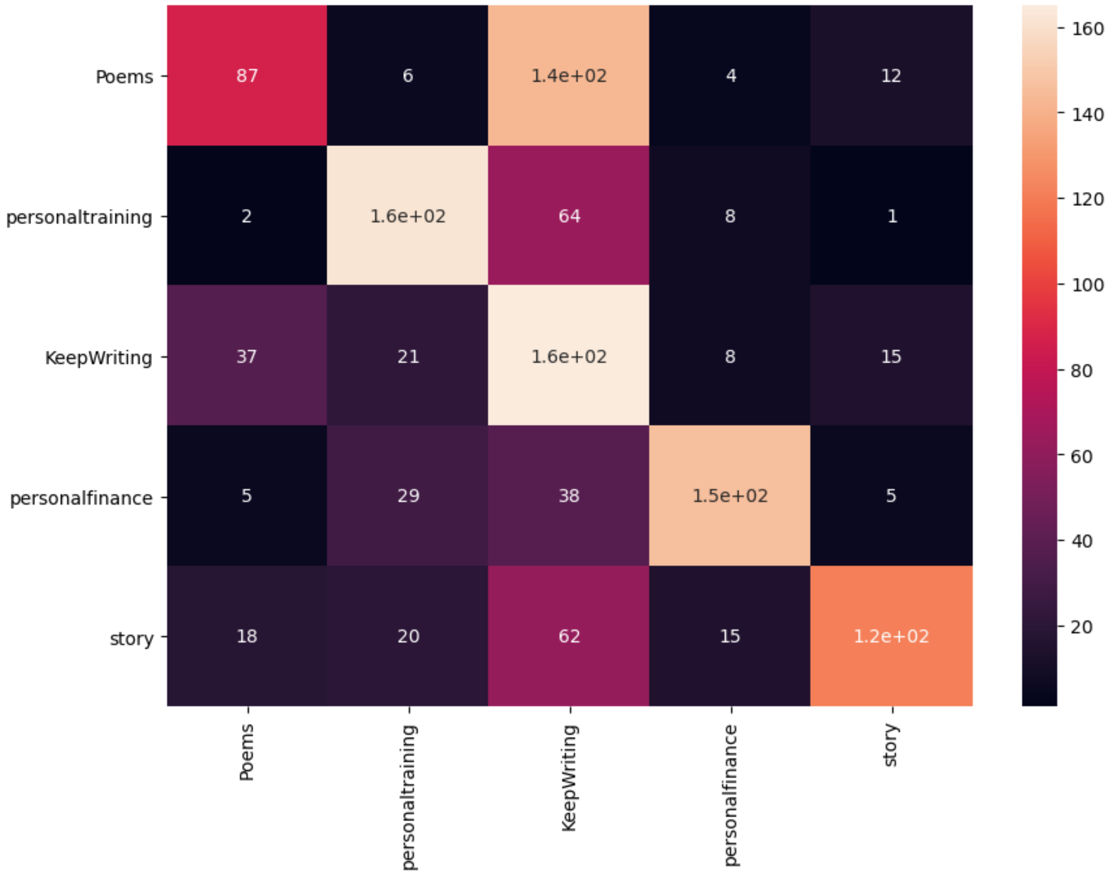
[34]:

```
RandomForestClassifier(n_estimators=20, n_jobs=-1, verbose=2)
```

[35]:

```
rf_y_pred = rf_classifier.predict(X_test_tfidf)
confusion_mat = confusion_matrix(y_test, rf_y_pred,labels=labels)
plot_cm(confusion_mat)
```

```
[Parallel(n_jobs=16)]: Using backend ThreadingBackend with 16 concurrent
workers.
[Parallel(n_jobs=16)]: Done  11 out of  20 | elapsed:    0.0s remaining:    0.0s
[Parallel(n_jobs=16)]: Done  20 out of  20 | elapsed:    0.0s finished
```



```
[36]: print(classification_report(y_test,rf_y_pred))
```

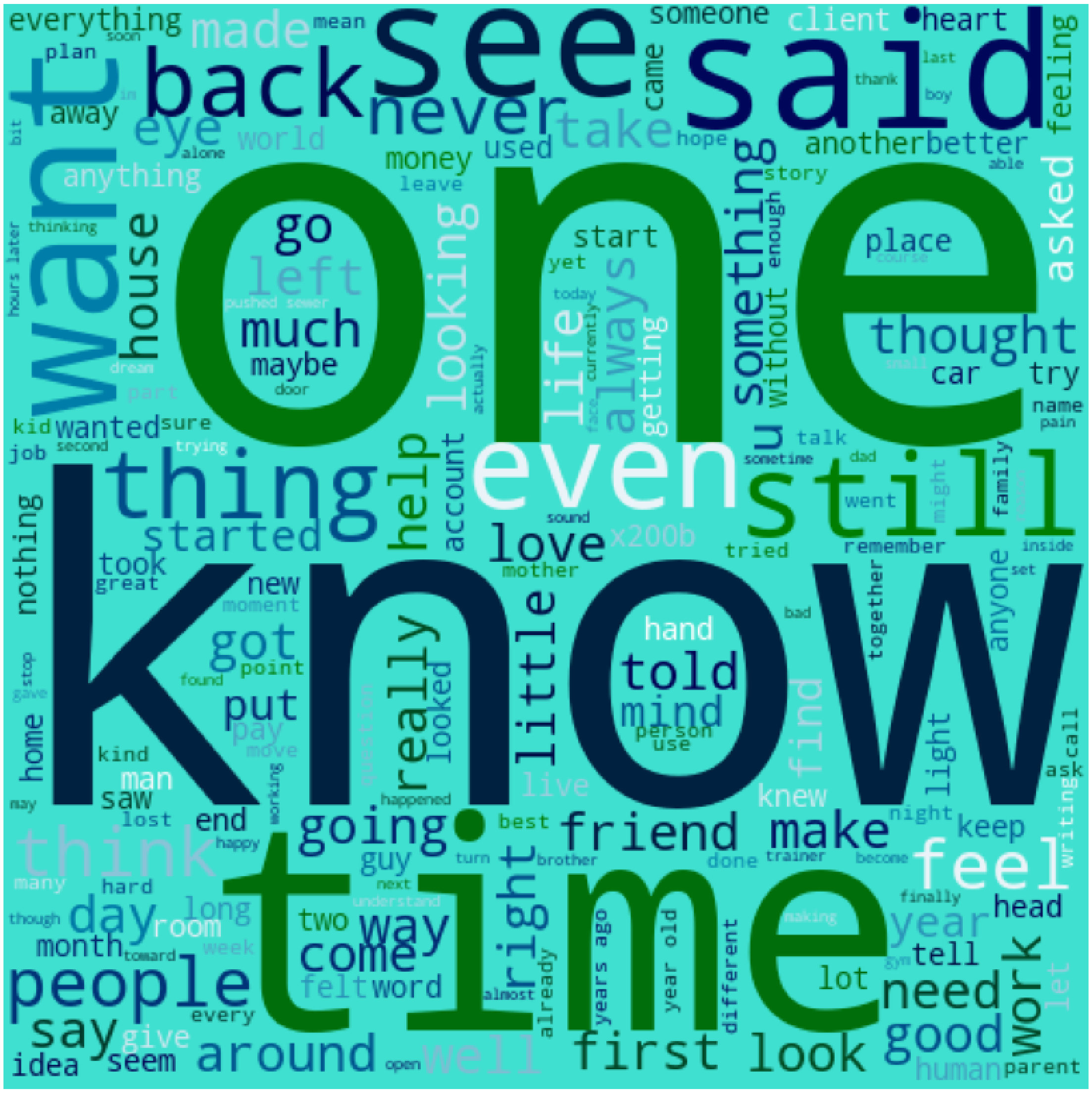
```
                 precision    recall  f1-score   support

    KeepWriting       0.35      0.67      0.46       246
          Poems       0.58      0.35      0.43       252
personalfinance       0.81      0.65      0.72       223
personaltraining      0.68      0.68      0.68       237
          story       0.79      0.51      0.62       236

       accuracy                           0.57      1194
      macro avg       0.64      0.57      0.58      1194
   weighted avg       0.64      0.57      0.58      1194
```

```
[37]: print(accuracy_score(y_test,rf_y_pred))
```

```
0.5703517587939698
```

1.7 LDA

```
[38]: #combine all the articles
      article_data = ""
      for text in X:
          article_data = article_data+" "+text

      #ploting the word cloud
      plt.figure(figsize=(10, 10))
      wordcloud = WordCloud(width = 500, height = 500, background_color='#40E0D0',␣
       ↪colormap="ocean",  random_state=10).generate(article_data)
      plt.imshow(wordcloud)
      plt.axis("off")
      plt.show()
```



[39]:

```
full_corpus = []
for i in df['tokens']:
    full_corpus.append(i)
```

[40]:

```
from gensim.corpora.dictionary import Dictionary
import warnings
warnings.filterwarnings('ignore')

# from gensim.models.ldamodel import LdaModel

# Create a corpus from a list of texts
id2word = Dictionary(full_corpus)

# Term Document Frequency
corpus = [id2word.doc2bow(text) for text in full_corpus]
```

[41]:

```
lda_model = gensim.models.ldamodel.LdaModel(corpus=corpus,
                                            id2word=id2word,
                                            num_topics=5,
                                            random_state=100,
                                            update_every=1,
                                            chunksize=100,
                                            passes=10,
                                            minimum_phi_value = 0.01,
                                            alpha='symmetric',
                                            per_word_topics=True,
                                            eta = 0.6)
```

[42]:

```
# Print the Keyword in the 10 topics
pprint(lda_model.print_topics())
doc_lda = lda_model[corpus]
```

```
[(0,
  '0.027*"sewer" + 0.021*"carmen" + 0.018*"pushed" + 0.014*"repost" + '
  '0.012*"shower" + 0.012*"jessica" + 0.011*"went" + 0.010*"neck" + '
  '0.010*"broke" + 0.010*"girls"'),
 (1,
  '0.022*"human" + 0.017*"humans" + 0.010*"com" + 0.008*"https" + '
  '0.008*"audiobook" + 0.006*"www" + 0.005*"paperback" + 0.005*"weird" + '
  '0.004*"steve" + 0.004*"ebook"'),
 (2,
  '0.010*"like" + 0.008*"one" + 0.008*"said" + 0.008*"would" + 0.007*"time" + '
  '0.007*"know" + 0.007*"get" + 0.006*"back" + 0.006*"got" + 0.005*"go"'),
 (3,
  '0.010*"max" + 0.006*"li" + 0.005*"shiki" + 0.004*"bank" + 0.004*"chi" + '
  '0.004*"chong" + 0.003*"cb" + 0.003*"tracy" + 0.003*"account" + '
  '0.002*"money"'),
 (4,
  '0.008*"eyes" + 0.005*"back" + 0.005*"door" + 0.004*"like" + 0.004*"face" + '
  '0.004*"light" + 0.004*"one" + 0.004*"man" + 0.004*"see" + 0.003*"away"')]
```

```
[43]: # Visualize the topics
      pyLDAvis.enable_notebook()
      vis = gensimvis.prepare(lda_model, corpus, id2word)
      vis
```

```
[43]: PreparedData(topic_coordinates=              x         y  topics  cluster
      Freq
      topic
      2     -0.232496 -0.095921       1        1  62.576205
      4     -0.054963 -0.131227       2        1  20.592860
      3      0.162269 -0.033227       3        1   7.447517
      0     -0.065621  0.287813       4        1   6.418766
      1      0.190811 -0.027439       5        1   2.964652, topic_info=        Term
      Freq        Total Category  logprob  loglift
      1081     went  1741.000000  1741.000000  Default  30.0000  30.0000
      10044   sewer   827.000000   827.000000  Default  29.0000  29.0000
      17608  carmen   664.000000   664.000000  Default  28.0000  28.0000
      168    school  1377.000000  1377.000000  Default  27.0000  27.0000
      3621   pushed   650.000000   650.000000  Default  26.0000  26.0000
      …        …          …            …        …       …       …
      1703    weird    71.566050   423.758474   Topic5  -5.3002   1.7399
      3276     book    50.606716   226.744092   Topic5  -5.6468   2.0187
      7595     blog    33.475224    74.882947   Topic5  -6.0600   2.7133
      16063   trump    35.558850   104.114662   Topic5  -5.9997   2.4441
      25       post    31.152057   402.661755   Topic5  -6.1320   0.9592

      [318 rows x 6 columns], token_table=      Topic      Freq           Term
      term
      110        1  0.584152        account
      110        2  0.004264        account
      110        3  0.413597        account
      6319       1  0.047691  administrator
      6319       2  0.015897  administrator
      …       …       …             …
      2416       3  0.046523          youtu
      2416       5  0.930466          youtu
      23395      1  0.036484         zariel
      23395      2  0.218903         zariel
      23395      3  0.729675         zariel

      [894 rows x 3 columns], R=30, lambda_step=0.01, plot_opts={'xlab': 'PC1',
      'ylab': 'PC2'}, topic_order=[3, 5, 4, 1, 2])
```

1.7.1 Looking for a high coherence score

[ ]:

```
# Compute Perplexity
print('\nPerplexity : ', lda_model.log_perplexity(corpus))

# Compute Coherence Score
coherence_model_lda = CoherenceModel(model=lda_model, texts=full_corpus,␣
 ↪dictionary=id2word, coherence='c_v')
coherence_lda = coherence_model_lda.get_coherence()
print('\nCoherence Score: ', coherence_lda)
```

```
Perplexity :  -8.420327458704653

/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/past/builtins/misc.py:45: DeprecationWarning: the imp module is
deprecated in favour of importlib; see the module's documentation for
alternative uses
  from imp import reload
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/numexpr/expressions.py:21: DeprecationWarning: distutils Version
classes are deprecated. Use packaging.version instead.
  _np_version_forbids_neg_powint = LooseVersion(numpy.__version__) >=
LooseVersion('1.12.0b1')
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/numexpr/expressions.py:21: DeprecationWarning: distutils Version
classes are deprecated. Use packaging.version instead.
  _np_version_forbids_neg_powint = LooseVersion(numpy.__version__) >=
LooseVersion('1.12.0b1')
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/pandas/core/computation/expressions.py:21: UserWarning: Pandas requires
version '2.7.3' or newer of 'numexpr' (version '2.7.1' currently installed).
  from pandas.core.computation.check import NUMEXPR_INSTALLED
/Users/travis/opt/anaconda3/lib/python3.8/site-packages/joblib/backports.py:36:
DeprecationWarning: distutils Version classes are deprecated. Use
packaging.version instead.
  if LooseVersion(np.__version__) < '1.13':
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/setuptools/_distutils/version.py:351: DeprecationWarning: distutils
Version classes are deprecated. Use packaging.version instead.
  other = LooseVersion(other)
/Users/travis/opt/anaconda3/lib/python3.8/site-packages/joblib/backports.py:36:
DeprecationWarning: distutils Version classes are deprecated. Use
packaging.version instead.
  if LooseVersion(np.__version__) < '1.13':
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/setuptools/_distutils/version.py:351: DeprecationWarning: distutils
Version classes are deprecated. Use packaging.version instead.
```

```
  other = LooseVersion(other)
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/past/builtins/misc.py:45: DeprecationWarning: the imp module is
deprecated in favour of importlib; see the module's documentation for
alternative uses
  from imp import reload
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/numexpr/expressions.py:21: DeprecationWarning: distutils Version
classes are deprecated. Use packaging.version instead.
  _np_version_forbids_neg_powint = LooseVersion(numpy.__version__) >=
LooseVersion('1.12.0b1')
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/numexpr/expressions.py:21: DeprecationWarning: distutils Version
classes are deprecated. Use packaging.version instead.
  _np_version_forbids_neg_powint = LooseVersion(numpy.__version__) >=
LooseVersion('1.12.0b1')
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/pandas/core/computation/expressions.py:21: UserWarning: Pandas requires
version '2.7.3' or newer of 'numexpr' (version '2.7.1' currently installed).
  from pandas.core.computation.check import NUMEXPR_INSTALLED
/Users/travis/opt/anaconda3/lib/python3.8/site-packages/joblib/backports.py:36:
DeprecationWarning: distutils Version classes are deprecated. Use
packaging.version instead.
  if LooseVersion(np.__version__) < '1.13':
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/setuptools/_distutils/version.py:351: DeprecationWarning: distutils
Version classes are deprecated. Use packaging.version instead.
  other = LooseVersion(other)
/Users/travis/opt/anaconda3/lib/python3.8/site-packages/joblib/backports.py:36:
DeprecationWarning: distutils Version classes are deprecated. Use
packaging.version instead.
  if LooseVersion(np.__version__) < '1.13':
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/setuptools/_distutils/version.py:351: DeprecationWarning: distutils
Version classes are deprecated. Use packaging.version instead.
  other = LooseVersion(other)
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/past/builtins/misc.py:45: DeprecationWarning: the imp module is
deprecated in favour of importlib; see the module's documentation for
alternative uses
  from imp import reload
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/numexpr/expressions.py:21: DeprecationWarning: distutils Version
classes are deprecated. Use packaging.version instead.
  _np_version_forbids_neg_powint = LooseVersion(numpy.__version__) >=
LooseVersion('1.12.0b1')
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/numexpr/expressions.py:21: DeprecationWarning: distutils Version
```

```
classes are deprecated. Use packaging.version instead.
  _np_version_forbids_neg_powint = LooseVersion(numpy.__version__) >=
LooseVersion('1.12.0b1')
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/pandas/core/computation/expressions.py:21: UserWarning: Pandas requires
version '2.7.3' or newer of 'numexpr' (version '2.7.1' currently installed).
  from pandas.core.computation.check import NUMEXPR_INSTALLED
/Users/travis/opt/anaconda3/lib/python3.8/site-packages/joblib/backports.py:36:
DeprecationWarning: distutils Version classes are deprecated. Use
packaging.version instead.
  if LooseVersion(np.__version__) < '1.13':
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/setuptools/_distutils/version.py:351: DeprecationWarning: distutils
Version classes are deprecated. Use packaging.version instead.
  other = LooseVersion(other)
/Users/travis/opt/anaconda3/lib/python3.8/site-packages/joblib/backports.py:36:
DeprecationWarning: distutils Version classes are deprecated. Use
packaging.version instead.
  if LooseVersion(np.__version__) < '1.13':
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/setuptools/_distutils/version.py:351: DeprecationWarning: distutils
Version classes are deprecated. Use packaging.version instead.
  other = LooseVersion(other)
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/past/builtins/misc.py:45: DeprecationWarning: the imp module is
deprecated in favour of importlib; see the module's documentation for
alternative uses
  from imp import reload
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/numexpr/expressions.py:21: DeprecationWarning: distutils Version
classes are deprecated. Use packaging.version instead.
  _np_version_forbids_neg_powint = LooseVersion(numpy.__version__) >=
LooseVersion('1.12.0b1')
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/numexpr/expressions.py:21: DeprecationWarning: distutils Version
classes are deprecated. Use packaging.version instead.
  _np_version_forbids_neg_powint = LooseVersion(numpy.__version__) >=
LooseVersion('1.12.0b1')
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/pandas/core/computation/expressions.py:21: UserWarning: Pandas requires
version '2.7.3' or newer of 'numexpr' (version '2.7.1' currently installed).
  from pandas.core.computation.check import NUMEXPR_INSTALLED
/Users/travis/opt/anaconda3/lib/python3.8/site-packages/joblib/backports.py:36:
DeprecationWarning: distutils Version classes are deprecated. Use
packaging.version instead.
  if LooseVersion(np.__version__) < '1.13':
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/setuptools/_distutils/version.py:351: DeprecationWarning: distutils
```

```
Version classes are deprecated. Use packaging.version instead.
  other = LooseVersion(other)
/Users/travis/opt/anaconda3/lib/python3.8/site-packages/joblib/backports.py:36:
DeprecationWarning: distutils Version classes are deprecated. Use
packaging.version instead.
  if LooseVersion(np.__version__) < '1.13':
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/setuptools/_distutils/version.py:351: DeprecationWarning: distutils
Version classes are deprecated. Use packaging.version instead.
  other = LooseVersion(other)
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/past/builtins/misc.py:45: DeprecationWarning: the imp module is
deprecated in favour of importlib; see the module's documentation for
alternative uses
  from imp import reload
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/numexpr/expressions.py:21: DeprecationWarning: distutils Version
classes are deprecated. Use packaging.version instead.
  _np_version_forbids_neg_powint = LooseVersion(numpy.__version__) >=
LooseVersion('1.12.0b1')
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/numexpr/expressions.py:21: DeprecationWarning: distutils Version
classes are deprecated. Use packaging.version instead.
  _np_version_forbids_neg_powint = LooseVersion(numpy.__version__) >=
LooseVersion('1.12.0b1')
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/pandas/core/computation/expressions.py:21: UserWarning: Pandas requires
version '2.7.3' or newer of 'numexpr' (version '2.7.1' currently installed).
  from pandas.core.computation.check import NUMEXPR_INSTALLED
/Users/travis/opt/anaconda3/lib/python3.8/site-packages/joblib/backports.py:36:
DeprecationWarning: distutils Version classes are deprecated. Use
packaging.version instead.
  if LooseVersion(np.__version__) < '1.13':
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/setuptools/_distutils/version.py:351: DeprecationWarning: distutils
Version classes are deprecated. Use packaging.version instead.
  other = LooseVersion(other)
/Users/travis/opt/anaconda3/lib/python3.8/site-packages/joblib/backports.py:36:
DeprecationWarning: distutils Version classes are deprecated. Use
packaging.version instead.
  if LooseVersion(np.__version__) < '1.13':
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/setuptools/_distutils/version.py:351: DeprecationWarning: distutils
Version classes are deprecated. Use packaging.version instead.
  other = LooseVersion(other)
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/past/builtins/misc.py:45: DeprecationWarning: the imp module is
deprecated in favour of importlib; see the module's documentation for
```

```
alternative uses
  from imp import reload
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/numexpr/expressions.py:21: DeprecationWarning: distutils Version
classes are deprecated. Use packaging.version instead.
  _np_version_forbids_neg_powint = LooseVersion(numpy.__version__) >=
LooseVersion('1.12.0b1')
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/numexpr/expressions.py:21: DeprecationWarning: distutils Version
classes are deprecated. Use packaging.version instead.
  _np_version_forbids_neg_powint = LooseVersion(numpy.__version__) >=
LooseVersion('1.12.0b1')
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/pandas/core/computation/expressions.py:21: UserWarning: Pandas requires
version '2.7.3' or newer of 'numexpr' (version '2.7.1' currently installed).
  from pandas.core.computation.check import NUMEXPR_INSTALLED
/Users/travis/opt/anaconda3/lib/python3.8/site-packages/joblib/backports.py:36:
DeprecationWarning: distutils Version classes are deprecated. Use
packaging.version instead.
  if LooseVersion(np.__version__) < '1.13':
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/setuptools/_distutils/version.py:351: DeprecationWarning: distutils
Version classes are deprecated. Use packaging.version instead.
  other = LooseVersion(other)
/Users/travis/opt/anaconda3/lib/python3.8/site-packages/joblib/backports.py:36:
DeprecationWarning: distutils Version classes are deprecated. Use
packaging.version instead.
  if LooseVersion(np.__version__) < '1.13':
/Users/travis/opt/anaconda3/lib/python3.8/site-
packages/setuptools/_distutils/version.py:351: DeprecationWarning: distutils
Version classes are deprecated. Use packaging.version instead.
  other = LooseVersion(other)
```

[ ]: