Chapter_8_Applying_Machine_Learning_to_Sentiment_Analysis

March 19, 2024

[1]:
```
# ! pip install PyPrind
```

[4]:
```
import pyprind
import pandas as pd
import os
# change the `basepath` to the directory of the
# unzipped movie dataset
basepath = 'aclImdb'
```

[ ]:
```
labels = {'pos': 1, 'neg': 0}
```

[ ]:
```
pbar = pyprind.ProgBar(50000)
df = pd.DataFrame()
```

[ ]:
```
for s in ('test', 'train'):
    for l in ('pos', 'neg'):
        path = os.path.join(basepath, s, l)
        for file in os.listdir(path):
            with open(os.path.join(path, file),'r', encoding='utf-8') as infile:
                txt = infile.read()
            df = df.append([[txt, labels[l]]],ignore_index=True)
            pbar.update()
```

[ ]:
```
df.columns = ['review', 'sentiment']
```

[ ]:
```
import numpy as np
np.random.seed(0)
df = df.reindex(np.random.permutation(df.index))
df.to_csv('movie_data.csv', index=False, encoding='utf-8')
```

[5]:
```
df = pd.read_csv('movie_data.csv', encoding='utf-8')
df.head(3)
```

[5]:

	review	sentiment
0	In 1974, the teenager Martha Moxley (Maggie Gr…	1
1	OK… so… I really like Kris Kristofferson a…	0

```
2  ***SPOILER*** Do not read this, if you think a…          0
```

0.1 Introducing the bag-of-words model

[10]:
```
import numpy as np
from sklearn.feature_extraction.text import CountVectorizer
count = CountVectorizer()
docs = np.array(['The sun is shining','The weather is sweet','The sun is␣
 ↪shining and the weather is sweet'])
bag = count.fit_transform(docs)
```

[11]:
```
# it is only creating a dictionary and in this word is maaped to an index which␣
 ↪means in dictionary
# sequence is: [and,is,shining,sun,sweet,the,weather]
print(count.vocabulary_)
```

```
{'the': 5, 'sun': 3, 'is': 1, 'shining': 2, 'weather': 6, 'sweet': 4, 'and': 0}
```

[12]:
```
print(bag.toarray()) # it creates a feature vector for the dictionary and␣
 ↪values here represents a count.
# 0111010 means in first document, "and" comes 0 times, "is" comes 1 times,␣
 ↪"shining" comes 1 time and so on
```

```
[[0 1 1 1 0 1 0]
 [0 1 0 0 1 1 1]
 [1 2 1 1 1 2 1]]
```

[13]:
```
# These values
# in the feature vectors are also called the raw term frequencies: tf (t,d )-
the number
# of times a term t occurs in a document d.
```

0.2 Assessing word relevancy via term frequency-inverse document frequency

[14]:
```
from sklearn.feature_extraction.text import TfidfTransformer
tfidf = TfidfTransformer(use_idf=True,norm='l2',smooth_idf=True)
np.set_printoptions(precision=2)
print(tfidf.fit_transform(count.fit_transform(docs)).toarray())
```

```
[[0.   0.43 0.56 0.56 0.   0.43 0.  ]
 [0.   0.43 0.   0.   0.56 0.43 0.56]
 [0.4  0.48 0.31 0.31 0.31 0.48 0.31]]
```

0.3 Cleaning text data

[15]:
```
df.loc[0, 'review'][-50:]
```

[15]:
```
'is seven.<br /><br />Title (Brazil): Not Available'
```

[16]:
```
import re
def preprocessor(text):
    text = re.sub('<[^>]*>', '', text)
    emoticons = re.findall('(?::|;|=)(?:-)?(?:\)|\(|D|P)',text)
    text = (re.sub('[\W]+', ' ', text.lower()) +' '.join(emoticons).
 ↪replace('-', ''))
    return text
```

[17]:
```
preprocessor(df.loc[0, 'review'][-50:])
```

[17]:
```
'is seven title brazil not available'
```

[18]:
```
preprocessor("</a>This :) is :( a test :-)!")
```

[18]:
```
'this is a test :) :( :)'
```

[19]:
```
df['review'] = df['review'].apply(preprocessor)
```

0.4 Processing documents into tokens

[20]:
```
def tokenizer(text):
    return text.split()
```

[21]:
```
tokenizer('runners like running and thus they run')
```

[21]:
```
['runners', 'like', 'running', 'and', 'thus', 'they', 'run']
```

[22]:
```
# ! pip install nltk
```

[23]:
```
from nltk.stem.porter import PorterStemmer
porter = PorterStemmer()
def tokenizer_porter(text):
    return [porter.stem(word) for word in text.split()]
tokenizer_porter('runners like running and thus they run')
```

[23]:
```
['runner', 'like', 'run', 'and', 'thu', 'they', 'run']
```

[24]:
```
import nltk
nltk.download('stopwords')
```

```
[nltk_data] Downloading package stopwords to
[nltk_data]     C:\Users\ankit19.gupta\AppData\Roaming\nltk_data…
[nltk_data]   Package stopwords is already up-to-date!
```

[24]:
```
True
```

[25]:
```
from nltk.corpus import stopwords
stop = stopwords.words('english')
```

```
[w for w in tokenizer_porter('a runner likes running and runs a lot')[-10:] if␣
 ↪w not in stop]
```

[25]:
```
['runner', 'like', 'run', 'run', 'lot']
```

0.5 Training a logistic regression model for document classification

[26]:
```
X_train = df.loc[:25000, 'review'].values
y_train = df.loc[:25000, 'sentiment'].values
X_test = df.loc[25000:, 'review'].values
y_test = df.loc[25000:, 'sentiment'].values
```

[ ]:
```
from sklearn.model_selection import GridSearchCV
from sklearn.pipeline import Pipeline
from sklearn.linear_model import LogisticRegression
from sklearn.feature_extraction.text import TfidfVectorizer
tfidf = TfidfVectorizer(strip_accents=None,lowercase=False,preprocessor=None)
param_grid = [{'vect__ngram_range': [(1,1)],'vect__stop_words': [stop,␣
 ↪None],'vect__tokenizer': [tokenizer,tokenizer_porter],'clf__penalty': ['l1',␣
 ↪'l2'],'clf__C': [1.0, 10.0, 100.0]},{'vect__ngram_range':␣
 ↪[(1,1)],'vect__stop_words': [stop, None],'vect__tokenizer':␣
 ↪[tokenizer,tokenizer_porter],'vect__use_idf':[False],'vect__norm':
 ↪[None],'clf__penalty': ['l1', 'l2'],'clf__C': [1.0, 10.0, 100.0]}]
lr_tfidf = Pipeline([('vect',␣
 ↪tfidf),('clf',LogisticRegression(random_state=0))])
gs_lr_tfidf = GridSearchCV(lr_tfidf, param_grid,scoring='accuracy',cv=5,␣
 ↪verbose=1,n_jobs=1)
gs_lr_tfidf.fit(X_train, y_train)
```

```
Fitting 5 folds for each of 48 candidates, totalling 240 fits

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    solver = _check_solver(self.solver, self.penalty, self.dual)
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Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-
regression
  extra_warning_msg=_LOGISTIC_SOLVER_CONVERGENCE_MSG)
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f_Projects\Python_Machine_Learning_Sebastian_Raschka\myenv\lib\site-
packages\sklearn\linear_model\_logistic.py:765: ConvergenceWarning: lbfgs failed
to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
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f_Projects\Python_Machine_Learning_Sebastian_Raschka\myenv\lib\site-
packages\sklearn\model_selection\_validation.py:619: FitFailedWarning: Estimator
fit failed. The score on this train-test partition for these parameters will be
set to nan. Details:
Traceback (most recent call last):
  File "C:\Users\ankit19.gupta\OneDrive - Reliance Corporate IT Park Limited\Des
ktop\Self_Projects\Python_Machine_Learning_Sebastian_Raschka\myenv\lib\site-
packages\sklearn\model_selection\_validation.py", line 598, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "C:\Users\ankit19.gupta\OneDrive - Reliance Corporate IT Park Limited\Des
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packages\sklearn\pipeline.py", line 346, in fit
    self._final_estimator.fit(Xt, y, **fit_params_last_step)
  File "C:\Users\ankit19.gupta\OneDrive - Reliance Corporate IT Park Limited\Des
ktop\Self_Projects\Python_Machine_Learning_Sebastian_Raschka\myenv\lib\site-
packages\sklearn\linear_model\_logistic.py", line 1306, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
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packages\sklearn\linear_model\_logistic.py", line 444, in _check_solver
    "got %s penalty." % (solver, penalty))
ValueError: Solver lbfgs supports only 'l2' or 'none' penalties, got l1 penalty.

  FitFailedWarning)
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f_Projects\Python_Machine_Learning_Sebastian_Raschka\myenv\lib\site-
packages\sklearn\feature_extraction\text.py:391: UserWarning: Your stop_words
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f_Projects\Python_Machine_Learning_Sebastian_Raschka\myenv\lib\site-
packages\sklearn\model_selection\_validation.py:619: FitFailedWarning: Estimator
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Traceback (most recent call last):
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packages\sklearn\linear_model\_logistic.py", line 1306, in fit
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  'stop_words.' % sorted(inconsistent))

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STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
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'whi', "you'r", "you'v", 'yourselv'] not in stop_words.
  'stop_words.' % sorted(inconsistent))
C:\Users\ankit19.gupta\OneDrive - Reliance Corporate IT Park Limited\Desktop\Sel
f_Projects\Python_Machine_Learning_Sebastian_Raschka\myenv\lib\site-
packages\sklearn\linear_model\_logistic.py:765: ConvergenceWarning: lbfgs failed
to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-
regression
  extra_warning_msg=_LOGISTIC_SOLVER_CONVERGENCE_MSG)
C:\Users\ankit19.gupta\OneDrive - Reliance Corporate IT Park Limited\Desktop\Sel
f_Projects\Python_Machine_Learning_Sebastian_Raschka\myenv\lib\site-
packages\sklearn\feature_extraction\text.py:391: UserWarning: Your stop_words
may be inconsistent with your preprocessing. Tokenizing the stop words generated
tokens ['abov', 'ani', 'becaus', 'befor', 'doe', 'dure', 'ha', 'hi', "it'",
'onc', 'onli', 'ourselv', "she'", "should'v", 'themselv', 'thi', 'veri', 'wa',
'whi', "you'r", "you'v", 'yourselv'] not in stop_words.
  'stop_words.' % sorted(inconsistent))
```

[ ]:
```
print('Best parameter set: %s ' % gs_lr_tfidf.best_params_)
```

[ ]:
```
print('CV Accuracy: %.3f' % gs_lr_tfidf.best_score_)
```

[ ]:
```
clf = gs_lr_tfidf.best_estimator_
```

[ ]:
```
print('Test Accuracy: %.3f' % clf.score(X_test, y_test))
```

0.6 Working with Bigger data - online algorithms and out-of-core learning

[6]:
```
import numpy as np
import re
from nltk.corpus import stopwords
stop = stopwords.words('english')
def tokenizer(text):
    text = re.sub('<[^>]*>', '', text)
    emoticons = re.findall('(?::|;|=)(?:-)?(?:\)|\(|D|P)',text.lower())
    text = re.sub('[\W]+', ' ', text.lower()) \
    + ' '.join(emoticons).replace('-', '')
    tokenized = [w for w in text.split() if w not in stop]
    return tokenized
```

[7]:
```
def stream_docs(path):
    with open(path, 'r', encoding='utf-8') as csv:
        next(csv) # skip header
        for line in csv:
            text, label = line[:-3], int(line[-2])
            yield text, label
```

[8]:
```
next(stream_docs(path='movie_data.csv'))
```

[8]:
```
('"In 1974, the teenager Martha Moxley (Maggie Grace) moves to the high-class
area of Belle Haven, Greenwich, Connecticut. On the Mischief Night, eve of
Halloween, she was murdered in the backyard of her house and her murder remained
unsolved. Twenty-two years later, the writer Mark Fuhrman (Christopher Meloni),
who is a former LA detective that has fallen in disgrace for perjury in O.J.
Simpson trial and moved to Idaho, decides to investigate the case with his
partner Stephen Weeks (Andrew Mitchell) with the purpose of writing a book. The
locals squirm and do not welcome them, but with the support of the retired
detective Steve Carroll (Robert Forster) that was in charge of the investigation
in the 70\'s, they discover the criminal and a net of power and money to cover
the murder.<br /><br />""Murder in Greenwich"" is a good TV movie, with the true
story of a murder of a fifteen years old girl that was committed by a wealthy
teenager whose mother was a Kennedy. The powerful and rich family used their
influence to cover the murder for more than twenty years. However, a snoopy
detective and convicted perjurer in disgrace was able to disclose how the
hideous crime was committed. The screenplay shows the investigation of Mark and
the last days of Martha in parallel, but there is a lack of the emotion in the
dramatization. My vote is seven.<br /><br />Title (Brazil): Not Available"',
 1)
```

[9]:
```
def get_minibatch(doc_stream, size):
    docs, y = [], []
    try:
        for _ in range(size):
            text, label = next(doc_stream)
            docs.append(text)
```

```
            y.append(label)
    except StopIteration:
        return None, None
    return docs, y
```

[11]:
```
from sklearn.feature_extraction.text import HashingVectorizer
from sklearn.linear_model import SGDClassifier
vect =␣
 ↪HashingVectorizer(decode_error='ignore',n_features=2**21,preprocessor=None,tokenizer=tokeni
clf = SGDClassifier(loss='log', random_state=1, max_iter=1)
doc_stream = stream_docs(path='movie_data.csv')
```

[12]:
```
import pyprind
pbar = pyprind.ProgBar(45)
classes = np.array([0, 1])
for _ in range(45):
    X_train, y_train = get_minibatch(doc_stream, size=1000)
    if not X_train:
        break
    X_train = vect.transform(X_train)
    clf.partial_fit(X_train, y_train, classes=classes)
    pbar.update()
```

```
0% [##############################] 100% | ETA: 00:00:00
Total time elapsed: 00:00:19
```

[13]:
```
X_test, y_test = get_minibatch(doc_stream, size=5000)
X_test = vect.transform(X_test)
print('Accuracy: %.3f' % clf.score(X_test, y_test))
```

```
Accuracy: 0.868
```

[14]:
```
clf = clf.partial_fit(X_test, y_test)
```

0.7 Topic modeling with Latent Dirichlet Allocation

0.7.1 Decomposing text documents with LDA

[15]:
```
import pandas as pd
df = pd.read_csv('movie_data.csv', encoding='utf-8')
```

[16]:
```
from sklearn.feature_extraction.text import CountVectorizer
count = CountVectorizer(stop_words='english',max_df=.1,max_features=5000)
X = count.fit_transform(df['review'].values)
```

[20]:
```
from sklearn.decomposition import LatentDirichletAllocation
lda =␣
 ↪LatentDirichletAllocation(n_components=10,random_state=123,learning_method='batch')
```

```
X_topics = lda.fit_transform(X)
```

[21]:
```
lda.components_.shape
```

[21]:
```
(10, 5000)
```

[22]:
```
n_top_words = 5
feature_names = count.get_feature_names()
for topic_idx, topic in enumerate(lda.components_):
    print("Topic %d:" % (topic_idx + 1))
    print(" ".join([feature_names[i] for i in topic.argsort() [:-n_top_words -␣
 ↪1:-1]]))
```

```
Topic 1:
worst minutes awful script stupid
Topic 2:
family mother father children girl
Topic 3:
american war dvd music tv
Topic 4:
human audience cinema art sense
Topic 5:
police guy car dead murder
Topic 6:
horror house sex girl woman
Topic 7:
role performance comedy actor performances
Topic 8:
series episode war episodes tv
Topic 9:
book version original read novel
Topic 10:
action fight guy guys cool
```

[23]:
```
horror = X_topics[:, 5].argsort()[::-1]
for iter_idx, movie_idx in enumerate(horror[:3]):
    print('\nHorror movie #%d:' % (iter_idx + 1))
    print(df['review'][movie_idx][:300], '...')
```

```
Horror movie #1:
House of Dracula works from the same basic premise as House of Frankenstein from
the year before; namely that Universal's three most famous monsters; Dracula,
Frankenstein's Monster and The Wolf Man are appearing in the movie together.
Naturally, the film is rather messy therefore, but the fact that …

Horror movie #2:
Okay, what the hell kind of TRASH have I been watching now? "The Witches'
```

```
Mountain" has got to be one of the most incoherent and insane Spanish
exploitation flicks ever and yet, at the same time, it's also strangely
compelling. There's absolutely nothing that makes sense here and I even doubt
there  …

Horror movie #3:
<br /><br />Horror movie time, Japanese style. Uzumaki/Spiral was a total
freakfest from start to finish. A fun freakfest at that, but at times it was a
tad too reliant on kitsch rather than the horror. The story is difficult to
summarize succinctly: a carefree, normal teenage girl starts coming fac …
```

[ ]: