ml_imdb_random_forest

March 12, 2021

[4]:
```
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call
drive.mount("/content/drive", force_remount=True).
```

[5]:
```
import sys, os
sys.path.insert(0,'/content/drive/My Drive/')
```

[8]:
```
!unzip /content/drive/MyDrive/imdb_data/aclImdb.zip
```

```
Archive:  /content/drive/MyDrive/imdb_data/aclImdb.zip
replace __MACOSX/._aclImdb? [y]es, [n]o, [A]ll, [N]one, [r]ename: N
```

[1]:
```
%matplotlib inline

## Install some stuff you likely don't have
!pip3 -q install --upgrade pip
!pip3 -q install pandas_path
!pip3 -q install fasttext
!pip3 -q install umap-learn[plot]
!pip3 -q install ipywidgets --user

import json
import logging
from pathlib import Path
import random
import tarfile
import tempfile
import warnings

import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import pandas_path  # Path style access for pandas
from tqdm import tqdm
```

```
import os

from PIL import Image
import umap
import umap.plot
```

[2]:
```
import seaborn as sns
from pylab import rcParams
import matplotlib.pyplot as plt
from matplotlib import rc
```

[3]:
```
import re

def preprocess_text(sen):
    # Removing html tags
    sentence = remove_tags(sen)
    # Remove punctuations and numbers
    sentence = re.sub('[^a-zA-Z]', ' ', sentence)
    # Single character removal
    sentence = re.sub(r"\s+[a-zA-Z]\s+", ' ', sentence)
    # Removing multiple spaces
    sentence = re.sub(r'\s+', ' ', sentence)
    return sentence
TAG_RE = re.compile(r'<[^>]+>')
def remove_tags(text):
    return TAG_RE.sub('', text)
```

[4]:
```
def path_to_dataframe(path):
  path1 = path+'neg/'
  all_files = os.listdir(path1)
  all_files.sort(key=lambda x:int(x[:-4]))
  dictionary_list = []
  for file in all_files:
    with open(os.path.join(path1, file),'r',encoding="utf8") as f:
      text = preprocess_text(f.read())
      dictionary_list.append({'text':text, 'label':0})
  path2 = path+'pos/'
  all_files = os.listdir(path2)
  all_files.sort(key=lambda x:int(x[:-4]))
  for file in all_files:
    with open(os.path.join(path2, file),'r',encoding="utf8") as f:
      text = preprocess_text(f.read())
      dictionary_list.append({'text':text, 'label':1})
  random.shuffle(dictionary_list)
  df = pd.DataFrame.from_dict(dictionary_list)
  return df
```

[5]:
```
train_path = '/content/aclImdb/train/'
test_path = '/content/aclImdb/test/'
```

```
original_set = path_to_dataframe(train_path)
test_set = path_to_dataframe(test_path)

print(original_set.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 25000 entries, 0 to 24999
Data columns (total 2 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   text    25000 non-null  object
 1   label   25000 non-null  int64
dtypes: int64(1), object(1)
memory usage: 390.8+ KB
None
```

[6]:
```
%matplotlib inline
%config InlineBackend.figure_format='retina'

sns.set(style='whitegrid', palette='muted', font_scale=1.2)

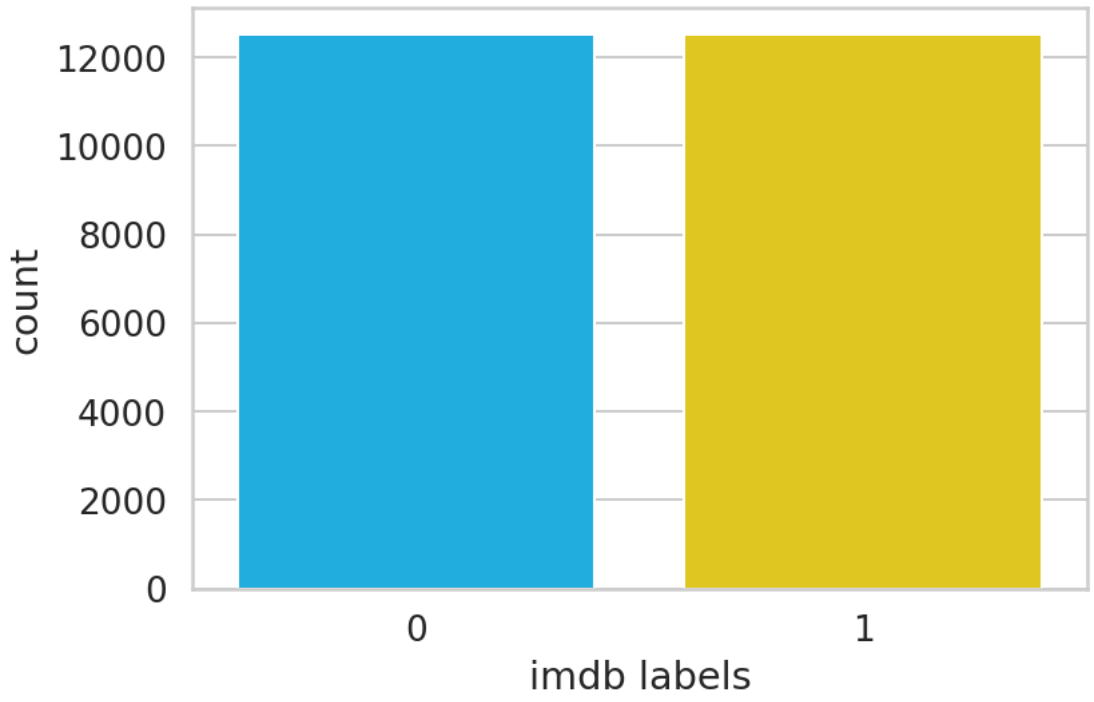
HAPPY_COLORS_PALETTE = ["#01BEFE", "#FFDD00", "#FF7D00", "#FF006D", "#ADFF02",␣
 ↪"#8F00FF"]

sns.set_palette(sns.color_palette(HAPPY_COLORS_PALETTE))
```

[7]:
```
sns.countplot(original_set.label)
plt.xlabel('imdb labels')
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning:
Pass the following variable as a keyword arg: x. From version 0.12, the only
valid positional argument will be `data`, and passing other arguments without an
explicit keyword will result in an error or misinterpretation.
  FutureWarning
```

[7]:
```
Text(0.5, 0, 'imdb labels')
```



[8]:
```
import re
import nltk
from sklearn.datasets import load_files
nltk.download('stopwords')
nltk.download('wordnet')
import pickle
from nltk.corpus import stopwords
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
[nltk_data] Downloading package wordnet to /root/nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
```

[33]:
```
preprocessed_train_x, y_train = original_set.text[:15000], original_set.label.
 ↪array[:15000]
preprocessed_test_x, y_test = test_set.text, test_set.label.array
```

[10]:
```
train_piles = []

from nltk.stem import WordNetLemmatizer

stemmer = WordNetLemmatizer()

for sen in range(0, len(preprocessed_train_x)):
    # Remove all the special characters
```

```
    train_pile = re.sub(r'\W', ' ', str(preprocessed_train_x[sen]))

    # remove all single characters
    train_pile = re.sub(r'\s+[a-zA-Z]\s+', ' ', train_pile)

    # Remove single characters from the start
    train_pile = re.sub(r'\^[a-zA-Z]\s+', ' ', train_pile)

    # Substituting multiple spaces with single space
    train_pile = re.sub(r'\s+', ' ', train_pile, flags=re.I)

    # Removing prefixed 'b'
    train_pile = re.sub(r'^b\s+', '', train_pile)

    # Converting to Lowercase
    train_pile = train_pile.lower()

    # Lemmatization
    train_pile = train_pile.split()

    train_pile = [stemmer.lemmatize(word) for word in train_pile]
    train_pile = ' '.join(train_pile)

    train_piles.append(train_pile)
```

[21]:
```
print(train_piles[2])
```

```
it should be against the law not to experience this extremely funny stand up
show with eddie murphy have never seen anything like it murphy go on for almost
minute about dick pussy tit and insaults so many famous people including his own
family among the people who get it by murphy are elvis mr michael jackson stevie
wonder mick jagger luther vandross and james brown have seriously never laughed
so hard of anything my entire life mean when person doesn know who mr is but
still laugh so hard of murphy a mr there something about it at the time saw the
show couldn remember who mr wa but still laughed now know who he is and that
just make it so much more funny because that what eddie do he can make those
impression so good that it don matter who the hell he trying to do it still
hilarious and on top of that we learn that murphy actually is very good singer
please watch it
```

[11]:
```
test_piles = []

for sen in range(0, len(preprocessed_test_x)):
    # Remove all the special characters
    test_pile = re.sub(r'\W', ' ', str(preprocessed_test_x[sen]))

    # remove all single characters
    test_pile = re.sub(r'\s+[a-zA-Z]\s+', ' ', test_pile)
```

```
    # Remove single characters from the start
    test_pile = re.sub(r'\^[a-zA-Z]\s+', ' ', test_pile)

    # Substituting multiple spaces with single space
    test_pile = re.sub(r'\s+', ' ', test_pile, flags=re.I)

    # Removing prefixed 'b'
    test_pile = re.sub(r'^b\s+', '', test_pile)

    # Converting to Lowercase
    test_pile = test_pile.lower()

    # Lemmatization
    test_pile = test_pile.split()

    test_pile = [stemmer.lemmatize(word) for word in test_pile]
    test_pile = ' '.join(test_pile)

    test_piles.append(test_pile)
```

[44]:
```
from sklearn.feature_extraction.text import CountVectorizer
vectorizer = CountVectorizer(max_features=1500, min_df=5, max_df=0.7,␣
 ↪stop_words=stopwords.words('english'))
x_train = vectorizer.fit_transform(train_piles).toarray()
x_test = vectorizer.fit_transform(test_piles).toarray()
```

[45]:
```
print(x_train[100])
```

```
[1 0 0 ... 0 0 0]
```

[46]:
```
from sklearn.feature_extraction.text import TfidfTransformer
tfidfconverter = TfidfTransformer()
x_train = tfidfconverter.fit_transform(x_train).toarray()
x_test = tfidfconverter.fit_transform(x_test).toarray()
```

[47]:
```
print(x_train[100])
```

```
[0.0815068 0.        0.        ... 0.        0.        0.       ]
```

[48]:
```
print(y_train)
```

```
<PandasArray>
[0, 0, 1, 1, 0, 1, 0, 1, 1, 1,
 ...
 0, 1, 0, 1, 1, 1, 0, 1, 1, 0]
Length: 15000, dtype: int64
```

[49]:
```
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score
```

[64]:
```
rf = RandomForestClassifier(n_estimators=1000, max_depth=None, random_state=42,␣
 ↪n_jobs=-1)
rf_model = rf.fit(x_train,y_train)
```

[65]:
```
test_predictions = rf_model.predict(x_test)
print(test_predictions)
print(accuracy_score(y_test,test_predictions))
```

```
[0 1 1 ... 0 1 1]
0.561
```

[66]:
```
predictions_df = pd.DataFrame()
predictions_df['y_pred'] = test_predictions
predictions_df['y_truth'] = test_set['label']
predictions_df['y_pred'] = predictions_df['y_pred'].astype(int)

predictions_df.head()
```

[66]:

	y_pred	y_truth
0	0	0
1	1	1
2	1	1
3	1	0
4	1	1

[67]:
```
predictions_df.to_csv('predictions_rf.csv')
```

[68]:
```
from google.colab import files
files.download('/content/predictions_rf.csv')
```

```
<IPython.core.display.Javascript object>


<IPython.core.display.Javascript object>
```

[ ]:
```
max_depths = [5, 300, 500, 700, 1000, 2000]
depth_accuracy = []

for depth in max_depths:
  rf = RandomForestClassifier(n_estimators=1000,max_depth=depth,n_jobs=-1)
  rf_model = rf.fit(x_train,y_train)
  test_predictions = rf_model.predict(x_test)
  depth_accuracy.append(accuracy_score(y_test,test_predictions))
```

[76]:
```
estimators_array = [100, 300, 400, 800, 1000, 200, 3000]
estimator_accuracy = []
```

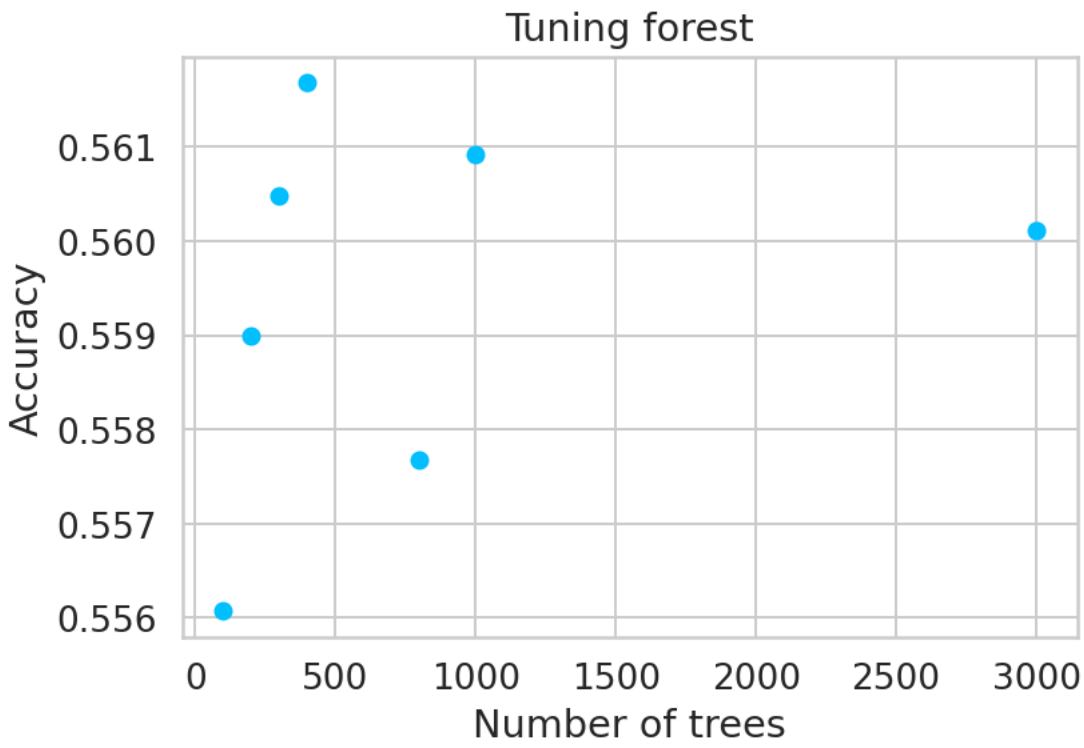
```
for n in estimators_array:
  rf = RandomForestClassifier(n_estimators=n,max_depth=None,n_jobs=-1)
  rf_model = rf.fit(x_train,y_train)
  test_predictions = rf_model.predict(x_test)
  estimator_accuracy.append(accuracy_score(y_test,test_predictions))
```

[77]:
```
print(depth_accuracy)
print(estimator_accuracy)
```

```
[0.52016, 0.56012, 0.5576, 0.56032, 0.5616, 0.55844]
[0.55608, 0.56048, 0.56168, 0.55768, 0.56092, 0.559, 0.56012]
```

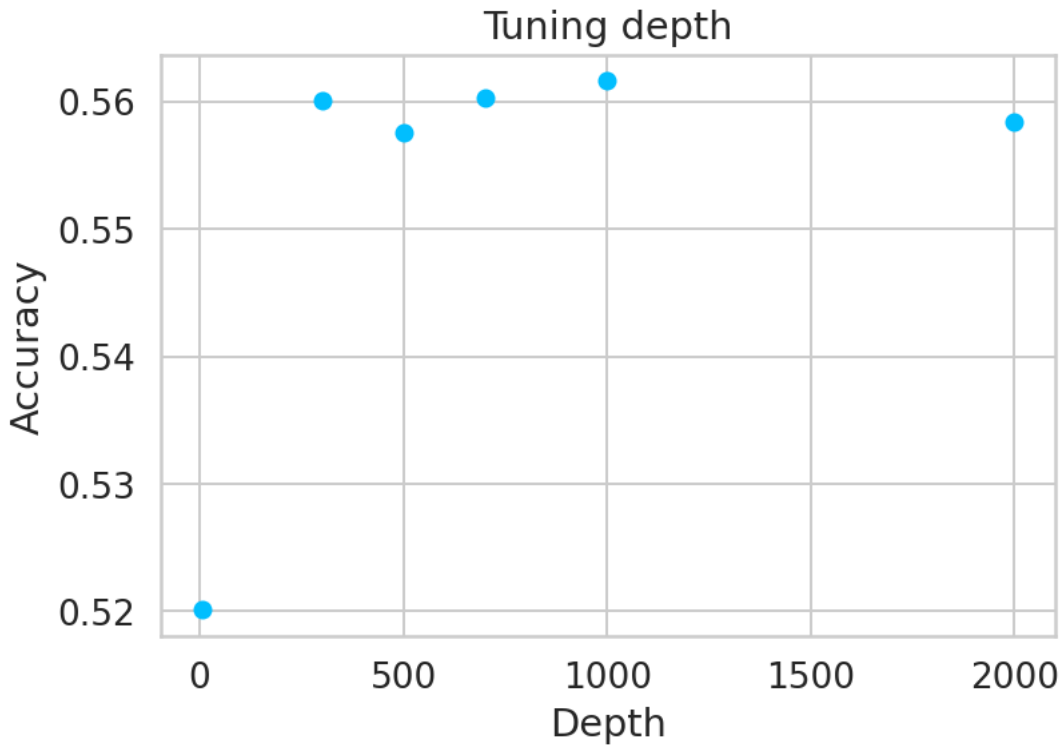
[83]:
```
plt.scatter(estimators_array, estimator_accuracy)
plt.title('Tuning forest')
plt.ylabel('Accuracy')
plt.xlabel('Number of trees')
```

[83]:
```
Text(0.5, 0, 'Number of trees')
```



[79]:
```
plt.scatter(max_depths, depth_accuracy)
plt.title('Tuning depth')
plt.ylabel('Accuracy')
plt.xlabel('Depth')
```

[79]:
```
Text(0.5, 0, 'Depth')
```



[80]:
```
!apt-get install texlive texlive-xetex texlive-latex-extra pandoc
!pip install pypandoc
```

```
Reading package lists... Done
Building dependency tree
Reading state information... Done
pandoc is already the newest version (1.19.2.4~dfsg-1build4).
pandoc set to manually installed.
The following additional packages will be installed:
  fonts-droid-fallback fonts-lato fonts-lmodern fonts-noto-mono fonts-texgyre
  javascript-common libcupsfilters1 libcupsimage2 libgs9 libgs9-common
  libijs-0.35 libjbig2dec0 libjs-jquery libkpathsea6 libpotrace0 libptexenc1
  libruby2.5 libsynctex1 libtexlua52 libtexluajit2 libzzip-0-13 lmodern
  poppler-data preview-latex-style rake ruby ruby-did-you-mean ruby-minitest
  ruby-net-telnet ruby-power-assert ruby-test-unit ruby2.5
  rubygems-integration t1utils tex-common tex-gyre texlive-base
  texlive-binaries texlive-fonts-recommended texlive-latex-base
  texlive-latex-recommended texlive-pictures texlive-plain-generic tipa
Suggested packages:
  fonts-noto apache2 | lighttpd | httpd poppler-utils ghostscript
  fonts-japanese-mincho | fonts-ipafont-mincho fonts-japanese-gothic
```

```
  | fonts-ipafont-gothic fonts-arphic-ukai fonts-arphic-uming fonts-nanum ri
  ruby-dev bundler debhelper gv | postscript-viewer perl-tk xpdf-reader
  | pdf-viewer texlive-fonts-recommended-doc texlive-latex-base-doc
  python-pygments icc-profiles libfile-which-perl
  libspreadsheet-parseexcel-perl texlive-latex-extra-doc
  texlive-latex-recommended-doc texlive-pstricks dot2tex prerex ruby-tcltk
  | libtcltk-ruby texlive-pictures-doc vprerex
The following NEW packages will be installed:
  fonts-droid-fallback fonts-lato fonts-lmodern fonts-noto-mono fonts-texgyre
  javascript-common libcupsfilters1 libcupsimage2 libgs9 libgs9-common
  libijs-0.35 libjbig2dec0 libjs-jquery libkpathsea6 libpotrace0 libptexenc1
  libruby2.5 libsynctex1 libtexlua52 libtexluajit2 libzzip-0-13 lmodern
  poppler-data preview-latex-style rake ruby ruby-did-you-mean ruby-minitest
  ruby-net-telnet ruby-power-assert ruby-test-unit ruby2.5
  rubygems-integration t1utils tex-common tex-gyre texlive texlive-base
  texlive-binaries texlive-fonts-recommended texlive-latex-base
  texlive-latex-extra texlive-latex-recommended texlive-pictures
  texlive-plain-generic texlive-xetex tipa
0 upgraded, 47 newly installed, 0 to remove and 29 not upgraded.
Need to get 146 MB of archives.
After this operation, 460 MB of additional disk space will be used.
Get:1 http://archive.ubuntu.com/ubuntu bionic/main amd64 fonts-droid-fallback
all 1:6.0.1r16-1.1 [1,805 kB]
Get:2 http://archive.ubuntu.com/ubuntu bionic/main amd64 fonts-lato all 2.0-2
[2,698 kB]
Get:3 http://archive.ubuntu.com/ubuntu bionic/main amd64 poppler-data all
0.4.8-2 [1,479 kB]
Get:4 http://archive.ubuntu.com/ubuntu bionic/main amd64 tex-common all 6.09
[33.0 kB]
Get:5 http://archive.ubuntu.com/ubuntu bionic/main amd64 fonts-lmodern all
2.004.5-3 [4,551 kB]
Get:6 http://archive.ubuntu.com/ubuntu bionic/main amd64 fonts-noto-mono all
20171026-2 [75.5 kB]
Get:7 http://archive.ubuntu.com/ubuntu bionic/universe amd64 fonts-texgyre all
20160520-1 [8,761 kB]
Get:8 http://archive.ubuntu.com/ubuntu bionic/main amd64 javascript-common all
11 [6,066 B]
Get:9 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 libcupsfilters1
amd64 1.20.2-0ubuntu3.1 [108 kB]
Get:10 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 libcupsimage2
amd64 2.2.7-1ubuntu2.8 [18.6 kB]
Get:11 http://archive.ubuntu.com/ubuntu bionic/main amd64 libijs-0.35 amd64
0.35-13 [15.5 kB]
Get:12 http://archive.ubuntu.com/ubuntu bionic/main amd64 libjbig2dec0 amd64
0.13-6 [55.9 kB]
Get:13 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 libgs9-common
all 9.26~dfsg+0-0ubuntu0.18.04.14 [5,092 kB]
Get:14 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 libgs9 amd64
```

```
9.26~dfsg+0-0ubuntu0.18.04.14 [2,265 kB]
Get:15 http://archive.ubuntu.com/ubuntu bionic/main amd64 libjs-jquery all
3.2.1-1 [152 kB]
Get:16 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 libkpathsea6
amd64 2017.20170613.44572-8ubuntu0.1 [54.9 kB]
Get:17 http://archive.ubuntu.com/ubuntu bionic/main amd64 libpotrace0 amd64
1.14-2 [17.4 kB]
Get:18 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 libptexenc1
amd64 2017.20170613.44572-8ubuntu0.1 [34.5 kB]
Get:19 http://archive.ubuntu.com/ubuntu bionic/main amd64 rubygems-integration
all 1.11 [4,994 B]
Get:20 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 ruby2.5 amd64
2.5.1-1ubuntu1.7 [48.6 kB]
Get:21 http://archive.ubuntu.com/ubuntu bionic/main amd64 ruby amd64 1:2.5.1
[5,712 B]
Get:22 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 rake all
12.3.1-1ubuntu0.1 [44.9 kB]
Get:23 http://archive.ubuntu.com/ubuntu bionic/main amd64 ruby-did-you-mean all
1.2.0-2 [9,700 B]
Get:24 http://archive.ubuntu.com/ubuntu bionic/main amd64 ruby-minitest all
5.10.3-1 [38.6 kB]
Get:25 http://archive.ubuntu.com/ubuntu bionic/main amd64 ruby-net-telnet all
0.1.1-2 [12.6 kB]
Get:26 http://archive.ubuntu.com/ubuntu bionic/main amd64 ruby-power-assert all
0.3.0-1 [7,952 B]
Get:27 http://archive.ubuntu.com/ubuntu bionic/main amd64 ruby-test-unit all
3.2.5-1 [61.1 kB]
Get:28 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 libruby2.5
amd64 2.5.1-1ubuntu1.7 [3,068 kB]
Get:29 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 libsynctex1
amd64 2017.20170613.44572-8ubuntu0.1 [41.4 kB]
Get:30 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 libtexlua52
amd64 2017.20170613.44572-8ubuntu0.1 [91.2 kB]
Get:31 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 libtexluajit2
amd64 2017.20170613.44572-8ubuntu0.1 [230 kB]
Get:32 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 libzzip-0-13
amd64 0.13.62-3.1ubuntu0.18.04.1 [26.0 kB]
Get:33 http://archive.ubuntu.com/ubuntu bionic/main amd64 lmodern all 2.004.5-3
[9,631 kB]
Get:34 http://archive.ubuntu.com/ubuntu bionic/main amd64 preview-latex-style
all 11.91-1ubuntu1 [185 kB]
Get:35 http://archive.ubuntu.com/ubuntu bionic/main amd64 t1utils amd64 1.41-2
[56.0 kB]
Get:36 http://archive.ubuntu.com/ubuntu bionic/universe amd64 tex-gyre all
20160520-1 [4,998 kB]
Get:37 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 texlive-
binaries amd64 2017.20170613.44572-8ubuntu0.1 [8,179 kB]
Get:38 http://archive.ubuntu.com/ubuntu bionic/main amd64 texlive-base all
```

```
2017.20180305-1 [18.7 MB]
Get:39 http://archive.ubuntu.com/ubuntu bionic/universe amd64 texlive-fonts-
recommended all 2017.20180305-1 [5,262 kB]
Get:40 http://archive.ubuntu.com/ubuntu bionic/main amd64 texlive-latex-base all
2017.20180305-1 [951 kB]
Get:41 http://archive.ubuntu.com/ubuntu bionic/main amd64 texlive-latex-
recommended all 2017.20180305-1 [14.9 MB]
Get:42 http://archive.ubuntu.com/ubuntu bionic/universe amd64 texlive all
2017.20180305-1 [14.4 kB]
Get:43 http://archive.ubuntu.com/ubuntu bionic/universe amd64 texlive-pictures
all 2017.20180305-1 [4,026 kB]
Get:44 http://archive.ubuntu.com/ubuntu bionic/universe amd64 texlive-latex-
extra all 2017.20180305-2 [10.6 MB]
Get:45 http://archive.ubuntu.com/ubuntu bionic/universe amd64 texlive-plain-
generic all 2017.20180305-2 [23.6 MB]
Get:46 http://archive.ubuntu.com/ubuntu bionic/universe amd64 tipa all 2:1.3-20
[2,978 kB]
Get:47 http://archive.ubuntu.com/ubuntu bionic/universe amd64 texlive-xetex all
2017.20180305-1 [10.7 MB]
Fetched 146 MB in 5s (26.5 MB/s)
Extracting templates from packages: 100%
Preconfiguring packages ...
Selecting previously unselected package fonts-droid-fallback.
(Reading database ... 160975 files and directories currently installed.)
Preparing to unpack .../00-fonts-droid-fallback_1%3a6.0.1r16-1.1_all.deb ...
Unpacking fonts-droid-fallback (1:6.0.1r16-1.1) ...
Selecting previously unselected package fonts-lato.
Preparing to unpack .../01-fonts-lato_2.0-2_all.deb ...
Unpacking fonts-lato (2.0-2) ...
Selecting previously unselected package poppler-data.
Preparing to unpack .../02-poppler-data_0.4.8-2_all.deb ...
Unpacking poppler-data (0.4.8-2) ...
Selecting previously unselected package tex-common.
Preparing to unpack .../03-tex-common_6.09_all.deb ...
Unpacking tex-common (6.09) ...
Selecting previously unselected package fonts-lmodern.
Preparing to unpack .../04-fonts-lmodern_2.004.5-3_all.deb ...
Unpacking fonts-lmodern (2.004.5-3) ...
Selecting previously unselected package fonts-noto-mono.
Preparing to unpack .../05-fonts-noto-mono_20171026-2_all.deb ...
Unpacking fonts-noto-mono (20171026-2) ...
Selecting previously unselected package fonts-texgyre.
Preparing to unpack .../06-fonts-texgyre_20160520-1_all.deb ...
Unpacking fonts-texgyre (20160520-1) ...
Selecting previously unselected package javascript-common.
Preparing to unpack .../07-javascript-common_11_all.deb ...
Unpacking javascript-common (11) ...
Selecting previously unselected package libcupsfilters1:amd64.
```

```
Preparing to unpack .../08-libcupsfilters1_1.20.2-0ubuntu3.1_amd64.deb ...
Unpacking libcupsfilters1:amd64 (1.20.2-0ubuntu3.1) ...
Selecting previously unselected package libcupsimage2:amd64.
Preparing to unpack .../09-libcupsimage2_2.2.7-1ubuntu2.8_amd64.deb ...
Unpacking libcupsimage2:amd64 (2.2.7-1ubuntu2.8) ...
Selecting previously unselected package libijs-0.35:amd64.
Preparing to unpack .../10-libijs-0.35_0.35-13_amd64.deb ...
Unpacking libijs-0.35:amd64 (0.35-13) ...
Selecting previously unselected package libjbig2dec0:amd64.
Preparing to unpack .../11-libjbig2dec0_0.13-6_amd64.deb ...
Unpacking libjbig2dec0:amd64 (0.13-6) ...
Selecting previously unselected package libgs9-common.
Preparing to unpack .../12-libgs9-common_9.26~dfsg+0-0ubuntu0.18.04.14_all.deb
...
Unpacking libgs9-common (9.26~dfsg+0-0ubuntu0.18.04.14) ...
Selecting previously unselected package libgs9:amd64.
Preparing to unpack .../13-libgs9_9.26~dfsg+0-0ubuntu0.18.04.14_amd64.deb ...
Unpacking libgs9:amd64 (9.26~dfsg+0-0ubuntu0.18.04.14) ...
Selecting previously unselected package libjs-jquery.
Preparing to unpack .../14-libjs-jquery_3.2.1-1_all.deb ...
Unpacking libjs-jquery (3.2.1-1) ...
Selecting previously unselected package libkpathsea6:amd64.
Preparing to unpack .../15-libkpathsea6_2017.20170613.44572-8ubuntu0.1_amd64.deb
...
Unpacking libkpathsea6:amd64 (2017.20170613.44572-8ubuntu0.1) ...
Selecting previously unselected package libpotrace0.
Preparing to unpack .../16-libpotrace0_1.14-2_amd64.deb ...
Unpacking libpotrace0 (1.14-2) ...
Selecting previously unselected package libptexenc1:amd64.
Preparing to unpack .../17-libptexenc1_2017.20170613.44572-8ubuntu0.1_amd64.deb
...
Unpacking libptexenc1:amd64 (2017.20170613.44572-8ubuntu0.1) ...
Selecting previously unselected package rubygems-integration.
Preparing to unpack .../18-rubygems-integration_1.11_all.deb ...
Unpacking rubygems-integration (1.11) ...
Selecting previously unselected package ruby2.5.
Preparing to unpack .../19-ruby2.5_2.5.1-1ubuntu1.7_amd64.deb ...
Unpacking ruby2.5 (2.5.1-1ubuntu1.7) ...
Selecting previously unselected package ruby.
Preparing to unpack .../20-ruby_1%3a2.5.1_amd64.deb ...
Unpacking ruby (1:2.5.1) ...
Selecting previously unselected package rake.
Preparing to unpack .../21-rake_12.3.1-1ubuntu0.1_all.deb ...
Unpacking rake (12.3.1-1ubuntu0.1) ...
Selecting previously unselected package ruby-did-you-mean.
Preparing to unpack .../22-ruby-did-you-mean_1.2.0-2_all.deb ...
Unpacking ruby-did-you-mean (1.2.0-2) ...
Selecting previously unselected package ruby-minitest.
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Preparing to unpack .../23-ruby-minitest_5.10.3-1_all.deb ...
Unpacking ruby-minitest (5.10.3-1) ...
Selecting previously unselected package ruby-net-telnet.
Preparing to unpack .../24-ruby-net-telnet_0.1.1-2_all.deb ...
Unpacking ruby-net-telnet (0.1.1-2) ...
Selecting previously unselected package ruby-power-assert.
Preparing to unpack .../25-ruby-power-assert_0.3.0-1_all.deb ...
Unpacking ruby-power-assert (0.3.0-1) ...
Selecting previously unselected package ruby-test-unit.
Preparing to unpack .../26-ruby-test-unit_3.2.5-1_all.deb ...
Unpacking ruby-test-unit (3.2.5-1) ...
Selecting previously unselected package libruby2.5:amd64.
Preparing to unpack .../27-libruby2.5_2.5.1-1ubuntu1.7_amd64.deb ...
Unpacking libruby2.5:amd64 (2.5.1-1ubuntu1.7) ...
Selecting previously unselected package libsynctex1:amd64.
Preparing to unpack .../28-libsynctex1_2017.20170613.44572-8ubuntu0.1_amd64.deb
...
Unpacking libsynctex1:amd64 (2017.20170613.44572-8ubuntu0.1) ...
Selecting previously unselected package libtexlua52:amd64.
Preparing to unpack .../29-libtexlua52_2017.20170613.44572-8ubuntu0.1_amd64.deb
...
Unpacking libtexlua52:amd64 (2017.20170613.44572-8ubuntu0.1) ...
Selecting previously unselected package libtexluajit2:amd64.
Preparing to unpack
.../30-libtexluajit2_2017.20170613.44572-8ubuntu0.1_amd64.deb ...
Unpacking libtexluajit2:amd64 (2017.20170613.44572-8ubuntu0.1) ...
Selecting previously unselected package libzzip-0-13:amd64.
Preparing to unpack .../31-libzzip-0-13_0.13.62-3.1ubuntu0.18.04.1_amd64.deb ...
Unpacking libzzip-0-13:amd64 (0.13.62-3.1ubuntu0.18.04.1) ...
Selecting previously unselected package lmodern.
Preparing to unpack .../32-lmodern_2.004.5-3_all.deb ...
Unpacking lmodern (2.004.5-3) ...
Selecting previously unselected package preview-latex-style.
Preparing to unpack .../33-preview-latex-style_11.91-1ubuntu1_all.deb ...
Unpacking preview-latex-style (11.91-1ubuntu1) ...
Selecting previously unselected package t1utils.
Preparing to unpack .../34-t1utils_1.41-2_amd64.deb ...
Unpacking t1utils (1.41-2) ...
Selecting previously unselected package tex-gyre.
Preparing to unpack .../35-tex-gyre_20160520-1_all.deb ...
Unpacking tex-gyre (20160520-1) ...
Selecting previously unselected package texlive-binaries.
Preparing to unpack .../36-texlive-
binaries_2017.20170613.44572-8ubuntu0.1_amd64.deb ...
Unpacking texlive-binaries (2017.20170613.44572-8ubuntu0.1) ...
Selecting previously unselected package texlive-base.
Preparing to unpack .../37-texlive-base_2017.20180305-1_all.deb ...
Unpacking texlive-base (2017.20180305-1) ...
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Selecting previously unselected package texlive-fonts-recommended.
Preparing to unpack .../38-texlive-fonts-recommended_2017.20180305-1_all.deb ...
Unpacking texlive-fonts-recommended (2017.20180305-1) ...
Selecting previously unselected package texlive-latex-base.
Preparing to unpack .../39-texlive-latex-base_2017.20180305-1_all.deb ...
Unpacking texlive-latex-base (2017.20180305-1) ...
Selecting previously unselected package texlive-latex-recommended.
Preparing to unpack .../40-texlive-latex-recommended_2017.20180305-1_all.deb ...
Unpacking texlive-latex-recommended (2017.20180305-1) ...
Selecting previously unselected package texlive.
Preparing to unpack .../41-texlive_2017.20180305-1_all.deb ...
Unpacking texlive (2017.20180305-1) ...
Selecting previously unselected package texlive-pictures.
Preparing to unpack .../42-texlive-pictures_2017.20180305-1_all.deb ...
Unpacking texlive-pictures (2017.20180305-1) ...
Selecting previously unselected package texlive-latex-extra.
Preparing to unpack .../43-texlive-latex-extra_2017.20180305-2_all.deb ...
Unpacking texlive-latex-extra (2017.20180305-2) ...
Selecting previously unselected package texlive-plain-generic.
Preparing to unpack .../44-texlive-plain-generic_2017.20180305-2_all.deb ...
Unpacking texlive-plain-generic (2017.20180305-2) ...
Selecting previously unselected package tipa.
Preparing to unpack .../45-tipa_2%3a1.3-20_all.deb ...
Unpacking tipa (2:1.3-20) ...
Selecting previously unselected package texlive-xetex.
Preparing to unpack .../46-texlive-xetex_2017.20180305-1_all.deb ...
Unpacking texlive-xetex (2017.20180305-1) ...
Setting up libgs9-common (9.26~dfsg+0-0ubuntu0.18.04.14) ...
Setting up libkpathsea6:amd64 (2017.20170613.44572-8ubuntu0.1) ...
Setting up libjs-jquery (3.2.1-1) ...
Setting up libtexlua52:amd64 (2017.20170613.44572-8ubuntu0.1) ...
Setting up fonts-droid-fallback (1:6.0.1r16-1.1) ...
Setting up libsynctex1:amd64 (2017.20170613.44572-8ubuntu0.1) ...
Setting up libptexenc1:amd64 (2017.20170613.44572-8ubuntu0.1) ...
Setting up tex-common (6.09) ...
update-language: texlive-base not installed and configured, doing nothing!
Setting up poppler-data (0.4.8-2) ...
Setting up tex-gyre (20160520-1) ...
Setting up preview-latex-style (11.91-1ubuntu1) ...
Setting up fonts-texgyre (20160520-1) ...
Setting up fonts-noto-mono (20171026-2) ...
Setting up fonts-lato (2.0-2) ...
Setting up libcupsfilters1:amd64 (1.20.2-0ubuntu3.1) ...
Setting up libcupsimage2:amd64 (2.2.7-1ubuntu2.8) ...
Setting up libjbig2dec0:amd64 (0.13-6) ...
Setting up ruby-did-you-mean (1.2.0-2) ...
Setting up t1utils (1.41-2) ...
Setting up ruby-net-telnet (0.1.1-2) ...
```

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Setting up libijs-0.35:amd64 (0.35-13) ...
Setting up rubygems-integration (1.11) ...
Setting up libpotrace0 (1.14-2) ...
Setting up javascript-common (11) ...
Setting up ruby-minitest (5.10.3-1) ...
Setting up libzzip-0-13:amd64 (0.13.62-3.1ubuntu0.18.04.1) ...
Setting up libgs9:amd64 (9.26~dfsg+0-0ubuntu0.18.04.14) ...
Setting up libtexluajit2:amd64 (2017.20170613.44572-8ubuntu0.1) ...
Setting up fonts-lmodern (2.004.5-3) ...
Setting up ruby-power-assert (0.3.0-1) ...
Setting up texlive-binaries (2017.20170613.44572-8ubuntu0.1) ...
update-alternatives: using /usr/bin/xdvi-xaw to provide /usr/bin/xdvi.bin
(xdvi.bin) in auto mode
update-alternatives: using /usr/bin/bibtex.original to provide /usr/bin/bibtex
(bibtex) in auto mode
Setting up texlive-base (2017.20180305-1) ...
mktexlsr: Updating /var/lib/texmf/ls-R-TEXLIVEDIST...
mktexlsr: Updating /var/lib/texmf/ls-R-TEXMFMAIN...
mktexlsr: Updating /var/lib/texmf/ls-R...
mktexlsr: Done.
tl-paper: setting paper size for dvips to a4: /var/lib/texmf/dvips/config
/config-paper.ps
tl-paper: setting paper size for dvipdfmx to a4: /var/lib/texmf/dvipdfmx
/dvipdfmx-paper.cfg
tl-paper: setting paper size for xdvi to a4: /var/lib/texmf/xdvi/XDvi-paper
tl-paper: setting paper size for pdftex to a4:
/var/lib/texmf/tex/generic/config/pdftexconfig.tex
Setting up texlive-fonts-recommended (2017.20180305-1) ...
Setting up texlive-plain-generic (2017.20180305-2) ...
Setting up texlive-latex-base (2017.20180305-1) ...
Setting up lmodern (2.004.5-3) ...
Setting up texlive-latex-recommended (2017.20180305-1) ...
Setting up texlive-pictures (2017.20180305-1) ...
Setting up tipa (2:1.3-20) ...
Regenerating '/var/lib/texmf/fmtutil.cnf-DEBIAN'... done.
Regenerating '/var/lib/texmf/fmtutil.cnf-TEXLIVEDIST'... done.
update-fmtutil has updated the following file(s):
        /var/lib/texmf/fmtutil.cnf-DEBIAN
        /var/lib/texmf/fmtutil.cnf-TEXLIVEDIST
If you want to activate the changes in the above file(s),
you should run fmtutil-sys or fmtutil.
Setting up texlive (2017.20180305-1) ...
Setting up texlive-latex-extra (2017.20180305-2) ...
Setting up texlive-xetex (2017.20180305-1) ...
Setting up ruby2.5 (2.5.1-1ubuntu1.7) ...
Setting up ruby (1:2.5.1) ...
Setting up ruby-test-unit (3.2.5-1) ...
Setting up rake (12.3.1-1ubuntu0.1) ...
```

```
Setting up libruby2.5:amd64 (2.5.1-1ubuntu1.7) ...
Processing triggers for mime-support (3.60ubuntu1) ...
Processing triggers for libc-bin (2.27-3ubuntu1.2) ...
/sbin/ldconfig.real: /usr/local/lib/python3.7/dist-
packages/ideep4py/lib/libmkldnn.so.0 is not a symbolic link

Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
Processing triggers for fontconfig (2.12.6-0ubuntu2) ...
Processing triggers for tex-common (6.09) ...
Running updmap-sys. This may take some time... done.
Running mktexlsr /var/lib/texmf ... done.
Building format(s) --all.
        This may take some time... done.
Collecting pypandoc
  Downloading pypandoc-1.5.tar.gz (26 kB)
Requirement already satisfied: setuptools in /usr/local/lib/python3.7/dist-
packages (from pypandoc) (54.0.0)
Requirement already satisfied: pip>=8.1.0 in /usr/local/lib/python3.7/dist-
packages (from pypandoc) (21.0.1)
Requirement already satisfied: wheel>=0.25.0 in /usr/local/lib/python3.7/dist-
packages (from pypandoc) (0.36.2)
Building wheels for collected packages: pypandoc
  Building wheel for pypandoc (setup.py) ... done
  Created wheel for pypandoc: filename=pypandoc-1.5-py3-none-any.whl size=17037
sha256=58a2f3c37c05f4ae8ea6731bf8ff9ba8272bcb58e601253a63487fb9ff59645a
  Stored in directory: /root/.cache/pip/wheels/06/a7/1d/3259fbf0089b15d491d9166b
97de3a23d1f915bf7591abafc7
Successfully built pypandoc
Installing collected packages: pypandoc
Successfully installed pypandoc-1.5
```

[81]:
```
!cp "/content/drive/MyDrive/Colab Notebooks/ml_imdb_random_forest.ipynb" ./
!jupyter nbconvert --to PDF "ml_imdb_random_forest.ipynb"
```

```
[NbConvertApp] Converting notebook ml_imdb_random_forest.ipynb to PDF
[NbConvertApp] Support files will be in ml_imdb_random_forest_files/
[NbConvertApp] Making directory ./ml_imdb_random_forest_files
[NbConvertApp] Making directory ./ml_imdb_random_forest_files
[NbConvertApp] Making directory ./ml_imdb_random_forest_files
[NbConvertApp] Writing 76905 bytes to ./notebook.tex
[NbConvertApp] Building PDF
[NbConvertApp] Running xelatex 3 times: [u'xelatex', u'./notebook.tex',
'-quiet']
[NbConvertApp] Running bibtex 1 time: [u'bibtex', u'./notebook']
[NbConvertApp] WARNING | bibtex had problems, most likely because there were no
citations
[NbConvertApp] PDF successfully created
[NbConvertApp] Writing 140939 bytes to ml_imdb_random_forest.pdf
```

[82]:
```
files.download('/content/ml_imdb_random_forest.ipynb')
files.download('/content/ml_imdb_random_forest.pdf')
```

```
<IPython.core.display.Javascript object>
```

```
<IPython.core.display.Javascript object>
```

```
<IPython.core.display.Javascript object>
```

```
<IPython.core.display.Javascript object>
```

Statement of Colaboration: Tokenization and Vectorizing techniques were taken from this link.