Movie genre classification and line prediction, trying to run LSTM and CNN models

This dataset is for different film genres and film lines with a total number of 225.8 million, I removed the dataset number for train to 15471 in order to run the code in a more portable way. val and train's dataset number is around 5k to 6k as a reference. I used LSTM, CNN, and MultinomialNB to train the dataset model and make predictions of movie lines.And use LDA, IF-IDF, and sentence_transformers to get some data

Import the required modules

In [1]:
```
pip install panda
```

```
Looking in indexes: https://pypi.tuna.tsinghua.edu.cn/simple
Requirement already satisfied: panda in /environment/miniconda3/lib/python3.10/si
te-packages (0.3.1)
Requirement already satisfied: setuptools in /environment/miniconda3/lib/python3.
10/site-packages (from panda) (67.8.0)
Requirement already satisfied: requests in /environment/miniconda3/lib/python3.1
0/site-packages (from panda) (2.31.0)
Requirement already satisfied: charset-normalizer<4,>=2 in /environment/miniconda
3/lib/python3.10/site-packages (from requests->panda) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in /environment/miniconda3/lib/python
3.10/site-packages (from requests->panda) (2.10)
Requirement already satisfied: urllib3<3,>=1.21.1 in /environment/miniconda3/lib/
python3.10/site-packages (from requests->panda) (1.25.11)
Requirement already satisfied: certifi>=2017.4.17 in /environment/miniconda3/lib/
python3.10/site-packages (from requests->panda) (2023.7.22)
Note: you may need to restart the kernel to use updated packages.
```

In [2]:
```
# Importing essential libraries Importing essential libraries for visualization
import numpy as np
import pandas as pd
import os

import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

Import data

In [3]:
```
# Loading the dataset
df = pd.read_csv('/home/featurize/dataset/movie_train.csv')
```

In [4]:
```
df = pd.read_csv("/home/featurize/dataset/movie_train.csv",encoding="utf-8")
print(df)
```

```
          id                                               text     genre
0          0  eady dead, maybe even wishing he was. INT. 2ND...  thriller
1          2  t, summa cum laude and all. And I'm about to l...    comedy
2          3   up Come, I have a surprise.... She takes him ...     drama
3          4  ded by the two detectives. INT. JEFF'S APARTME...  thriller
4          5  nd dismounts, just as the other children reach...     drama
...      ...                                                ...       ...
15465  19343  ce time. ROCKY Thanks, Mr. Gazzo. Rocky enters...     drama
15466  19345  evere bandages on the spear caused holes of hi...    action
15467  19348  en at DR. SCOTT. BRAD JANET Dr. Scott! FRANK G...    comedy
15468  19349  bs, who crashes into his computer table, sendi...  thriller
15469  19350   it all. ARLO blows BRYNNER grunts continues u...  thriller

[15470 rows x 3 columns]
```

In [5]:
```
dataset_dir = '/home/featurize/dataset/movie_train.csv'
```

In [6]:
```
train_path = os.path.join(dataset_dir, '/home/featurize/dataset/movie_train.csv')
test_path = os.path.join(dataset_dir, '/home/featurize/dataset/movie_test.csv')
print('Training_set_path', train_path)
print('Testing_set_path', test_path)
```

```
Training_set_path /home/featurize/dataset/movie_train.csv
Testing_set_path /home/featurize/dataset/movie_test.csv
```

Data Cleaning and Preprocessing

Exploring the dataset

In [7]:
```
df.columns
```

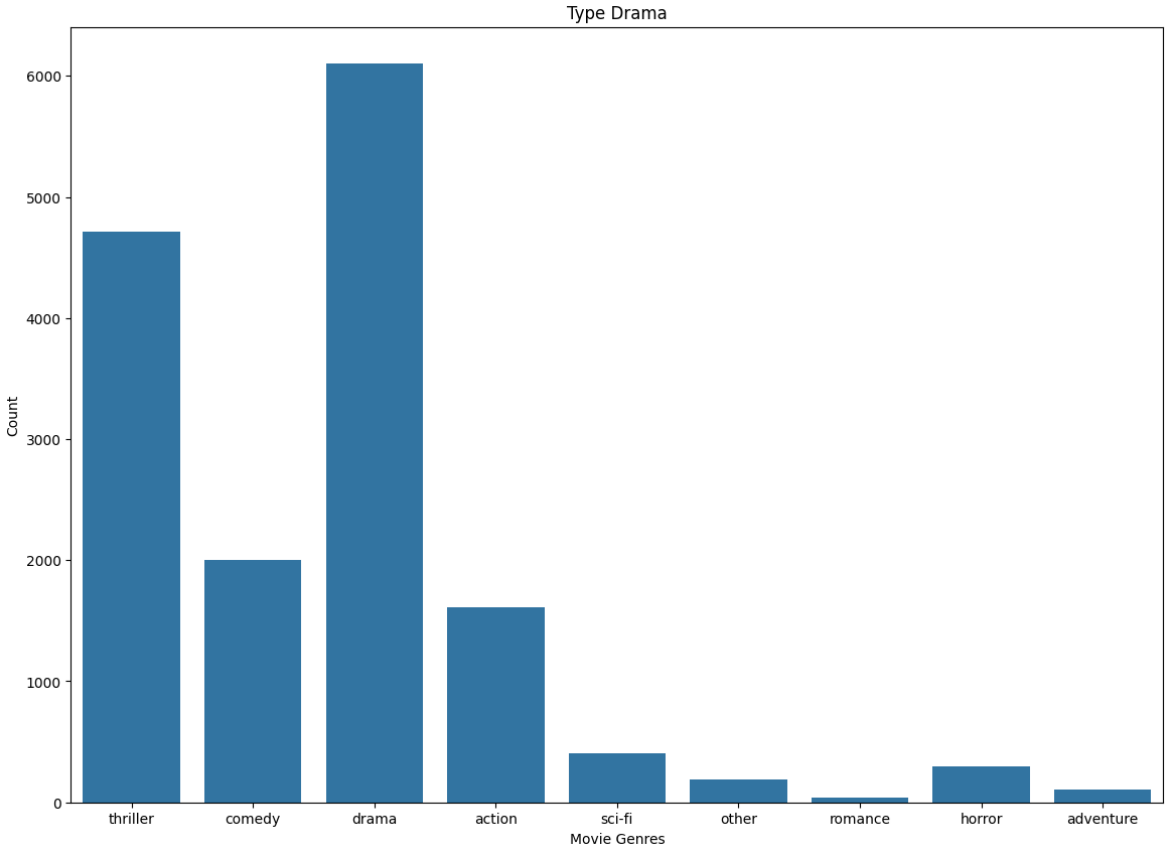
Out[7]:
```
Index(['id', 'text', 'genre'], dtype='object')
```

In [8]:
```
df.shape
```

Out[8]:
```
(15470, 3)
```

In [9]:
```
#df.head(10)
```

In [10]:
```
# Visualizing the count of 'genre' column from the dataset
plt.figure(figsize=(14,10))
sns.countplot(x='genre', data=df)
plt.ylabel('Count')
plt.xlabel('Movie Genres')
plt.title('Type Drama')
plt.show()
```



In [11]:
```
# Finding unique genres
movie_genre = list(df['genre'].unique())
movie_genre.sort()
movie_genre
```

Out[11]:
```
['action',
 'adventure',
 'comedy',
 'drama',
 'horror',
 'other',
 'romance',
 'sci-fi',
 'thriller']
```

In [12]:
```
# Mapping the genres to values
genre_mapper = {'other': 0, 'action': 1, 'adventure': 2, 'comedy':3, 'drama':4,
df['genre'] = df['genre'].map(genre_mapper)
df.head(10)
```

Out[12]:

	id	text	genre
0	0	eady dead, maybe even wishing he was. INT. 2ND...	8
1	2	t, summa cum laude and all. And I'm about to l...	3
2	3	up Come, I have a surprise.... She takes him ...	4
3	4	ded by the two detectives. INT. JEFF'S APARTME...	8
4	5	nd dismounts, just as the other children reach...	4
5	6	breadth of the bluff. Gabe pulls out his ancie...	8
6	7	uilding. A MAN in pajamas runs out into the ra...	8
7	9	ELLES AND RITA HAYWORTH Just disgustingly rich...	4
8	10	Memphis goes back into the garage, Budgy cack...	8
9	11	e reels as the world spins. Sweat pours off hi...	1

In [13]:
```
# Finding any NaN values
df.isna().any()
```

Out[13]:
```
id       False
text     False
genre    False
dtype: bool
```

In [14]:
```
# Removing the 'id' column
df.drop('id', axis=1, inplace=True)
df.columns
```

Out[14]:
```
Index(['text', 'genre'], dtype='object')
```

In [15]:
```
pip install nltk
```

```
Looking in indexes: https://pypi.tuna.tsinghua.edu.cn/simple
Requirement already satisfied: nltk in /environment/miniconda3/lib/python3.10/sit
e-packages (3.8.1)
Requirement already satisfied: click in /environment/miniconda3/lib/python3.10/si
te-packages (from nltk) (7.1.2)
Requirement already satisfied: joblib in /environment/miniconda3/lib/python3.10/s
ite-packages (from nltk) (1.3.2)
Requirement already satisfied: regex>=2021.8.3 in /environment/miniconda3/lib/pyt
hon3.10/site-packages (from nltk) (2023.12.25)
Requirement already satisfied: tqdm in /environment/miniconda3/lib/python3.10/sit
e-packages (from nltk) (4.65.0)
Note: you may need to restart the kernel to use updated packages.
```

In [16]:
```
# Importing essential libraries for performing Natural Language Processing on gi
import nltk
import re
nltk.download('stopwords')
from nltk.corpus import stopwords
from nltk.stem.porter import PorterStemmer
```

```
[nltk_data] Error loading stopwords: <urlopen error [SSL:
[nltk_data]     UNEXPECTED_EOF_WHILE_READING] EOF occurred in
[nltk_data]     violation of protocol (_ssl.c:1007)>
```

In [17]:
```
df.shape
```

Out[17]: (15470, 2)

In [18]:
```
(22579, 2)
```

Out[18]: (22579, 2)

In [19]:
```
# Cleaning the text
corpus = []
ps = PorterStemmer()

for i in range(0, df.shape[0]):

  # Cleaning special character from the dialog/script
  dialog = re.sub(pattern='[^a-zA-Z]', repl=' ', string=df['text'][i])

  # Converting the entire dialog/script into lower case
  dialog = dialog.lower()

  # Tokenizing the dialog/script by words
  words = dialog.split()

  # Removing the stop words
  dialog_words = [word for word in words if word not in set(stopwords.words('eng

  # Stemming the words
  words = [ps.stem(word) for word in dialog_words]

  # Joining the stemmed words
  dialog = ' '.join(words)

  # Creating a corpus
  corpus.append(dialog)
```

In [20]:
```
corpus[0:10]
```

Out[20]: ['eadi dead mayb even wish int nd floor hallway three night orderli lead liza d
oor orderli white guy open door step room three white guy mid look wild straigh
t jacket jerri liza reach end rope shake head int decrepit hospit room night ba
ll fetal realli head press cement tri sing jerri blue moon blue moon int nd flo
or hallway three night liza stand lean rail wall orderli sure go know bad order
li okay liza start hall orderli follow orderli got new patient last week want s
ee liza wave hopeless stop chicken wire window end hall look light break jerri
somewher orderli look gotta get back work',
'summa cum laud launch brand new magazin call expos homag miss juli conroy xen
ia ohio juli grin juli know find excel editor chief ted yellow page juli let fi
nger walk suddenli music chang peopl ted grin ted play song extend hand dare as
k danc juli take hand better ted juli begin danc kiss b g charli jimmi feign te
ar charli sucker happi end hug jimmi hold start rise nelson hous cloud xenia te
d v guess everybodi pretti much live happili ever parent give groceri store des
cend cloud quickli find ext london buckingham palac day mom dad take pictur smo
och front palac ted v manag sneak away second honeymoon',
'come surpris take hand lead hallway salvator look feel pang seem smaller age
wither bodi slightli stoop hair gather knot back head must tire want rest time
funer salvator interrupt mamma take hour air know maria smile iron tell year sa
lvator get messag feel guilti think seem incred never come maria open door step
asid let son whisper put thing go go salvator lake step flabbergast sight old r
oom perfectli reconstruct preserv look like museum museum past despit bed cloth
cupboard book shelv perfectli clear one ever live',
'ded two detect int jeff apart night medium shot thorwald fight dislodg jeff g
rip ext jeff apart night close shot look jeff face show strain pain thorwald at
tack brick floor patio seem hundr feet int jeff apart night medium shot thorwal
d jeff struggl ext neighborhood night semi close shot doyl pull top wall lisa s
tella two men look lisa white face frighten int jeff apart night medium shot th
orwald smash jeff arm hand jeff grip begin slip ext neighborhood night semi clo
se shot doyl reach top wall look jeff ext neighborhood night medium long shot j
eff seen doyl angl hang somehow weather thorwald insan attack ext neighborhood
night semi close shot doyl reach servic revolv look call one dete',
'nd dismount children reach throw arm embrac charlott hurri behind martin lock
eye envelop hug children ext fresh water plantat even summer oak tree cover lea
v martin hous partial rebuilt habit workshop alreadi complet martin children na
than samuel margaret william play tall grass front hous two great dane charlott
sit front porch nurs infant martin walk workshop trail susan carri complet rock
chair chair work art thin light spider web perfectli turn wood nail glue step o
nto porch next charlott place rock chair next martin two pound fourteen ounc ch
arlott love smile make minut adjust chair posit sit settl back',
'breadth bluff gabe pull ancient binocular scan crack gabe pov crack pictur mi
ne shaft design madman crack move upward errat side straight width crack uneven
rang six inch six feet look outsid gabe turn binocular insid crack look crack g
oe way bluff rout gabe tunnel mountain instead go side gabe get side jessi gone
far right think better shape gabe simpl ye would done jessi want lead gabe cute
ext top bluff day vista point see everyth els mountain rang thing taller tower
two mountain lie drop mere four thousand feet qualen said way across h',
'uild man pajama run rain cabbi lose grip bumper terrenc jerk closer sewer man
grab cabbi hand pull resid gather sidewalk polic car siren approach someth give
man pajama fall backward puddl small crowd look see terrenc pull free hole moan
semi conscious move bodi past bleed stump leg use follow blood swirl eddi rain
water flow black storm drain cut fierc bull charg matador red muletta snort blo
od crowd goe wild bull fight arena blaze spanish sun camera dolli past cheer sp
aniard find small group american student earli twenti gord man believ paid good
money watch guy tight pant kill cow sherri disgust make',
'ell rita hayworth disgustingli rich well make money make quick start littl wa
r think slick smother sabl like betti grabl disgustingli rich build castl cost
passel resid pan presid aspir higher higher get marri buy girl darn pretti head
swirl rita hayworth swim highbal stew eyebal well rita hayworth disgustingli ri
ch well rita hayworth chorin nifti soft shoe turn schaefer turn mank schaefer s

```
erious truli care ever work mank yeah swell well rita hayworth conclud littl da
nc break well resum song well ev ry summer sail sea littl yacht normandi pet li
ttl dachshund friend kiss louella big rear end disgustingli rich louella storm
eat salmon play ba',
 'memphi goe back garag budgi cackl cut ext rancho palo verd busi district ford
escort drive upscal street palo verd three kid insid driver freb littl dim back
mirror man black alway wear mirror shade passeng seat kip memphi younger brothe
r car pull stop fanci store close line affluent busi district freb consult piec
paper freb corner hawthorn granvia tumbler mess said lotu would corner hawthorn
granvia kip mess point corner build exot motor ltd twenti foot high glass windo
w surround showroom exot dream car porsch ferrari lamborghini berton lotu espri
t v gleam night showroom light freb mirror man startl freb mirror man shittin',
 'e reel world spin sweat pour pressur build insid skull brain put centrifug ne
o believ believ cypher go pop vomit violent neo pitch forward black int neo roo
m blink regain conscious room dark neo stretch bed neo go back morpheu sit like
shadow chair far corner morpheu could would realli want deep neo know answer mo
rpheu feel owe apolog rule free mind reach certain age danger troubl let go min
d turn seen happen broke rule stare dark confess much neo morpheu matrix first
built man born insid abil chang want remak mat']
```

In [21]:
```
df[df['genre']==4].index
```

Out[21]:
```
Index([    2,     4,     7,    10,    11,    12,    13,    14,    15,    16,
       ...
       15444, 15447, 15450, 15451, 15454, 15456, 15457, 15459, 15463, 15465],
      dtype='int64', length=6099)
```

In [22]:
```
len(corpus)
```

Out[22]:
```
15470
```

In [23]:
```
drama_words = []
for i in list(df[df['genre']==4].index):
  drama_words.append(corpus[i])

action_words = []
for i in list(df[df['genre']==1].index):
  action_words.append(corpus[i])

comedy_words = []
for i in list(df[df['genre']==3].index):
  comedy_words.append(corpus[i])

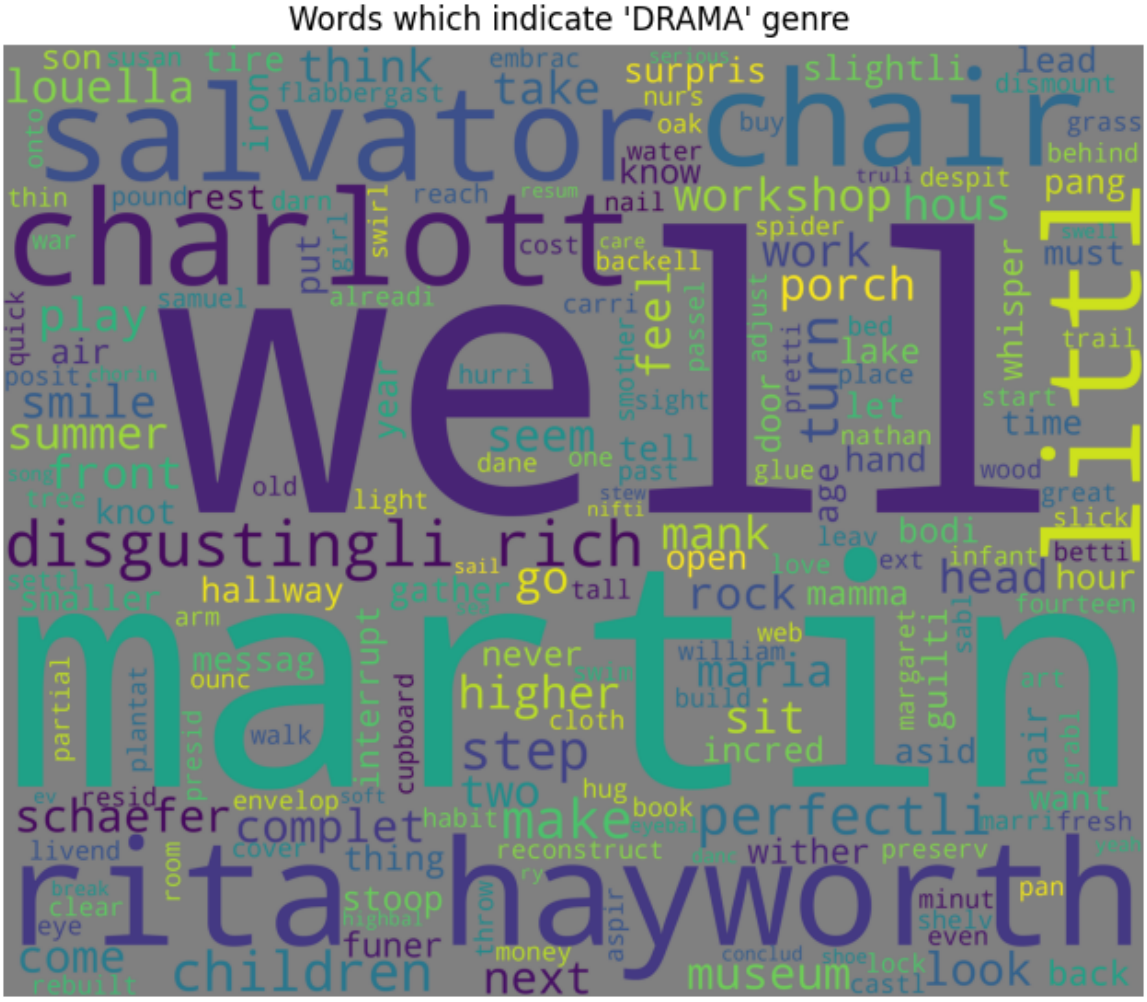
drama = ''
action = ''
comedy = ''
for i in range(0, 3):
  drama += drama_words[i]
  action += action_words[i]
  comedy += comedy_words[i]
```

In [24]:
```
pip install wordcloud
```

```
Looking in indexes: https://pypi.tuna.tsinghua.edu.cn/simple
Requirement already satisfied: wordcloud in /environment/miniconda3/lib/python3.1
0/site-packages (1.9.3)
Requirement already satisfied: numpy>=1.6.1 in /environment/miniconda3/lib/python
3.10/site-packages (from wordcloud) (1.24.1)
Requirement already satisfied: pillow in /environment/miniconda3/lib/python3.10/s
ite-packages (from wordcloud) (9.3.0)
Requirement already satisfied: matplotlib in /environment/miniconda3/lib/python3.
10/site-packages (from wordcloud) (3.8.1)
Requirement already satisfied: contourpy>=1.0.1 in /environment/miniconda3/lib/py
thon3.10/site-packages (from matplotlib->wordcloud) (1.2.0)
Requirement already satisfied: cycler>=0.10 in /environment/miniconda3/lib/python
3.10/site-packages (from matplotlib->wordcloud) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in /environment/miniconda3/lib/p
ython3.10/site-packages (from matplotlib->wordcloud) (4.44.0)
Requirement already satisfied: kiwisolver>=1.3.1 in /environment/miniconda3/lib/p
ython3.10/site-packages (from matplotlib->wordcloud) (1.4.5)
Requirement already satisfied: packaging>=20.0 in /environment/miniconda3/lib/pyt
hon3.10/site-packages (from matplotlib->wordcloud) (23.0)
Requirement already satisfied: pyparsing>=2.3.1 in /environment/miniconda3/lib/py
thon3.10/site-packages (from matplotlib->wordcloud) (3.1.1)
Requirement already satisfied: python-dateutil>=2.7 in /environment/miniconda3/li
b/python3.10/site-packages (from matplotlib->wordcloud) (2.8.2)
Requirement already satisfied: six>=1.5 in /environment/miniconda3/lib/python3.1
0/site-packages (from python-dateutil>=2.7->matplotlib->wordcloud) (1.16.0)
Note: you may need to restart the kernel to use updated packages.
```

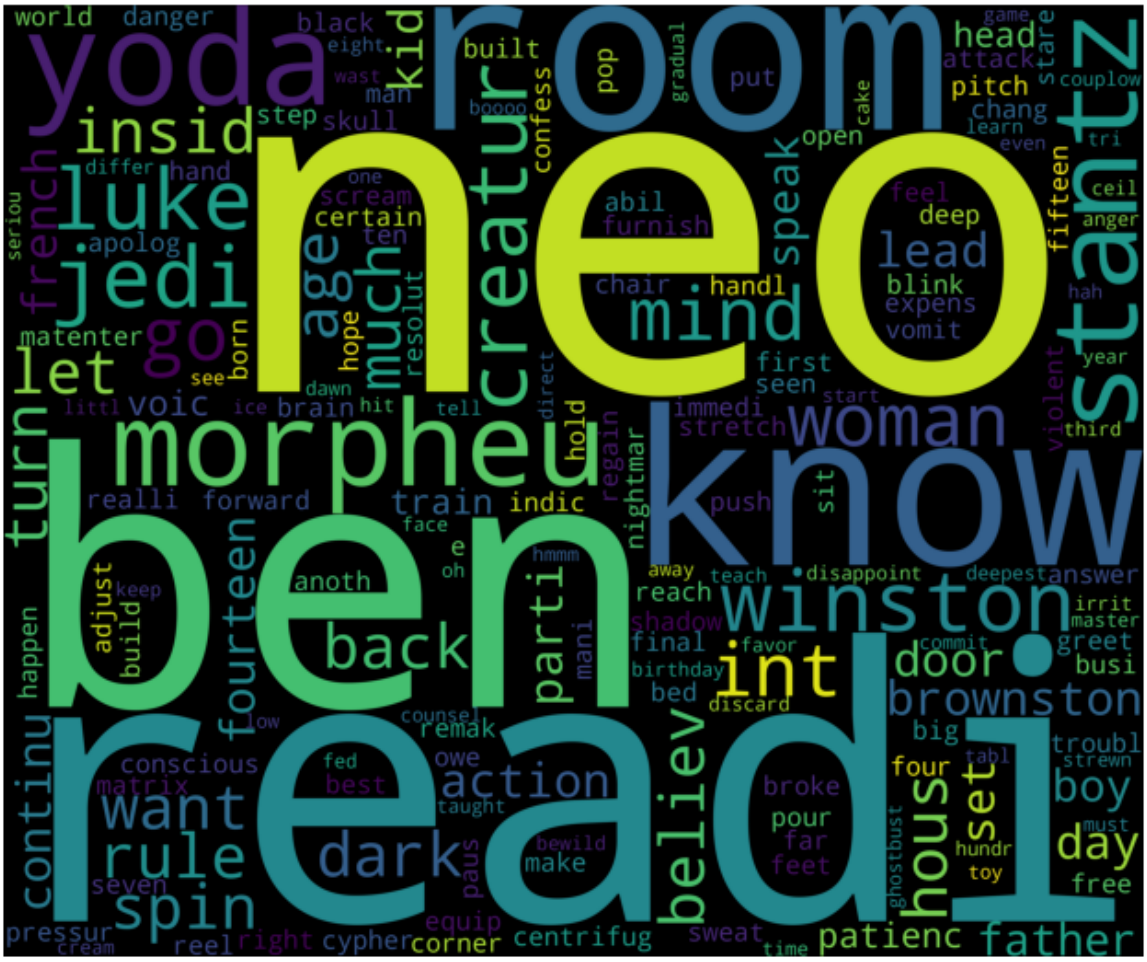
In [29]:

```
# Creating wordcloud for drama genre
from wordcloud import WordCloud
wordcloud1 = WordCloud(background_color='gray', width=3000, height=2500).generat
plt.figure(figsize=(8,8))
plt.imshow(wordcloud1)
plt.axis('off')
plt.title("Words which indicate 'DRAMA' genre ")
plt.show()
```



In [30]:
```
# Creating wordcloud for action genre
wordcloud2 = WordCloud(background_color='black', width=3000, height=2500).genera
plt.figure(figsize=(8,8))
plt.imshow(wordcloud2)
plt.axis('off')
plt.title("Words which indicate 'ACTION' genre ")
plt.show()
```

Words which indicate 'ACTION' genre



In [35]:
```
# Creating wordcloud for comedy genre
wordcloud3 = WordCloud(background_color='white', width=3000, height=2500).genera
plt.figure(figsize=(8,8))
plt.imshow(wordcloud3)
plt.axis('off')
plt.title("Words which indicate 'COMEDY' genre ")
plt.show()
```

In [36]:
```
# Creating the Bag of Words model
from sklearn.feature_extraction.text import CountVectorizer
cv = CountVectorizer(max_features=10000, ngram_range=(1,2))
X = cv.fit_transform(corpus).toarray()
```

In [37]:
```
y = df['genre'].values
```

Try LSTM and CNN

LSTM

In [60]:
```
import os
data_dir = '/home/featurize/dataset'
print(os.listdir(data_dir))
```

```
['movie_test.csv', 'movie_train.csv', 'movie_val.csv']
```

In [73]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import os
import time
import datetime
```

```
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.utils import class_weight as cw
```

In [72]:
```
!pip install keras   -i https://pypi.tuna.tsinghua.edu.cn/simple
```

```
Looking in indexes: https://pypi.tuna.tsinghua.edu.cn/simple
Requirement already satisfied: keras in /environment/miniconda3/lib/python3.10/si
te-packages (2.13.1)
```

In [79]:
```
!pip install tensorflow -i https://pypi.tuna.tsinghua.edu.cn/simple
```

```
Looking in indexes: https://pypi.tuna.tsinghua.edu.cn/simple
Requirement already satisfied: tensorflow in /environment/miniconda3/lib/python3.
10/site-packages (2.13.0)
Requirement already satisfied: absl-py>=1.0.0 in /environment/miniconda3/lib/pyth
on3.10/site-packages (from tensorflow) (1.4.0)
Requirement already satisfied: astunparse>=1.6.0 in /environment/miniconda3/lib/p
ython3.10/site-packages (from tensorflow) (1.6.3)
Requirement already satisfied: flatbuffers>=23.1.21 in /environment/miniconda3/li
b/python3.10/site-packages (from tensorflow) (23.5.26)
Requirement already satisfied: gast<=0.4.0,>=0.2.1 in /environment/miniconda3/li
b/python3.10/site-packages (from tensorflow) (0.4.0)
Requirement already satisfied: google-pasta>=0.1.1 in /environment/miniconda3/li
b/python3.10/site-packages (from tensorflow) (0.2.0)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in /environment/miniconda3/li
b/python3.10/site-packages (from tensorflow) (1.56.2)
Requirement already satisfied: h5py>=2.9.0 in /environment/miniconda3/lib/python
3.10/site-packages (from tensorflow) (3.9.0)
Requirement already satisfied: keras<2.14,>=2.13.1 in /environment/miniconda3/li
b/python3.10/site-packages (from tensorflow) (2.13.1)
Requirement already satisfied: libclang>=13.0.0 in /environment/miniconda3/lib/py
thon3.10/site-packages (from tensorflow) (16.0.6)
Requirement already satisfied: numpy<=1.24.3,>=1.22 in /environment/miniconda3/li
b/python3.10/site-packages (from tensorflow) (1.24.1)
Requirement already satisfied: opt-einsum>=2.3.2 in /environment/miniconda3/lib/p
ython3.10/site-packages (from tensorflow) (3.3.0)
Requirement already satisfied: packaging in /environment/miniconda3/lib/python3.1
0/site-packages (from tensorflow) (23.0)
Requirement already satisfied: protobuf!=4.21.0,!=4.21.1,!=4.21.2,!=4.21.3,!=4.2
1.4,!=4.21.5,<5.0.0dev,>=3.20.3 in /environment/miniconda3/lib/python3.10/site-pa
ckages (from tensorflow) (4.23.4)
Requirement already satisfied: setuptools in /environment/miniconda3/lib/python3.
10/site-packages (from tensorflow) (67.8.0)
Requirement already satisfied: six>=1.12.0 in /environment/miniconda3/lib/python
3.10/site-packages (from tensorflow) (1.16.0)
Requirement already satisfied: tensorboard<2.14,>=2.13 in /environment/miniconda
3/lib/python3.10/site-packages (from tensorflow) (2.13.0)
Requirement already satisfied: tensorflow-estimator<2.14,>=2.13.0 in /environmen
t/miniconda3/lib/python3.10/site-packages (from tensorflow) (2.13.0)
Requirement already satisfied: termcolor>=1.1.0 in /environment/miniconda3/lib/py
thon3.10/site-packages (from tensorflow) (2.3.0)
Requirement already satisfied: typing-extensions<4.6.0,>=3.6.6 in /environment/mi
niconda3/lib/python3.10/site-packages (from tensorflow) (4.5.0)
Requirement already satisfied: wrapt>=1.11.0 in /environment/miniconda3/lib/pytho
n3.10/site-packages (from tensorflow) (1.15.0)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in /environme
nt/miniconda3/lib/python3.10/site-packages (from tensorflow) (0.33.0)
Requirement already satisfied: wheel<1.0,>=0.23.0 in /environment/miniconda3/lib/
python3.10/site-packages (from astunparse>=1.6.0->tensorflow) (0.38.4)
Requirement already satisfied: google-auth<3,>=1.6.3 in /environment/miniconda3/l
ib/python3.10/site-packages (from tensorboard<2.14,>=2.13->tensorflow) (2.22.0)
Requirement already satisfied: google-auth-oauthlib<1.1,>=0.5 in /environment/min
iconda3/lib/python3.10/site-packages (from tensorboard<2.14,>=2.13->tensorflow)
(1.0.0)
Requirement already satisfied: markdown>=2.6.8 in /environment/miniconda3/lib/pyt
hon3.10/site-packages (from tensorboard<2.14,>=2.13->tensorflow) (3.4.4)
Requirement already satisfied: requests<3,>=2.21.0 in /environment/miniconda3/li
b/python3.10/site-packages (from tensorboard<2.14,>=2.13->tensorflow) (2.31.0)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in /environm
ent/miniconda3/lib/python3.10/site-packages (from tensorboard<2.14,>=2.13->tensor
flow) (0.7.1)
```

```
Requirement already satisfied: werkzeug>=1.0.1 in /environment/miniconda3/lib/pyt
hon3.10/site-packages (from tensorboard<2.14,>=2.13->tensorflow) (2.3.6)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in /environment/miniconda3/
lib/python3.10/site-packages (from google-auth<3,>=1.6.3->tensorboard<2.14,>=2.13
->tensorflow) (5.3.1)
Requirement already satisfied: pyasn1-modules>=0.2.1 in /environment/miniconda3/l
ib/python3.10/site-packages (from google-auth<3,>=1.6.3->tensorboard<2.14,>=2.13-
>tensorflow) (0.3.0)
Requirement already satisfied: rsa<5,>=3.1.4 in /environment/miniconda3/lib/pytho
n3.10/site-packages (from google-auth<3,>=1.6.3->tensorboard<2.14,>=2.13->tensorf
low) (4.9)
Requirement already satisfied: urllib3<2.0 in /environment/miniconda3/lib/python
3.10/site-packages (from google-auth<3,>=1.6.3->tensorboard<2.14,>=2.13->tensorfl
ow) (1.25.11)
Requirement already satisfied: requests-oauthlib>=0.7.0 in /environment/miniconda
3/lib/python3.10/site-packages (from google-auth-oauthlib<1.1,>=0.5->tensorboard<
2.14,>=2.13->tensorflow) (1.3.1)
Requirement already satisfied: charset-normalizer<4,>=2 in /environment/miniconda
3/lib/python3.10/site-packages (from requests<3,>=2.21.0->tensorboard<2.14,>=2.13
->tensorflow) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in /environment/miniconda3/lib/python
3.10/site-packages (from requests<3,>=2.21.0->tensorboard<2.14,>=2.13->tensorflo
w) (2.10)
Requirement already satisfied: certifi>=2017.4.17 in /environment/miniconda3/lib/
python3.10/site-packages (from requests<3,>=2.21.0->tensorboard<2.14,>=2.13->tens
orflow) (2023.7.22)
Requirement already satisfied: MarkupSafe>=2.1.1 in /environment/miniconda3/lib/p
ython3.10/site-packages (from werkzeug>=1.0.1->tensorboard<2.14,>=2.13->tensorflo
w) (2.1.2)
Requirement already satisfied: pyasn1<0.6.0,>=0.4.6 in /environment/miniconda3/li
b/python3.10/site-packages (from pyasn1-modules>=0.2.1->google-auth<3,>=1.6.3->te
nsorboard<2.14,>=2.13->tensorflow) (0.5.0)
Requirement already satisfied: oauthlib>=3.0.0 in /environment/miniconda3/lib/pyt
hon3.10/site-packages (from requests-oauthlib>=0.7.0->google-auth-oauthlib<1.1,>=
0.5->tensorboard<2.14,>=2.13->tensorflow) (3.2.2)
```

In [81]:
```
from keras import Sequential

from keras.models import Model

from keras.layers import LSTM,Activation,Dense,Dropout,Input,Embedding,BatchNorm
from keras.layers import Conv1D,Conv2D,Convolution1D,MaxPool1D,SeparableConv1D,S
#from keras.pooling import GlobalMaxPooling1D
from keras.layers import MaxPooling2D,GlobalMaxPooling2D,GlobalAveragePooling2D

from keras.optimizers import RMSprop,Adam

from keras.preprocessing.text import Tokenizer
from keras.preprocessing import sequence

from keras.utils import to_categorical

from keras.callbacks import EarlyStopping
from keras.callbacks import ModelCheckpoint
from keras.callbacks import ReduceLROnPlateau

%matplotlib inline

import warnings
warnings.filterwarnings("ignore")
```

In [256…
```
# Mapping the genres to values
genre_mapper = {'other': 0, 'action': 1, 'adventure': 2, 'comedy':3, 'drama':4,
df['genre'] = df['genre'].map(genre_mapper)
df.head(10)
```

Out[256…

	id	text	genre
0	0	eady dead, maybe even wishing he was. INT. 2ND...	NaN
1	2	t, summa cum laude and all. And I'm about to l...	NaN
2	3	up Come, I have a surprise.... She takes him ...	NaN
3	4	ded by the two detectives. INT. JEFF'S APARTME...	NaN
4	5	nd dismounts, just as the other children reach...	NaN
5	6	breadth of the bluff. Gabe pulls out his ancie...	NaN
6	7	uilding. A MAN in pajamas runs out into the ra...	NaN
7	9	ELLES AND RITA HAYWORTH Just disgustingly rich...	NaN
8	10	Memphis goes back into the garage, Budgy cack...	NaN
9	11	e reels as the world spins. Sweat pours off hi...	NaN

In [128…
```
train_df = pd.read_csv("/home/featurize/dataset/movie_train.csv",encoding="utf-8
valid_df = pd.read_csv("/home/featurize/dataset/movie_val.csv",encoding="utf-8",
test_df = pd.read_csv("/home/featurize/dataset/movie_test.csv",encoding="utf-8",
```

In [129…
```
#可能报废
#train_df = pd.read_csv("/home/featurize/dataset/movie_train.csv",encoding="utf-
#valid_df = pd.read_csv("/home/featurize/dataset/movie_val.csv",encoding="utf-8"
#test_df = pd.read_csv("/home/featurize/dataset/movie_test.csv",encoding="utf-8"
```

In [170…
```
print(train_df)
```

```
    Index                                               text     genre
0   10653  nd made his way into this room. His sister's r...  thriller
1    6253  CH NIGHT Anna waits at the boat. Neville runs ...     drama
2   14963  ns its huge jaws menacingly, all the time star...    action
3    4996  ightning. REAGAN Just stay cool. Everybody sta...     drama
4   12090  t kind of game? MAN Turn off the light. Her ha...  thriller
..    ...                                                ...       ...
45  19301  our rectum to change that shitty attitude of y...       NaN
46  13444  like this. This is a big moment for me ANNIE o...       NaN
47  13151  ley's place can't ask any questions or talk ou...       NaN
48  13766  the crowds to Bennie's depot. The streets are ...       NaN
49  23312  oseph? BELLIARD I don't know what has happened...       NaN

[22366 rows x 3 columns]
```

Category table figures

In [171…
```
df.columns
```

Out[171…
```
Index(['id', 'text', 'genre'], dtype='object')
```

In [173…
```
# Mapping the genres to values
genre_mapper = {'other': 0, 'action': 1, 'adventure': 2, 'comedy':3, 'drama':4,
df['genre'] = df['genre'].map(genre_mapper)
df.head(10)
```

Out[173…

	id	text	genre
0	0	eady dead, maybe even wishing he was. INT. 2ND...	NaN
1	2	t, summa cum laude and all. And I'm about to l...	NaN
2	3	up Come, I have a surprise.... She takes him ...	NaN
3	4	ded by the two detectives. INT. JEFF'S APARTME...	NaN
4	5	nd dismounts, just as the other children reach...	NaN
5	6	breadth of the bluff. Gabe pulls out his ancie...	NaN
6	7	uilding. A MAN in pajamas runs out into the ra...	NaN
7	9	ELLES AND RITA HAYWORTH Just disgustingly rich...	NaN
8	10	Memphis goes back into the garage, Budgy cack...	NaN
9	11	e reels as the world spins. Sweat pours off hi...	NaN

In [174…
```
# re-order
train_df = train_df.sample(frac=1).reset_index(drop=True)
```

In [175…
```
train_df
```

Out[175...

	Index	text	genre
0	1487	you know who I am? B 9 You are me. DATA No. My...	thriller
1	19317	. A gang of his BROTHERS walk behind him. DON ...	drama
2	4500	im, the same guy we saw when Bo Catlett was he...	thriller
3	17192	ser and he thrusts out his mailed fist to keep...	drama
4	11940	quickly the last few steps and slips into the ...	thriller
...	...	...	...
22361	4774	ette speaking to the Floor Clerk. SUZETTE And ...	drama
22362	17136	cks up last. INT. PLATFORM IN SERVICE SHAFT Th...	thriller
22363	18059	0 1892. Right. He crosses with executive towar...	comedy
22364	17124	T SECRETARY Nothing. JOE Thank you. Joe shuts ...	comedy
22365	213	these distinctions between Jews and non Jews. ...	drama

22366 rows × 3 columns

In [176...

```
valid_df
```

Out[176...

	Index	text	genre
0	5634	his stock promoting was phoney and the card ga...	comedy
1	3722	n't kill the baby. LEVEAU halting You have pro...	drama
2	1716	The recorded crowd screams with laughter, as ...	horror
3	6932	n! My God! suddenly energized You can't fight ...	drama
4	1389	mbs and you had a face. And a name. THE PATIEN...	drama
...	...	...	...
45	19301	our rectum to change that shitty attitude of y...	NaN
46	13444	like this. This is a big moment for me ANNIE o...	NaN
47	13151	ley's place can't ask any questions or talk ou...	NaN
48	13766	the crowds to Bennie's depot. The streets are ...	NaN
49	23312	oseph? BELLIARD I don't know what has happened...	NaN

6895 rows × 3 columns

In [177...

```
# re-order
valid_df = valid_df.sample(frac=1).reset_index(drop=True)
```

In [178...

```
valid_df
```

Out[178…

	Index	text	genre
0	805	here it is. Good. SALIERI Majesty, I hope you ...	drama
1	3865	We'll toss it when we make the blind curve. E...	thriller
2	1071	step toward that, not even perceptible, but i...	other
3	5900	at a shiny gold cherub dangling from a small, ...	drama
4	3710	... Isabella laughs. She kisses him under the ...	drama
...	...	...	...
6890	5675	f your water? JUDGE Get on with it, counselor!...	action
6891	3689	court. HAWKINS is flanked by MACE and SANDRA.....	drama
6892	5014	motion earthquake, large boulders and giant cr...	thriller
6893	7111	e device as she addresses the four VETERANS. S...	drama
6894	5750	s the music. PETER You busted me. FRIDA Are yo...	sci-fi

6895 rows × 3 columns

In [179…
```
test_df
```

Out[179…

	Index	text	genre
0	721	hed fragment of a briefcase handle. T.J. Yes, ...	NaN
1	13340	ess. DOCTOR quiet, careful All right, nurse, w...	NaN
2	10012	. ICH Kampai. They clink glasses. Ich drinks i...	NaN
3	2008	e was a tree right there... he points Blocking...	NaN
4	9434	iled up beside him, uneaten. Beside him, Fathe...	NaN
...	...	...	...
5071	9644	where Mills stands looking up at the wall. Th...	NaN
5072	21305	ished walls. Giant leaves and vines burst insi...	NaN
5073	13617	omething where a tycoon buys a lousy team and ...	NaN
5074	23862	ou can have it your way or you can have it his...	NaN
5075	12098	nd. She doesn't wanna marry me. beat Can you p...	NaN

5076 rows × 3 columns

In [180…
```
# re-order
test_df = test_df.sample(frac=1).reset_index(drop=True)
```

In [181…
```
test_df
```

Out[181...

	Index	text	genre
0	9793	ON THE LEFT. SPLIT SCREEN INT. DIANE'S BEDROO...	NaN
1	16788	ou know, things to see, people to do? He laugh...	NaN
2	11677	pas tries, he heads for them. PARRISH to the ...	NaN
3	7300	Yeah boss? Again we hear the same muffled cri...	NaN
4	22703	trying to keep a straight face elbows him. Si...	NaN
...	...	...	...
5071	22443	er them. CAMERA PANS BACK to the Monster as he...	NaN
5072	21329	ranging my assassination. TITCH We meant only ...	NaN
5073	18161	derivations...I remember I was at this lecture...	NaN
5074	12468	! He rises up in the torchlight. The Picts tau...	NaN
5075	14921	know she's there. Don't fuck around with me. ...	NaN

5076 rows × 3 columns

In [182...
```
print(train_df.shape,valid_df.shape,test_df.shape)
```

```
(22366, 3) (6895, 3) (5076, 3)
```

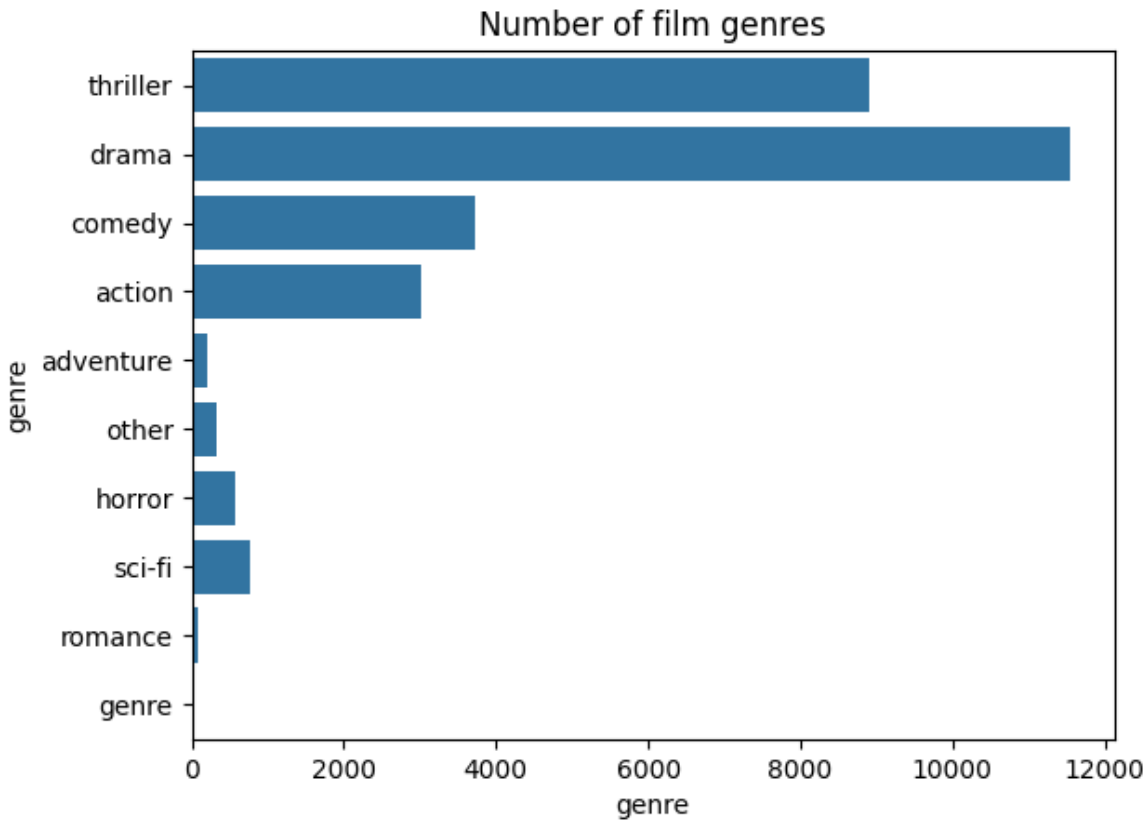
In [183...
```
valid_df = pd.concat([valid_df,test_df[:50]],axis=0)
```

In [184...
```
# consolidation
train_df = pd.concat([train_df,valid_df],axis=0)
print(train_df.shape)
```

```
(29311, 3)
```

In [186...
```
# Get the statistics.
sns.countplot(train_df["genre"])
plt.title("Number of film genres")
plt.xlabel("genre")
```

Out[186...
```
Text(0.5, 0, 'genre')
```



Label data processing

In [188…

```
x_train = train_df["text"]
y_train = train_df["genre"]


le = LabelEncoder()
y_train = le.fit_transform(y_train)
y_train = y_train.reshape(-1,1)
```

Text data processing

Tokenizer Tokenizer is a class for vectorising text, or converting text into a sequence (i.e. a list consisting of the subscripts of words in a dictionary, counting from 1) Class methods fit_on_texts(texts) :texts list of texts to use for training texts_to_sequences(texts) :list of texts to be converted to sequences return value: list of sequences, each sequence in the list corresponds to a piece of input text

padding sequences pad_sequences converts sequences of length nb_smaples to (nb_samples,nb_timesteps)2Dnumpy attay. if maxlen is supplied, nb_timesteps=maxlen, # otherwise its value is the longest sequence. Otherwise its value is the length of the longest sequence. All other sequences shorter than that length are padded with zeros at the end to reach that length. Sequences longer than nb_timesteps are staged to make them match that target length.

In [189…

```
max_words = len(set(" ".join(x_train).split()))
max_len = x_train.apply(lambda x:len(x)).max()
```

```
tok = Tokenizer(num_words=max_words)

tok.fit_on_texts(x_train)

sequences = tok.texts_to_sequences(x_train)
sequences_matrix = sequence.pad_sequences(sequences,maxlen=max_len)
```

ModelCheckpoint: this callback function will save the model to filepath after each epoch. EarlyStopping: this callback function will stop the training when the monitoring value is no longer improving. ReduceLROnPlateau: reduces the learning rate when the evaluation metrics no longer improve. Reducing the learning rate by a factor of 2 or 10 usually gives better results when learning has stalled. This callback function checks the metrics and reduces the learning rate if no model performance improvement is seen in the patient epoch.

In [190…

```
print("Setting Callbacks")

checkpoint = ModelCheckpoint("model.h5",
                                                    monitor="val_acc",
                                                    verbose=1,
                                                    save_best_only=True,
                                                    mode="max")

early_stopping = EarlyStopping(monitor="val_loss",
                                                    patience=3,
                                                    verbose=1,
                                                    restore_best_weights=True,
                                                    mode="min")

reduce_lr = ReduceLROnPlateau(monitor="val_loss",
                                                     factor=0.5,
                                                     patience=2,
                                                     verbose=1,
                                                     mode="min")

callbacks=[checkpoint,early_stopping,reduce_lr]
```

```
Setting Callbacks
```

Defining Deep Learning Models RNN

In [191…

```
# Defining RNN
def RNN():
    model = Sequential()

    model.add(Embedding(max_words,128,input_length=max_len))
    model.add(LSTM(64))

    model.add(Dropout(0.5))
    model.add(BatchNormalization())

    model.add(Dense(256,activation="relu"))
    model.add(Dropout(0.5))
    model.add(BatchNormalization())
```

```
    model.add(Dense(64,activation="relu"))

    model.add(Dropout(0.5))

    model.add(Dense(1,activation="sigmoid"))

    model.summary()

    return model
```

In [192…

```
# pic
def plot_performance(history=None,figure_directory=None,ylim_pad=[0,0]):
    xlabel="Epoch"
    legends=["Training","Validation"]

    plt.figure(figsize=(20,5))

    y1=history.history["accuracy"]
    y2=history.history["val_accuracy"]

    min_y=min(min(y1),min(y2))-ylim_pad[0]
    max_y=max(max(y1),max(y2))+ylim_pad[0]

    plt.subplot(121)

    plt.plot(y1)
    plt.plot(y2)

    plt.title("Model Accuracy\n",fontsize=17)
    plt.xlabel(xlabel,fontsize=15)
    plt.ylabel("Accuracy",fontsize=15)
    plt.ylim(min_y,max_y)
    plt.legend(legends,loc="upper left")
    plt.grid()

    y1=history.history["loss"]
    y2=history.history["val_loss"]

    min_y=min(min(y1),min(y2))-ylim_pad[1]
    max_y=max(max(y1),max(y2))+ylim_pad[1]

    plt.subplot(122)

    plt.plot(y1)
    plt.plot(y2)

    plt.title("Model Loss:\n",fontsize=17)
    plt.xlabel(xlabel,fontsize=15)
    plt.ylabel("Loss",fontsize=15)
    plt.ylim(min_y,max_y)
    plt.legend(legends,loc="upper left")
    plt.grid()
    plt.show()
```

In [193…

```
rnn_model = RNN()
```

```
2024-02-28 18:24:58.683891: I tensorflow/compiler/xla/stream_executor/cuda/cuda_g
pu_executor.cc:995] successful NUMA node read from SysFS had negative value (-1),
but there must be at least one NUMA node, so returning NUMA node zero. See more a
t https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus
-pci#L344-L355
2024-02-28 18:24:58.755567: I tensorflow/compiler/xla/stream_executor/cuda/cuda_g
pu_executor.cc:995] successful NUMA node read from SysFS had negative value (-1),
but there must be at least one NUMA node, so returning NUMA node zero. See more a
t https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus
-pci#L344-L355
2024-02-28 18:24:58.756068: I tensorflow/compiler/xla/stream_executor/cuda/cuda_g
pu_executor.cc:995] successful NUMA node read from SysFS had negative value (-1),
but there must be at least one NUMA node, so returning NUMA node zero. See more a
t https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus
-pci#L344-L355
2024-02-28 18:24:58.759694: I tensorflow/compiler/xla/stream_executor/cuda/cuda_g
pu_executor.cc:995] successful NUMA node read from SysFS had negative value (-1),
but there must be at least one NUMA node, so returning NUMA node zero. See more a
t https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus
-pci#L344-L355
2024-02-28 18:24:58.760141: I tensorflow/compiler/xla/stream_executor/cuda/cuda_g
pu_executor.cc:995] successful NUMA node read from SysFS had negative value (-1),
but there must be at least one NUMA node, so returning NUMA node zero. See more a
t https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus
-pci#L344-L355
2024-02-28 18:24:58.760483: I tensorflow/compiler/xla/stream_executor/cuda/cuda_g
pu_executor.cc:995] successful NUMA node read from SysFS had negative value (-1),
but there must be at least one NUMA node, so returning NUMA node zero. See more a
t https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus
-pci#L344-L355
2024-02-28 18:25:02.743722: I tensorflow/compiler/xla/stream_executor/cuda/cuda_g
pu_executor.cc:995] successful NUMA node read from SysFS had negative value (-1),
but there must be at least one NUMA node, so returning NUMA node zero. See more a
t https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus
-pci#L344-L355
2024-02-28 18:25:02.744004: I tensorflow/compiler/xla/stream_executor/cuda/cuda_g
pu_executor.cc:995] successful NUMA node read from SysFS had negative value (-1),
but there must be at least one NUMA node, so returning NUMA node zero. See more a
t https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus
-pci#L344-L355
2024-02-28 18:25:02.744179: I tensorflow/compiler/xla/stream_executor/cuda/cuda_g
pu_executor.cc:995] successful NUMA node read from SysFS had negative value (-1),
but there must be at least one NUMA node, so returning NUMA node zero. See more a
t https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus
-pci#L344-L355
2024-02-28 18:25:02.744315: W tensorflow/core/common_runtime/gpu/gpu_bfc_allocato
r.cc:47] Overriding orig_value setting because the TF_FORCE_GPU_ALLOW_GROWTH envi
ronment variable is set. Original config value was 0.
2024-02-28 18:25:02.744423: I tensorflow/core/common_runtime/gpu/gpu_device.cc:16
39] Created device /job:localhost/replica:0/task:0/device:GPU:0 with 7540 MB memo
ry:  -> device: 0, name: NVIDIA GeForce RTX 3080, pci bus id: 0000:10:00.0, compu
te capability: 8.6
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 embedding (Embedding)       (None, 1000, 128)         20247040

 lstm (LSTM)                 (None, 64)                49408

 dropout (Dropout)           (None, 64)                0

 batch_normalization (Batch  (None, 64)                256
 Normalization)

 dense (Dense)               (None, 256)               16640

 dropout_1 (Dropout)         (None, 256)               0

 batch_normalization_1 (Bat  (None, 256)               1024
 chNormalization)

 dense_1 (Dense)             (None, 64)                16448

 dropout_2 (Dropout)         (None, 64)                0

 dense_2 (Dense)             (None, 1)                 65

=================================================================
Total params: 20330881 (77.56 MB)
Trainable params: 20330241 (77.55 MB)
Non-trainable params: 640 (2.50 KB)
_________________________________________________________________
```

In [194…

```
loss = "binary_crossentropy"
metrics=["accuracy"]
```

In [195…

```
# RNN model training
print("Starting...\n")
learning_rate=0.001
optimizer=Adam(learning_rate)

print("\n\nCompliling Model...\n")
rnn_model.compile(optimizer=optimizer,
                                  loss=loss,
                                  metrics=metrics)

verbose = 1
epochs=100
batch_size=128
validation_split=0.1
print("Trainning Model...\n")

rnn_history=rnn_model.fit(sequences_matrix,
                                             y_train,
                                             batch_size=batch_size,
                                             epochs=epochs,
                                             verbose=1,
                                             callbacks=callbacks,
                                             validation_split=validation_split)
```

```
Starting...



Compliling Model...

Trainning Model...

Epoch 1/100
2024-02-28 18:25:52.506811: I tensorflow/compiler/xla/stream_executor/cuda/cuda_dnn.cc:432] Loaded cuDNN version 8700
2024-02-28 18:25:53.326674: I tensorflow/compiler/xla/stream_executor/cuda/cuda_blas.cc:606] TensorFloat-32 will be used for the matrix multiplication. This will only be logged once.
2024-02-28 18:25:53.881603: I tensorflow/compiler/xla/service/service.cc:168] XLA service 0x78c23280 initialized for platform CUDA (this does not guarantee that XLA will be used). Devices:
2024-02-28 18:25:53.881662: I tensorflow/compiler/xla/service/service.cc:176]   StreamExecutor device (0): NVIDIA GeForce RTX 3080, Compute Capability 8.6
2024-02-28 18:25:54.036568: I tensorflow/compiler/mlir/tensorflow/utils/dump_mlir_util.cc:255] disabling MLIR crash reproducer, set env var `MLIR_CRASH_REPRODUCER_DIRECTORY` to enable.
2024-02-28 18:25:54.838316: I ./tensorflow/compiler/jit/device_compiler.h:186] Compiled cluster using XLA!  This line is logged at most once for the lifetime of the process.
```

```
207/207 [==============================] - ETA: 0s - loss: -889.7079 - accuracy:
0.0156WARNING:tensorflow:Can save best model only with val_acc available, skippin
g.
207/207 [==============================] - 61s 254ms/step - loss: -889.7079 - acc
uracy: 0.0156 - val_loss: -2691.8687 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 2/100
207/207 [==============================] - ETA: 0s - loss: -15060.8096 - accurac
y: 0.0072WARNING:tensorflow:Can save best model only with val_acc available, skip
ping.
207/207 [==============================] - 38s 185ms/step - loss: -15060.8096 - a
ccuracy: 0.0072 - val_loss: -32699.2246 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 3/100
207/207 [==============================] - ETA: 0s - loss: -72981.9219 - accurac
y: 0.0069WARNING:tensorflow:Can save best model only with val_acc available, skip
ping.
207/207 [==============================] - 29s 140ms/step - loss: -72981.9219 - a
ccuracy: 0.0069 - val_loss: -126092.6406 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 4/100
207/207 [==============================] - ETA: 0s - loss: -204848.0625 - accurac
y: 0.0069WARNING:tensorflow:Can save best model only with val_acc available, skip
ping.
207/207 [==============================] - 20s 97ms/step - loss: -204848.0625 - a
ccuracy: 0.0069 - val_loss: -309912.8750 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 5/100
207/207 [==============================] - ETA: 0s - loss: -429388.7812 - accurac
y: 0.0069WARNING:tensorflow:Can save best model only with val_acc available, skip
ping.
207/207 [==============================] - 22s 103ms/step - loss: -429388.7812 -
accuracy: 0.0069 - val_loss: -546748.1875 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 6/100
207/207 [==============================] - ETA: 0s - loss: -763860.4375 - accurac
y: 0.0124WARNING:tensorflow:Can save best model only with val_acc available, skip
ping.
207/207 [==============================] - 19s 94ms/step - loss: -763860.4375 - a
ccuracy: 0.0124 - val_loss: -954213.5625 - val_accuracy: 0.0553 - lr: 0.0010
Epoch 7/100
207/207 [==============================] - ETA: 0s - loss: -1222055.3750 - accura
cy: 0.0252WARNING:tensorflow:Can save best model only with val_acc available, ski
pping.
207/207 [==============================] - 18s 89ms/step - loss: -1222055.3750 -
accuracy: 0.0252 - val_loss: -1543426.1250 - val_accuracy: 0.0645 - lr: 0.0010
Epoch 8/100
207/207 [==============================] - ETA: 0s - loss: -1812089.2500 - accura
cy: 0.0303WARNING:tensorflow:Can save best model only with val_acc available, ski
pping.
207/207 [==============================] - 18s 86ms/step - loss: -1812089.2500 -
accuracy: 0.0303 - val_loss: -2213316.0000 - val_accuracy: 0.0140 - lr: 0.0010
Epoch 9/100
207/207 [==============================] - ETA: 0s - loss: -2539416.5000 - accura
cy: 0.0283WARNING:tensorflow:Can save best model only with val_acc available, ski
pping.
207/207 [==============================] - 18s 86ms/step - loss: -2539416.5000 -
accuracy: 0.0283 - val_loss: -2997024.2500 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 10/100
207/207 [==============================] - ETA: 0s - loss: -3389202.2500 - accura
cy: 0.0262WARNING:tensorflow:Can save best model only with val_acc available, ski
pping.
207/207 [==============================] - 18s 89ms/step - loss: -3389202.2500 -
accuracy: 0.0262 - val_loss: -3998136.0000 - val_accuracy: 0.0072 - lr: 0.0010
Epoch 11/100
```

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207/207 [==============================] - ETA: 0s - loss: -4422852.0000 - accura
cy: 0.0229WARNING:tensorflow:Can save best model only with val_acc available, ski
pping.
207/207 [==============================] - 17s 81ms/step - loss: -4422852.0000 -
accuracy: 0.0229 - val_loss: -5171820.5000 - val_accuracy: 0.0246 - lr: 0.0010
Epoch 12/100
207/207 [==============================] - ETA: 0s - loss: -5619196.5000 - accura
cy: 0.0218WARNING:tensorflow:Can save best model only with val_acc available, ski
pping.
207/207 [==============================] - 17s 82ms/step - loss: -5619196.5000 -
accuracy: 0.0218 - val_loss: -6393529.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 13/100
207/207 [==============================] - ETA: 0s - loss: -6968025.5000 - accura
cy: 0.0195WARNING:tensorflow:Can save best model only with val_acc available, ski
pping.
207/207 [==============================] - 16s 79ms/step - loss: -6968025.5000 -
accuracy: 0.0195 - val_loss: -7858693.5000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 14/100
207/207 [==============================] - ETA: 0s - loss: -8474176.0000 - accura
cy: 0.0194WARNING:tensorflow:Can save best model only with val_acc available, ski
pping.
207/207 [==============================] - 17s 81ms/step - loss: -8474176.0000 -
accuracy: 0.0194 - val_loss: -9281204.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 15/100
207/207 [==============================] - ETA: 0s - loss: -10192961.0000 - accur
acy: 0.0176WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 17s 82ms/step - loss: -10192961.0000 -
accuracy: 0.0176 - val_loss: -11188139.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 16/100
207/207 [==============================] - ETA: 0s - loss: -12021313.0000 - accur
acy: 0.0173WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 17s 81ms/step - loss: -12021313.0000 -
accuracy: 0.0173 - val_loss: -13211214.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 17/100
207/207 [==============================] - ETA: 0s - loss: -14017440.0000 - accur
acy: 0.0160WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 16s 78ms/step - loss: -14017440.0000 -
accuracy: 0.0160 - val_loss: -15506929.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 18/100
207/207 [==============================] - ETA: 0s - loss: -16306862.0000 - accur
acy: 0.0150WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 17s 82ms/step - loss: -16306862.0000 -
accuracy: 0.0150 - val_loss: -17878438.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 19/100
207/207 [==============================] - ETA: 0s - loss: -18755282.0000 - accur
acy: 0.0148WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 15s 75ms/step - loss: -18755282.0000 -
accuracy: 0.0148 - val_loss: -20428478.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 20/100
207/207 [==============================] - ETA: 0s - loss: -21336530.0000 - accur
acy: 0.0145WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 16s 79ms/step - loss: -21336530.0000 -
accuracy: 0.0145 - val_loss: -23021746.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 21/100
```

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207/207 [==============================] - ETA: 0s - loss: -24164896.0000 - accur
acy: 0.0132WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 17s 82ms/step - loss: -24164896.0000 -
accuracy: 0.0132 - val_loss: -26289336.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 22/100
207/207 [==============================] - ETA: 0s - loss: -27187418.0000 - accur
acy: 0.0133WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 16s 78ms/step - loss: -27187418.0000 -
accuracy: 0.0133 - val_loss: -28695824.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 23/100
207/207 [==============================] - ETA: 0s - loss: -30270110.0000 - accur
acy: 0.0133WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 16s 78ms/step - loss: -30270110.0000 -
accuracy: 0.0133 - val_loss: -32869124.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 24/100
207/207 [==============================] - ETA: 0s - loss: -33705088.0000 - accur
acy: 0.0132WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 16s 79ms/step - loss: -33705088.0000 -
accuracy: 0.0132 - val_loss: -36447056.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 25/100
207/207 [==============================] - ETA: 0s - loss: -37408088.0000 - accur
acy: 0.0122WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 15s 75ms/step - loss: -37408088.0000 -
accuracy: 0.0122 - val_loss: -40226920.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 26/100
207/207 [==============================] - ETA: 0s - loss: -41180336.0000 - accur
acy: 0.0117WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 16s 75ms/step - loss: -41180336.0000 -
accuracy: 0.0117 - val_loss: -43866220.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 27/100
207/207 [==============================] - ETA: 0s - loss: -45299300.0000 - accur
acy: 0.0116WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 16s 76ms/step - loss: -45299300.0000 -
accuracy: 0.0116 - val_loss: -48856572.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 28/100
207/207 [==============================] - ETA: 0s - loss: -49555816.0000 - accur
acy: 0.0115WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 15s 75ms/step - loss: -49555816.0000 -
accuracy: 0.0115 - val_loss: -53030444.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 29/100
207/207 [==============================] - ETA: 0s - loss: -53973704.0000 - accur
acy: 0.0114WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 16s 79ms/step - loss: -53973704.0000 -
accuracy: 0.0114 - val_loss: -57761844.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 30/100
207/207 [==============================] - ETA: 0s - loss: -58586052.0000 - accur
acy: 0.0111WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 16s 77ms/step - loss: -58586052.0000 -
accuracy: 0.0111 - val_loss: -62957692.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 31/100
```

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207/207 [==============================] - ETA: 0s - loss: -63610032.0000 - accur
acy: 0.0113WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 16s 76ms/step - loss: -63610032.0000 -
accuracy: 0.0113 - val_loss: -67754856.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 32/100
207/207 [==============================] - ETA: 0s - loss: -68849360.0000 - accur
acy: 0.0104WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 16s 75ms/step - loss: -68849360.0000 -
accuracy: 0.0104 - val_loss: -73655320.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 33/100
207/207 [==============================] - ETA: 0s - loss: -74535736.0000 - accur
acy: 0.0101WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 16s 78ms/step - loss: -74535736.0000 -
accuracy: 0.0101 - val_loss: -78061096.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 34/100
207/207 [==============================] - ETA: 0s - loss: -80120024.0000 - accur
acy: 0.0102WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 16s 76ms/step - loss: -80120024.0000 -
accuracy: 0.0102 - val_loss: -84353776.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 35/100
207/207 [==============================] - ETA: 0s - loss: -86039232.0000 - accur
acy: 0.0102WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 15s 73ms/step - loss: -86039232.0000 -
accuracy: 0.0102 - val_loss: -91343176.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 36/100
207/207 [==============================] - ETA: 0s - loss: -91983656.0000 - accur
acy: 0.0102WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 16s 80ms/step - loss: -91983656.0000 -
accuracy: 0.0102 - val_loss: -96303512.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 37/100
207/207 [==============================] - ETA: 0s - loss: -98490016.0000 - accur
acy: 0.0105WARNING:tensorflow:Can save best model only with val_acc available, sk
ipping.
207/207 [==============================] - 15s 74ms/step - loss: -98490016.0000 -
accuracy: 0.0105 - val_loss: -102421992.0000 - val_accuracy: 0.0068 - lr: 0.0010
Epoch 38/100
207/207 [==============================] - ETA: 0s - loss: -105243208.0000 - accu
racy: 0.0108WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 77ms/step - loss: -105243208.0000
- accuracy: 0.0108 - val_loss: -110936688.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 39/100
207/207 [==============================] - ETA: 0s - loss: -112154336.0000 - accu
racy: 0.0105WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 74ms/step - loss: -112154336.0000
- accuracy: 0.0105 - val_loss: -119946928.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 40/100
207/207 [==============================] - ETA: 0s - loss: -119411872.0000 - accu
racy: 0.0104WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 78ms/step - loss: -119411872.0000
```

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- accuracy: 0.0104 - val_loss: -126024312.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 41/100
207/207 [==============================] - ETA: 0s - loss: -127032040.0000 - accu
racy: 0.0102WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 78ms/step - loss: -127032040.0000
- accuracy: 0.0102 - val_loss: -137072608.0000 - val_accuracy: 0.0072 - lr: 0.001
0
Epoch 42/100
207/207 [==============================] - ETA: 0s - loss: -134656848.0000 - accu
racy: 0.0100WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 79ms/step - loss: -134656848.0000
- accuracy: 0.0100 - val_loss: -143210752.0000 - val_accuracy: 0.0072 - lr: 0.001
0
Epoch 43/100
207/207 [==============================] - ETA: 0s - loss: -142714960.0000 - accu
racy: 0.0102WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 80ms/step - loss: -142714960.0000
- accuracy: 0.0102 - val_loss: -150337456.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 44/100
207/207 [==============================] - ETA: 0s - loss: -151430784.0000 - accu
racy: 0.0097WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 72ms/step - loss: -151430784.0000
- accuracy: 0.0097 - val_loss: -160067648.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 45/100
207/207 [==============================] - ETA: 0s - loss: -160188832.0000 - accu
racy: 0.0094WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 74ms/step - loss: -160188832.0000
- accuracy: 0.0094 - val_loss: -168679152.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 46/100
207/207 [==============================] - ETA: 0s - loss: -168933568.0000 - accu
racy: 0.0094WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 74ms/step - loss: -168933568.0000
- accuracy: 0.0094 - val_loss: -175458304.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 47/100
207/207 [==============================] - ETA: 0s - loss: -178321168.0000 - accu
racy: 0.0092WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 73ms/step - loss: -178321168.0000
- accuracy: 0.0092 - val_loss: -186567168.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 48/100
207/207 [==============================] - ETA: 0s - loss: -187796832.0000 - accu
racy: 0.0091WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 17s 80ms/step - loss: -187796832.0000
- accuracy: 0.0091 - val_loss: -196788384.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 49/100
207/207 [==============================] - ETA: 0s - loss: -197665680.0000 - accu
```

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racy: 0.0094WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 17s 84ms/step - loss: -197665680.0000
- accuracy: 0.0094 - val_loss: -206485344.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 50/100
207/207 [==============================] - ETA: 0s - loss: -207597920.0000 - accu
racy: 0.0093WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 78ms/step - loss: -207597920.0000
- accuracy: 0.0093 - val_loss: -217486672.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 51/100
207/207 [==============================] - ETA: 0s - loss: -217731056.0000 - accu
racy: 0.0095WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 79ms/step - loss: -217731056.0000
- accuracy: 0.0095 - val_loss: -229838912.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 52/100
207/207 [==============================] - ETA: 0s - loss: -228799728.0000 - accu
racy: 0.0091WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 79ms/step - loss: -228799728.0000
- accuracy: 0.0091 - val_loss: -242170032.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 53/100
207/207 [==============================] - ETA: 0s - loss: -288118048.0000 - accu
racy: 0.0091WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 74ms/step - loss: -288118048.0000
- accuracy: 0.0091 - val_loss: -299129280.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 58/100
207/207 [==============================] - ETA: 0s - loss: -301186592.0000 - accu
racy: 0.0091WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 78ms/step - loss: -301186592.0000
- accuracy: 0.0091 - val_loss: -312528032.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 59/100
207/207 [==============================] - ETA: 0s - loss: -314068576.0000 - accu
racy: 0.0086WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 75ms/step - loss: -314068576.0000
- accuracy: 0.0086 - val_loss: -329110368.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 60/100
207/207 [==============================] - ETA: 0s - loss: -328229536.0000 - accu
racy: 0.0088WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 73ms/step - loss: -328229536.0000
- accuracy: 0.0088 - val_loss: -339029600.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 61/100
207/207 [==============================] - ETA: 0s - loss: -342504192.0000 - accu
racy: 0.0090WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 73ms/step - loss: -342504192.0000
- accuracy: 0.0090 - val_loss: -357288832.0000 - val_accuracy: 0.0068 - lr: 0.001
```

```
0
Epoch 62/100
207/207 [==============================] - ETA: 0s - loss: -355133088.0000 - accu
racy: 0.0088WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 76ms/step - loss: -355133088.0000
- accuracy: 0.0088 - val_loss: -372526592.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 63/100
207/207 [==============================] - ETA: 0s - loss: -370175616.0000 - accu
racy: 0.0086WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 75ms/step - loss: -370175616.0000
- accuracy: 0.0086 - val_loss: -389070016.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 64/100
207/207 [==============================] - ETA: 0s - loss: -384798048.0000 - accu
racy: 0.0087WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 74ms/step - loss: -384798048.0000
- accuracy: 0.0087 - val_loss: -403843072.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 65/100
207/207 [==============================] - ETA: 0s - loss: -401045312.0000 - accu
racy: 0.0086WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 76ms/step - loss: -401045312.0000
- accuracy: 0.0086 - val_loss: -415678848.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 66/100
207/207 [==============================] - ETA: 0s - loss: -416099936.0000 - accu
racy: 0.0086WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 75ms/step - loss: -416099936.0000
- accuracy: 0.0086 - val_loss: -431735936.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 67/100
207/207 [==============================] - ETA: 0s - loss: -431700608.0000 - accu
racy: 0.0087WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 76ms/step - loss: -431700608.0000
- accuracy: 0.0087 - val_loss: -451347904.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 68/100
207/207 [==============================] - ETA: 0s - loss: -448060448.0000 - accu
racy: 0.0085WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 76ms/step - loss: -448060448.0000
- accuracy: 0.0085 - val_loss: -466750624.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 69/100
207/207 [==============================] - ETA: 0s - loss: -466419744.0000 - accu
racy: 0.0089WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 72ms/step - loss: -466419744.0000
- accuracy: 0.0089 - val_loss: -485135520.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 70/100
207/207 [==============================] - ETA: 0s - loss: -482303968.0000 - accu
racy: 0.0086WARNING:tensorflow:Can save best model only with val_acc available, s
```

```
kipping.
207/207 [==============================] - 16s 78ms/step - loss: -482303968.0000
- accuracy: 0.0086 - val_loss: -501001344.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 71/100
207/207 [==============================] - ETA: 0s - loss: -500043392.0000 - accu
racy: 0.0089WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 73ms/step - loss: -500043392.0000
- accuracy: 0.0089 - val_loss: -521721184.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 72/100
207/207 [==============================] - ETA: 0s - loss: -517121504.0000 - accu
racy: 0.0083WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 76ms/step - loss: -517121504.0000
- accuracy: 0.0083 - val_loss: -537089600.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 73/100
207/207 [==============================] - ETA: 0s - loss: -537318592.0000 - accu
racy: 0.0085WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 74ms/step - loss: -537318592.0000
- accuracy: 0.0085 - val_loss: -550752768.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 74/100
207/207 [==============================] - ETA: 0s - loss: -556739200.0000 - accu
racy: 0.0085WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 76ms/step - loss: -556739200.0000
- accuracy: 0.0085 - val_loss: -577175488.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 75/100
207/207 [==============================] - ETA: 0s - loss: -575100480.0000 - accu
racy: 0.0085WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 75ms/step - loss: -575100480.0000
- accuracy: 0.0085 - val_loss: -598079360.0000 - val_accuracy: 0.0072 - lr: 0.001
0
Epoch 76/100
207/207 [==============================] - ETA: 0s - loss: -594694464.0000 - accu
racy: 0.0089WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 77ms/step - loss: -594694464.0000
- accuracy: 0.0089 - val_loss: -615601024.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 77/100
207/207 [==============================] - ETA: 0s - loss: -615364032.0000 - accu
racy: 0.0088WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 74ms/step - loss: -615364032.0000
- accuracy: 0.0088 - val_loss: -637987840.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 78/100
207/207 [==============================] - ETA: 0s - loss: -635838464.0000 - accu
racy: 0.0083WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 75ms/step - loss: -635838464.0000
- accuracy: 0.0083 - val_loss: -660682432.0000 - val_accuracy: 0.0068 - lr: 0.001
0
```

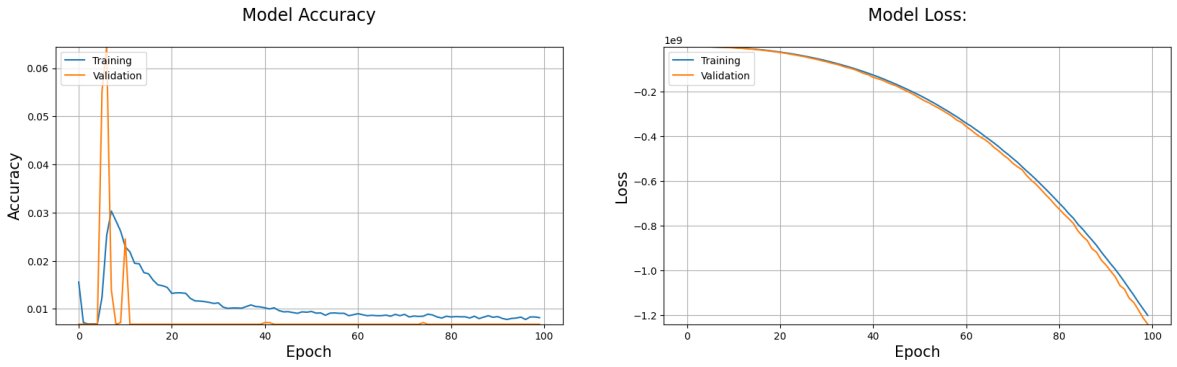
```
Epoch 79/100
207/207 [==============================] - ETA: 0s - loss: -657116160.0000 - accu
racy: 0.0081WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 75ms/step - loss: -657116160.0000
- accuracy: 0.0081 - val_loss: -682055552.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 80/100
207/207 [==============================] - ETA: 0s - loss: -678527552.0000 - accu
racy: 0.0085WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 74ms/step - loss: -678527552.0000
- accuracy: 0.0085 - val_loss: -706165760.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 81/100
207/207 [==============================] - ETA: 0s - loss: -700685440.0000 - accu
racy: 0.0083WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 73ms/step - loss: -700685440.0000
- accuracy: 0.0083 - val_loss: -727640896.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 82/100
207/207 [==============================] - ETA: 0s - loss: -722024576.0000 - accu
racy: 0.0084WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 73ms/step - loss: -722024576.0000
- accuracy: 0.0084 - val_loss: -749274624.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 83/100
207/207 [==============================] - ETA: 0s - loss: -746323200.0000 - accu
racy: 0.0084WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 73ms/step - loss: -746323200.0000
- accuracy: 0.0084 - val_loss: -769308416.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 84/100
207/207 [==============================] - ETA: 0s - loss: -767305600.0000 - accu
racy: 0.0084WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 73ms/step - loss: -767305600.0000
- accuracy: 0.0084 - val_loss: -790598656.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 85/100
207/207 [==============================] - ETA: 0s - loss: -794879360.0000 - accu
racy: 0.0081WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 75ms/step - loss: -794879360.0000
- accuracy: 0.0081 - val_loss: -824258368.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 86/100
207/207 [==============================] - ETA: 0s - loss: -816186944.0000 - accu
racy: 0.0085WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 73ms/step - loss: -816186944.0000
- accuracy: 0.0085 - val_loss: -848466048.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 87/100
207/207 [==============================] - ETA: 0s - loss: -841320448.0000 - accu
racy: 0.0080WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
```

```
207/207 [==============================] - 16s 77ms/step - loss: -841320448.0000
- accuracy: 0.0080 - val_loss: -867480832.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 88/100
207/207 [==============================] - ETA: 0s - loss: -865048704.0000 - accu
racy: 0.0083WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 16s 76ms/step - loss: -865048704.0000
- accuracy: 0.0083 - val_loss: -903686016.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 89/100
207/207 [==============================] - ETA: 0s - loss: -889393792.0000 - accu
racy: 0.0086WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 75ms/step - loss: -889393792.0000
- accuracy: 0.0086 - val_loss: -919836736.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 90/100
207/207 [==============================] - ETA: 0s - loss: -918445696.0000 - accu
racy: 0.0083WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 74ms/step - loss: -918445696.0000
- accuracy: 0.0083 - val_loss: -954645952.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 91/100
207/207 [==============================] - ETA: 0s - loss: -944452480.0000 - accu
racy: 0.0084WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 74ms/step - loss: -944452480.0000
- accuracy: 0.0084 - val_loss: -976447232.0000 - val_accuracy: 0.0068 - lr: 0.001
0
Epoch 92/100
207/207 [==============================] - ETA: 0s - loss: -971110976.0000 - accu
racy: 0.0080WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 73ms/step - loss: -971110976.0000
- accuracy: 0.0080 - val_loss: -1003646720.0000 - val_accuracy: 0.0068 - lr: 0.00
10
Epoch 93/100
207/207 [==============================] - ETA: 0s - loss: -995790336.0000 - accu
racy: 0.0078WARNING:tensorflow:Can save best model only with val_acc available, s
kipping.
207/207 [==============================] - 15s 74ms/step - loss: -995790336.0000
- accuracy: 0.0078 - val_loss: -1029049216.0000 - val_accuracy: 0.0068 - lr: 0.00
10
Epoch 94/100
207/207 [==============================] - ETA: 0s - loss: -1023974528.0000 - acc
uracy: 0.0080WARNING:tensorflow:Can save best model only with val_acc available,
skipping.
207/207 [==============================] - 15s 73ms/step - loss: -1023974528.0000
- accuracy: 0.0080 - val_loss: -1068292160.0000 - val_accuracy: 0.0068 - lr: 0.00
10
Epoch 95/100
207/207 [==============================] - ETA: 0s - loss: -1052559808.0000 - acc
uracy: 0.0081WARNING:tensorflow:Can save best model only with val_acc available,
skipping.
207/207 [==============================] - 15s 72ms/step - loss: -1052559808.0000
- accuracy: 0.0081 - val_loss: -1085242624.0000 - val_accuracy: 0.0068 - lr: 0.00
10
Epoch 96/100
```

```
207/207 [==============================] - ETA: 0s - loss: -1083023232.0000 - acc
uracy: 0.0083WARNING:tensorflow:Can save best model only with val_acc available,
skipping.
207/207 [==============================] - 16s 77ms/step - loss: -1083023232.0000
- accuracy: 0.0083 - val_loss: -1125478912.0000 - val_accuracy: 0.0068 - lr: 0.00
10
Epoch 97/100
207/207 [==============================] - ETA: 0s - loss: -1112215552.0000 - acc
uracy: 0.0078WARNING:tensorflow:Can save best model only with val_acc available,
skipping.
207/207 [==============================] - 15s 72ms/step - loss: -1112215552.0000
- accuracy: 0.0078 - val_loss: -1144928640.0000 - val_accuracy: 0.0068 - lr: 0.00
10
Epoch 98/100
207/207 [==============================] - ETA: 0s - loss: -1144152448.0000 - acc
uracy: 0.0083WARNING:tensorflow:Can save best model only with val_acc available,
skipping.
207/207 [==============================] - 15s 74ms/step - loss: -1144152448.0000
- accuracy: 0.0083 - val_loss: -1178595072.0000 - val_accuracy: 0.0068 - lr: 0.00
10
Epoch 99/100
207/207 [==============================] - ETA: 0s - loss: -1173491840.0000 - acc
uracy: 0.0083WARNING:tensorflow:Can save best model only with val_acc available,
skipping.
207/207 [==============================] - 16s 76ms/step - loss: -1173491840.0000
- accuracy: 0.0083 - val_loss: -1213841920.0000 - val_accuracy: 0.0068 - lr: 0.00
10
Epoch 100/100
207/207 [==============================] - ETA: 0s - loss: -1202311424.0000 - acc
uracy: 0.0082WARNING:tensorflow:Can save best model only with val_acc available,
skipping.
207/207 [==============================] - 15s 72ms/step - loss: -1202311424.0000
- accuracy: 0.0082 - val_loss: -1242058368.0000 - val_accuracy: 0.0068 - lr: 0.00
10
```

In [196…

```
# Visualisation
plot_performance(history=rnn_history)
```



Model Building - sklearn

In [350…

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.20, random
print('X_train size: {}, X_test size: {}'.format(X_train.shape, X_test.shape))
```

```
X_train size: (12376, 10000), X_test size: (3094, 10000)
```

In [351…
```
# Fitting Naive Bayes to the Training set
from sklearn.naive_bayes import MultinomialNB
nb_classifier = MultinomialNB()
nb_classifier.fit(X_train, y_train)
```

Out[351…
```
▾ MultinomialNB
MultinomialNB()
```

In [352…
```
# Predicting the Test set results
nb_y_pred = nb_classifier.predict(X_test)
```

In [353…
```
# Calculating Accuracy
from sklearn.metrics import accuracy_score
score1 = accuracy_score(y_test, nb_y_pred)
print("---- Score ----")
print("Accuracy score is: {}%".format(round(score1*100,2)))
```

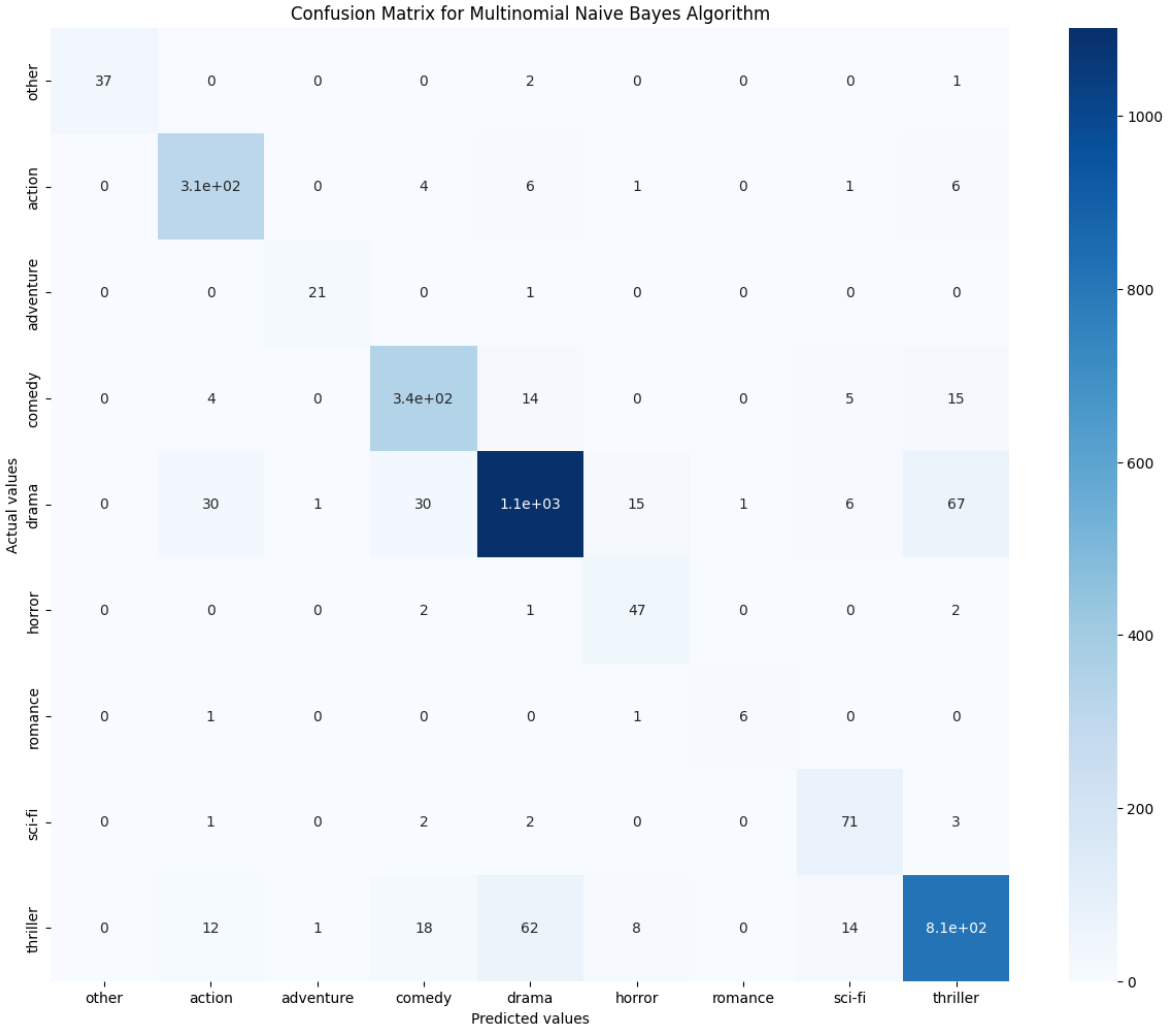
```
---- Score ----
Accuracy score is: 89.01%
```

In [354…
```
# Making the Confusion Matrix
from sklearn.metrics import confusion_matrix
nb_cm = confusion_matrix(y_test, nb_y_pred)
```

In [355…
```
nb_cm
```

Out[355…
```
array([[  37,    0,    0,    0,    2,    0,    0,    0,    1],
       [   0,  312,    0,    4,    6,    1,    0,    1,    6],
       [   0,    0,   21,    0,    1,    0,    0,    0,    0],
       [   0,    4,    0,  344,   14,    0,    0,    5,   15],
       [   0,   30,    1,   30, 1102,   15,    1,    6,   67],
       [   0,    0,    0,    2,    1,   47,    0,    0,    2],
       [   0,    1,    0,    0,    0,    1,    6,    0,    0],
       [   0,    1,    0,    2,    2,    0,    0,   71,    3],
       [   0,   12,    1,   18,   62,    8,    0,   14,  814]])
```

In [356…
```
# Plotting the confusion matrix
plt.figure(figsize=(15,12))
axis_labels = ['other', 'action', 'adventure', 'comedy', 'drama', 'horror', 'rom
sns.heatmap(data=nb_cm, annot=True, cmap="Blues", xticklabels=axis_labels, yticl
plt.xlabel('Predicted values')
plt.ylabel('Actual values')
plt.title('Confusion Matrix for Multinomial Naive Bayes Algorithm')
plt.show()
```



In [372…

```
# Hyperparameter tuning the Naive Bayes Classifier
best_accuracy = 0.0
alpha_val = 0.0
for i in np.arange(0.1,1.1,0.1):
  temp_classifier = MultinomialNB(alpha=i)
  temp_classifier.fit(X_train, y_train)
  temp_y_pred = temp_classifier.predict(X_test)
  score = accuracy_score(y_test, temp_y_pred)
  print("Accuracy score for alpha={} is: {}%".format(round(i,1), round(score*100
  if score>best_accuracy:
    best_accuracy = score
    alpha_val = i
print('---------------------------------')
print('The best accuracy is {}% with alpha value as {}'.format(round(best_accura
```

```
Accuracy score for alpha=0.1 is: 91.18%
Accuracy score for alpha=0.2 is: 90.66%
Accuracy score for alpha=0.3 is: 90.37%
Accuracy score for alpha=0.4 is: 90.01%
Accuracy score for alpha=0.5 is: 89.75%
Accuracy score for alpha=0.6 is: 89.5%
Accuracy score for alpha=0.7 is: 89.24%
Accuracy score for alpha=0.8 is: 89.04%
Accuracy score for alpha=0.9 is: 89.11%
Accuracy score for alpha=1.0 is: 89.01%
---------------------------------
The best accuracy is 91.18% with alpha value as 0.1
```

In [359…
```
classifier = MultinomialNB(alpha=0.1)
classifier.fit(X_train, y_train)
```

Out[359…
```
MultinomialNB
MultinomialNB(alpha=0.1)
```

Predictions

In [360…
```
def genre_prediction(sample_script):
  sample_script = re.sub(pattern='[^a-zA-Z]',repl=' ', string=sample_script)
  sample_script = sample_script.lower()
  sample_script_words = sample_script.split()
  sample_script_words = [word for word in sample_script_words if not word in set
  ps = PorterStemmer()
  final_script = [ps.stem(word) for word in sample_script_words]
  final_script = ' '.join(final_script)
  temp = cv.transform([final_script]).toarray()
  return classifier.predict(temp)[0]
```

In [361…
```
# For generating random integer
from random import randint
```

In [362…
```
# Loading test dataset
test = pd.read_csv('/home/featurize/dataset/movie_test.csv')
test.columns
```

Out[362…
```
Index(['id', 'text'], dtype='object')
```

In [364…
```
test.shape
```

Out[364…
```
(5075, 2)
```

In [365…
```
test.drop('id', axis=1, inplace=True)
test.head(10)
```

Out[365…

	text
0	glances at her. BOOK Maybe I ought to learn t...
1	hout breaking stride. Tatiana sees her and can...
2	dead bodies. GEORDI Mitchell... DePaul... LANG...
3	take myself. BRANDON How bad is the other thi...
4	her body to shield his own. KAY Freeze it, Bug...
5	im from ear to ear. Ya want me to make a state...
6	BEN We need to help Reed Sue shakes her head,...
7	slowly. At the entrance to the alley stands a ...
8	edge of the field. Neil steps closer. THE TOMB...
9	special, take ya in the kitchen and suck your ...

In [366…

```
# Predicting values
row = randint(0,test.shape[0]-1)
sample_script = test.text[row]

print('Script: {}'.format(sample_script))
value = genre_prediction(sample_script)
print('Prediction: {}'.format(list(genre_mapper.keys())[value]))
```

```
Script: t one. But what do I know? I like Laurel and Hardy movies. DANA Really? I
never really cared for those. Why does the fat one always have to be so mean to t
he skinny one? INT. ENID'S ROOM EVENING It's 9 30 PM. Enid is drawing in her sket
chbook. She looks impatiently at the phone. Time passes it's 11 PM. She can't sta
nd it anymore. INT. SEYMOUR'S APARTMENT CONTINUOUS Seymour picks up the phone. Da
na is in the background getting some ice in the kitchen. SEYMOUR Uh... hello? ENI
D Hi, it's me... SEYMOUR Oh, hi... ENID So, what happened? SEYMOUR almost whisper
ing Actually, it's kind of still happening... she's over here right now... I thin
k everything's going pretty well... ENID What? You're kidding me... SEYMOUR Yeah,
so I better go it's not really the best time to talk... ENID What, are you going
to like have sex with her on your first date? SEYMOUR Jesus, Enid... I'll talk to
you later... bye! He hangs up. Enid is stunned... Now what? She calls Rebecca. IN
T. OOMIE'S LIVING ROOM CONTINUOUS
Prediction: drama
```

In [367…

```
# Predicting values
row = randint(0,test.shape[0]-1)
sample_script = test.text[row]

print('Script: {}'.format(sample_script))
value = genre_prediction(sample_script)
print('Prediction: {}'.format(list(genre_mapper.keys())[value]))
```

```
Script: ars. Thank God looks don't matter as much as they once did. LOGAN, a wild
gleam in his eye, moves out of the room, following where the others went, that LO
NG BLADED SCALPEL still clutched in his hand. The others follow. 94 INT. THE HOSP
ITAL NIGHT JOHN, SARAH AND LUKEY are facing out across the compound. A TEEMING TR
OPICAL RAIN has started to fall. JOHN This just ain't your day, is it, darlin' Sa
rah. SARAH can't help but snicker. Suddenly her head spins exhaustion is conqueri
ng her body as last. JOHN puts a big arm around her. JOHN Three more minutes. The
n you can sleep. You gotta stay with it for three more minutes. McDERMOTT joins t
hem and the group moves out into the rain. LUKEY waddles back through the maze of
cots. LOGAN, SPIDER AND DIESEL have moved to about the center of the big room. Th
e patients around them, their eyes bulging, look like lemurs. LOGAN How do we kno
w she's alright? How do we know? The same intonation again. This guy's wrapping i
s definitely coming loose. THE ZOM
Prediction: thriller
```

In [368…

```
# Predicting values
row = randint(0,test.shape[0]-1)
sample_script = test.text[row]

print('Script: {}'.format(sample_script))
value = genre_prediction(sample_script)
print('Prediction: {}'.format(list(genre_mapper.keys())[value]))
```

```
Script: nry passes the joint to Anthony. Anthony smokes it. MR. HENRY But you're
thieves. It's what you are. ANTHONY Yeah. MR. HENRY It's an esoteric journey. Ant
hony passes the joint back to Mr. Henry. MR. HENRY We're renegades from despair.
ANTHONY nods Can I ask you something, Mr. Henry? MR. HENRY Absolutely. ANTHONY Wh
y'd you want to help us? MR. HENRY inhales, pause, holding in smoke Because I was
like you once. And there was no one there to help me. Mr. Henry exhales the smok
e. He hands the joint to Anthony. Anthony takes a hit. They stare out at the dark
ness. INT. BOB'S HOUSE. NIGHT Anthony and Dignan are sitting in the kitchen. Anth
ony's got on a t shirt and boxers. Dignan's wearing a bathrobe. All the lights in
the house are out except one in the kitchen. Anthony's drinking a glass of milk.
Dignan's got orange juice. DIGNAN Next week we'll be drinking pi a coladas. ANTHO
NY nods Hopefully this trip'll go a little smoother than the last one. Dignan nod
s. ANTHONY Or I might end up with a
Prediction: comedy
```

In [369…

```
# Predicting values
row = randint(0,test.shape[0]-1)
sample_script = test.text[row]

print('Script: {}'.format(sample_script))
value = genre_prediction(sample_script)
print('Prediction: {}'.format(list(genre_mapper.keys())[value]))
```

```
Script: inishing touches to Jerome's hair. He wheels himself out of the way. The
final accomplice in Jerome's deception, a BLACK MARKET COMPUTER GRAPHICS DESIGNE
R, takes Jerome's photo with a video camera. Manipulating the captured image, the
Designer morphs Jerome's face into the face of Eugene. The resulting photo that s
pits out of a printer is neither one nor the other but an acceptable combination
of the two. INT. HOUSING PROJECT APARTMENT. DAY. EUGENE is starting to prepare Je
rome's specimen bags for the first time. He winces in pain as he plucks several h
airs from his head. JEROME, now out of his casts, prepares job applications. EUGE
NE still grimacing, referring to the follicles You really need that much? JEROME
More than that. You'll get used to it. EUGENE yanking out another hair God, what
wouldn't you do to leave the planet? JEROME inspecting a hair follicle Leave? Jus
t a few million years ago every atom in this hair in our bodies was a part of a s
tar. I don't see it as leaving. I se
Prediction: drama
```

TF-IDF

In [68]:

```
# # Put it in a file and stop it because it's too big.
import numpy as np

from sklearn.feature_extraction.text import CountVectorizer
from sklearn.feature_extraction.text import TfidfTransformer

def sklearn_tfidf():
    train_data = open('/home/featurize/dataset/movie_val1.csv')
    samples = []
    for data in  train_data:
        samples.append(data)

    vectorizer = CountVectorizer() #Converting words in text to a word frequency
    X = vectorizer.fit_transform(samples) #Counting the number of occurrences of

    transformer = TfidfTransformer()
    tfidf = transformer.fit_transform(X)  #Statistics of the word frequency matr
    for i in range(len(samples)):
        print(samples[i])
```

```
        print(tfidf.toarray()[i])
sklearn_tfidf()
```

id,text,genre

[0. 0. 0. ... 0. 0. 0.]
0,"eady dead, maybe even wishing he was. INT. 2ND FLOOR HALLWAY THREE NIGHT The O rderly leads Liza to a door. ORDERLY In here. White guy in his 30s. He opens the door and they step into... ROOM THREE There's a white guy in his mid 30s. He look s up. Wild. Straight jacketed. Not Jerry. Liza's reached the end of her rope. She just shakes her head. INT. DECREPIT HOSPITAL ROOM NIGHT Balled up. Fetal. Not rea lly all there. Head pressed to the cement, he tries to sing to himself. JERRY Blu e moon... Blue moon... INT. 2ND FLOOR HALLWAY THREE NIGHT Liza just stands there, leaning on a rail on the wall. The Orderly isn't sure what's going on, but he kno ws it's bad. ORDERLY You okay? Liza starts down the hall with the Orderly followi ng. ORDERLY We got some new patients last week. You want to see them? Liza waves them off. It's hopeless. She stops at a chicken wired window at the end of the ha ll, looks out. Light's about to break and Jerry's out there somewhere. ORDERLY Lo ok, I gotta get back to work.",thriller

[0. 0. 0. ... 0. 0. 0.]
2,"t, summa cum laude and all. And I'm about to launch a brand new magazine calle d EXPOSED! An homage to Miss Julie Conroy of Xenia, Ohio. Julie grins. JULIE I kn ow where you can find an excellent editor in chief. TED Yellow pages? JULIE Let y our fingers do the walking. Suddenly the music changes. People. Ted grins. TED Th ey're playing our song. extending his hand Dare I ask for this dance? JULIE takin g his hand You better. Ted and Julie begin dancing and kissing in the b.g. Charli e and Jimmy feign tears. CHARLIE I'm a sucker for a happy ending. hugging Jimmy H old me. And we start to RISE AGAIN, above the NELSON HOUSE, into the clouds above Xenia... TED V.O. So, as you can guess, everybody pretty much lived happily ever after. My parents didn't give up the grocery store... We descend through clouds a nd quickly find we're... EXT. LONDON BUCKINGHAM PALACE DAY Mom and Dad take pictu res and smooch in front of the palace. TED V.O. ...but they did manage to sneak a way for a second honeymoon. ON",comedy

[0. 0. 0. ... 0. 0. 0.]
3," up Come, I have a surprise.... She takes him by the hand and leads him out to the hallway. SALVATORE looks at her and feels a pang. She seems smaller, age with ers the body, she is slightly stooped, her hair is gathered into a knot at the ba ck other head. You must be tired. If you want to rest, there's time before the fu neral. SALVATORE Interrupting her No, Mamma, it only takes an hour by air, you kn ow. MARIA Smiling, ironically You shouldn't tell me that now. After all these yea rs! SALVATORE gets the message, feels guilty. Thinking about it, it seems incredi ble that he has never come before. MARIA opens a door, steps aside to let her son in, whispers I put all your things in here. Go in, go in... SALVATORE lakes a few steps, is flabbergasted at the sight of his old room perfectly reconstructed and preserved. It looks like a museum, the museum of the past. Despite the bed, the c lothes in the cupboard, the books on the shelves, it is perfectly clear that no o ne has ever lived in it and ",drama

[0. 0. 0. ... 0. 0. 0.]
4,"ded by the two detectives. INT. JEFF'S APARTMENT NIGHT MEDIUM SHOT Thorwald fi ghts to dislodge Jeff's grip. EXT. JEFF'S APARTMENT NIGHT CLOSE SHOT Looking down on Jeff's face, showing his strain and the pain of Thorwald's attack. The brick f loor of the patio seems a hundred feet below. INT. JEFF'S APARTMENT NIGHT MEDIUM SHOT Thorwald and Jeff struggling. EXT. NEIGHBORHOOD NIGHT SEMI CLOSE SHOT Doyle pulling himself to the top of the wall. Lisa, Stella and the two men below, looki ng up. Lisa is white faced and frightened. INT. JEFF'S APARTMENT NIGHT MEDIUM SHO T Thorwald smashes at Jeff's arms and hands. Jeff's grip begins to slip. EXT. NEI GHBORHOOD NIGHT SEMI CLOSE SHOT Doyle reaches the top of the wall, looks up at Je ff. EXT. NEIGHBORHOOD NIGHT MEDIUM LONG SHOT Jeff, as seen from Doyle's angle, ha nging, somehow weathering Thorwald's insane attack. EXT. NEIGHBORHOOD NIGHT SEMI CLOSE SHOT Doyle reaches for his service revolver. He doesn't have it! He looks d

```
own, and calls one of the dete",thriller
```

```
---------------------------------------------------------------------------
KeyboardInterrupt                         Traceback (most recent call last)
Cell In[68], line 20
     18         print(samples[i])
     19         print(tfidf.toarray()[i])
---> 20 sklearn_tfidf()

Cell In[68], line 19, in sklearn_tfidf()
     17 for i in range(len(samples)):
     18     print(samples[i])
---> 19     print(tfidf.toarray()[i])

File /environment/miniconda3/lib/python3.10/site-packages/scipy/sparse/_compresse
d.py:1061, in _cs_matrix.toarray(self, order, out)
   1059     y = out.T
   1060 M, N = x._swap(x.shape)
-> 1061 csr_todense(M, N, x.indptr, x.indices, x.data, y)
   1062 return out

KeyboardInterrupt:
```

LDA

In [ ]:

```
# Put it in a file and stop it because it's too big.
from gensim import corpora, models, similarities
from pprint import pprint

# import logging
# logging.basicConfig(format='%(asctime)s : %(levelname)s : %(message)s', level=


if __name__ == '__main__':
    f = open('/home/featurize/dataset/movie_val1.csv')
    stop_list = set('for a of the and to in'.split())
    #texts = [line.strip().split() for line in f]
    #print(texts)
    texts = [[word for word in line.strip().lower().split() if word not in stop_
    print ('Text = ')
    pprint(texts)
    dictionary = corpora.Dictionary(texts)
    V = len(dictionary)
    corpus = [dictionary.doc2bow(text) for text in texts]
    corpus_tfidf = models.TfidfModel(corpus)[corpus]
    for c in corpus_tfidf:
        print(c)

#Topic-word distribution
    print ('\nLSI Model:')
    lsi = models.LsiModel(corpus_tfidf, num_topics=2, id2word=dictionary)
    topic_result = [a for a in lsi[corpus_tfidf]]
    pprint(topic_result)
    print ('LSI Topics:')
    pprint(lsi.print_topics(num_topics=2, num_words=5))
    similarity = similarities.MatrixSimilarity(lsi[corpus_tfidf])   # similariti
    print ('Similarity:')
    pprint(list(similarity))
```

```
    print ('\nLDA Model:')
    num_topics = 2
    lda = models.LdaModel(corpus_tfidf, num_topics=num_topics, id2word=dictionar
                          alpha='auto', eta='auto', minimum_probability=0.001)
    doc_topic = [doc_t for doc_t in lda[corpus_tfidf]]

#Document-Topic Distribution
    print ('Document-Topic:\n')
    pprint(doc_topic)
    for doc_topic in lda.get_document_topics(corpus_tfidf):
        print(doc_topic)
    for topic_id in range(num_topics):
        print( 'Topic', topic_id)
        # pprint(lda.get_topic_terms(topicid=topic_id))
        pprint(lda.show_topic(topic_id))
```

text matching task

1.1 Using the sentence_transformers package

In [65]:
```
pip install -U sentence-transformers
```

```
Looking in indexes: https://pypi.tuna.tsinghua.edu.cn/simple
Requirement already satisfied: sentence-transformers in /environment/miniconda3/l
ib/python3.10/site-packages (2.5.1)
Requirement already satisfied: transformers<5.0.0,>=4.32.0 in /environment/minico
nda3/lib/python3.10/site-packages (from sentence-transformers) (4.38.2)
Requirement already satisfied: tqdm in /environment/miniconda3/lib/python3.10/sit
e-packages (from sentence-transformers) (4.65.0)
Requirement already satisfied: torch>=1.11.0 in /environment/miniconda3/lib/pytho
n3.10/site-packages (from sentence-transformers) (2.0.1+cu118)
Requirement already satisfied: numpy in /environment/miniconda3/lib/python3.10/si
te-packages (from sentence-transformers) (1.24.1)
Requirement already satisfied: scikit-learn in /environment/miniconda3/lib/python
3.10/site-packages (from sentence-transformers) (1.3.2)
Requirement already satisfied: scipy in /environment/miniconda3/lib/python3.10/si
te-packages (from sentence-transformers) (1.11.3)
Requirement already satisfied: huggingface-hub>=0.15.1 in /environment/miniconda
3/lib/python3.10/site-packages (from sentence-transformers) (0.21.4)
Requirement already satisfied: Pillow in /environment/miniconda3/lib/python3.10/s
ite-packages (from sentence-transformers) (9.3.0)
Requirement already satisfied: filelock in /environment/miniconda3/lib/python3.1
0/site-packages (from huggingface-hub>=0.15.1->sentence-transformers) (3.9.0)
Requirement already satisfied: fsspec>=2023.5.0 in /environment/miniconda3/lib/py
thon3.10/site-packages (from huggingface-hub>=0.15.1->sentence-transformers) (202
4.2.0)
Requirement already satisfied: requests in /environment/miniconda3/lib/python3.1
0/site-packages (from huggingface-hub>=0.15.1->sentence-transformers) (2.31.0)
Requirement already satisfied: pyyaml>=5.1 in /environment/miniconda3/lib/python
3.10/site-packages (from huggingface-hub>=0.15.1->sentence-transformers) (6.0.1)
Requirement already satisfied: typing-extensions>=3.7.4.3 in /environment/minicon
da3/lib/python3.10/site-packages (from huggingface-hub>=0.15.1->sentence-transfor
mers) (4.8.0)
Requirement already satisfied: packaging>=20.9 in /environment/miniconda3/lib/pyt
hon3.10/site-packages (from huggingface-hub>=0.15.1->sentence-transformers) (23.
0)
Requirement already satisfied: sympy in /environment/miniconda3/lib/python3.10/si
te-packages (from torch>=1.11.0->sentence-transformers) (1.11.1)
Requirement already satisfied: networkx in /environment/miniconda3/lib/python3.1
0/site-packages (from torch>=1.11.0->sentence-transformers) (3.0)
Requirement already satisfied: jinja2 in /environment/miniconda3/lib/python3.10/s
ite-packages (from torch>=1.11.0->sentence-transformers) (3.1.2)
Requirement already satisfied: triton==2.0.0 in /environment/miniconda3/lib/pytho
n3.10/site-packages (from torch>=1.11.0->sentence-transformers) (2.0.0)
Requirement already satisfied: cmake in /environment/miniconda3/lib/python3.10/si
te-packages (from triton==2.0.0->torch>=1.11.0->sentence-transformers) (3.25.0)
Requirement already satisfied: lit in /environment/miniconda3/lib/python3.10/site
-packages (from triton==2.0.0->torch>=1.11.0->sentence-transformers) (15.0.7)
Requirement already satisfied: regex!=2019.12.17 in /environment/miniconda3/lib/p
ython3.10/site-packages (from transformers<5.0.0,>=4.32.0->sentence-transformers)
(2023.12.25)
Requirement already satisfied: tokenizers<0.19,>=0.14 in /environment/miniconda3/
lib/python3.10/site-packages (from transformers<5.0.0,>=4.32.0->sentence-transfor
mers) (0.15.2)
Requirement already satisfied: safetensors>=0.4.1 in /environment/miniconda3/lib/
python3.10/site-packages (from transformers<5.0.0,>=4.32.0->sentence-transformer
s) (0.4.2)
Requirement already satisfied: joblib>=1.1.1 in /environment/miniconda3/lib/pytho
n3.10/site-packages (from scikit-learn->sentence-transformers) (1.3.2)
Requirement already satisfied: threadpoolctl>=2.0.0 in /environment/miniconda3/li
b/python3.10/site-packages (from scikit-learn->sentence-transformers) (3.2.0)
Requirement already satisfied: MarkupSafe>=2.0 in /environment/miniconda3/lib/pyt
```

```
hon3.10/site-packages (from jinja2->torch>=1.11.0->sentence-transformers) (2.1.2)
Requirement already satisfied: charset-normalizer<4,>=2 in /environment/miniconda
3/lib/python3.10/site-packages (from requests->huggingface-hub>=0.15.1->sentence-
transformers) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in /environment/miniconda3/lib/python
3.10/site-packages (from requests->huggingface-hub>=0.15.1->sentence-transformer
s) (2.10)
Requirement already satisfied: urllib3<3,>=1.21.1 in /environment/miniconda3/lib/
python3.10/site-packages (from requests->huggingface-hub>=0.15.1->sentence-transf
ormers) (1.25.11)
Requirement already satisfied: certifi>=2017.4.17 in /environment/miniconda3/lib/
python3.10/site-packages (from requests->huggingface-hub>=0.15.1->sentence-transf
ormers) (2023.7.22)
Requirement already satisfied: mpmath>=0.19 in /environment/miniconda3/lib/python
3.10/site-packages (from sympy->torch>=1.11.0->sentence-transformers) (1.2.1)
Note: you may need to restart the kernel to use updated packages.
```

In [66]:

```python
from sentence_transformers import SentenceTransformer, util
model = SentenceTransformer('distilbert-base-nli-mean-tokens')

sentences = [
    'She cant stand it anymore.',
    'I dont see it as leaving. ',
    'You ll get used to it.'
    ]
sentence_embeddings = model.encode(sentences)

for sentence, embedding in zip(sentences, sentence_embeddings):
    print("Sentence:", sentence)
    print("Embedding:", embedding)
    print("")
```

```
/environment/miniconda3/lib/python3.10/site-packages/tqdm/auto.py:21: TqdmWarnin
g: IProgress not found. Please update jupyter and ipywidgets. See https://ipywidg
ets.readthedocs.io/en/stable/user_install.html
  from .autonotebook import tqdm as notebook_tqdm
/environment/miniconda3/lib/python3.10/site-packages/torch/_utils.py:776: UserWar
ning: TypedStorage is deprecated. It will be removed in the future and UntypedSto
rage will be the only storage class. This should only matter to you if you are us
ing storages directly.  To access UntypedStorage directly, use tensor.untyped_sto
rage() instead of tensor.storage()
  return self.fget.__get__(instance, owner)()
```

```
Sentence: She cant stand it anymore.
Embedding: [-4.96767879e-01 -4.66517568e-01  7.31650949e-01  1.36780515e-01
 -7.18036532e-01 -1.33838713e-01  1.93751246e-01  3.21577005e-02
 -4.15003926e-01  5.98054588e-01  3.48344266e-01 -3.90772596e-02
  3.95547181e-01  2.71866322e-01  7.07978964e-01  1.69023931e-01
  1.61616251e-01 -5.54133318e-02 -8.24754417e-01 -1.08984673e+00
 -3.33068632e-02 -2.09181711e-01  4.71347392e-01  1.46679267e-01
 -2.83551097e-01  1.02381635e+00  5.95521688e-01 -2.72083223e-01
 -8.24737400e-02  8.41009319e-02  1.88313216e-01  4.28532273e-01
 -9.49644367e-04  7.71964574e-03  4.31190789e-01 -5.08984149e-01
  1.73890486e-01 -4.48024213e-01  1.72951758e-01 -1.08949995e+00
 -3.14511627e-01 -9.47183728e-01 -1.11600652e-01  1.37532085e-01
  1.99710816e-01  2.15249166e-01 -1.11021936e+00  5.87940961e-02
 -1.55773270e+00 -9.28892791e-01 -4.22675133e-01  5.67046881e-01
  1.71987140e+00 -1.18928432e-01 -5.23850799e-01 -3.59969348e-01
 -4.11145002e-01  1.14250886e+00 -5.03175676e-01  6.55437410e-02
  6.21748388e-01  5.35363197e-01 -6.57410383e-01 -4.17618901e-01
 -5.77758908e-01  9.63229835e-02  7.86794722e-01  1.04370248e+00
  5.36668003e-01 -6.06587410e-01  1.27448797e+00  2.92173717e-02
  4.44985032e-01 -7.02295750e-02 -3.58891517e-01  3.26305740e-02
  3.31103921e-01 -3.77776086e-01  9.06226695e-01 -6.14806175e-01
  9.55016255e-01 -3.91174793e-01 -5.39157987e-01  1.39374942e-01
  3.83224934e-02 -9.41666305e-01 -5.13856053e-01 -1.49437055e-01
 -1.16371997e-02  1.20164704e+00  1.73011065e-01 -3.05390984e-01
  2.32190877e-01 -2.37639800e-01 -1.09573102e+00 -6.21432543e-01
  7.95132697e-01 -2.22616270e-01 -2.61519551e-01  4.19786215e-01
  7.37138450e-01 -1.18491876e+00  9.38128769e-01  3.08272898e-01
 -4.54131544e-01  7.81429470e-01  3.58006150e-01  8.76997232e-01
  4.06218171e-01 -5.02966046e-01 -6.74652398e-01 -1.19334078e+00
  8.47615659e-01 -6.81547999e-01  1.04117379e-01 -9.24036264e-01
 -1.42179698e-01 -5.62165797e-01  5.93287170e-01  5.92932761e-01
  6.34560049e-01  5.69094956e-01  1.74532514e-02  4.03982371e-01
  9.02209803e-02  1.03357208e+00  5.75625479e-01  1.80732787e-01
 -6.75221920e-01 -4.52990264e-01  2.29321778e-01  4.89408076e-01
 -4.50807996e-03 -9.73178029e-01 -1.36865258e-01  6.54532015e-02
  5.18208742e-03  5.00730157e-01 -2.16809481e-01 -3.54943991e-01
  8.25147331e-02  1.02902460e+00  1.39628723e-01 -2.49927208e-01
 -7.54905790e-02 -4.76574570e-01 -9.79485661e-02 -8.44539627e-02
  2.21115857e-01 -3.16465378e-01 -5.25339246e-01 -8.02401483e-01
  1.13836683e-01 -4.27114695e-01 -8.89345169e-01 -1.36175287e+00
  1.07196510e+00 -1.13272595e+00 -1.65184236e+00  5.07833660e-01
  4.28030759e-01 -3.84382904e-01  2.69152611e-01  2.97031611e-01
  2.85070203e-02 -6.72966957e-01 -2.31684342e-01 -1.38523370e-01
  2.46540140e-02  4.61818367e-01  2.34418795e-01 -6.66707575e-01
  1.18670925e-01  4.62762415e-01 -5.14790118e-01  1.12027168e-01
 -1.34254289e+00  4.51481968e-01 -5.84330201e-01  3.96271423e-02
 -7.20537841e-01  4.98934120e-01  6.29744291e-01 -1.18933968e-01
 -7.70559728e-01 -2.49544933e-01  1.38080483e-02 -1.38247240e+00
  7.17196643e-01  4.12562311e-01 -2.66238749e-01 -3.58669043e-01
  3.57569635e-01  2.62553006e-01  2.48742849e-01  1.08357541e-01
  3.42702806e-01 -8.74042630e-01  1.99443549e-01 -3.54878634e-01
  7.88899183e-01 -2.40468636e-01  1.64378715e+00  8.77513111e-01
 -2.15009496e-01  1.00409556e-02  5.50176203e-01 -1.03814852e+00
  8.99557233e-01  1.02121544e+00  4.93392736e-01  2.85340607e-01
 -1.19328892e+00 -7.94356108e-01  3.23263466e-01  3.67479175e-01
  3.07212234e-01 -1.44368812e-01  4.40781057e-01  3.09873611e-01
 -2.95269758e-01 -6.91579580e-01 -9.74011302e-01 -3.92682701e-01
 -2.57747233e-01 -3.20291966e-01  3.11608523e-01  8.82712960e-01
 -3.73724997e-01 -3.17951798e-01  5.91819644e-01  2.42878258e-01
 -6.07359171e-01 -7.02524304e-01 -1.53262481e-01  1.28259945e+00
```

-4.55851227e-01 -5.21911621e-01 2.13281617e-01 -7.06094325e-01
-1.22325987e-01 6.31469309e-01 -3.93354408e-02 6.38265312e-02
 4.16829258e-01 -1.96184754e-01 -7.61119843e-01 -6.00823164e-01
 1.15650162e-01 1.88977033e-01 -1.08910477e+00 -5.45777559e-01
-5.70083857e-01 -1.43341720e-01 -2.93214440e-01 -3.42477739e-01
-1.13441658e+00 2.84695506e-01 2.34488428e-01 -8.08260515e-02
-2.27340356e-01 -3.45244437e-01 4.20105189e-01 -1.48710728e-01
-1.56746522e-01 -2.20022798e+00 -4.26905364e-01 -7.24854171e-01
 5.22524834e-01 3.86888921e-01 3.63351047e-01 4.87623364e-01
 9.35559928e-01 1.01504989e-01 -8.95451307e-01 -6.60049975e-01
 8.54364455e-01 3.27151209e-01 -1.49039567e-01 -3.51714969e-01
-1.44880995e-01 -1.03801489e+00 2.56596267e-01 1.21157241e+00
 2.43903086e-01 9.35279191e-01 9.95957136e-01 1.11938685e-01
-7.78273821e-01 -4.50687081e-01 -2.51754105e-01 1.03886163e+00
-1.38907766e+00 5.37948906e-01 -3.39706868e-01 -3.46836776e-01
-6.32485747e-01 -9.18547288e-02 -6.87528551e-01 2.29637548e-01
-2.18808830e-01 -7.34413147e-01 -2.16554761e-01 6.63511574e-01
-3.75990510e-01 5.53092420e-01 -2.38114119e-01 -2.79057622e-01
 2.65024781e-01 -3.84192348e-01 -1.87592044e-01 5.38065672e-01
-8.08271408e-01 8.07353973e-01 1.96884334e-01 2.12277263e-01
-3.00723054e-02 5.25916278e-01 -3.69923651e-01 1.19805419e+00
-2.93959975e-01 3.07978123e-01 -4.64294583e-01 3.03366333e-01
-8.57846260e-01 -4.73260194e-01 -6.99021816e-01 1.10409307e+00
-1.59358427e-01 -5.51092923e-01 6.73184514e-01 -3.68234158e-01
-2.95538545e-01 1.00613010e+00 4.37688231e-01 7.13076353e-01
-5.44106722e-01 -7.66935647e-02 -1.01152718e+00 3.06749605e-02
 4.86726642e-01 1.05669275e-01 -2.98149198e-01 1.32683709e-01
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 7.55221471e-02  3.09463888e-01  2.04666451e-01 -5.04684567e-01]
```

In [67]:
```
from scipy.spatial import distance
print(1 - distance.cosine(sentence_embeddings[0], sentence_embeddings[1]))
print(1 - distance.cosine(sentence_embeddings[0], sentence_embeddings[2]))
print(1 - distance.cosine(sentence_embeddings[1], sentence_embeddings[2]))
```

```
0.7611411809921265
0.5598791241645813
0.5903242826461792
```

In [ ]:
```

```