Multi-Output Text Classification

December 9, 2021

0.0.1 Multi-Output Text Classification

- Binary Classification: target has either 0 or 1
- Multi-Class: A classification problem consisting of more than two classes.
- Multi-Label: A target can have more than two labels at the same time
- Multi-output: A target where each sample has multiple classification/regression labels
  - Multiclass-multioutput classification (also known as multitask classification) is a classification task which labels each sample with a set of non-binary properties.
  - Both the number of properties and the number of classes per property is greater than 2.

0.0.2 Libraries

- Scikit-Learn
  - sklearn.multioutput
- Scikit-Multi-Learn
- Tensorflow
- Pytorch
- etc

Multi Class vs Multi-Label vs Multi-Output Classification

Multi- Class

	X	Class
	X1	Positive
	X2	Negative
	X3	Neutral
	X4	Positive
	X5	Positive

Multi-Label

X	Python	PHP	SQL
X1	1	0	0
X2	0	0	1
X3	1	0	1

Multi-Output Multiclass

X	Class 1	Class 2
X1	Positive	Joy
X2	Negative	Sad
X3	Neutral	Kind
X4	Positive	Happy

Multi- Class

	X	Class
	X1	TV Show
	X2	Movie
	X3	TV Show
	X4	Movie
	X5	Unknown

Multi-Label

X	Action	Romance	Crime
X1	1	0	0
X2	0	0	1
X3	1	0	1

Multi-Output Multiclass

X	Class 1	Rating
X1	TV Show	PG
X2	Movie	TV-14
X3	TV Show	PG-13

```
[1]: # Load EDA Pkgs
     import pandas as pd
     import numpy as np
```

```
[2]: # Load Data Viz Pkgs
     import seaborn as sns
     import matplotlib.pyplot as plt
```

```
[3]: # Load ML Pkgs
     from sklearn.linear_model import LogisticRegression
     from sklearn.tree import DecisionTreeClassifier
     from sklearn.neighbors import KNeighborsClassifier
     from sklearn.naive_bayes import MultinomialNB

     # Transformers
     from sklearn.feature_extraction.text import CountVectorizer,TfidfVectorizer
     # Others
     from sklearn.model_selection import train_test_split
     from sklearn.pipeline import Pipeline
     from sklearn.metrics import␣
      ↪accuracy_score,classification_report,confusion_matrix,plot_confusion_matrix
```

```
[8]: # Load Dataset
     df = pd.read_csv("data/netflix_titles_dataset.csv")
```

```
[9]: df.head()
```

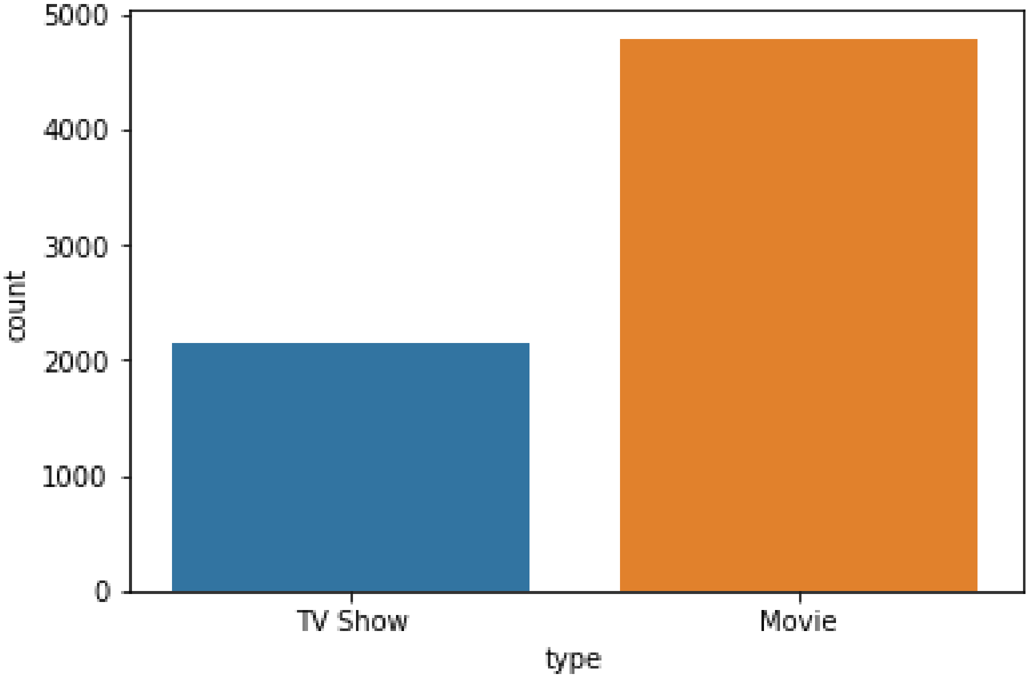
```
[9]:    Unnamed: 0  title                                         description  \
     0           0     3%  In a future where the elite inhabit an island …
     1           1   7:19  After a devastating earthquake hits Mexico Cit…
     2           2  23:59  When an army recruit is found dead, his fellow…
     3           3      9  In a postapocalyptic world, rag-doll robots hi…
     4           4     21  A brilliant group of students become card-coun…

           type rating
     0  TV Show  TV-MA
     1    Movie  TV-MA
     2    Movie      R
     3    Movie  PG-13
     4    Movie  PG-13
```

```
[10]: # Class 1/Target 1/Output 1 Distribution
      df['type'].value_counts()
```

```
[10]: Movie      4788
      TV Show    2143
      Name: type, dtype: int64
```

[11]:
```
sns.countplot(x='type',data=df)
```

[11]:
```
<AxesSubplot:xlabel='type', ylabel='count'>
```

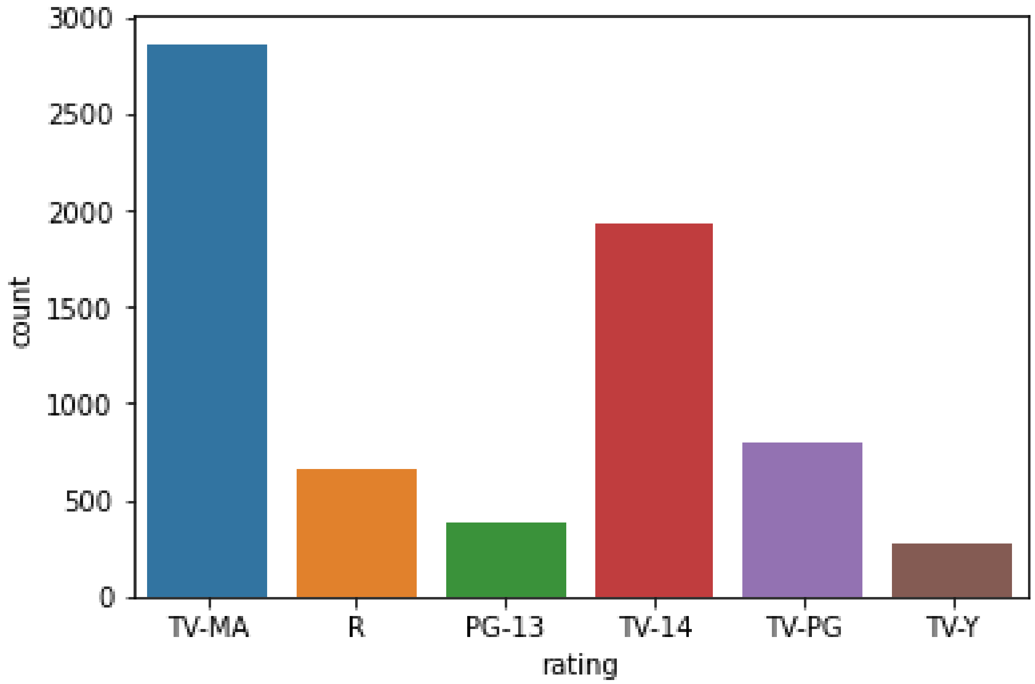


[12]:
```
# Class 2/Target 2/Output 2 Distribution
df['rating'].value_counts()
```

[12]:
```
TV-MA    2863
TV-14    1931
TV-PG     806
R         665
PG-13     386
TV-Y      280
Name: rating, dtype: int64
```

[13]:
```
sns.countplot(x='rating',data=df)
```

[13]:
```
<AxesSubplot:xlabel='rating', ylabel='count'>
```



```
[14]: # Load Pkgs
      from sklearn.multioutput import MultiOutputClassifier
```

```
[16]: # Text Cleaning
      import neattext.functions as nfx
```

```
[19]: df['title'] = df['title'].str.lower()
```

```
[20]: df.head()
```

```
[20]:    Unnamed: 0  title                                          description  \
      0           0     3%  In a future where the elite inhabit an island …
      1           1   7:19  After a devastating earthquake hits Mexico Cit…
      2           2  23:59  When an army recruit is found dead, his fellow…
      3           3      9  In a postapocalyptic world, rag-doll robots hi…
      4           4     21  A brilliant group of students become card-coun…

            type rating
      0  TV Show  TV-MA
      1    Movie  TV-MA
      2    Movie      R
      3    Movie  PG-13
      4    Movie  PG-13
```

[23]:
```
# Features & Labels
Xfeatures = df['title']
ylabels = df[['type','rating']]
```

[24]:
```
# Split Data
x_train,x_test,y_train,y_test = train_test_split(Xfeatures,ylabels,test_size=0.
 ↪3,random_state=7)
```

0.0.3 Build A Pipeline for our Model

[25]:
```
pipe_lr = Pipeline(steps=[('cv',CountVectorizer()),
                                         ␣
 ↪('lr_multi',MultiOutputClassifier(LogisticRegression()))])
```

[26]:
```
# Fit on Dataset
pipe_lr.fit(x_train,y_train)
```

```
/usr/local/lib/python3.9/dist-packages/sklearn/linear_model/_logistic.py:763:
ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-
regression
  n_iter_i = _check_optimize_result(
```

[26]:
```
Pipeline(steps=[('cv', CountVectorizer()),
                ('lr_multi',
                 MultiOutputClassifier(estimator=LogisticRegression()))])
```

[27]:
```
# Accuracy Score
pipe_lr.score(x_test,y_test)
```

[27]:
```
0.2639423076923077
```

[30]:
```
# Sample Prediction
print(x_test.iloc[0])
print("Actual Prediction:",y_test.iloc[0])
```

```
the midnight sky
Actual Prediction: type      Movie
rating    PG-13
Name: 5917, dtype: object
```

[31]:
```
ex1 = x_test.iloc[0]
```

[32]:
```
ex1
```

[32]:
```
'the midnight sky'
```

[33]:
```
pipe_lr.predict([ex1])
```

[33]:
```
array([['Movie', 'TV-MA']], dtype=object)
```

[35]:
```
# Prediction Prob
print(pipe_lr.classes_)
pipe_lr.predict_proba([ex1])
```

```
[array(['Movie', 'TV Show'], dtype=object), array(['PG-13', 'R', 'TV-14', 'TV-
MA', 'TV-PG', 'TV-Y'], dtype=object)]
```

[35]:
```
[array([[0.74445483, 0.25554517]]),
 array([[0.12310188, 0.07038494, 0.21476461, 0.46916205, 0.10270243,
         0.01988409]])]
```

Using ML Estimators that support multi-output

- KNN
- RF
- DT

[36]:
```
pipe_knn =␣
 ↪Pipeline(steps=[('cv',CountVectorizer()),('knn',KNeighborsClassifier(n_neighbors=4))])
```

[37]:
```
pipe_knn.fit(x_train,y_train)
```

[37]:
```
Pipeline(steps=[('cv', CountVectorizer()),
                ('knn', KNeighborsClassifier(n_neighbors=4))])
```

[38]:
```
pipe_knn.predict([ex1])
```

[38]:
```
array([['Movie', 'TV-MA']], dtype=object)
```

Narrative

- Difficult to compute accuracy using .score()

[39]:
```
#### Thanks For Watching
#### Jesus Saves @JCharisTech
#### Jesse E.Agbe(JCharis)
```

[ ]:
```

```