Text Analysis: Identifying Comedy Movies

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OUTLINE

1.Abstract
In this group project, we analysed text descriptions of movies and developed a predictive model that can predict whether or not a movie is a comedy. The descriptions/story were used to create textual features of the movie descriptions/story and multiple models were created in order to find the best performing model.

2.Introduction
There is nothing more frustrating than not finding the right movie to watch. Understanding movie descriptions/story could give an insight of the type of genre the movie is. It can be a comedy, romance, horror or another type of film. Sorting through movies by their genre would make it easier for movie viewers to find the movie they want to watch. The goal of this group project is to predict whether or not a movie is a comedy based on the movie description/story.

3.Data
The data used for this group project was provided by Dr. Mahyar S Vanghefi. This data consisted of 3 csv files found below: movie_story_student_file.csv, movie_story_evaluation_file.csv and movies.csv.

```
**movie_story_evaluation_file.csv**
      movie_id                                              story
0       122349  Growing up in the Mission district of San Fran...
1       122351  A soldier returns home from the Iraq war only ...
2       122361  Marco the Monkey works as a beach officer. But...
3       187901  When an honest cop, Vijay Kumar\'s family is r...
4       187903  Kathiresan aka Kaththi, a criminal, escapes fr...
...        ...                                                ...
3493    131062  In the middle of nowhere, 20 years after an ap...
3494    131064  After living for years as a struggling artist ...
3495    131066  Ronal is a young barbarian with low self-estee...
3496    131068  Ziege, H\xc3\xa4schen and Max have now moved t...
3497    131070  During their childhood, Hanna and Clarissa wer...

[3498 rows x 2 columns]

**movie_story_student_file.csvv**
       movie_id                                              story
0        131072  A girl who always tends to fall in love with t...
1        196609  Bigfoot has come to the town of Ellwood City, ...
2        131074  At an altitude of 18,000 feet, Alaska\'s Mount...
3        196611  In her first special since 2003, Ellen revisit...
4        196613  Mike and Sulley are back at Monsters Universit...
...         ...                                                ...
19995     56801  The iconic creatures from two of the scariest ...
19996    122337  When a bored-with-life English teacher meets a...
19997    187875  Herbert Blount is a crowdfunding contributor f...
19998    187873  REAL BOY is the coming-of-age story of Bennett...
19999     56805  Following a childhood tragedy, Dewey Cox follo...

[20000 rows x 2 columns]

**movies.csv**
       movieId                                 title  \
0        27509                       Carolina (2005)
1        27618             Sound of Thunder, A (2005)
2        27788                    Jacket, The (2005)
3        27821               Interpreter, The (2005)
4        27839                  Ring Two, The (2005)
...        ...                                   ...
23493   209051  Jeff Garlin: Our Man in Chicago (2019)
23494   209085             The Mistletoe Secret (2019)
23495   209133           The Riot and the Dance (2018)
23496   209157                             We (2018)
23497   209163                      Bad Poems (2018)

                                    genres
0                           Comedy|Romance
1       Action|Adventure|Drama|Sci-Fi|Thriller
2                Drama|Mystery|Sci-Fi|Thriller
3                           Drama|Thriller
4                Drama|Horror|Mystery|Thriller
...                                    ...
23493                   (no genres listed)
23494                              Romance
23495                   (no genres listed)
23496                                Drama
23497                         Comedy|Drama

[23498 rows x 3 columns]
```

The movies.csv dataset was used to create a new column to contain the target feature (genres) for movie_story_student_file.csv and movie_story_evaluation.csv.This was done by joining the data on movieid/movie_id. Next, this new column was turned into a binary format and identified 1 for comedy and 0 for non-comedy. The final dataset for movie_story_student_file.csv and movie_story_evaluation.csv are shown below:

- Movie_story_student_file.csv

	movieId	story	genres
0	131072	A girl who always tends to fall in love with t...	1
1	196609	Bigfoot has come to the town of Ellwood City, ...	1
2	131074	At an altitude of 18,000 feet, Alaska\'s Mount...	0
3	196611	In her first special since 2003, Ellen revisit...	1
4	196613	Mike and Sulley are back at Monsters Universit...	1
...	...	...	...
18881	56801	The iconic creatures from two of the scariest ...	0
18882	122337	When a bored-with-life English teacher meets a...	0
18883	187875	Herbert Blount is a crowdfunding contributor f...	0
18884	187873	REAL BOY is the coming-of-age story of Bennett...	0
18885	56805	Following a childhood tragedy, Dewey Cox follo...	1

18886 rows × 3 columns

- Movie_story_evaluation.csv

	movie_id	story	genres	ComedyGenre2
0	122349	Growing up in the Mission district of San Fran...	Drama	0
1	122351	A soldier returns home from the Iraq war only ...	Horror|Thriller	0
2	122361	Marco the Monkey works as a beach officer. But...	Animation|Children|Comedy	1
3	187901	When an honest cop, Vijay Kumar\'s family is r...	Action|Romance	0
4	187903	Kathiresan aka Kaththi, a criminal, escapes fr...	Action|Drama|Romance	0
...	...	...	...	...
3493	131062	In the middle of nowhere, 20 years after an ap...	Drama|Fantasy|Sci-Fi	0
3494	131064	After living for years as a struggling artist ...	Comedy	1
3495	131066	Ronal is a young barbarian with low self-estee...	Adventure|Animation|Fantasy	0
3496	131068	Ziege, H\xc3\xa4schen and Max have now moved t...	Comedy	1
3497	131070	During their childhood, Hanna and Clarissa wer...	Drama|Mystery|Thriller	0

3498 rows × 4 columns

Later in the modeling, Movie_story_student_file.csv is used to train models and find the best performing model and Movie_story_evaluation.csv is used to test the best performing model created with Movie_story_student_file.csv.

In order to turn the unstructured data into structured, word embedding was used. We decided to take this approach because we noticed we had over 100,000 features when we used the count vectorizer method from sklearn. Also, Word embedding seems to be a better approach with dealing with high dimensional data. Regarding word embedding, GLoVe 300d was used as our pre trained word embedding method.

4.The Model

We chose to use logistic regression, decision tree, random forest and Stochastic Gradient Descent for binary classification of comedy movies. The data was split 70% training and 30% test using train_test_split from sklearn.

4.1 Logistic regression

As stated earlier, we used word embedding and GLoVe 300d was used as our pre trained word embedding method to reduce the dimension to 300 features. This modeling approach implements probability of a document belonging to 1 or 0.

$$y = \frac{1}{1+e^{-z}}, z = \beta_0 + \beta_0 X_1 + \beta_2 X_2 + \ldots + \beta_m X_m$$

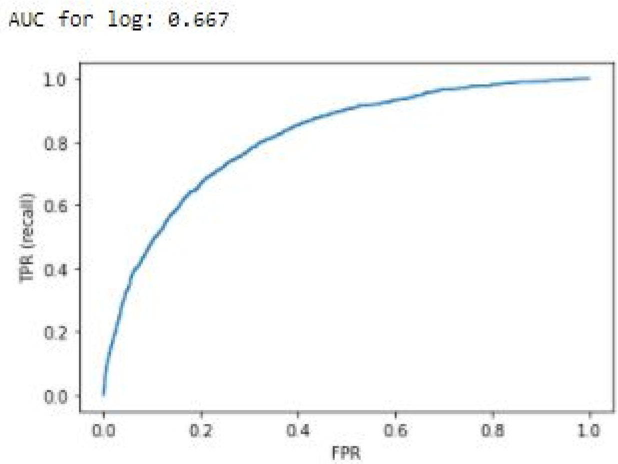
$$prob(y^{(i)} = 1 | X^{(i)}) = \frac{1}{1+e^{-z^{(i)}}}, z^{(i)} = \beta_0 + \beta_0 X_1^{(i)} + \beta_2 X_2^{(i)} + \ldots + \beta_m X_m^{(i)}$$

GridsearchCV was used for cross validation to find the best λ and 'C' value to find the best inverse of regularization strength for our logistic regression model.

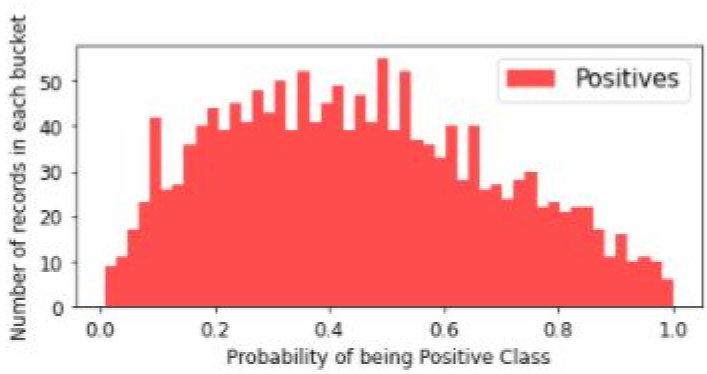
C:[1, 0.75, 0.65, 0.5, 0.25, 0.1]
Best 'C' was 1
In sample accuracy: 79.485
Out of sample accuracy: 79.1666

```
Confusion Matrix:
[[4110  310]
 [ 940  640]]
Classification Report:
              precision    recall  f1-score   support

           0       0.81      0.93      0.87      4420
           1       0.67      0.41      0.51      1580

    accuracy                           0.79      6000
   macro avg       0.74      0.67      0.69      6000
weighted avg       0.78      0.79      0.77      6000
```

This model predicted more non comedy cases correctly than correct comedy cases. Also, it produced less type 1 errors than type 2 errors. Also, we will compare precision and recall with the next model later.



Looking at the AUC curve above, we can see how accurate it predicts 1 as 1 and 0 as 0.This auc is not very pleasing.



The above graph displays the probability of a document as a comedy. Probabilities that were greater than 0.5 will result as comedy and anything less, will result as a non comedy. The distribution is good.

4.2 K-Nearest Neighbours

We have used GridSerch method to determine the best number of neighbours for our model. And It turns out to be 19 in our case.

N_neighbors: range(1 to 20]

N_splits: 5

```
Best Parameter: {'n_neighbors': 19}
Best Cross Vlidation Score: 0.7641428571428571
```

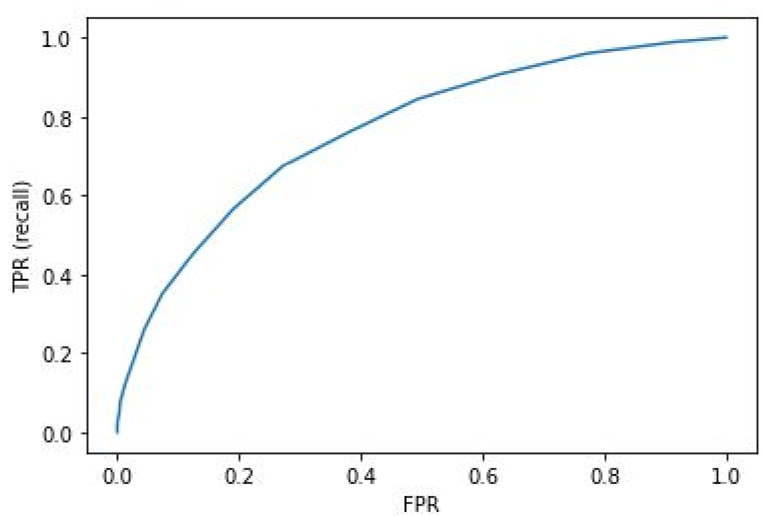
The in-sample accuracy is 78.97857142857143

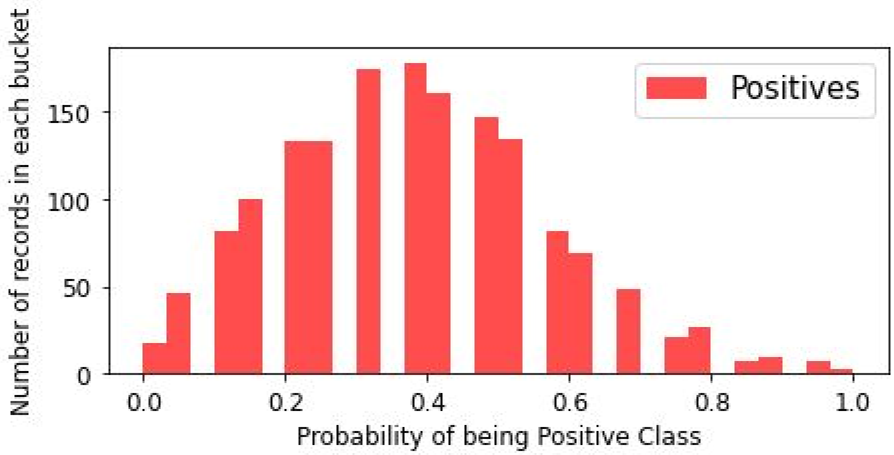
The out-of-sample accuracy is 77.23333333333333

```
Confusion Matrix
[[4226  194]
 [1172  408]]
Classification Report
              precision    recall  f1-score   support

           0       0.78      0.96      0.86      4420
           1       0.68      0.26      0.37      1580

    accuracy                           0.77      6000
   macro avg       0.73      0.61      0.62      6000
weighted avg       0.76      0.77      0.73      6000
```

This model's accuracy is lower to logistic regression, where the variance is low and the bias is reasonable; so, logistic regression is performing better than this model.

```
AUC for log: 0.607
```





4.3 Stochastic Gradient Descent

We decided to use a classic model from text classification and natural language. This model handles sparse data very well.

```
Confusion Matrix
[[4325   95]
 [1277  303]]
Classification Report
              precision    recall  f1-score   support

           0       0.77      0.98      0.86      4420
           1       0.76      0.19      0.31      1580

    accuracy                           0.77      6000
   macro avg       0.77      0.59      0.58      6000
weighted avg       0.77      0.77      0.72      6000
```

In sample accuracy: 77.4
Out of sample accuracy: 77.1

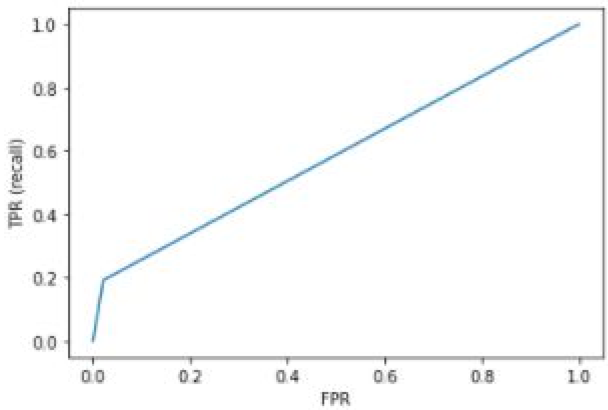
This model's accuracy is similar to logistic regression, where the variance is low and the bias is reasonable; but, logistic regression is still performing better than this model. Although this model does not commit as many type 1 error as the logistic regression, it lacks the accuracy when a comedy is a comedy and it predicted it as a comedy correctly.

Looking at the recall here, it is fairly low.
Recall is calculated using the formula below:

$$Recall = TruePositives / (TruePositives + FalseNegatives)$$

Here, we can assume this model is producing too many false negatives and it is causing the recall to drop. Unlike, the logistic model.

AUC for log: 0.667



Looking at the AUC curve above, we can see how accurate it predicts 1 as 1 and 0 as 0.This auc is not very pleasing.

4.4 Decision Tree

Using sklearn, we developed a decision tree model. This model used the gini index for node purity.

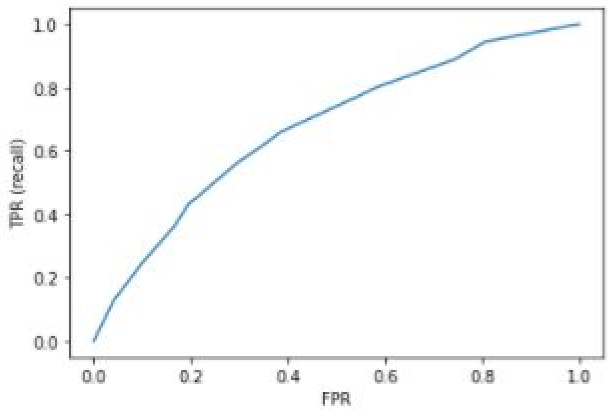
$$G(k) = \sum_{i=1}^{m} p(i) \times (1 - p(i))$$

Using decision trees was not better than logistic regression. This model was able to classify comedy movies 74% correct. It is predicting more non comedy movies when they were a comedy than logistic regression was.

```
Confusion Matrix
[[4229  191]
 [1368  212]]
Classification report
              precision    recall  f1-score   support

           0       0.76      0.96      0.84      4420
           1       0.53      0.13      0.21      1580

    accuracy                           0.74      6000
   macro avg       0.64      0.55      0.53      6000
weighted avg       0.70      0.74      0.68      6000
```

In sample accuracy: 74.914
Out of sample accuracy: 74.016

```
AUC for log: 0.545
```



Looking at the AUC curve above, we can see how accurate it predicts 1 as 1 and 0 as 0.This auc is not very pleasing.

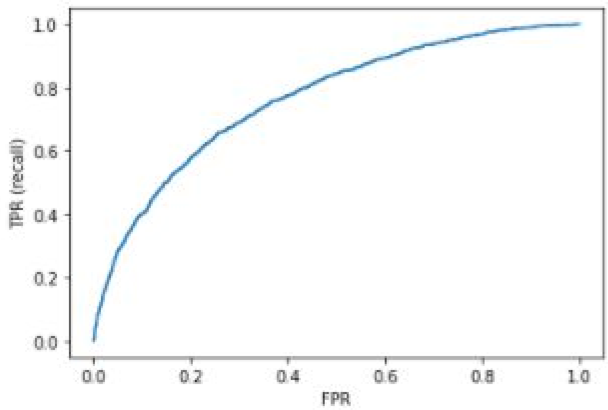
4.5 Random Forest

Naturally, Decision tree models suffer from overfitting. In order to avoid this, we decided on a random forest model next.

```
Confusion Matrix
[[4336   84]
 [1356  224]]
Classification report
              precision    recall  f1-score   support

           0       0.76      0.98      0.86      4420
           1       0.73      0.14      0.24      1580

    accuracy                           0.76      6000
   macro avg       0.74      0.56      0.55      6000
weighted avg       0.75      0.76      0.69      6000
```

Here, we can see a similar confusion matrix like Stochastic Gradient Descent, where it is producing a lot of type 2 errors. This is something that the logistic model does not do. Also, we can see that the recall is also suffering. This is similar to Stochastic Gradient Descent

AUC for log: 0.561



Looking at the AUC curve above, we can see how accurate it predicts 1 as 1 and 0 as 0. This auc is not very pleasing.

In sample accuracy: 99.5
Out of sample accuracy: 76.0

This model has very high variance compared to the bias. The in sample is almost 100% and one could possibly assume that this model is suffering from overfitting if more analysis is done with this model.

5. Conclusion

The goal of this group project was to predict whether or not a movie is a comedy based on the movie description/story. And, to use the movie_story_student_file.csv dataset to train different models in order to find the best model for classifying comedy movies; and then using the Movie_story_evaluation.csv data set to further test our best model.

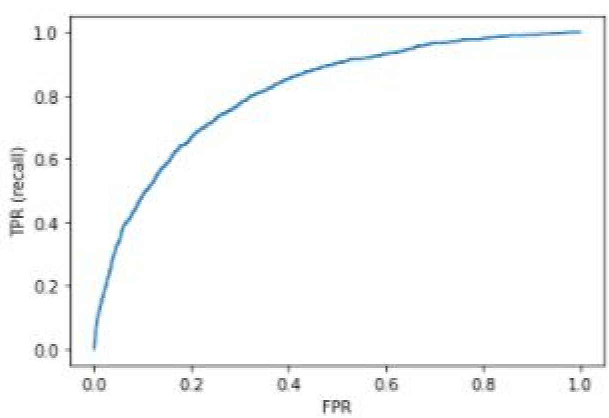
Logistic regression performed the best out of all of the models we trained. At first, we were worried that our initial logistic regression model was suffering from underfitting. This was because we found our accuracy to have a large amount of bias and very low variance but after using this new data set, the accuracy came very close to what it previously was predicting and no issues were found.

```
Confusion Matrix
[[2445  178]
 [ 530  345]]
Classification report
              precision    recall  f1-score   support

           0       0.82      0.93      0.87      2623
           1       0.66      0.39      0.49       875

    accuracy                           0.80      3498
   macro avg       0.74      0.66      0.68      3498
weighted avg       0.78      0.80      0.78      3498
```

This model performed the when in terms of the confusion matrix, precision, recal and even f1-score. By looking at the concussion matrix, it did fairly okay and avoided too many type 1 and type 2 error compared to the rest of the models.

Evaluation data accuracy: 79.759

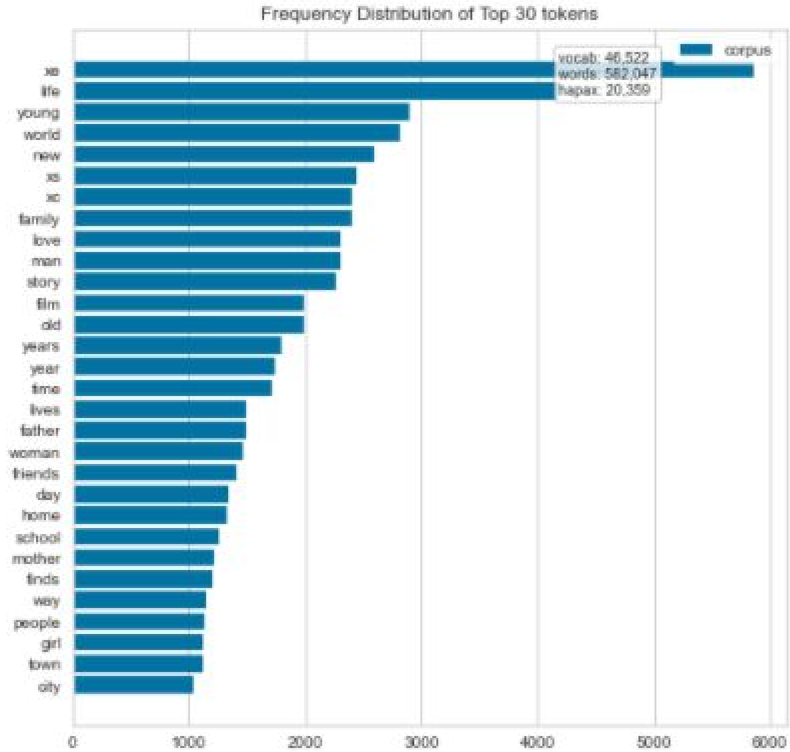
AUC for log: 0.663



Also, as we saw from the rest of the models, the auc is fairly low and not very pleasing.

6. Appendix

6.1 Frequency Distribution of the Top 30 Tokens



Using data from the Movie_story_student_file.csv data set before splitting, here is the frequency distribution of the top 30 tokens.