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1. Data Exploration:

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- | Score | Frequency |
|-------|-----------|
| 5.0 | ~750,000 |
| 4.0 | ~320,000 |
| 3.0 | ~170,000 |
| 1.0 | ~90,000 |
| 2.0 | ~90,000 |

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- ## 2. Feature Extraction:

1. Based on the dataset analysis 'Text' is the only column used to predict 'Score', 'Text' is a string(review), preprocessing is to remove the noise in the string.
2. The preprocessing steps:

- a. Removal of punctuation marks
- b. Converting all the string to lower case, because the lower case and upper case words would be interpreted differently.
- c. Removed stop words, experiments included two stop lists as follows.
 - i. **Stop 1:** ['no', 'nor', 'not', 'ain', 'aren', "aren't", 'couldn', 'what', 'which', 'who', 'whom', 'why', 'how', "couldn't", 'didn', "didn't", 'doesn', "doesn't", 'hadn', "hadn't", 'hasn', "hasn't", 'haven', "haven't", 'isn', "isn't", 'ma', 'mightn', "mightn't", 'mustn' "mustn't", 'needn', "needn't", 'shan', "shan't", 'shouldn', "shouldn't", 'wasn', "wasn't", 'weren', "weren't", 'won', "won't", 'wouldn', "wouldn't", 'don', "don't"]
 - ii. **Stop 2:** ['a', 'an', 'the', 'and', 'this', 'that']
3. TF-IDF Vectoriser from sklearn library was used to convert the string to a matrix of TF-IDF features.

3. Dataset:

1. Training Data had x rows and Test data had 300000 rows, test data does not have scores, so for **local validation**, Training Data was split into train and test datasets.
2. Performance on the local test set will give us a sense of how the model will perform on the unknown data
3. After preprocessing I saved the preprocessed results to a CSV file so that I don't have to repeat the process if the kernel resets or if the Kaggle notebook times out.
4. Since Random forest is very memory intensive, I need to subsample the dataset for a few experiments, I created a subsample ensuring there is an equal number of samples in all classes to **avoid data imbalance**.

4. Models, Hyperparameter and Training:

1. Models that were mainly used in the experiment were Support Vector Machine and Random Forest.
 - a. Why SVM?: SVM is very effective in high dimensional space, it also used a subset of training points in the decision function, so it is memory efficient. Since we have a very large training dataset, SVM seemed the most memory-efficient option.
 - b. Why Random Forest?: is a very good classification model and wanted to experiment with that.
2. To optimise the model's hyperparameters I experimented a bit with GridSearch, but since the dataset is a too large portion of it was used but I ended up using hyperparameters based on intuition.

3. While training the model I used Sklearn's **Pipeline** function. Since the dataset is large fitting TF-IDF is very time-consuming before training a model every single time, using Pipeline makes to process much faster and streamlines it.
4. Saved model as a pickle file to use whenever needed.

5. Experiments:

My best model was an ensemble of predictions of 6 models: 3 SVM and 3 Random forest model.

1. SVM:

- a. Experiment 1: Removed the stop words from the stop 2 list (2.2.c) and processed the string using TF-IDF. Training on the split and achieved a decent accuracy so trained it on the entire training dataset.
- b. Experiment 2: Removed the stop words from the stop 1 list (2.2.c) and processed the string using TF-IDF.
- c. Experiment 2: Removed the stop words from the stop 2 list and processed the string using first using Vector counter and then transformed it using TF-IDF.

All three experiments gave descent results and yielded RMSE close to 0.98.

2. Random Forest: Random forest was very memory intensive so had to use a sample dataset (3.4)

- a. Experiment 1: Removed the stop words from the stop 2 list (2.2.c) and processed the string using TF-IDF. Trained the model on the split training data (40,000 rows).
- b. Experiment 2: Removed the stop words from the stop 2 list (2.2.c) and processed the string using TF-IDF. Trained the model on the split training data (50,000 rows).
- c. Experiment 2: Removed the stop words from the stop 2 list (2.2.c) and processed the string using TF-IDF. Trained the model on the entire dataset by tuning the hyperparameter (Max Depth =2)

All the experiments gave very poor results and yielded RMSE close to 1.4.

Ensemble: At first I did not want to use Randomforest results and just created an ensemble (Mean prediction) of the SVM results and it improved the accuracy, But while experimenting a bit with creating an ensemble of all 6 experiments with weighted voting method my accuracy improved. Giving the SVM models higher weightage and Random Forest models low weightage based on their performance in the test set.

$$0.25*svm_1+0.2*svm_2+0.25*svm_3+0.1*rf_1+0.1*rf_2+0.1*rf_3$$