ECS 111 Homework Assignment #3

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1 Introduction

A logistic regression model and Multi Layer Peceptron(MLP) were used to predict a movie watchers rating of a movie. The dataset contained the user's ID, rating, and timestamp, as well as the movie's ID, title, release date, and genres. The algorithms stated above were able to achieve roughly a 40% accuracy of guessing the rating, resulting in a RMSE value of roughly 1.1.

2 Data Processing

After the data was loaded in and the movie and user data was matched together, the data was split into a training and testing set, with 80% of the data being used for training and 20% being used for testing. Values which could be normalized were, and genres and other categorical data were one-hot encoded, with each genre being represented by a binary value. Additionally, the data had its dimensionality reduced using Singular Value Decomposition (SVD) to reduce the number of features and compare the performance of the model with and without SVD.

3 Results

The logistic regression model was fairly consistent, with hyperparameter tuning not changing the results significantly. The model was able to achieve a 1.045 RMSE on the training set, 1.139 RMSE on the validation set, and 1.123 RMSE on the test set. Results are shown in Table 1.

The Multi Layer Perceptron (MLP) model had 3 fully connected layers with ReLU activation functions in between. There were 500 neurons in each layer, although results were very similar when testing with both 100 and 1000 neurons. Cross entropy loss was used with the ADAM optimizer. The MLP model was more sensitive to hyperparameter tuning, with changes in training time vastly decreasing the validation accuracy. A plot of the validation accuracy vs. training time is shown in Figure 1.

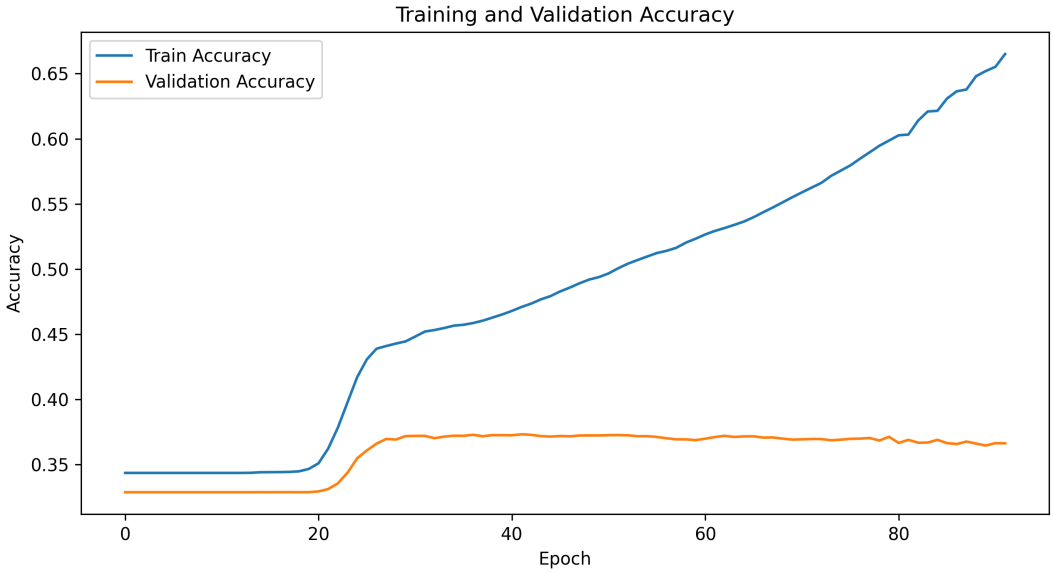

Figure 1: Validation Accuracy vs Number of Epochs for MLP Model

As shown above, there was severe overfitting with large numbers of epochs. To combat this, the model parameters were saved after each epoch, and the model with the highest validation accuracy was used for testing. The model achieved RMSEs of 0.788 for the training data, 1.17 for the validation data, and 1.094 for the test data. Results are shown in Table 1.

Lastly, the algorithms were run with SVD, which reduced the number of features from 2668 to 991. This was chosen as it captured 95% of the variance in the data. A plot of the variance explained by each SVD component is shown in Figure 2.

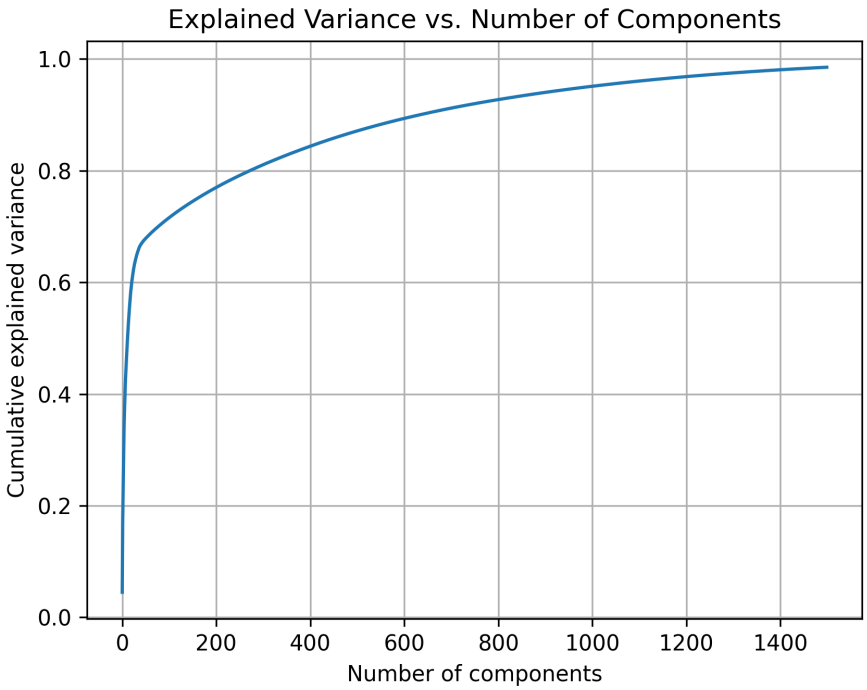

Figure 2: Variance Explained by Each SVD Component

Both the logistic regression and MLP models were able to achieve similar results to the models without SVD, although they were slightly worse. Results for all models are shown in Table 1.

Table 1: Results of Logistic Regression and MLP Models

Model	SVD	Train Acc	Val Acc	Test Acc	Train RMSE	Val RMSE	Test RMSE
Logistic Regression	No	0.487	0.37	0.415	1.045	1.139	1.123
MLP	No	0.471	0.373	0.416	0.788	1.17	1.094
Logistic Regression	Yes	0.456	0.361	0.399	1.09	1.151	1.141
MLP	Yes	0.478	0.368	0.403	0.736	1.21	1.118

The MLP model was able to achieve the best results, with a test RMSE of 1.094, therefore this is the final model that is being chosen.

4 Discussion

As in many machine learning tasks, data sparsity was a major issue contributing to the complexity of the problem. The dataset contained a large number of users and movies, but most users only rated a small number of movies, and most movies were rated by a small number of users. This resulted in a sparse dataset, which increased the dimensionalty of

the input, even though the inherent dimensionality of the problem was much lower. This can be seen in the number of features, which was 2668 before SVD and 991 after SVD. The models were able to achieve similar results with and without SVD, showing that the input data after passing through SVD did in fact represent the original data well. Since computationally complexity of many common algorithms scales poorly with the number of features, the sparsity can drastically increase the time it takes to train a model for real world applications.