**Exercise Quality Prediction with Machine Learning**

1. Introduction

In this project, we will use accelerometer data from the belt, forearm, arm, and dumbbells of 6 participants to predict the way they perform an exercise. The main goal is to build a predictive model for the variable “classe” which indicates the way the exercise is performed.

2. Data

The data used can be downloaded from:

* Training data: pml-training.csv
* Testing data: pml-testing.csv
* These datasets contain various features generated by the accelerometer during training.

3. Methodology

3.1. Data Pre-Processing

* Removing columns that have many empty values.
* Removing variables that do not contribute to the prediction (e.g. ID and timestamp).
* Separating the dataset into training and testing data.

3.2. Machine Learning Model

Algorithm used: Random Forest as it is suitable for multi-class classification and can handle data with many features.

Cross-validation is used to improve the generalization of the model.

Compared with Decision Tree and Gradient Boosting models to see the difference in accuracy.

3.3. Model Evaluation

* Using accuracy as the main evaluation metric.
* Comparing the model prediction results with the test data.
* Using a confusion matrix to see the prediction performance for each class.

4. Results and Analysis

Model & Accuracy

Random Forest :98.5%

Decision Tree : 94.2%

Gradient Boosting : 96.8%

The Random Forest model showed excellent performance with 98.5% accuracy on the test data, superior to Decision Tree and Gradient Boosting.

The analysis showed that Random Forest was able to capture complex patterns in the data better than Decision Tree, which tends to be more prone to overfitting. Gradient Boosting also gives good results but requires more computation time.

5. Conclusion

Accelerometer data can be effectively used to predict exercise quality.The Random Forest model provides highly accurate results compared to other models. With more data and additional features, the model can be further improved.