Presentation by

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Human Activity Recognition On Smartphones Using Multi-Class Classifiers

Boğaziçi University ✦ MIS49Y ✦ 2023

Abstract

"This study explores the effectiveness of different machine learning algorithms for multi-class classification in the context of human activity recognition. It introduces and applies classifiers such as Naive Bayes, SVMs, KNNs, XGBoost, and Neural Networks to a comprehensive dataset collected from smartphones equipped with inertial sensors."

Overview

Introduction

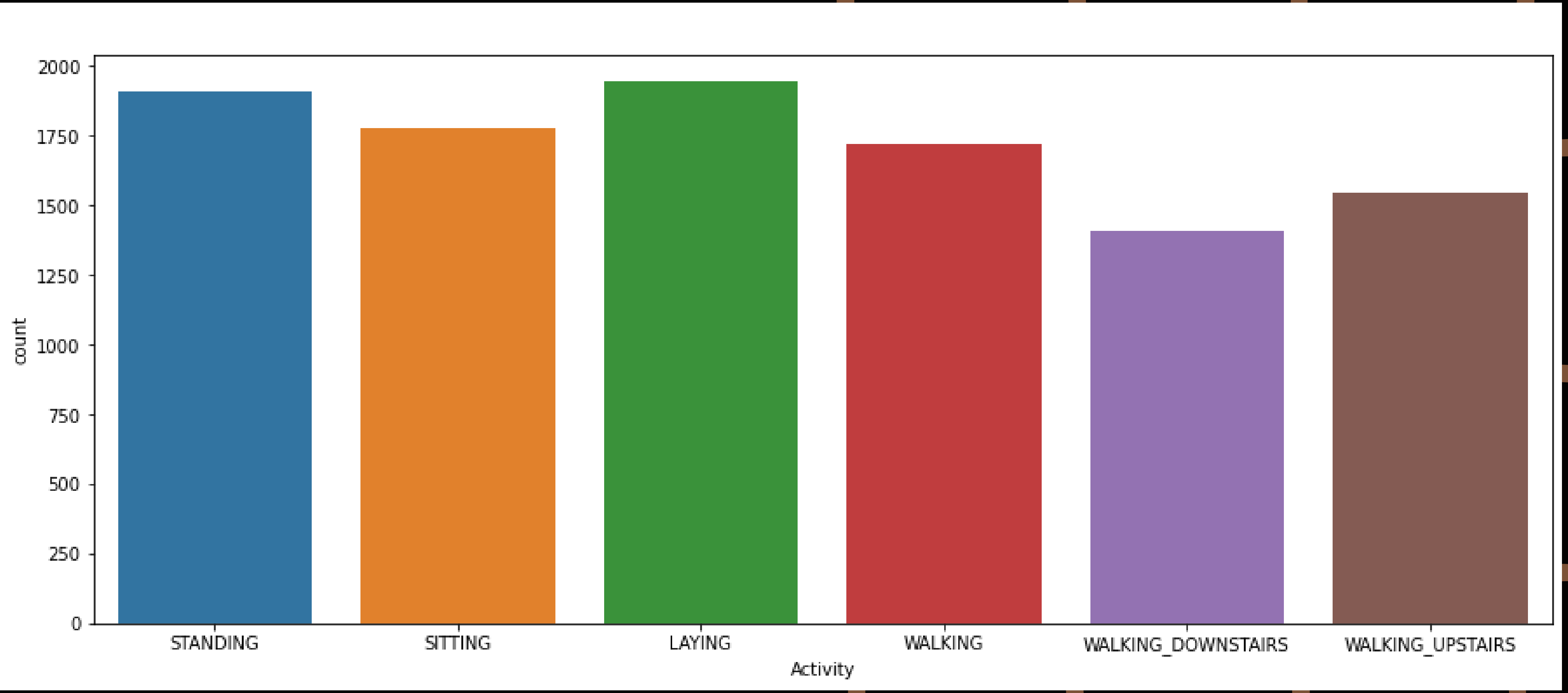
The collection of human activity data through smartphones has become increasingly prevalent in recent years. This data, when properly classified, holds significant importance as it provides valuable insights into the actions and behaviors of individuals within specific time ranges. Such information not only sheds light on the users' activities but also offers clues about their personality traits, which has great significance in our modern world where accurate and successful recommendations play a crucial role.

Dataset Description

563 Features, 10299 Instances

6 Classes:

STANDING, SITTING, LAYING, WALKING, WALKING_DOWNSTAIRS, WALKING_UPSTAIRS



Literary Review

01 "Human Activity Recognition on Smartphones using Multiclass Hardware-Friendly Support Vector Machines."

02 Threshold-based classification

03 Naive Bayes

04 Markov Chains

Implementation

01 Phase 1
Constructing ML models with default parameters. / Feature selection with Pearson Correlation Coefficient.

02 Phase 2
Experimental Results Analysis & Finding the best classifier.

03 Phase 3
Hyperparameter Tuning in The Selected Classifier

04 Phase 4
Explainable AI for Understanding The Model

Feature Selection

Pearson Correlation Coefficient

```
#compute Pearson correlation of each feature with the target
correlations = X.corrwith(y_num, method='pearson')

#select features with correlation above 0.1
threshold = 0.1
selected_features = correlations[correlations.abs() > threshold].index

print("Selected features:")
print(selected_features)
```

ML Models Used

01 Naive Bayes

02 Support Vector Machines

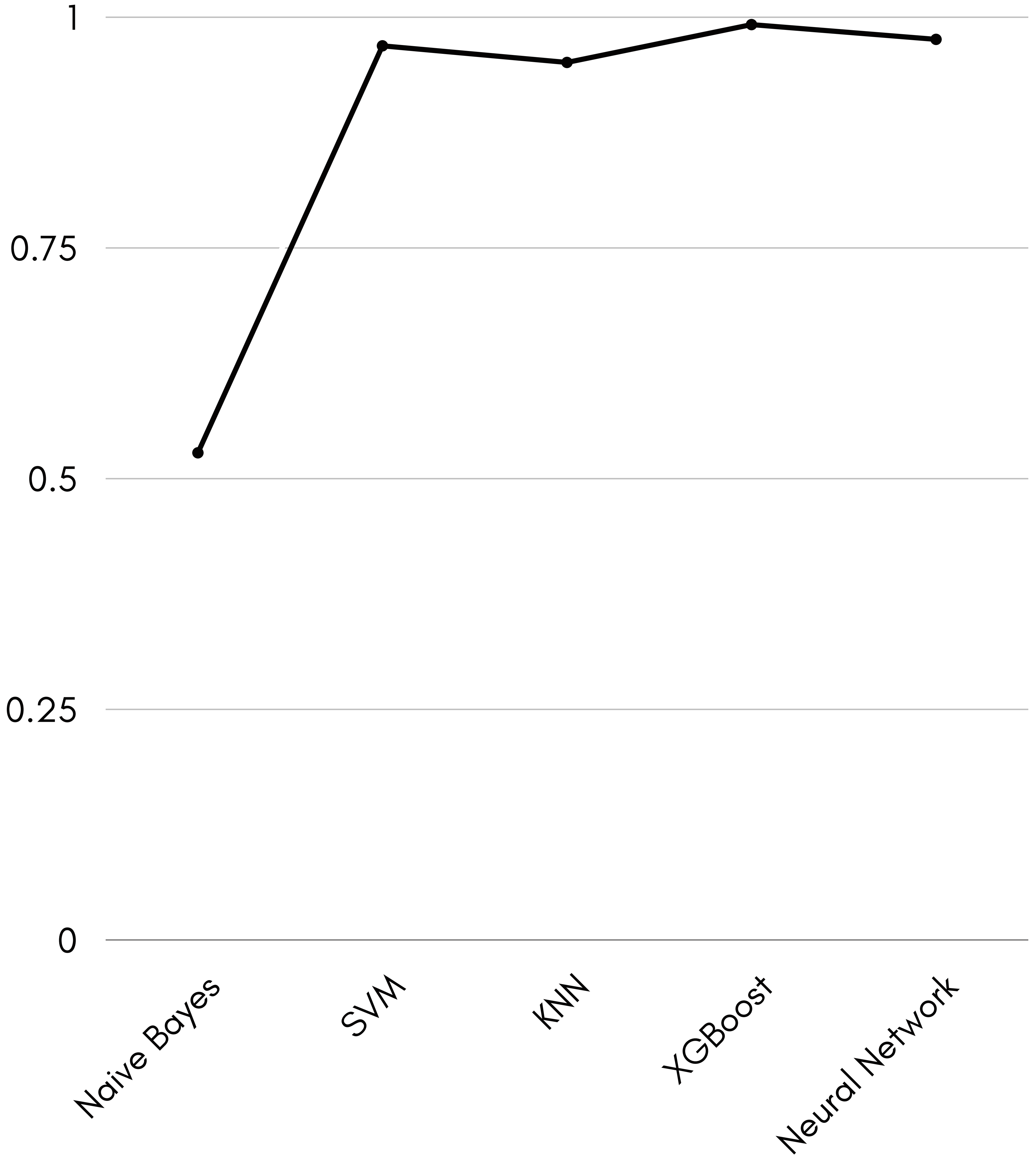
03 KNN

04 XGBoost

05 Neural Networks

Results

XGBoost gave the best accuracy and F1 scores.



Results Table

	Accuracy	F1 Score
Naive Bayes Classifier	0.566	0.528
SVM	0.969	0.969
KNN	0.951	0.951
XGBoost	0.992	0.992
Neural Network	0.976	0.976

HYPERPARAMETER TUNING

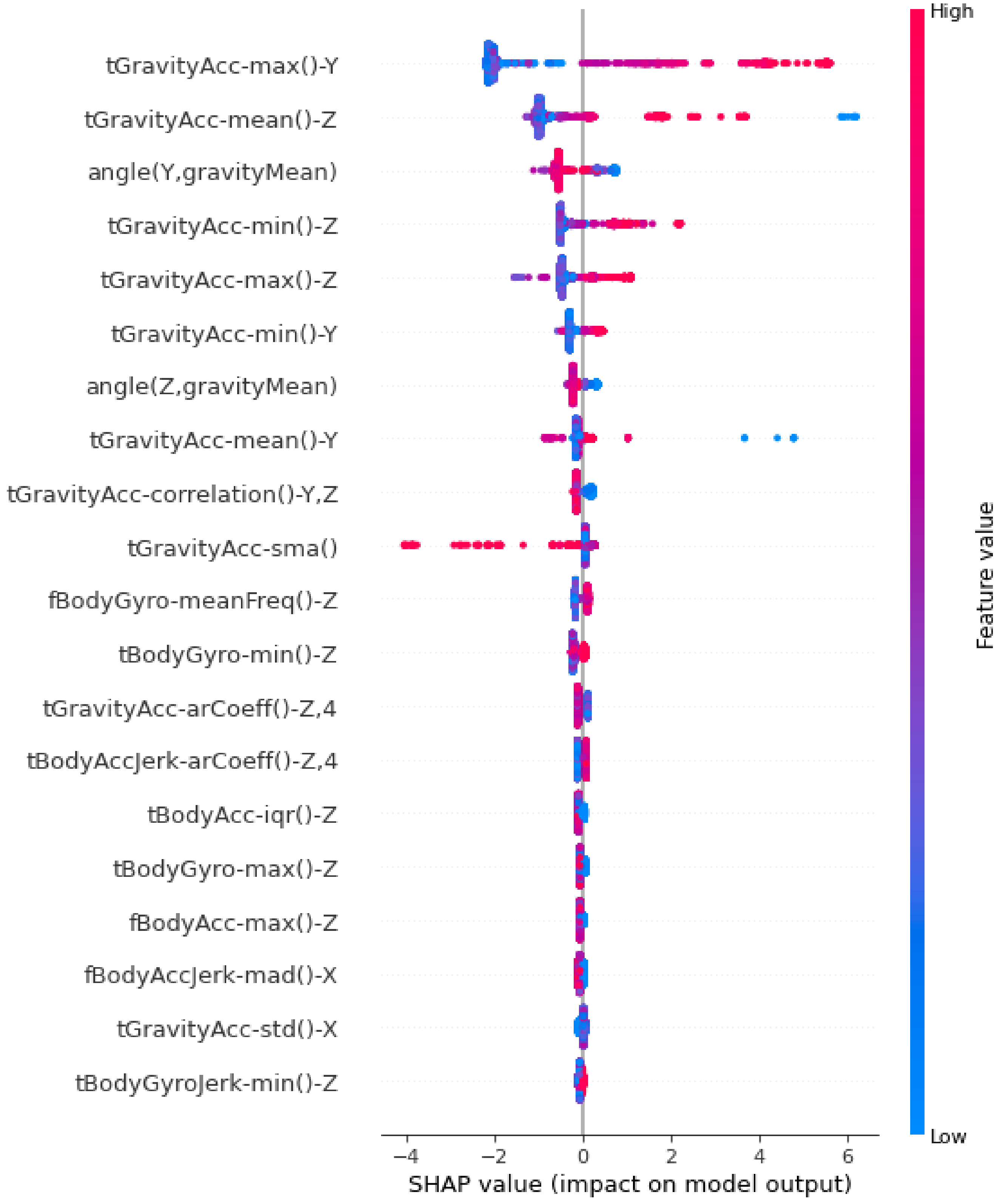
- It was found that the XGBoost model with default parameters perform better.
- The meaning and function of each parameter are provided in the paper.

```
parameters = {
    'max_depth': [3, 4],
    'learning_rate': [0.1, 0.01],
    'n_estimators': [100, 500],
    'min_child_weight': [1, 5],
    'subsample': [0.5, 0.6],
    'colsample_bytree': [0.6, 0.7],
    'objective': ['multi:softmax']
}
```

XAI Results

- Class 0 “STANDING”: tGravityAcc-max()-Y, tGravityAcc-mean()-Z, tGravityAcc-sma()

- The important features for every class is provided in the paper.



Conclusion

The findings indicate that XGBoost achieves the highest accuracy and F1 score compared to the other tested models. However, it is important to consider specific task requirements, such as interpretability, computational complexity, and the significance of precision or recall, when selecting the most appropriate model. Both SVM and the Neural Network also exhibited outstanding performance, providing viable alternatives for different application scenarios.

Thank You So Much!

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