Interpretable Human Activity Classification

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Problem

1. Classification for multivariate time-series data
2. Explainability of the results

Results overview

95.7% accuracy

for best performing model

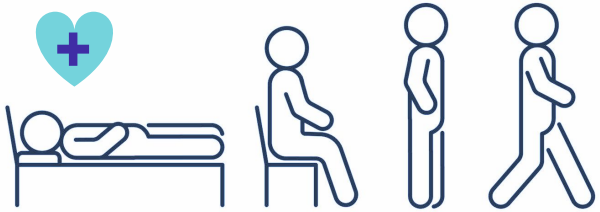
2 methods

were used to find the most important features

Dataset

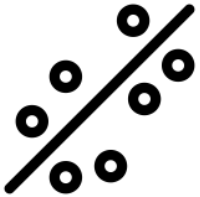
Human Activity Recognition Using Smartphones (UCI)

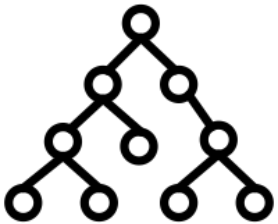
- 30 volunteers wearing smartphones accelerometers
  - performed six activities (walking, walking upstairs, walking downstairs, sitting, standing, laying)
- Signals from the accelerometer and gyroscope post aggregated

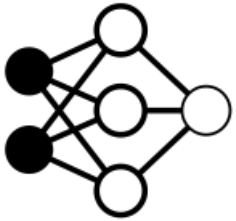


Models

- Linear models
  - SVM, Naive Bayes, Stochastic Gradient Descent Classifier
- Tree-based models
  - Decision Tree, Random Forest, XGBoost
- Neural Networks
  - LSTM







Evaluation

Metrics used

- Accuracy
- F1 score

Best performing models (accuracy ~93-96%)

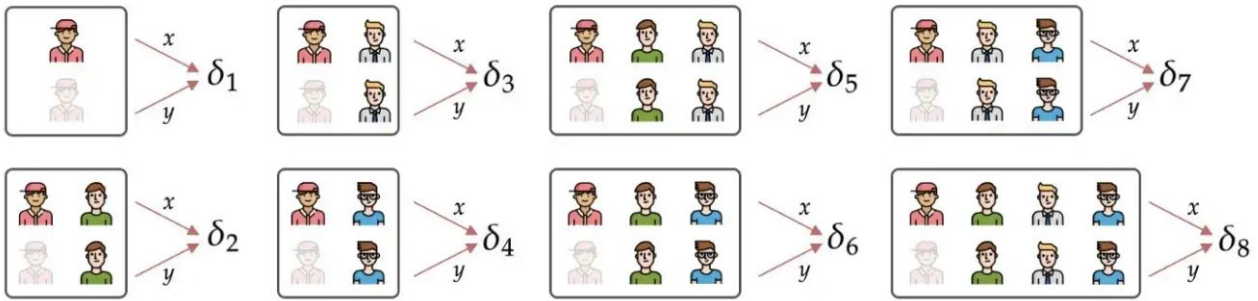
- Ridge Classifier
- XGBoost
- Stochastic Gradient Descent Classifier
- Linear SVM
- LSTM

Model	Accuracy	F1 Score
Ridge	95.69%	95.71%
XGBoost	93.96%	93.94%
SGD	94.23%	94.19%
Linear SVM	95.52%	95.51%
LSTM	89.75%	89.72%
Nearest Neighbors	89.07%	88.99%
Decision Tree	83.85%	83.66%
QDA	80.08%	79.44%
Naive Bayes	77.03%	76.88%
Random Forest	73.40%	72.12%

Interpretability

- Methods
  - Model coefficients
  - Shapley Values
- Results
- Experiment for validation

Interpretability: Shapley Values



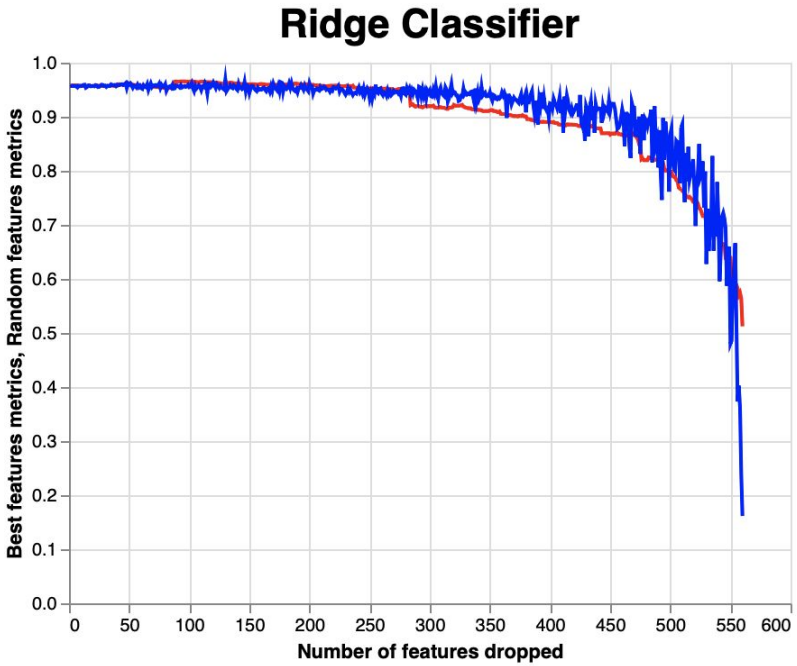
The Shapley value for member

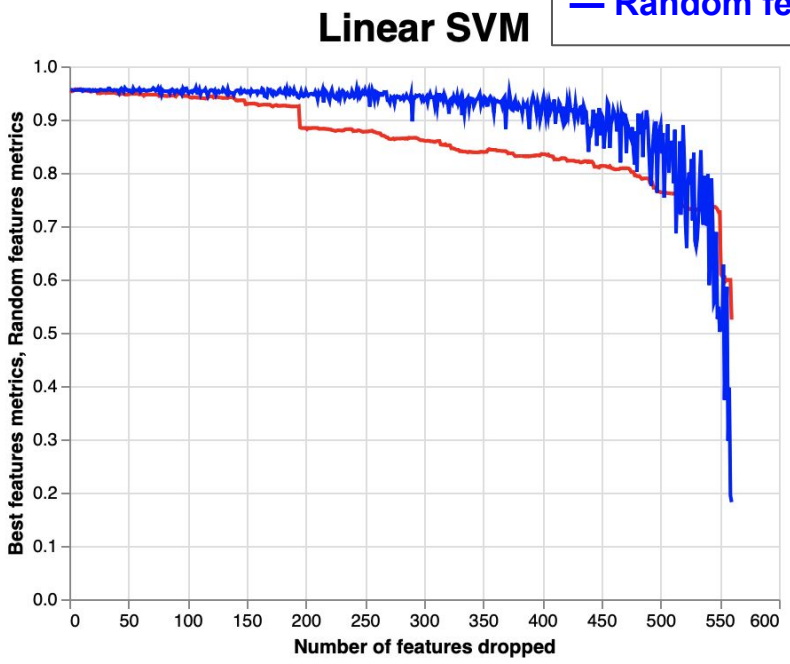
is given by:

$$\phi_i = \frac{\delta_1 + \delta_3 + \delta_4 + \delta_5 + \delta_6 + \delta_7 + \delta_8}{8}$$

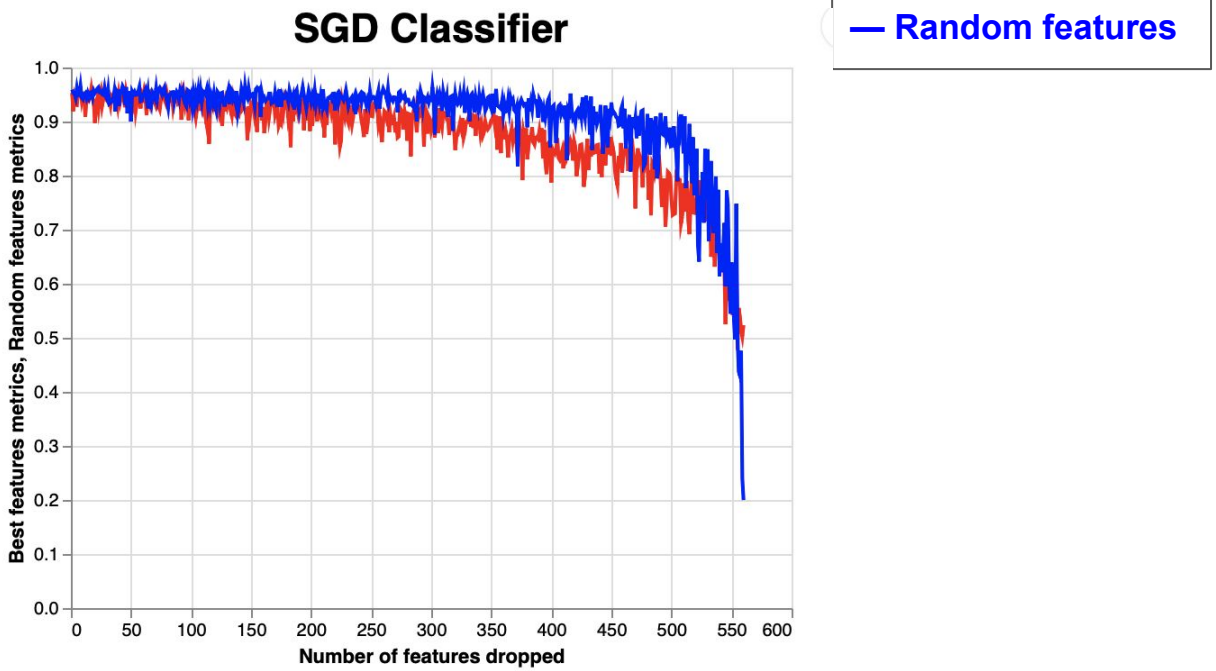
Interpretability: Results

Experiment with dropping features



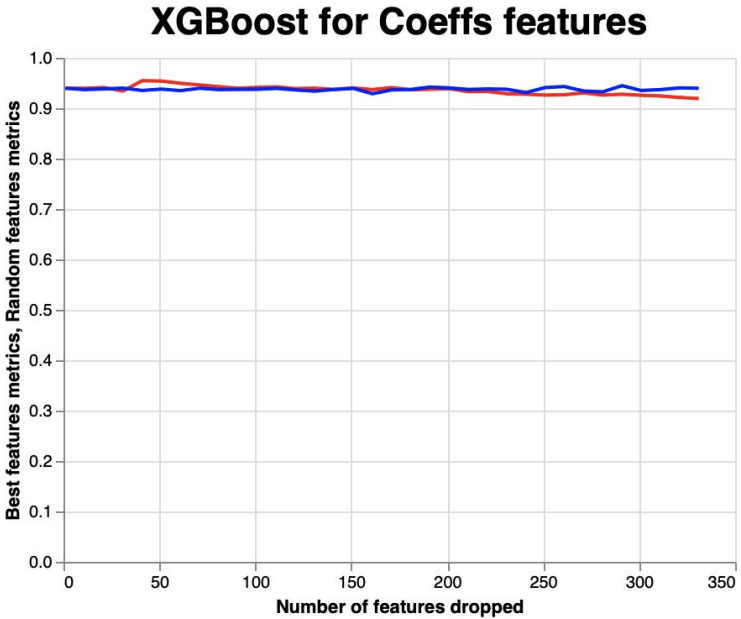


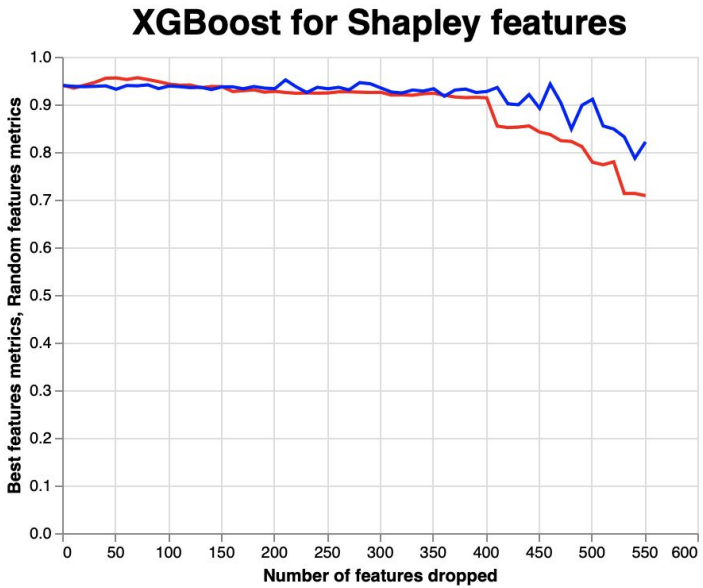
Experiment with dropping features



Experiment with dropping features

— Best features
— Random features





What does it mean to be interpretable?

Q&A