

Interpretable Heart Failure Identification Utilizing Auto Machine Learning Tools.

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Abstract:

Heart failure is a major global health issue affecting millions of people, and this study presents an interpretable predictive framework using Machine Learning (ML) and Explainable Artificial Intelligence (XAI) to address it. A heart failure (HF) dataset with 13 features is used, and class imbalance is handled using the Synthetic Minority Over-sampling Technique (SMOTE). To improve model performance, we apply Automated Machine Learning (AutoML) tools including Tree-based Pipeline Optimization Tool (TPOT), H2O.ai (H2O), and Machine Learning Jar (MLJAR) for feature selection and model optimization. Five ensemble ML models are employed: Gradient Boosting Machine (GBM), Light Gradient Boosting Machine (LGBM), Extreme Gradient Boosting (XGB), Random Forest (RF), and Tree Selection and Stacking Ensemble-Based Random Forest (TSRF). These models are evaluated using accuracy, precision, recall, F1-score, and specificity, derived from confusion matrices, with a 10-fold cross-validation approach to ensure robustness. Among them, XGB optimized by TPOT achieves the highest performance, with 99.51% in all key metrics. To ensure interpretability, we apply XAI techniques such as Shapley Additive Explanations (SHAP) and Local Interpretable Model-Agnostic Explanations (LIME), which provide clear insights into feature importance. This work highlights the strength of combining AutoML and XAI for accurate and transparent heart failure prediction, supporting effective clinical decisionmaking.

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