Explainable AI
Assignment - 4

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1. Introduction :

In this assignment, we explored Explainable Artificial Intelligence (XAI) using Permutation
Importance, SHAP, and LIME on the Titanic survival prediction problem. We trained a Logistic Regression model with preprocessing (OneHotEncoding + scaling) to predict survival, and then applied multiple XAI techniques to interpret the model both globally and locally.

2. Problem Statement :

The task was to interpret which passenger attributes most influence survival predictions in the Titanic dataset. Objectives: - Use Permutation Importance to rank survival features. - Apply SHAP for global (summary plot) and local (force plot) explanations. - Use LIME to provide case-specific explanations for two passengers. - Compare and analyze consistency across methods.

3. Methodology :

- Step 1 — Data Preprocessing: Selected numeric and categorical features. Missing values imputed. Categorical encoded using OneHotEncoder.
- Step 2 — Model Building: Logistic Regression classifier with OneHot + scaling in a pipeline.
- Step 3 — Model Evaluation: Accuracy, ROC-AUC, and classification report generated.

- Step 4 — Explainability: Applied Permutation Importance, SHAP (summary + force plot), and LIME (two instances).
- Step 5 — Comparative Analysis: Compared consistency and differences across methods.

4. Results :

- Permutation Importance identified top global features such as sex, class/pclass, fare, and age.
- SHAP summary plot confirmed the importance of these features, showing direction of effect.
- SHAP local force plot illustrated how individual passenger's features contributed to survival prediction.
- LIME explanations for two passengers highlighted personalized feature contributions with slight variability.

5. Insights :

- Permutation Importance and SHAP showed overlap in key features (sex, class, age, fare).
- PI measures global sensitivity, while SHAP attributes precise contributions per feature.
- SHAP can reveal binary indicators (e.g., sex=female) with clear direction, unlike PI.
- LIME showed local explanations which sometimes differ from global importance rankings.
- LIME explanations vary slightly due to randomness but give human-friendly insights.
- SHAP aligns with model coefficients for linear models, making results consistent with logistic regression expectations.
- Class and fare consistently emerged as strong predictors across all methods.

6. Conclusion :

This assignment demonstrated the power of combining multiple XAI methods to understand predictions of a Logistic Regression model on Titanic survival data. Permutation Importance highlighted global

feature rankings, SHAP provided both global and local interpretability, and LIME offered personalized explanations for individual passengers. Together, these methods gave a comprehensive understanding of feature influence on survival predictions.