LAB -04

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BATCH-38

Short Methods Summary (3–5 lines)

- **Permutation Importance (PI):** Measures feature importance by shuffling feature values and tracking drops in accuracy.
- **SHAP:** Uses Shapley values from game theory to attribute contributions of each feature, offering both global and local explanations.
- **LIME:** Builds local linear models around specific predictions to explain how features affect individual cases.
- All applied to a **RandomForestClassifier** trained on penguin morphological and ecological data.

Key Insights (Consistencies & Differences)

- **Consistent Top Features:** Bill length, bill depth, and flipper length ranked highly by both PI and SHAP.
- **Overlap:** Strong agreement between PI and SHAP on the main morphological features.
- **Global vs Local:** PI & SHAP emphasize broad patterns, while LIME highlights instance-specific influences.

- **Body Mass:** Shows mixed importance—sometimes relevant, sometimes overshadowed by bill dimensions.

- **Island & Sex:** Moderate global importance, but locally decisive in certain predictions (per LIME).

- **Method Strengths:**

    - PI → simple & model-agnostic

    - SHAP → principled & interaction-aware

    - LIME → intuitive local explanations

- **Ecological Meaning:** Bill morphology is the strongest species discriminator; flipper length reflects locomotion adaptation.

- **Limitations:** PI doesn't show direction, SHAP can be computationally heavy, and LIME may oversimplify nonlinear patterns.