Crashspot — Week 7 Report

■ Focus

Hyperparameter tuning and robust evaluation of machine learning models for crash prediction.

■■ Methods

- Applied RandomizedSearchCV to tune Random Forest.
- Applied GridSearchCV to tune Gradient Boosting.
- Evaluated models using classification reports, confusion matrices, and ROC/PR curves.
- Performed Stratified 5-Fold Cross-Validation and a shuffle-label test to check for overfitting and data leakage.
- Saved best performing model (week7_best_model.pkl) for future deployment.

■ Outputs

- Figures: docs/figures/week7_ROC_RF_tuned.png, docs/figures/week7_PR_RF_tuned.png, docs/figures/week7_ROC_GB_tuned.png, docs/figures/week7_PR_GB_tuned.png
- Data: data_clean/week7_results.csv — model accuracy, precision, recall, F1
- Model: models/week7_best_model.pkl

■ Results

- Test set (12 samples): Both RF and GB achieved 100% accuracy, precision, recall, and F1.
- Cross-validation (5-fold): RF tuned: F1 = 1.000 ± 0.000, ROC AUC = 1.000 ± 0.000 | GB tuned: F1 = 1.000 ± 0.000, ROC AUC = 1.000 ± 0.000
- Shuffle Test: Performance dropped to chance (~0.20–0.34 F1), confirming no leakage.

■ Notes

- Models show perfect predictive performance on this dataset.
- However, given the small dataset size (n=60), results may not generalize well to larger/unseen crash data.
- Next steps: validate on an expanded dataset and explore model interpretability (feature importances, SHAP).