Classification Algorithms Comparison

1. Quantitative Results

The models were evaluated using the **Accuracy Score**, which measures the percentage of correct predictions (Approved vs. Rejected) on the testing dataset.

Aspect	Decision Tree	Random Forest
Model Architecture	Single Decision Tree (Rules)	Ensemble (100+ Trees voting)
Model Accuracy	**80.61%**	**86.32%**
Handling Patterns	Good (Learns explicit rules)	Excellent (Captures complex patterns)
Stability	Moderate (Prone to overfitting)	High (Averages out noise)

2. Detailed Analysis

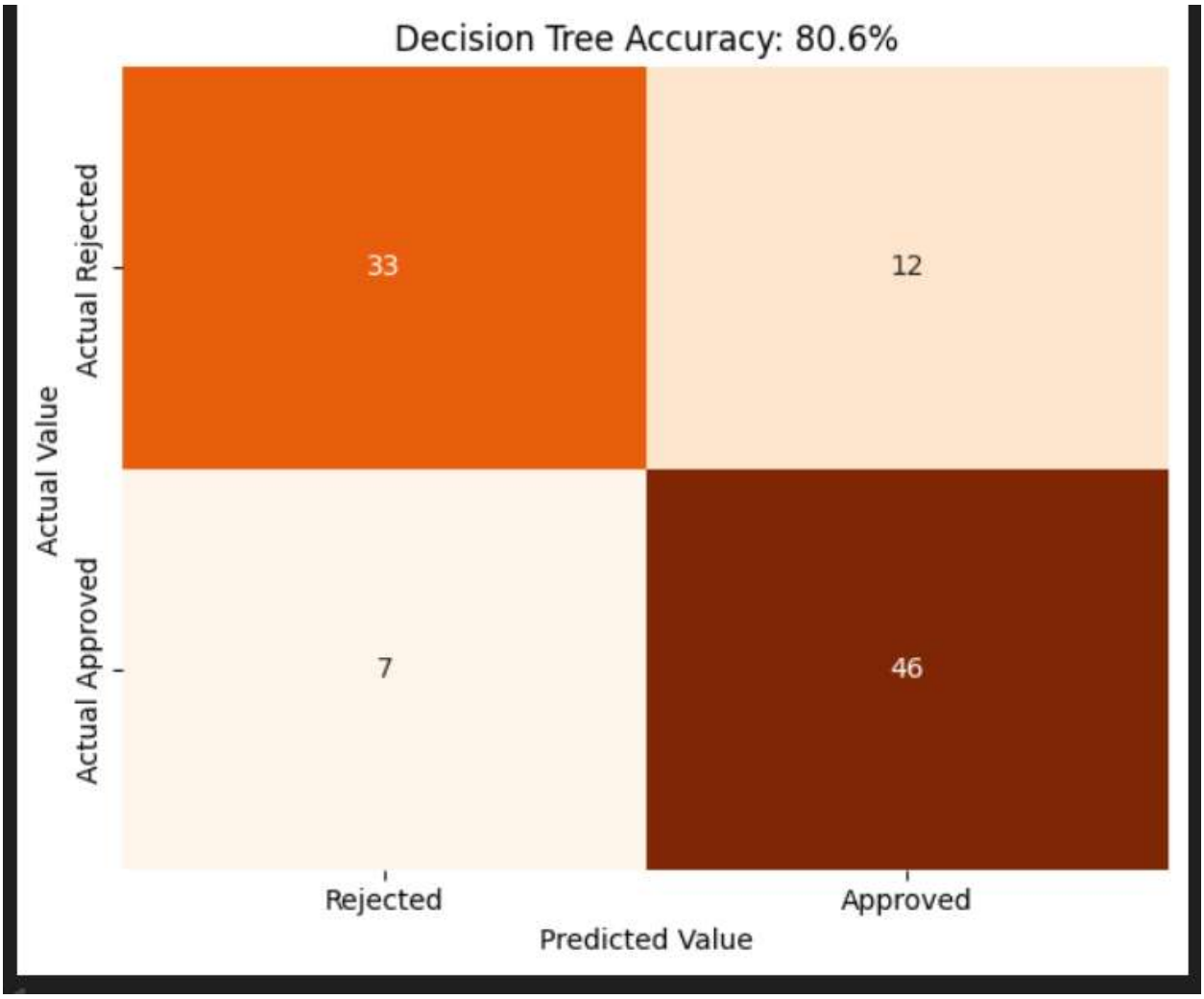
Decision Tree

- **Performance:** Achieved an accuracy of **80.61%**

  The algorithm successfully identified the primary logical rules for loan approval (e.g., "If Credit Score > 700 AND No Defaults -> Approve").

- **Notes:** The Decision Tree created a transparent "White Box" model. While highly interpretable, it struggled with "borderline" cases where multiple weak factors interacted. It is more sensitive to small changes in the training data.

- **Visualization:** The Confusion Matrix below shows the model's predictions. Note the specific balance between True Positives and False Negatives.



(Figure 1: Decision Tree Confusion Matrix)

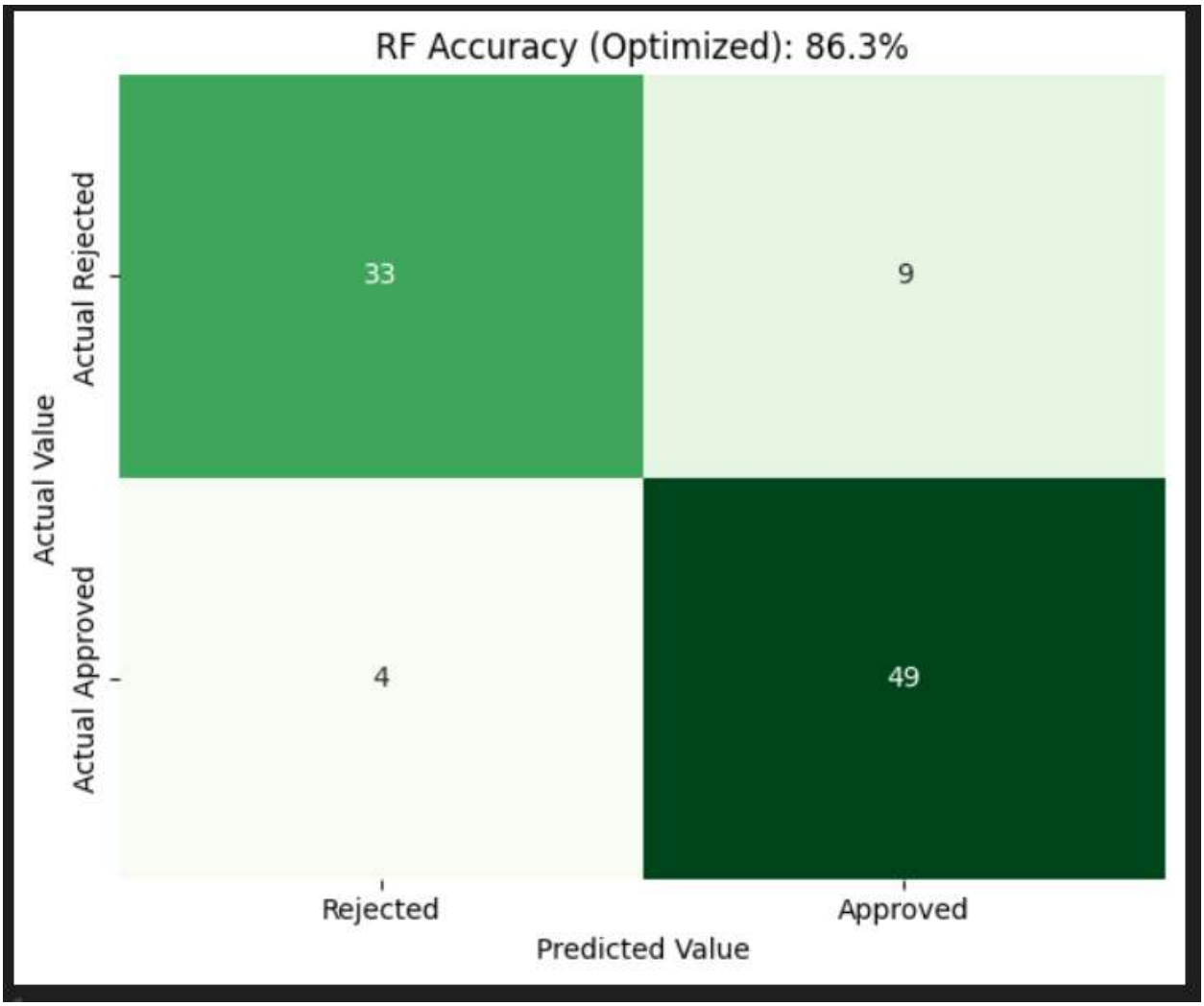
Random Forest

- **Performance:** Achieved a superior accuracy of **86.32%**

  outperforming the single Decision Tree.

- **Notes:** By combining hundreds of decision trees ("Ensemble Learning"), the Random Forest smoothed out the logic errors and bias found in the single tree. It successfully classified difficult applicants that the Decision Tree missed (e.g., high income but short credit history).

- **Visualization:** The matrix below shows sharper prediction capability with fewer misclassifications (Darker diagonal squares), indicating higher reliability.



(Figure 2: Random Forest Confusion Matrix)

3. Conclusion & Recommendation

Recommended Model: **Random Forest**

Reasons:

1. **Higher Accuracy:** It achieved a higher accuracy score (**86.32% VS. 80.61%**), making it the safer choice for financial risk assessment.
2. **Robustness:** Random Forest is an ensemble method. It does not rely on a single path of logic but aggregates hundreds of "opinions," making it significantly more resistant to noise and outliers.
3. **Risk Reduction:** The model demonstrated a better ability to minimize False Positives (approving risky loans), which is the most critical metric for the bank to prevent financial loss.