📊 Project Summary & Executive Insights – Telco Customer Churn Prediction :

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Link to Github repo

1. Executive Summary (Business-Focused)

The goal of this project was to build a machine learning solution to proactively identify customers at high risk of churn for a telecommunications provider.

By integrating predictive modeling with explainability and dashboard visualizations, the project provides leaders with:

- A reliable churn prediction system (**ROC-AUC ~0.83**)
- Customer-level churn risk **explainability using SHAP**
- Key churn drivers crucial for **targeted retention strategies**
- **Dash & Streamlit dashboards** for operational monitoring

The final **soft-voting ensemble** (Tuned RF + Tuned XGB) emerged as the best balance of performance and stability, achieving:

- **Accuracy**: 78.1%
- **ROC-AUC**: 0.8336
- **Recall** (Churners): 0.5909
- **Precision** (Churners): 0.5878

This performance allows the company to reliably flag high-risk customers for proactive retention outreach.

2. Key Insights on Churn Behavior

➢ **Top Predictive Drivers (Consistent Across RF + XGB + SHAP)**

Across all models, the **most influential drivers of churn** were:

A. PaymentMethod_Electronic check

- Customers paying by electronic check exhibit high churn probability.
- SHAP plots consistently show strong positive contributions to churn.
- Business implication: High-friction billing methods or payment dissatisfaction.

B. InternetService_Fiber optic

- Fiber customers show elevated churn risk, possibly due to pricing or competition.
- SHAP indicates high values push predictions toward churn.

3. TotalServices / MultipleLines_Yes

- Fewer services → higher churn
- More bundled services → lower churn
- Interpretation: Multi-service bundling strengthens retention.

4. Tenure

- One of the strongest negative predictors of churn.
- Short-tenure customers are significantly more likely to churn.

5. TotalCharges / AvgMonthlyCharge / MonthlyCharges

- Higher monthly and average charges correlate with churn risk.
- TotalCharges often acts as a proxy for tenure, but in combination with MonthlyCharges, reveals pricing fatigue.

6. Contract type (Contract_Two year)

- Longer contracts → lower churn risk.
- Short-term or month-to-month customers consistently show high churn.

3. Model Comparison Summary

Model	Accuracy	ROC-AUC	Churn Recall	Churn Precision	Notes
Logistic Regression	78.6%	0.8367	0.6123	0.5948	Best recall, Interpretable
Tuned RF	76.7%	0.8230	0.6043	0.5567	Strong SHAP clarity
Tuned XGBoost	77.0%	0.8158	0.5642	0.5672	Best Stability; strong for interactions
Ensemble (Final)	78.1%	0.8336	0.5909	0.5878	Best Balanced Model

Why the Ensemble Was Selected:

1. Achieved near-best ROC-AUC (just below LR but more stable).
2. More balanced precision–recall tradeoff than XGBoost or RF individually.
3. Less variance across folds.
4. Consistent SHAP explanations from RF + XGB synergy.

4. Explainability Summary (SHAP)

XGBoost SHAP Key Takeaways:

- TotalServices is a major stabilizing feature; more services = lower churn.
- Electronic check and Fiber optic are high-risk features.
- Charges (Total, Monthly, AvgMonthly) influence pricing dissatisfaction.
- Tenure consistently pulls predictions toward non-churn.
- Random Forest SHAP Key Takeaways

Similar ranking:

- Electronic check
- Fiber optic
- Tenure
- TotalCharges
- Contract length

The alignment across models increases confidence in these insights.

5. Business Recommendations

A. Targeted Retention Campaigns

- Electronic check users → offer payment method incentives
- Fiber-optic customers → provide discounts or customer service outreach
- Short-tenure customers (<6 months) → onboarding support & loyalty perks

B. Increase Multi-Service Bundling

- Encourage additional service adoption
- Bundling consistently lowers churn risk

C. Pricing Strategy Optimization

- Review monthly charge spikes
- Introduce usage-based or loyalty discounts

D. Contract Optimization

- Incentivize 1–2 year contracts
- Month-to-month users show elevated churn risk