**ENHANCING TELECOM CUSTOMER RETENTION THROUGH MACHINE LEARNING AND DEEP LEARNING-POWERED CHURN PREDICTION**

**About Data:** The data set from a customer churns dataset, likely from a telecommunications company. This dataset includes 7043 entries with 20 columns, detailing various attributes of customers and whether they have churned (left the service) or not. Here’s a breakdown of the columns:

gender: Gender of the customer (e.g., male, female).

SeniorCitizen: Whether the customer is a senior citizen (likely encoded as binary, e.g., 0 for no, 1 for yes).

Partner: Whether the customer has a partner (e.g., yes, no).

Dependents: Whether the customer has dependents (e.g., yes, no).

tenure: Number of months the customer has stayed with the company.

PhoneService: Whether the customer has phone service (e.g., yes, no).

MultipleLines: Whether the customer has multiple lines (e.g., yes, no, no phone service).

InternetService: Type of internet service the customer has (e.g., DSL, Fiber optic, No).

OnlineSecurity: Whether the customer has online security add-on (e.g., yes, no, no internet service).

OnlineBackup: Whether the customer has online backup add-on (e.g., yes, no, no internet service).

DeviceProtection: Whether the customer has device protection add-on (e.g., yes, no, no internet service).

TechSupport: Whether the customer has tech support add-on (e.g., yes, no, no internet service).

StreamingTV: Whether the customer has streaming TV service (e.g., yes, no, no internet service).

StreamingMovies: Whether the customer has streaming movies service (e.g., yes, no, no internet service).

Contract: Type of contract the customer has (e.g., month-to-month, one year, two year).

PaperlessBilling: Whether the customer has paperless billing (e.g., yes, no).

PaymentMethod: Customer’s payment method (e.g., electronic check, mailed check, bank transfer (automatic), credit card (automatic)).

MonthlyCharges: Monthly charges the customer incurs.

TotalCharges: Total charges the customer has incurred.

Churn: Whether the customer has churned (e.g., yes, no).

**PROJECT OBJECTIVE**

The primary objective of the "Telecom Dynamics: Advancing Customer Retention with Machine Learning-Powered Churn Analysis" project is to identify and analyze key factors influencing customer churn in the telecommunications sector. By leveraging various machine learning models, the project aims to predict which customers are at high risk of churning and provide actionable insights to enhance customer retention strategies.

**PROJECT OUTCOMES**

**Model Performance:**

* **K-Nearest Neighbors (KNN):** Among the models tested, KNN with K=31 and the Manhattan distance metric demonstrated superior performance in predicting customer churn.
* **Other Models:** A total of 12 models were evaluated, including Random Forest, KNN with hyperparameter tuning, XGBoost, SVM with linear and polynomial kernels, Random Forest with hyperparameter tuning, Random Forest with feature selection, Random Forest with undersampling, Artificial Neural Networks (ANN), and Convolutional Neural Networks (CNN). SVM with a linear kernel achieved the highest accuracy of 80%, although it had a lower precision score compared to other metrics.

**Churn Prediction:**

* The KNN model effectively identified high-risk churn customers, enabling targeted retention efforts.
* The SVM model with a linear kernel showed strong overall accuracy, although its precision score was an area needing improvement.

**Key Indicators of Churn:**

* **Total Charges:** A significant predictor of churn, indicating that higher total charges correlate with a higher likelihood of customers leaving.
* **Tenure:** Customers with shorter tenure were more likely to churn, highlighting the importance of early intervention.
* **Monthly Charges:** Higher monthly charges were linked to increased churn risk, suggesting that pricing strategies play a critical role in customer retention.
* **Internet Service:** The type of internet service (e.g., DSL, Fiber optic, No service) also significantly influenced churn.

**Churn Likelihood:**

* The combination of Total Charges, Tenure, Monthly Charges, and Internet Service accounted for a significant portion of the likelihood of customer churn, underscoring their importance in predictive modeling.

**Strategic Insights:**

* The analysis provided strategic insights into the factors driving customer churn. By focusing on managing Total Charges, optimizing Tenure-based interventions, and adjusting Monthly Charges, telecommunications companies can better retain their customers.

**Competitive Advantage:**

* Utilizing machine learning models for churn analysis offers a competitive advantage in the market by enabling proactive customer retention strategies and personalized interventions.

The project successfully demonstrated that machine learning models, particularly KNN and SVM with a linear kernel, can effectively predict customer churn in the telecommunications sector. Key factors such as Total Charges, Tenure, Monthly Charges, and Internet Service type are critical in understanding and managing customer churn. By focusing on these factors, telecommunications companies can develop targeted strategies to enhance customer retention, thereby maintaining a competitive edge in the market.

**CONCLUSION:**

This project predicts whether customers will churn from a telecom service using various machine learning (ML) and deep learning (DL) models. We applied 12 different types of models, including Random Forest, KNN, KNN with hyperparameter tuning, XGBoost, SVM with linear and polynomial kernels, Random Forest with hyperparameter tuning, Random Forest with feature selection, Random Forest with undersampling, ANN, and CNN models. The SVM model with a linear kernel achieved the highest accuracy at 80% compared to other models. Except for the precision score, all other accuracy metrics were better for the SVM with a linear kernel compared to the other 11 models.

Feature importance analysis using the Random Forest with undersampling technique revealed that Total Charges, Tenure, Monthly Charges, and Internet Service are the most significant factors contributing to customer churn. These findings suggest that telecom companies should focus on these factors to retain their customers effectively.