

INFO6145 Data Science and Machine Learning

Predicting Passenger Transport Status on the Spaceship Titanic

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Introduction

- ▶ **Objective:** Predict whether passengers aboard the "Spaceship Titanic" were transported to an alternate dimension.
- ▶ **Key Challenges:**
 - ▶ Handling complex data with both numerical and categorical features.
 - ▶ Optimizing models for classification performance.

Dataset Overview

- ▶ **Data Source:** Kaggle's Spaceship Titanic competition.
- ▶ **Features:**
 - ▶ Passenger details: Age, CryoSleep, VIP, PassengerGroup, etc.
 - ▶ Service usage: RoomService, FoodCourt, ShoppingMall, Spa, VRDeck.
 - ▶ Target: Transported (Yes/No).
- ▶ **Missing Data:** The dataset had missing values for almost all features.

Data Preprocessing

- ▶ **Feature Engineering:**

- ▶ Created new features by extracting details (PassengerId, Cabin).

- ▶ **Handling Missing Data:**

- ▶ Careful imputation (VIP, CryoSleep, Services, HomePlanet, Deck).
- ▶ Mean imputation (Services, Age).
- ▶ Mode imputation (Side, Destination).

- ▶ **Feature types:**

- ▶ Ensured every feature was either a float, int, or boolean.

- ▶ **Feature Encoding:**

- ▶ One-hot encoding for categorical variables (e.g., CryoSleep, PassengerGroup).

Feature Relations Graphs

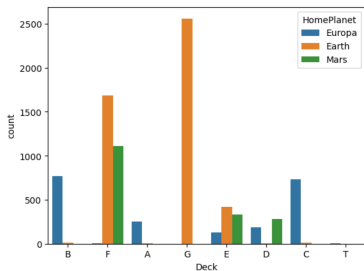


Figure: Relation Deck
HomePlanet

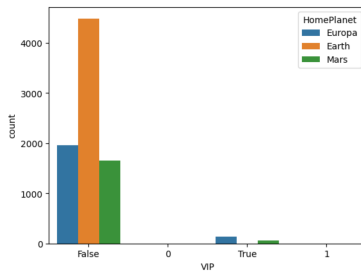


Figure: Relation VIP
HomePlanet

Model Selection

- ▶ **Models Evaluated:**
 - ▶ Logistic Regression
 - ▶ MLP Classifier
 - ▶ Gradient Boosting Classifier
 - ▶ Random Forest Classifier
- ▶ **Feature Scaling:**
 - ▶ StandardScaler
 - ▶ MinMaxScaler
- ▶ **Hyperparameter Tuning:** Grid search for optimal hyperparameters (MLP Classifier, Gradient Boosting).
- ▶ **Evaluation Metrics:** Accuracy, Precision, Recall, F1 Score, Confusion Matrix.

Model Performance Metrics

Model	Accuracy	F1 Score	Recall	Precision
Logistic Regression	0.7832	0.7950	0.8345	0.7591
MLP Classifier	0.8016	0.8056	0.8162	0.7953
Gradient Boosting	0.8022	0.8076	0.8242	0.7917
Random Forest	0.8079	0.8051	0.7877	0.8234

Table: Model performance using StandardScaler

Model	Accuracy	F1 Score	Recall	Precision
Logistic Regression	0.7810	0.7923	0.8316	0.7584
MLP Classifier	0.7984	0.8033	0.8131	0.7945
Gradient Boosting	0.7990	0.8048	0.8194	0.7886
Random Forest	0.8046	0.8035	0.7862	0.8176

Table: Model performance using MinMaxScaler

Model Performance Confusion Matrix

Confusion Matrix for GradientBoostingClassifier with MinMaxScaler

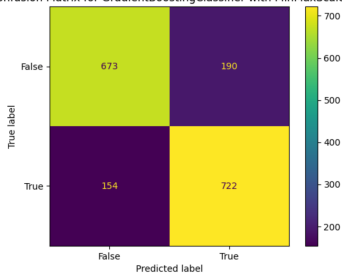


Figure: Gradient Boosting

Confusion Matrix for RandomForestClassifier with StandardScaler

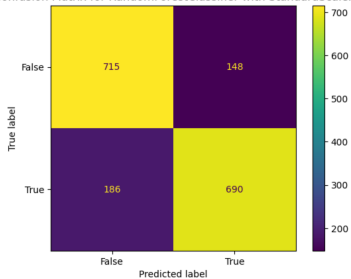


Figure: Random Forest

Model Comparison & Final Results

- ▶ **Best Performing Model:** Random Forest with 80.79% accuracy and 82.34% precision.
- ▶ **Best Recall:** Gradient Boosting with 82.42% (with both scalers).
- ▶ **MLP Classifier:** A bit disappointing, lacked hyperparameter tuning.

Feature Importance Insights

- ▶ **Top Features:**

- ▶ RoomService, FoodCourt, Spa, VRDeck, and ShoppingMall.
- ▶ CryoSleep, PassengerGroup.

- ▶ **Differences:**

- ▶ Age ranked higher by Random Forest.
- ▶ Deck G ranked higher by Gradient Boosting.

Feature Importance Graphs

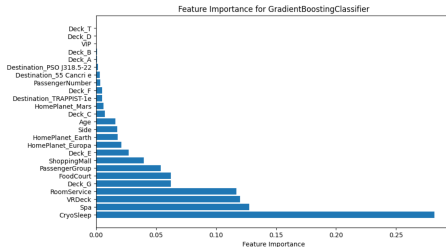


Figure: Gradient Boosting

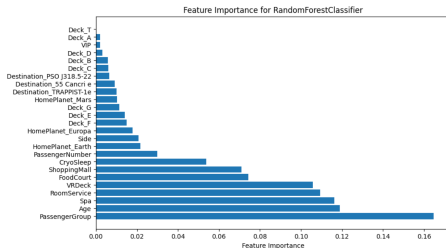


Figure: Random Forest

Conclusion

▶ **Summary:**

- ▶ Random Forest outperformed other models, achieving higher accuracy and precision.
- ▶ Gradient Boosting was very close, thanks to hyperparameter tuning.
- ▶ MLP Classifier results were disappointing.

▶ **Future Work:**

- ▶ Better preprocessing.
- ▶ Fine-tuning model hyperparameters.
- ▶ Bigger dataset.
- ▶ Exploring other ensemble methods.
- ▶ Aim for higher accuracy in binary classification (the best was 96%).

References



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