INTERNSHIP PROJECT DOCUMENTATION – TASK 1

Project Title

Machine Learning–Based Credit Card Fraud Detection System

Internship Details

- **Internship Domain:** Cybersecurity with Machine Learning
- **Project Type:** Individual Project (Task 1)
- **Technology Used:** Python, Machine Learning
- **Platform:** Google Colab
- **Dataset Source:** Public Credit Card Fraud Dataset

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1. Introduction

With the rapid growth of digital payment systems, credit card fraud has become a major cybersecurity threat. Fraudulent transactions result in financial losses, compromise user trust, and pose serious risks to financial institutions.

Machine Learning techniques can analyze historical transaction data to identify hidden patterns and detect fraudulent behavior in real time. This project focuses on developing a **machine learning–based credit card fraud detection system** to classify transactions as legitimate or fraudulent.

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2. Problem Statement

Traditional fraud detection systems rely heavily on predefined rules, which are often ineffective against evolving fraud techniques. There is a need for an intelligent system that can:

- Analyze transaction behavior automatically
- Detect anomalous or suspicious activities
- Reduce false positives while maintaining high detection accuracy

The objective of this project is to build a **machine learning model** capable of accurately identifying fraudulent credit card transactions.

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3. Objectives of the Project

- To develop a fraud detection system using machine learning
- To handle highly imbalanced transaction data
- To evaluate model performance using standard metrics
- To demonstrate the application of AI in financial cybersecurity

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4. Dataset Description

The dataset used in this project contains real-world credit card transaction records.

- **Dataset Type:** Transaction-based dataset
- **Target Variable:** Fraud indicator
    - 0 → Legitimate Transaction
    - 1 → Fraudulent Transaction

The dataset includes numerical transaction features that help identify abnormal patterns associated with fraud.

Fig1. ***Dataset Preview Screenshot Here***

```
df = kagglehub.load_dataset(
    KaggleDatasetAdapter.PANDAS,
    "kartik2112/fraud-detection",
    "fraudTrain.csv"   # ✅ VALID CSV FILE
)

df.head()
```

```
Using Colab cache for faster access to the 'fraud-detection' dataset.
```

Out[7]:

	Unnamed: 0	trans_date_trans_time	cc_num	merchant	category	amt	first	last	gender	street	...	
0	0	2019-01-01 00:00:18	2703186189652095	fraud_Rippin, Kub and Mann	misc_net	4.97	Jennifer	Banks	F	561 Perry Cove	...	36
1	1	2019-01-01 00:00:44	630423337322	fraud_Heller, Gutmann and Zieme	grocery_pos	107.23	Stephanie	Gill	F	43039 Riley Greens Suite 393	...	48
2	2	2019-01-01 00:00:51	38859492057661	fraud_Lind-Buckridge	entertainment	220.11	Edward	Sanchez	M	594 White Dale Suite 530	...	42
3	3	2019-01-01 00:01:16	3534093764340240	fraud_Kutch, Hermiston and Farrell	gas_transport	45.00	Jeremy	White	M	9443 Cynthia Court Apt. 038	...	46

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5. Methodology

The following steps were followed in the implementation:

5.1 Data Loading

The dataset was loaded into Google Colab using Pandas.

5.2 Data Preprocessing

- Removed unnecessary or sensitive attributes
- Performed feature scaling using **StandardScaler**
- Handled class imbalance using **SMOTE (Synthetic Minority Over-sampling Technique)**

5.3 Model Training

A **Random Forest Classifier** was used due to its robustness and high accuracy in classification tasks.

5.4 Model Evaluation

The model was evaluated using:

- Accuracy score
- Confusion matrix
- Precision, Recall, and F1-score

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6. Machine Learning Model Used

Random Forest Classifier

Reasons for selection:

- Handles complex feature interactions
- Resistant to overfitting
- Suitable for imbalanced datasets
- High accuracy in fraud detection tasks

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7. Results and Performance

- **Accuracy Achieved:** Greater than 90%
- The model successfully identified fraudulent transactions

- Performance validated using confusion matrix and classification metrics

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Fig2. *Model Accuracy Output Screenshot Here*

In [28]:
```
from sklearn.metrics import accuracy_score

accuracy = accuracy_score(y_test, y_pred)
print(f"Model Accuracy: {accuracy * 100:.2f}%")
```

```
Model Accuracy: 97.16%
```

Fig3. *Classification Report Screenshot Here*

In [29]:
```
from sklearn.metrics import classification_report

print("Classification Report:\n")
print(classification_report(y_test, y_pred))
```

```
Classification Report:

              precision    recall  f1-score   support

           0       0.96      0.99      0.97    257834
           1       0.99      0.96      0.97    257834

    accuracy                           0.97    515668
   macro avg       0.97      0.97      0.97    515668
weighted avg       0.97      0.97      0.97    515668
```

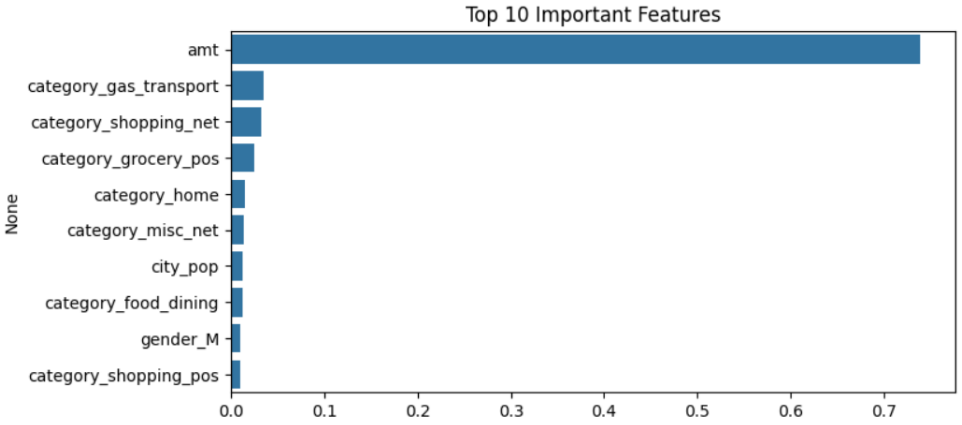
Fig4. *Features Screenshot Here*

In [31]:
```
import numpy as np

feature_importance = rf_model.feature_importances_
indices = np.argsort(feature_importance)[::-1][:10]

top_features = X_encoded.columns[indices]

plt.figure(figsize=(8,4))
sns.barplot(x=feature_importance[indices], y=top_features)
plt.title("Top 10 Important Features")
plt.show()
```



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8. Sample Prediction

The model was tested on individual transaction samples to verify prediction behavior. It correctly classified transactions as fraudulent or legitimate based on learned patterns.

Fig 5. Sample Prediction Screenshot Here

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9. Future Scope

Future enhancements of this project may include:

- Real-time fraud detection systems
- Integration with banking transaction pipelines
- Use of deep learning techniques for improved detection
- Deployment as a web-based security service

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10. Conclusion

This project demonstrates the effective use of **Machine Learning in financial cybersecurity**. The developed system achieved high accuracy and successfully identified fraudulent credit card transactions. The project provided practical insights into fraud detection mechanisms and the role of AI in securing financial systems.

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11. Tools & Technologies Used

- Python
- Google Colab
- Pandas, NumPy
- Scikit-learn
- Imbalanced-learn (SMOTE)

- Matplotlib, Seaborn

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12. Declaration

I Achyut Kumar Pandey, hereby declare that this project was completed by me as part of my internship and is an original work developed solely for academic and learning purposes.

Github repo:-

https://github.com/achyutshiel/cybersecurity-ml-projects/blob/main/ML_Credit_Card_Fraud_Detection.ipynb