```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder, StandardScaler
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score, classification_report, confusion_matrix
import os
```

```
from google.colab import files

uploaded = files.upload()  # Opens a file picker
```

```
Choose files cybersecurit...on_data.csv
• cybersecurity_intrusion_data.csv(text/csv) - 725128 bytes, last modified: 23/02/2025 - 100% done
Saving cybersecurity_intrusion_data.csv to cybersecurity_intrusion_data.csv
```

```
# Load the dataset
file_path = "cybersecurity_intrusion_data.csv"  # Update the path if needed
df = pd.read_csv("cybersecurity_intrusion_data.csv")
```

```
df.head(10)
```

	session_id	network_packet_size	protocol_type	login_attempts	session_duration	encryption_used	ip_reputation_score	failed_lo
0	SID_00001	599	TCP	4	492.983263	DES	0.606818	
1	SID_00002	472	TCP	3	1557.996461	DES	0.301569	
2	SID_00003	629	TCP	3	75.044262	DES	0.739164	
3	SID_00004	804	UDP	4	601.248835	DES	0.123267	
4	SID_00005	453	TCP	5	532.540888	AES	0.054874	
5	SID_00006	453	UDP	5	380.471550	AES	0.422486	
6	SID_00007	815	ICMP	4	728.107165	AES	0.413772	
7	SID_00008	653	TCP	3	12.599906	DES	0.097719	
8	SID_00009	406	TCP	2	542.558895	NaN	0.294580	
9	SID_00010	608	UDP	6	531.944107	NaN	0.424117	

Next steps: Generate code with df | View recommended plots | New interactive sheet

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9537 entries, 0 to 9536
Data columns (total 11 columns):
 #   Column               Non-Null Count  Dtype
---  ------               --------------  -----
 0   session_id           9537 non-null   object
 1   network_packet_size  9537 non-null   int64
 2   protocol_type        9537 non-null   object
 3   login_attempts       9537 non-null   int64
 4   session_duration     9537 non-null   float64
 5   encryption_used      7571 non-null   object
 6   ip_reputation_score  9537 non-null   float64
 7   failed_logins        9537 non-null   int64
 8   browser_type         9537 non-null   object
 9   unusual_time_access  9537 non-null   int64
 10  attack_detected      9537 non-null   int64
dtypes: float64(2), int64(5), object(4)
memory usage: 819.7+ KB
```

```
df.describe()
```

	network_packet_size	login_attempts	session_duration	ip_reputation_score	failed_logins	unusual_time_access	attack_detect
count	9537.000000	9537.000000	9537.000000	9537.000000	9537.000000	9537.000000	9537.0000
mean	500.430639	4.032086	792.745312	0.331338	1.517773	0.149942	0.4471
std	198.379364	1.963012	786.560144	0.177175	1.033988	0.357034	0.4972
min	64.000000	1.000000	0.500000	0.002497	0.000000	0.000000	0.0000
25%	365.000000	3.000000	231.953006	0.191946	1.000000	0.000000	0.0000
50%	499.000000	4.000000	556.277457	0.314778	1.000000	0.000000	0.0000
75%	635.000000	5.000000	1105.380602	0.453388	2.000000	0.000000	1.0000
max	1285.000000	13.000000	7190.392213	0.924299	5.000000	1.000000	1.0000

```
df.isnull().sum()  # Check for missing values
```

	0
session_id	0
network_packet_size	0
protocol_type	0
login_attempts	0
session_duration	0
encryption_used	1966
ip_reputation_score	0
failed_logins	0
browser_type	0
unusual_time_access	0
attack_detected	0

```
# Encode categorical columns
categorical_cols = ['protocol_type', 'encryption_used', 'browser_type']
label_encoders = {col: LabelEncoder() for col in categorical_cols}

for col in categorical_cols:
    df[col] = label_encoders[col].fit_transform(df[col])
    print(f"Encoded values for {col}:")
    print(df[col].unique())  # Print unique encoded values
```

```
Encoded values for protocol_type:
[1 2 0]
Encoded values for encryption_used:
[1 0 2]
Encoded values for browser_type:
[1 2 0 4 3]
```

```
# Define features and target variable
X = df.drop(columns=['session_id', 'attack_detected'])  # Remove non-predictive ID
y = df['attack_detected']


print("Features (X) Sample:")
print(X.head())  # Display first few rows of features

print("\nTarget (y) Sample:")
print(y.value_counts())  # Show distribution of attack_detected
```

```
Features (X) Sample:
   network_packet_size  protocol_type  login_attempts  session_duration  \
0                  599              1               4        492.983263
1                  472              1               3       1557.996461
2                  629              1               3         75.044262
3                  804              2               4        601.248835
4                  453              1               5        532.540888

   encryption_used  ip_reputation_score  failed_logins  browser_type  \
0                1             0.606818              1             1
1                1             0.301569              0             2
2                1             0.739164              2             0
```

```
3               1            0.123267             0             4
4               0            0.054874             1             2

   unusual_time_access
0                    0
1                    0
2                    0
3                    0
4                    0

Target (y) Sample:
attack_detected
0    5273
1    4264
Name: count, dtype: int64
```

```
# Scale numeric features
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)
print("Scaled Features (X_scaled) Sample:")
print(pd.DataFrame(X_scaled, columns=X.columns).head())  # Convert to DataFrame for readability
```

```
Scaled Features (X_scaled) Sample:
   network_packet_size  protocol_type  login_attempts  session_duration  \
0             0.496899      -0.386226       -0.016346         -0.381125
1            -0.143322      -0.386226       -0.525794          0.972960
2             0.648132      -0.386226       -0.525794         -0.912503
3             1.530327       1.553444       -0.016346         -0.243473
4            -0.239103      -0.386226        0.493102         -0.330830

   encryption_used  ip_reputation_score  failed_logins  browser_type  \
0         0.365746             1.554930      -0.500779      0.063225
1         0.365746            -0.168029      -1.467959      0.904191
2         0.365746             2.301950       0.466400     -0.777742
3         0.365746            -1.174443      -1.467959      2.586125
4        -0.907289            -1.560484      -0.500779      0.904191

   unusual_time_access
0            -0.419989
1            -0.419989
2            -0.419989
3            -0.419989
4            -0.419989
```

```
# Split dataset into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size=0.2, random_state=42, stratify=y)
```

```
# Train Random Forest Model
rf_model = RandomForestClassifier(n_estimators=100, random_state=42)
rf_model.fit(X_train, y_train)
```

```
RandomForestClassifier
RandomForestClassifier(random_state=42)
```

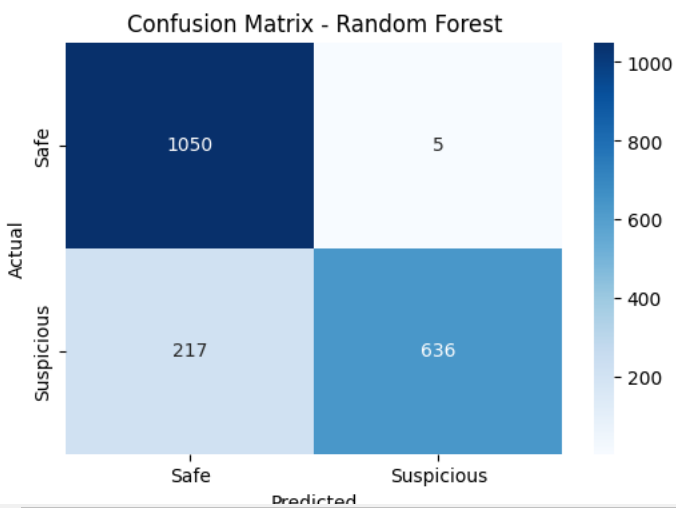
```
# Predictions
y_pred = rf_model.predict(X_test)
print("Sample Predictions:")
print(y_pred[:10])  # Display first 10 predictions
```

```
Sample Predictions:
[1 1 1 0 0 0 1 0 0 0]
```

```
# Evaluate Model Performance
accuracy = accuracy_score(y_test, y_pred)
print(f"Accuracy: {accuracy:.4f}")
print("Classification Report:\n", classification_report(y_test, y_pred))
```

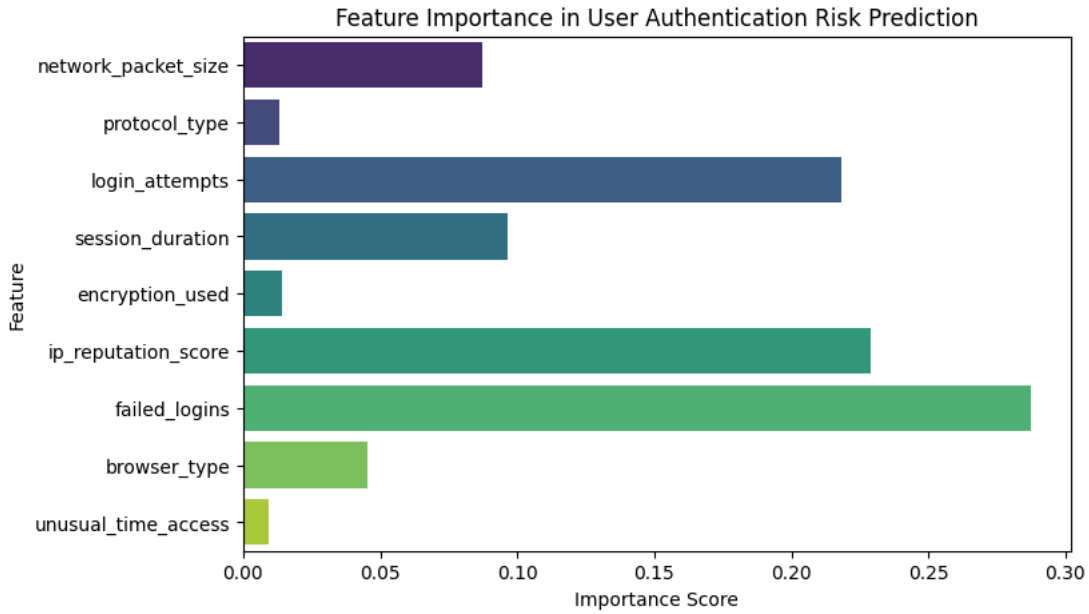
```
Accuracy: 0.8836
Classification Report:
                precision    recall  f1-score   support

           0       0.83      1.00      0.90      1055
           1       0.99      0.75      0.85       853

    accuracy                           0.88      1908
   macro avg       0.91      0.87      0.88      1908
weighted avg       0.90      0.88      0.88      1908
```

```
# Confusion Matrix Visualization
conf_matrix = confusion_matrix(y_test, y_pred)
plt.figure(figsize=(6, 4))
sns.heatmap(conf_matrix, annot=True, fmt='d', cmap='Blues', xticklabels=['Safe', 'Suspicious'], yticklabels=['Safe', 'Suspicious'])
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.title("Confusion Matrix - Random Forest")
plt.show()
```




```
# Feature Importance Plot
feature_importances = rf_model.feature_importances_
feature_names = X.columns
plt.figure(figsize=(8, 5))
sns.barplot(x=feature_importances, y=feature_names, palette="viridis")
plt.xlabel("Importance Score")
plt.ylabel("Feature")
plt.title("Feature Importance in User Authentication Risk Prediction")
plt.show()
```

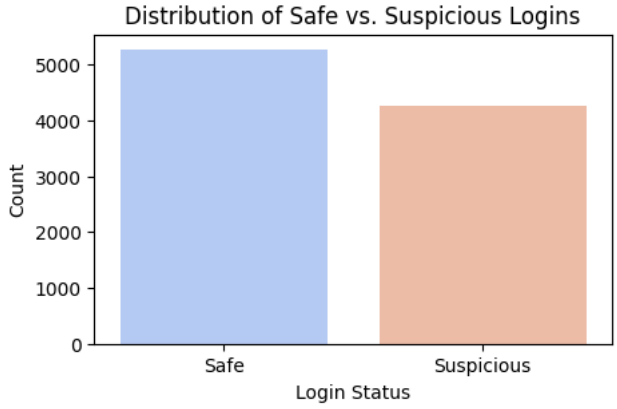
```
<ipython-input-17-db5a1c1d656b>:5: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `y` variable to `hue` and set `le

  sns.barplot(x=feature_importances, y=feature_names, palette="viridis")
```



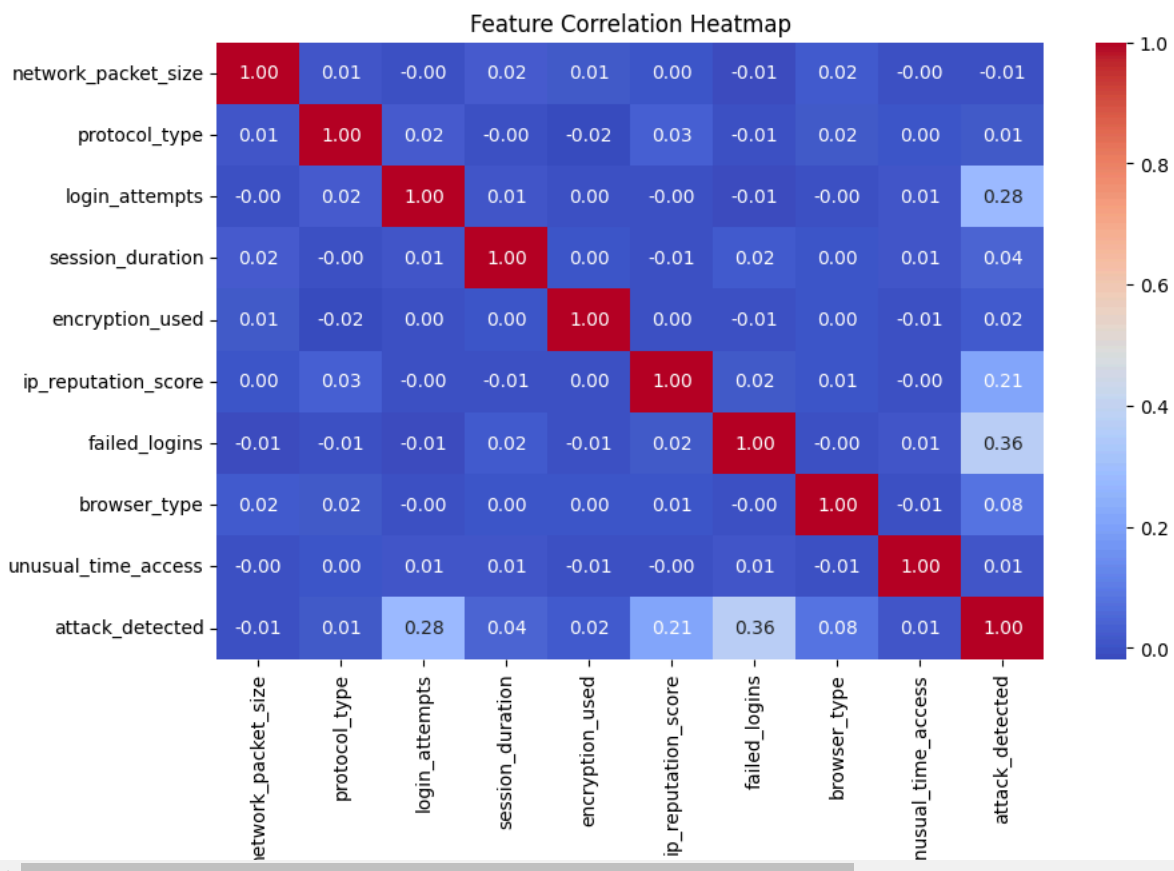

```
# Attack vs Safe Login Distribution
plt.figure(figsize=(5, 3))
sns.countplot(x=y, palette="coolwarm")
plt.xticks(ticks=[0, 1], labels=["Safe", "Suspicious"])
plt.xlabel("Login Status")
plt.ylabel("Count")
```

```
plt.title("Distribution of Safe vs. Suspicious Logins")
plt.show()
```

```
<ipython-input-18-c9a0288d5e11>:3: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `le

  sns.countplot(x=y, palette="coolwarm")
```




```
# Drop non-numeric columns before calculating correlation
df_numeric = df.drop(columns=['session_id'])  # Exclude session_id since it's not numeric

# Heatmap of Feature Correlations
plt.figure(figsize=(10, 6))
sns.heatmap(df_numeric.corr(), annot=True, cmap='coolwarm', fmt='.2f')
plt.title("Feature Correlation Heatmap")
plt.show()
```




```
# Example of predicting attack risk for a new login attempt
new_data = np.array([[500, 1, 3, 300.5, 1, 0.7, 2, 2, 1]])  # Example input
new_data_scaled = scaler.transform(new_data)

# Get prediction and probabilities
prediction = rf_model.predict(new_data_scaled)
prediction_proba = rf_model.predict_proba(new_data_scaled)
```

```
# Display prediction probabilities
print("Predicted probabilities:", prediction_proba)

# Print the final decision message
if prediction[0] == 1:
    print("The login attempt is SUSPICIOUS!")
else:
    print("The login attempt is SAFE!")

print("Thank you for using the User Authentication Risk Prediction System!")
```

```
Predicted probabilities: [[0.02 0.98]]
The login attempt is SUSPICIOUS!
Thank you for using the User Authentication Risk Prediction System!
/usr/local/lib/python3.11/dist-packages/sklearn/utils/validation.py:2739: UserWarning: X does not have valid feature names, but Star
  warnings.warn(
```