In [ ]:
```
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix, accuracy_score, classificatior

# Disable scientific notation for large numbers
pd.options.display.float_format = '{:.0f}'.format

# Setting display options for Pandas to show three decimal places for floati
pd.set_option('display.float_format', lambda x: '%.2f' % x)
```

Data Loading

In [ ]:
```
# import data
student_performance_df = pd.read_csv('/content/drive/MyDrive/student_perform
```

Data Exploration

In [ ]:
```
student_performance_df.info() # Display information about the DataFrame, inc
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 40000 entries, 0 to 39999
Data columns (total 7 columns):
 #   Column                                    Non-Null Count  Dtype
---  ------                                    --------------  -----
 0   Student ID                                40000 non-null  object
 1   Study Hours per Week                      38005 non-null  float64
 2   Attendance Rate                           38008 non-null  float64
 3   Previous Grades                           38006 non-null  float64
 4   Participation in Extracurricular Activities  38000 non-null  object
 5   Parent Education Level                    38000 non-null  object
 6   Passed                                    38000 non-null  object
dtypes: float64(3), object(4)
memory usage: 2.1+ MB
```

In [ ]:
```
student_performance_df.head() # Display top 5 records
```

Out[ ]:

	Student ID	Study Hours per Week	Attendance Rate	Previous Grades	Participation in Extracurricular Activities	Parent Education Level	Passed
0	S00001	12.50	NaN	75.00	Yes	Master	Yes
1	S00002	9.30	95.30	60.60	No	High School	No
2	S00003	13.20	NaN	64.00	No	Associate	No
3	S00004	17.60	76.80	62.40	Yes	Bachelor	No
4	S00005	8.80	89.30	72.70	No	Master	No

In [ ]:
```
student_performance_df.describe() # Statistical info about dataset
```

Out[ ]:

	Study Hours per Week	Attendance Rate	Previous Grades
count	38005.00	38008.00	38006.00
mean	9.96	75.28	65.44
std	5.03	20.39	16.50
min	-12.30	-14.30	8.30
25%	6.60	61.60	55.10
50%	10.00	75.30	65.20
75%	13.40	88.80	75.20
max	32.40	150.20	200.00

Data Preprocessing

In [ ]:
```
# Map 'yes' to 1 and 'no' to 0
student_performance_df['Passed'] = student_performance_df['Passed'].map({'Ye
student_performance_df['Participation in Extracurricular Activities'] = stuc
```

In [ ]:
```
from sklearn.preprocessing import OrdinalEncoder
import numpy as np
encoder = OrdinalEncoder(categories=[['High School', 'Bachelor', 'Master','A
student_performance_df['Parent Education Level'] = encoder.fit_transform(stu
```

In [ ]:
```
student_performance_df.head()
```

Out[ ]:

	Student ID	Study Hours per Week	Attendance Rate	Previous Grades	Participation in Extracurricular Activities	Parent Education Level	Passed
0	S00001	12.50	NaN	75.00	1.00	2.00	1.00
1	S00002	9.30	95.30	60.60	0.00	0.00	0.00
2	S00003	13.20	NaN	64.00	0.00	3.00	0.00
3	S00004	17.60	76.80	62.40	1.00	1.00	0.00
4	S00005	8.80	89.30	72.70	0.00	2.00	0.00

In [ ]:
```
student_performance_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 40000 entries, 0 to 39999
Data columns (total 7 columns):
 #   Column                                      Non-Null Count  Dtype  
---  ------                                      --------------  -----  
 0   Student ID                                  40000 non-null  object 
 1   Study Hours per Week                        38005 non-null  float64
 2   Attendance Rate                             38008 non-null  float64
 3   Previous Grades                             38006 non-null  float64
 4   Participation in Extracurricular Activities  38000 non-null  float64
 5   Parent Education Level                      38000 non-null  float64
 6   Passed                                      38000 non-null  float64
dtypes: float64(6), object(1)
memory usage: 2.1+ MB
```

Data Cleaning

In [ ]:
```
# Replace null values in 'Passed','Participation in Extracurricular Activiti
student_performance_df['Passed'].fillna(0, inplace=True)
student_performance_df['Participation in Extracurricular Activities'].fillna
student_performance_df['Parent Education Level'].fillna(0, inplace=True)
```

```
/tmp/ipython-input-12-1938445274.py:2: FutureWarning: A value is trying to b
e set on a copy of a DataFrame or Series through chained assignment using an
inplace method.
The behavior will change in pandas 3.0. This inplace method will never work
because the intermediate object on which we are setting values always behave
s as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using 'd
f.method({col: value}, inplace=True)' or df[col] = df[col].method(value) ins
tead, to perform the operation inplace on the original object.


  student_performance_df['Passed'].fillna(0, inplace=True)
/tmp/ipython-input-12-1938445274.py:3: FutureWarning: A value is trying to b
e set on a copy of a DataFrame or Series through chained assignment using an
inplace method.
The behavior will change in pandas 3.0. This inplace method will never work
because the intermediate object on which we are setting values always behave
s as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using 'd
f.method({col: value}, inplace=True)' or df[col] = df[col].method(value) ins
tead, to perform the operation inplace on the original object.


  student_performance_df['Participation in Extracurricular Activities'].fill
na(0, inplace=True)
/tmp/ipython-input-12-1938445274.py:4: FutureWarning: A value is trying to b
e set on a copy of a DataFrame or Series through chained assignment using an
inplace method.
The behavior will change in pandas 3.0. This inplace method will never work
because the intermediate object on which we are setting values always behave
s as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using 'd
f.method({col: value}, inplace=True)' or df[col] = df[col].method(value) ins
tead, to perform the operation inplace on the original object.


  student_performance_df['Parent Education Level'].fillna(0, inplace=True)
```

In [ ]:
```
student_performance_df.isna().sum()
```

Out[ ]:

	0
Student ID	0
Study Hours per Week	1995
Attendance Rate	1992
Previous Grades	1994
Participation in Extracurricular Activities	0
Parent Education Level	0
Passed	0

dtype: int64

In [ ]:
```
# Convert 'Passed','Participation in Extracurricular Activities' and 'Parent
student_performance_df['Passed'] = student_performance_df['Passed'].astype(i
student_performance_df['Parent Education Level'] = student_performance_df['P
student_performance_df['Participation in Extracurricular Activities'] = stud
```

In [ ]:
```
student_performance_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 40000 entries, 0 to 39999
Data columns (total 7 columns):
 #   Column                                      Non-Null Count  Dtype
---  ------                                      --------------  -----
 0   Student ID                                  40000 non-null  object
 1   Study Hours per Week                        38005 non-null  float64
 2   Attendance Rate                             38008 non-null  float64
 3   Previous Grades                             38006 non-null  float64
 4   Participation in Extracurricular Activities 40000 non-null  int64
 5   Parent Education Level                      40000 non-null  int64
 6   Passed                                      40000 non-null  int64
dtypes: float64(3), int64(3), object(1)
memory usage: 2.1+ MB
```

In [ ]:
```
student_performance_df.head()
```

Out[ ]:

	Student ID	Study Hours per Week	Attendance Rate	Previous Grades	Participation in Extracurricular Activities	Parent Education Level	Passed
0	S00001	12.50	NaN	75.00	1	2	1
1	S00002	9.30	95.30	60.60	0	0	0
2	S00003	13.20	NaN	64.00	0	3	0
3	S00004	17.60	76.80	62.40	1	1	0
4	S00005	8.80	89.30	72.70	0	2	0

In [ ]:
```
# Remove rows with missing data in relevant columns 'Study Hours per Week' a
student_performance_df.dropna(subset=['Study Hours per Week','Attendance Rat
```

In [ ]:
```
student_performance_df.isna().sum() # Find sum of missing values
```

Out[ ]:

	0
Student ID	0
Study Hours per Week	0
Attendance Rate	0
Previous Grades	1793
Participation in Extracurricular Activities	0
Parent Education Level	0
Passed	0

dtype: int64

In [ ]:
```
student_performance_df.fillna(0, inplace=True)  # Replace missing value with
```

In [ ]:
```
print(student_performance_df.isna().sum().sum())  # Find sum of missing valu
```

```
0
```

In [ ]:
```
print(student_performance_df.duplicated().sum())  # Find sum of duplicated v
```

```
0
```

Since, sum of duplicated values is zero, so there is no need to drop duplicates.

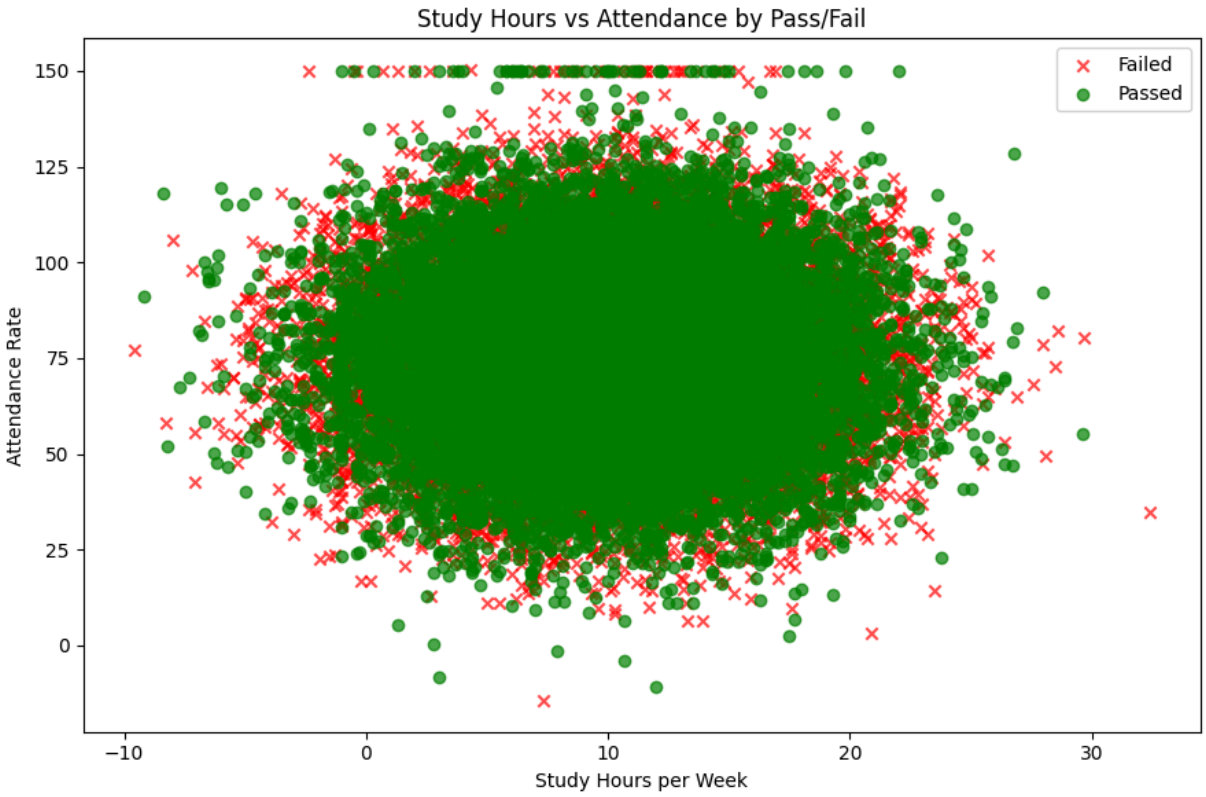
Data Exploration

In [ ]:
```
# Plot the relationship between Study Hours, Attendance, and Pass to visuali
plt.figure(figsize=(9, 6))
colors = student_performance_df['Passed'].map({1: 'green', 0: 'red'})
markers = student_performance_df['Passed'].map({1: 'o', 0: 'x'})

for p in [0, 1]:
    plt.scatter(
        student_performance_df[student_performance_df['Passed'] == p]['Study
        student_performance_df[student_performance_df['Passed'] == p]['Atter
        alpha=0.7,
        c='green' if p == 1 else 'red',
        label='Passed' if p == 1 else 'Failed',
        marker='o' if p == 1 else 'x'
    )

plt.xlabel('Study Hours per Week')
plt.ylabel('Attendance Rate')
```

```
plt.title('Study Hours vs Attendance by Pass/Fail')
plt.legend()
plt.tight_layout()
plt.show()
```



Model training and evaluation

In [ ]:
```
# Select features and target, handle missing values and target conversions
X = student_performance_df[['Study Hours per Week', 'Attendance Rate']]
y = student_performance_df['Passed']

# Split into training and test datasets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, rar

# Instantiate and train logistic regression model
model = LogisticRegression()
model.fit(X_train, y_train)

# Model predictions
y_pred = model.predict(X_test)

# Print Evaluation metrics
print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("\nAccuracy Score:", accuracy_score(y_test, y_pred))

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

```
Confusion Matrix:
[[3803    1]
 [3419    0]]

Accuracy Score: 0.5265125294199087

Classification Report:
              precision    recall  f1-score   support

           0       0.53      1.00      0.69      3804
           1       0.00      0.00      0.00      3419

    accuracy                           0.53      7223
   macro avg       0.26      0.50      0.34      7223
weighted avg       0.28      0.53      0.36      7223
```

Key predictors of student performance

In [ ]:
```python
from sklearn.ensemble import RandomForestClassifier

# Define features and target
exclude_cols = ['Student ID', 'Passed']  # Exclude ID and target from featur
features = [col for col in student_performance_df.columns if col not in excl


X = student_performance_df[features]
y = student_performance_df['Passed']

# Train a Random Forest Classifier
model = RandomForestClassifier(random_state=42)
model.fit(X, y)

# Feature importance
importances = model.feature_importances_
feature_ranking = sorted(zip(features, importances), key=lambda x: x[1], rev

print("Key Predictors of Student Performance:")
for feature, importance in feature_ranking:
    print(f"{feature}: {importance:.3f}")
```

```
Key Predictors of Student Performance:
Attendance Rate: 0.333
Previous Grades: 0.315
Study Hours per Week: 0.287
Parent Education Level: 0.046
Participation in Extracurricular Activities: 0.020
```

In [ ]:
```python
# Create plot for key predictors of student performance
feature_names = X.columns

# Sort features by importance
indices = importances.argsort()[::-1]
sorted_features = feature_names[indices]
```

```
sorted_importances = importances[indices]

# Plot
plt.figure(figsize=(10,6))
plt.barh(sorted_features, sorted_importances, color='skyblue')
plt.xlabel("Importance Score")
plt.title("Feature Importance for Predicting Student Performance")
plt.gca().invert_yaxis()  # Highest at top
plt.tight_layout()
plt.show()
```