□ Student Performance Predictor

This notebook analyzes student performance based on various factors and builds a machine learning model to predict final grades (G3).

```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.ensemble import RandomForestRegressor
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_absolute_error, mean_squared_error,
r2_score

df = pd.read_csv("student-math.csv")
df.head()
```

```
  school sex  age address famsize Pstatus  Medu  Fedu     Mjob
Fjob  ...  \
0     GP   F   18       U     GT3       A     4     4  at_home
teacher  ...
1     GP   F   17       U     GT3       T     1     1  at_home
other  ...
2     GP   F   15       U     LE3       T     1     1  at_home
other  ...
3     GP   F   15       U     GT3       T     4     2   health
services  ...
4     GP   F   16       U     GT3       T     3     3    other
other  ...

  famrel freetime  goout  Dalc  Walc health absences  G1  G2  G3
0      4        3      4     1     1      3        6   5   6   6
1      5        3      3     1     1      3        4   5   5   6
2      4        3      2     2     3      3       10   7   8  10
3      3        2      2     1     1      5        2  15  14  15
4      4        3      2     1     2      5        4   6  10  10

[5 rows x 33 columns]
```

□ Data Preprocessing

Handling missing values, encoding categorical variables, and selecting relevant features.

```
# Encode categorical features
label_encoders = {}
```

```
categorical_columns = df.select_dtypes(include=['object']).columns
for col in categorical_columns:
    le = LabelEncoder()
    df[col] = le.fit_transform(df[col])
    label_encoders[col] = le

X = df.drop(columns=['G3'])  # Features
y = df['G3']  # Target Variable
X_train, X_test, y_train, y_test = train_test_split(X, y, 
test_size=0.2, random_state=42)
```

🤖 Model Training & Evaluation

Training models and evaluating their performance.

```
# Train Linear Regression Model
lr = LinearRegression()
lr.fit(X_train, y_train)
y_pred_lr = lr.predict(X_test)

# Evaluation
mae = mean_absolute_error(y_test, y_pred_lr)
mse = mean_squared_error(y_test, y_pred_lr)
r2 = r2_score(y_test, y_pred_lr)
print(f'Linear Regression - MAE: {mae:.2f}, MSE: {mse:.2f}, R²: 
{r2:.2f}')
```

```
Linear Regression - MAE: 1.50, MSE: 5.03, R²: 0.75
```

```
# Train Random Forest Model
rf = RandomForestRegressor(n_estimators=100, random_state=42)
rf.fit(X_train, y_train)
y_pred_rf = rf.predict(X_test)

# Evaluation
mae_rf = mean_absolute_error(y_test, y_pred_rf)
mse_rf = mean_squared_error(y_test, y_pred_rf)
r2_rf = r2_score(y_test, y_pred_rf)
print(f'Random Forest - MAE: {mae_rf:.2f}, MSE: {mse_rf:.2f}, R²: 
{r2_rf:.2f}')
```

```
Random Forest - MAE: 1.11, MSE: 3.49, R²: 0.83
```

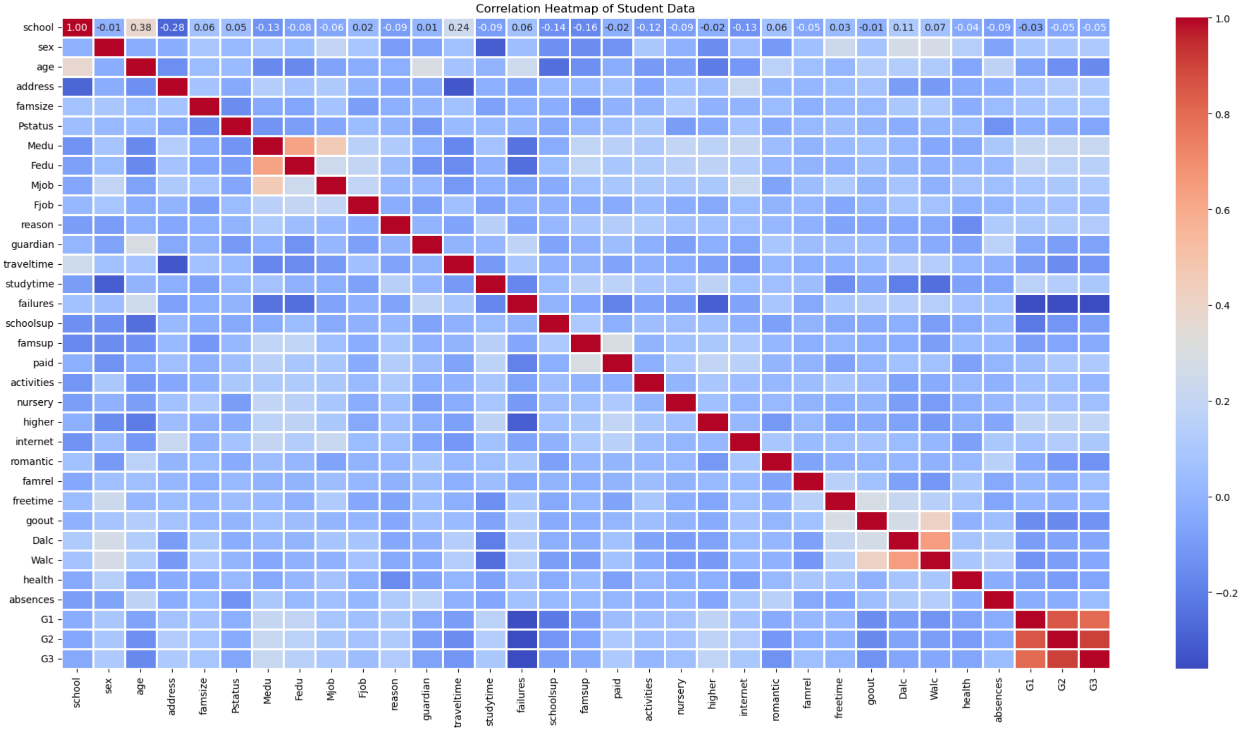
▯ Conclusion

- The model predicts student performance based on various factors.
- Random Forest generally performs better than Linear Regression.
- Feature selection and hyperparameter tuning can improve accuracy.

▯ Correlation Heatmap

This heatmap shows how different features correlate with the final grade (G3).

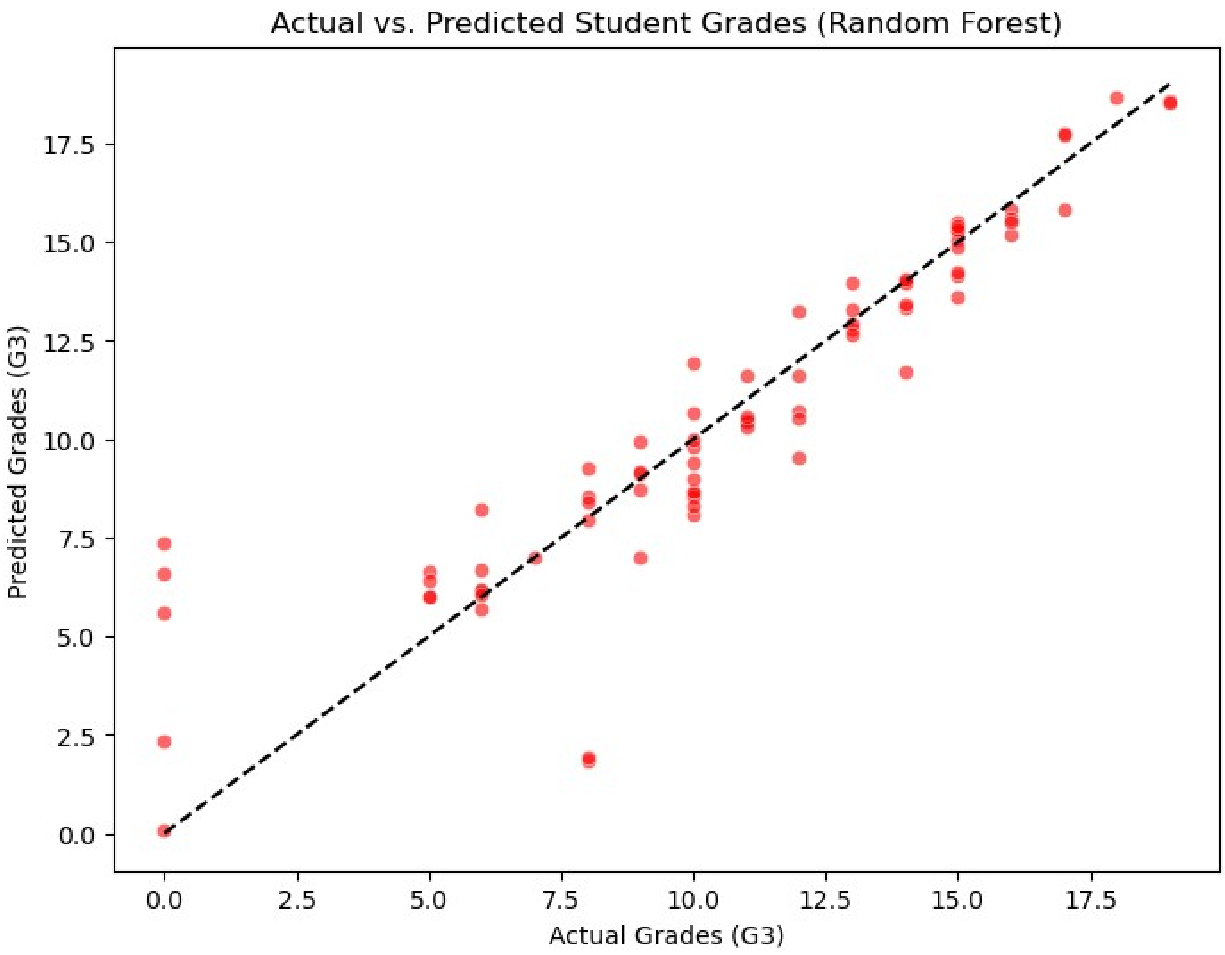
```
plt.figure(figsize=(24,12))
sns.heatmap(df.corr(), annot=True, cmap='coolwarm', fmt='.2f',
linewidths=0.85)
plt.title('Correlation Heatmap of Student Data')
plt.show()
```



▯ Actual vs. Predicted Grades

Comparing the actual student grades (G3) with the predicted grades.

```
plt.figure(figsize=(8,6))
sns.scatterplot(x=y_test, y=y_pred_rf, color='red', alpha=0.6)
plt.plot([min(y_test), max(y_test)], [min(y_test), max(y_test)],
color='black', linestyle='--')  # Perfect predictions line
plt.xlabel('Actual Grades (G3)')
plt.ylabel('Predicted Grades (G3)')
plt.title('Actual vs. Predicted Student Grades (Random Forest)')
plt.show()
```

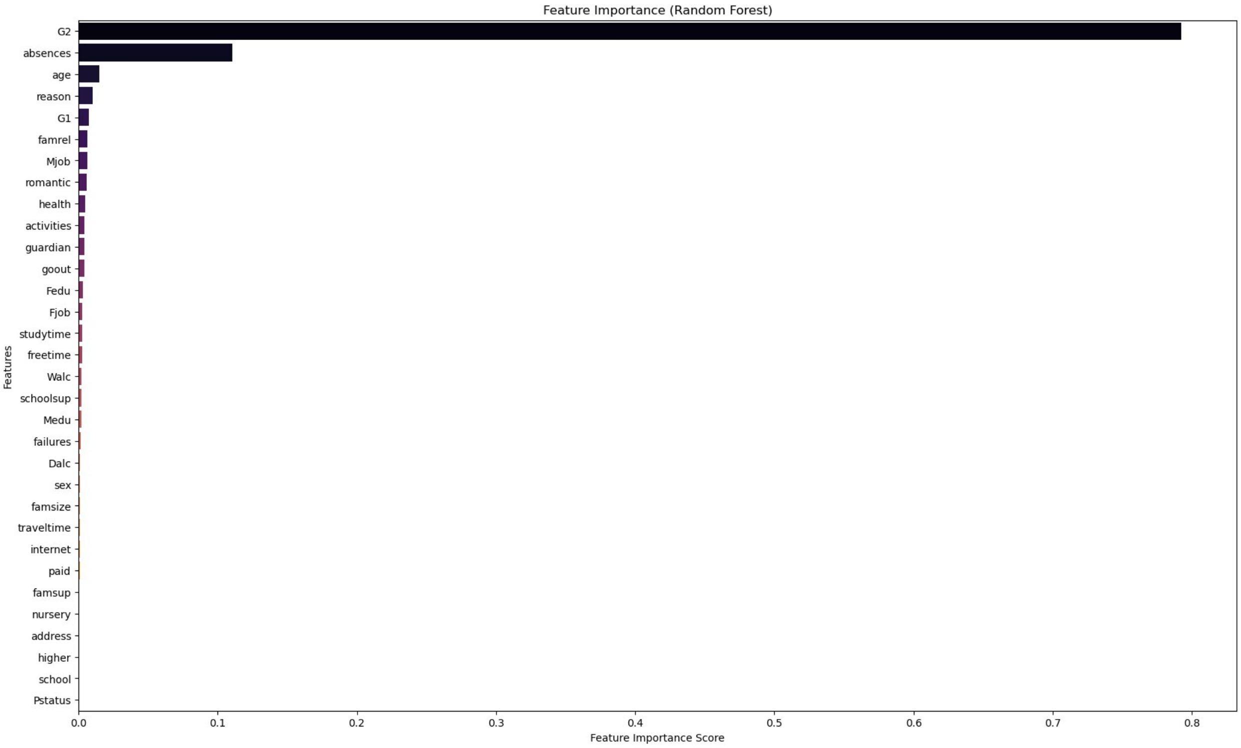


Feature Importance (Random Forest)

Shows which features have the most impact on predicting student grades.

```
feature_importances = pd.Series(rf.feature_importances_,
index=X.columns)
feature_importances = feature_importances.sort_values(ascending=False)

plt.figure(figsize=(20,12))
sns.barplot(x=feature_importances, y=feature_importances.index,
palette='inferno')
plt.xlabel('Feature Importance Score')
plt.ylabel('Features')
plt.title('Feature Importance (Random Forest)')
plt.show()
```



```
#Enter student details for prediction:
#Enter value for school: GP
#Enter value for sex: F
#Enter value for age: 17
#Enter value for address: U
#Enter value for famsize: GT3
#Enter value for Pstatus: T
#Enter value for Medu: 4
#Enter value for Fedu: 2
#Enter value for Mjob: teacher
#Enter value for Fjob: other
#Enter value for reason: course
#Enter value for guardian: mother
#Enter value for traveltime: 1
#Enter value for studytime: 2
#Enter value for failures: 0
#Enter value for schoolsup: no
#Enter value for famsup: yes
#Enter value for paid: no
#Enter value for activities: yes
#Enter value for nursery: yes
#Enter value for higher: yes
#Enter value for internet: yes
#Enter value for romantic: no
#Enter value for famrel: 4
#Enter value for freetime: 3
#Enter value for goout: 2
```

```
#Enter value for Dalc: 1
#Enter value for Walc: 1
#Enter value for health: 5
#Enter value for absences: 4
#Enter value for G1: 12
#Enter value for G2: 13

#Predicted Final Grade (G3): 13.5


# Function for dynamic user input and prediction
def predict_student_performance():
    import numpy as np

    print("Enter student details for prediction:")

    X = df.drop(columns=['G3'])  # Features

    user_data = {}
    for col in X.columns:
        value = input(f"Enter value for {col}: ")
        try:
            user_data[col] = float(value)  # Convert numerical inputs
        except ValueError:
            if col in label_encoders:
                if value in label_encoders[col].classes_:
                    user_data[col] =
label_encoders[col].transform([value])[0]
                else:
                    print(f"Invalid input for {col}, defaulting to
0.")
                    user_data[col] = 0
            else:
                print(f"Invalid input for {col}, defaulting to 0.")
                user_data[col] = 0

    # Convert to DataFrame
    user_df = pd.DataFrame([user_data])

    # Make prediction
    prediction = rf.predict(user_df)
    print(f"Predicted Final Grade (G3): {prediction[0]:.2f}")

# Run the function to take user input
predict_student_performance()
```

```
Enter student details for prediction:

Enter value for school:  GP
Enter value for sex:  F
Enter value for age:  17
Enter value for address:  U
Enter value for famsize:  GT3
Enter value for Pstatus:  T
Enter value for Medu:  4
Enter value for Fedu:  2
Enter value for Mjob:  teacher
Enter value for Fjob:  other
Enter value for reason:  course
Enter value for guardian:  mother
Enter value for traveltime:  1
Enter value for studytime:  2
Enter value for failures:  0
Enter value for schoolsup:  no
Enter value for famsup:  yes
Enter value for paid:  no
Enter value for activities:  yes
Enter value for nursery:  yes
Enter value for higher:  yes
Enter value for internet:  yes
Enter value for romantic:  no
Enter value for famrel:  4
Enter value for freetime:  3
Enter value for goout:  2
Enter value for Dalc:  1
Enter value for Walc:  1
Enter value for health:  5
Enter value for absences:  4
Enter value for G1:  12
Enter value for G2:  13

Predicted Final Grade (G3): 12.50
```