Intelligent Systems | HS2025 | SW05

Example of simple linear regression with python, SW05 lecture

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Forecasting Students Grade

1. Import Libraries

In [14]:
```
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.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score

# Set Seaborn style for plots
sns.set_style('whitegrid')
```

2. Load Data

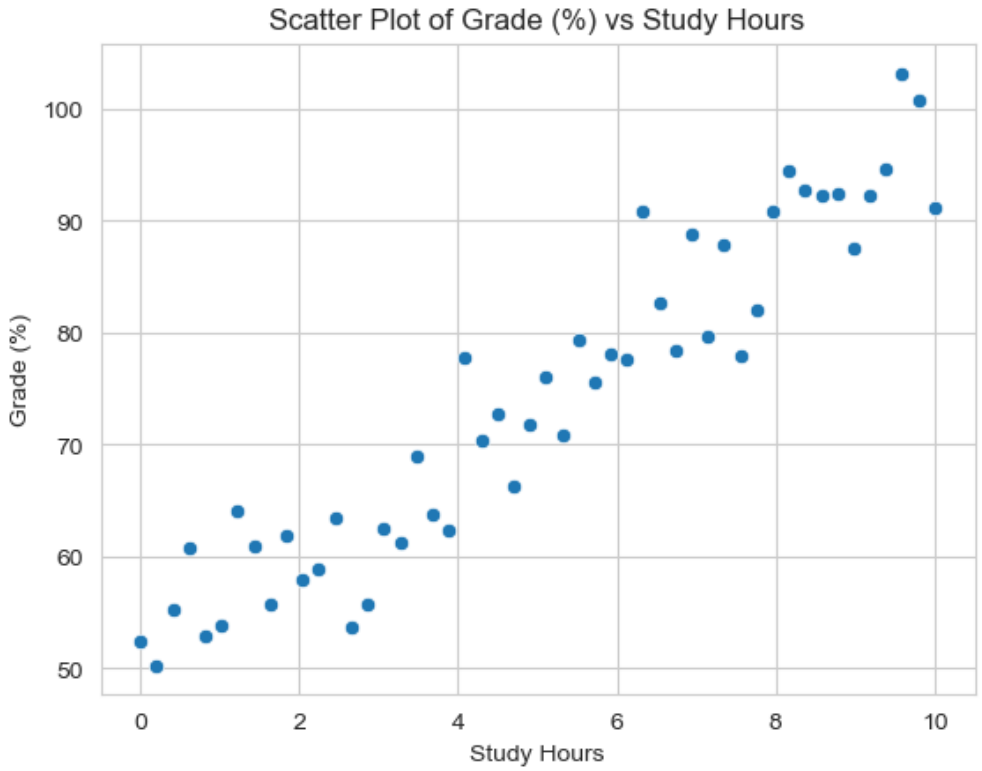
In [15]:
```
# Load the uploaded data from the CSV file
data = pd.read_csv('study_hours_grades_50.csv')

# Display the first few rows of the DataFrame to understand the structure
data.head()
```

Out[15]:

	Study Hours	Grade (%)
0	0.00	52.5
1	0.20	50.3
2	0.41	55.3
3	0.61	60.7
4	0.82	52.9

3. Visualize Data

In [16]:
```
# Scatter plot to visualize the relationship between Gas Pumps and Sales per Year
sns.scatterplot(x='Study Hours', y='Grade (%)', data=data)
plt.xlabel('Study Hours')
plt.ylabel('Grade (%)')
plt.title('Scatter Plot of Grade (%) vs Study Hours')
plt.show()
```



4. Prepare Data

In [17]:
```
# Separate the features/independent variables (Study Hours) and the target/dependent variable
X = data[['Study Hours']].values
y = data['Grade (%)'].values
```

In [18]:
```
# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=0)
```

5. Train The Model

In [19]:
```
# Initialize the Linear Regression model
model = LinearRegression()

# Fit (or learn) the model to the training data
model.fit(X_train, y_train)
```

Out[19]:
```
▾ LinearRegression
LinearRegression()
```

6. Display Slope and Intercept

In [20]:
```
# Display the slope (coefficient) and intercept of the trained model
print(f'Coefficient (Slope): {model.coef_[0]:.2f}')
print(f'Intercept: {model.intercept_:.2f}')
```

```
Coefficient (Slope): 4.67
Intercept: 50.27
```

7. Make Predictions

In [21]:
```
# Predict the target variable for the test set
y_pred = model.predict(X_test)
```

8. Evaluate The Model

In [22]:
```
print(f'Test Data (How many study hours):\n{X_test}\n')
print(f'Predictions from trained model (Predicted grade (%)):\n {y_pred}')
```

```
Test Data (How many study hours):
[[5.71]
 [2.24]
 [2.04]
 [8.37]
 [0.41]
 [5.51]
 [7.76]
 [6.33]
 [4.49]
 [0.82]]

Predictions from trained model (Predicted grade (%)):
 [76.96039036 60.73945819 59.80453415 89.39488015 52.18490319 76.02546632
 86.54336182 79.8586549  71.25735369 54.10149748]
```

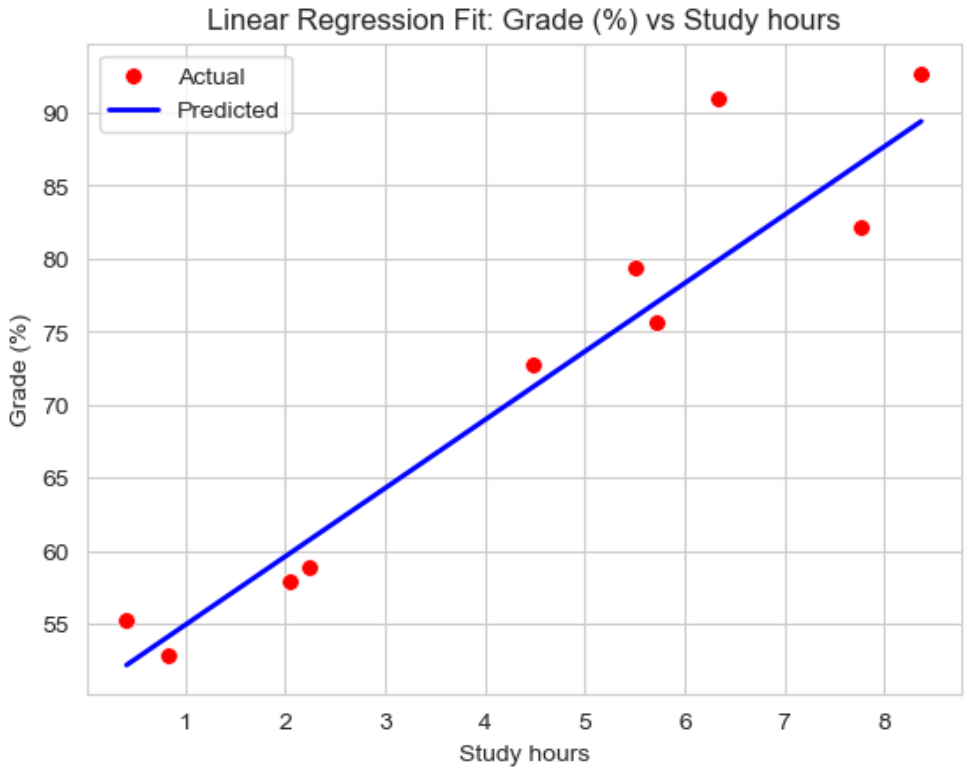
9. Calculate Mean Squared Error and R-squared

In [23]:
```
# Calculate Mean Squared Error and R-squared
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)

# Output the evaluation metrics
print(f'Mean Squared Error: {mse:.2f}')
print(f'R-squared: {r2:.2f}')
```

```
Mean Squared Error: 18.64
R-squared: 0.91
```

10. Visualize the Linear Regression Line

In [24]:
```
# Create a scatter plot for the actual data points
sns.scatterplot(x=X_test.flatten(), y=y_test, color='red', label='Actual', s=50)

# Create a line plot for the regression line (predicted values)
sns.lineplot(x=X_test.flatten(), y=y_pred, color='blue', linewidth=2, label='Predicted')

# Label the plot
plt.xlabel('Study hours')
plt.ylabel('Grade (%)')
plt.title('Linear Regression Fit: Grade (%) vs Study hours')
plt.legend()
plt.show()
```



In [25]:
```
# New grade with 2.5 hours of study
new_study = np.array([[2.5]])

# Use the trained model to predict sales for the new gas station
predicted_grade = model.predict(new_study)

# Output the prediction
print(f'Predicted Grade for a 2.5 hours of study: {predicted_grade[0]:.2f} (in %)')
```

```
Predicted Grade for a 2.5 hours of study: 61.95 (in %)
```

In [ ]: