7. Develop a program to demonstrate the working of Linear Regression and Polynomial Regression. Use Boston Housing Dataset for Linear Regression and Auto MPG Dataset (for vehicle fuel efficiency prediction) for Polynomial Regression.

Linear Regression

```
import numpy as np
import matplotlib.pyplot as plt
from sklearn.datasets import fetch_california_housing
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.preprocessing import PolynomialFeatures
from sklearn.metrics import mean_squared_error, r2_score

# Step 1: Load the California Housing Dataset
california = fetch_california_housing()
X = california.data
y = california.target

# Step 2: Split the dataset into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Step 3: Linear Regression
# Create a Linear Regression model
linear_model = LinearRegression()

# Train the model
linear_model.fit(X_train, y_train)

# Make predictions
y_pred_linear = linear_model.predict(X_test)

# Evaluate the model
mse_linear = mean_squared_error(y_test, y_pred_linear)
r2_linear = r2_score(y_test, y_pred_linear)

print("Linear Regression:")
print(f"Mean Squared Error: {mse_linear}")
```

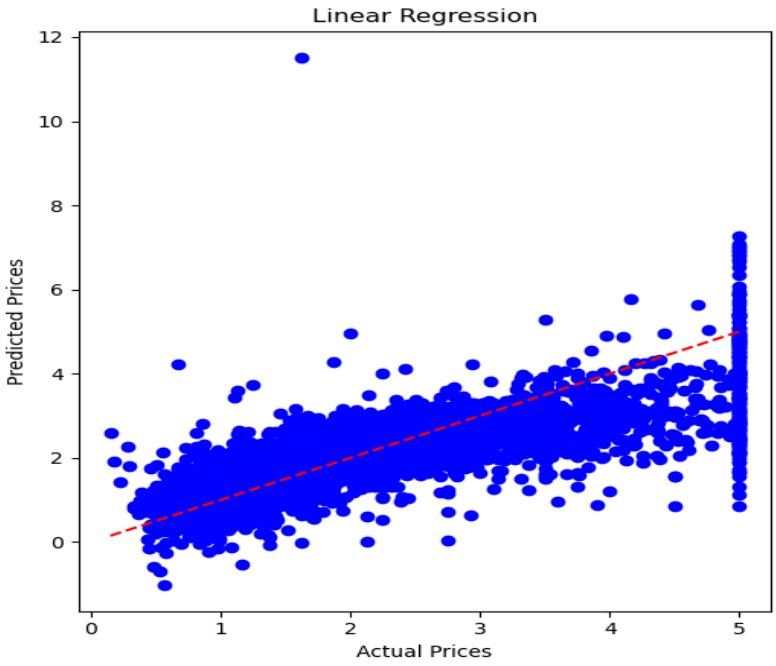
```
print(f"R^2 Score: {r2_linear}")

# Step 4: Visualization
# Plot the results
plt.figure(figsize=(10, 6))
# Plot Linear Regression results
plt.subplot(1, 2, 1)
plt.scatter(y_test, y_pred_linear, color='blue')
plt.plot([min(y_test), max(y_test)], [min(y_test), max(y_test)], color='red', linestyle='--')
plt.title('Linear Regression')
plt.xlabel('Actual Prices')
plt.ylabel('Predicted Prices')
plt.tight_layout()
plt.show()
```

Output

Mean Squared Error: 0.555891598695242

R^2 Score: 0.5757877060324526



Polynomial Regression

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import PolynomialFeatures, StandardScaler
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error

# Load dataset
dataset_url = "https://archive.ics.uci.edu/ml/machine-learning-databases/auto-mpg/auto-mpg.data"
columns = ["mpg", "cylinders", "displacement", "horsepower", "weight", "acceleration", "model_year", "origin"]
df = pd.read_csv(dataset_url, delim_whitespace=True, names=columns, na_values='?')
# Drop rows with missing values
df.dropna(inplace=True)
# Convert 'horsepower' column to numeric
df['horsepower'] = df['horsepower'].astype(float)
# Features and target selection
X = df[['displacement', 'horsepower', 'weight', 'acceleration']]
y = df['mpg']
# Split the dataset
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
# Polynomial transformation
degree = 2
poly = PolynomialFeatures(degree=degree)
X_train_poly = poly.fit_transform(X_train)
X_test_poly = poly.transform(X_test)
# Feature Scaling
scaler = StandardScaler()
X_train_poly = scaler.fit_transform(X_train_poly)
```

```
X_test_poly = scaler.transform(X_test_poly)
# Train the Polynomial Regression model
model = LinearRegression()
model.fit(X_train_poly, y_train)
# Predictions
y_pred = model.predict(X_test_poly)
# Evaluate the model
mse = mean_squared_error(y_test, y_pred)
print(f"Mean Squared Error: {mse:.2f}")
# Visualization (for single feature: weight vs mpg)
plt.scatter(X_test['weight'], y_test, color='blue', label='Actual')
plt.scatter(X_test['weight'], y_pred, color='red', label='Predicted', alpha=0.5)
plt.xlabel('Weight')
plt.ylabel('MPG')
plt.title('Polynomial Regression: Weight vs MPG')
plt.legend()
plt.show()
```

Output

Mean Squared Error: 0.47