jupyter A2 Last Checkpoint: 2 minutes ago

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Code JupyterLab No Kernel

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[1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.datasets import load_diabetes
from sklearn.metrics import mean_squared_error
```

[2]:
```
diabetes = load_diabetes()
X = diabetes.data[:, 0].reshape(-1, 1)
y = diabetes.target
print('this is x' , X)
print('this is label(Y)' , y)
```

```
this is x [[ 0.03807591]
 [-0.00188202]
 [ 0.08529891]
 [-0.08906294]
 [ 0.00538306]
 [-0.09269548]
 [-0.04547248]
 [ 0.06350368]
 [ 0.04170844]
 [-0.07090025]
 [-0.09632802]
 [ 0.02717829]
 [ 0.01628068]
 [ 0.00538306]
 [ 0.04534098]
 [-0.05273755]
 [-0.00551455]
 [ 0.07076875]
```

[3]:
```
# Split data into training and test set

X_train, X_test = X[:40], X[-40:]
y_train, y_test = y[:40], y[-40:]

print("Training samples:", X_train.shape[0],X_train)
print("Testing samples:", X_test.shape[0],X_test)
print("Training target:", y_train.shape[0],y_train)
print("Testing target:", y_test.shape[0],y_test)
```

```
Training samples: 40 [[ 0.03807591]
 [-0.00188202]
 [ 0.08529891]
 [-0.08906294]
 [ 0.00538306]
 [-0.09269548]
 [-0.04547248]
 [ 0.06350368]
 [ 0.04170844]
 [-0.07090025]
 [-0.09632802]
 [ 0.02717829]
 [ 0.01628068]
 [ 0.00538306]
 [ 0.04534098]
 [-0.05273755]
 [-0.00551455]
 [ 0.07076875]
 [-0.0382074 ]
 [-0.02730979]
 [-0.04910502]
 [-0.0854304 ]
 [-0.0854304 ]
 [ 0.04534098]
 [-0.06363517]
 [-0.06726771]
 [-0.10722563]
 [-0.02367725]
 [ 0.05260606]
 [ 0.06713621]
 [-0.06000263]
 [-0.02367725]
 [ 0.03444337]
 [ 0.03081083]
 [ 0.01628068]
 [ 0.04897352]
 [ 0.01264814]
 [-0.00914709]
 [-0.00188202]
 [-0.00188202]]
Testing samples: 40 [[ 0.11072668]
 [-0.02004471]
 [-0.01641217]
 [ 0.04897352]
 [-0.05637009]
 [ 0.02717829]
 [ 0.06350368]
 [-0.05273755]
 [-0.00914709]
 [ 0.00538306]
 [ 0.07440129]
 [-0.05273755]
 [ 0.08166637]
 [-0.00551455]
 [-0.02730979]
 [-0.05273755]
 [ 0.0090156 ]
 [-0.02004471]
 [ 0.02354575]
 [ 0.03807591]
 [-0.07816532]
 [ 0.0090156 ]
 [ 0.00175052]
 [-0.07816532]
 [ 0.03081083]
 [-0.03457486]
 [ 0.04897352]
 [-0.04183994]
 [-0.00914709]
 [ 0.07076875]
 [ 0.0090156 ]
 [-0.02730979]
 [ 0.01628068]
 [-0.01277963]
 [-0.05637009]
 [ 0.04170844]
 [-0.00551455]
 [ 0.04170844]
 [-0.04547248]
 [-0.04547248]]
```

```
Training target: 40 [151.  75. 141. 206. 135.  97. 138.  63. 110. 310. 101.  69. 179. 185.
 118. 171. 166. 144.  97. 168.  68.  49.  68. 245. 184. 202. 137.  85.
 131. 283. 129.  59. 341.  87.  65. 102. 265. 276. 252.  90.]
Testing target: 40 [168. 275. 293. 281.  72. 140. 189. 181. 209. 136. 261. 113. 131. 174.
 257.  55.  84.  42. 146. 212. 233.  91. 111. 152. 120.  67. 310.  94.
 183.  66. 173.  72.  49.  64.  48. 178. 104. 132. 220.  57.]
```

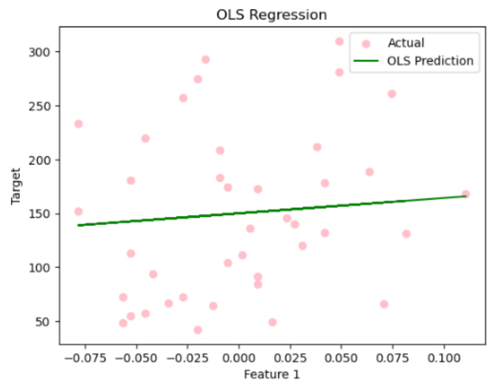
[4]:

```python
def ols_fit(X, y):
    X_bias = np.hstack((np.ones((X.shape[0], 1)), X))
    beta = np.linalg.inv(X_bias.T @ X_bias) @ X_bias.T @ y
    return beta

def ols_predict(X, beta):
    X_bias = np.hstack((np.ones((X.shape[0], 1)), X))
    return X_bias @ beta

beta_ols = ols_fit(X_train, y_train)
y_pred_ols = ols_predict(X_test, beta_ols)

# Calculate MSE
mse_ols = mean_squared_error(y_test, y_pred_ols)

print("OLS Coefficients:", beta_ols)
print("OLS Mean Squared Error:", mse_ols)
```

```
OLS Coefficients: [149.94060574 142.14820865]
OLS Mean Squared Error: 5547.6208521530625
```

[5]:

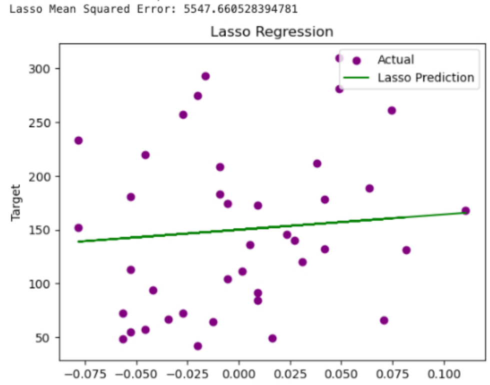
```python
#plot it

plt.scatter(X_test, y_test, label="Actual", color= 'pink')
plt.plot(X_test, y_pred_ols, color='green', label="OLS Prediction")
plt.xlabel("Feature 1")
plt.ylabel("Target")
plt.title("OLS Regression")
plt.legend()
plt.show()
```



[6]:

```python
def lasso_fit(X, y, alpha, num_iter=1000, lr=0.01):
    X_bias = np.hstack((np.ones((X.shape[0], 1)), X))
    beta = np.zeros(X_bias.shape[1])

    for _ in range(num_iter):
        error = y - X_bias @ beta
        beta[0] += lr * np.sum(error)

        for j in range(1, len(beta)):
            ro = X_bias[:, j].T @ (y - X_bias @ beta + beta[j] * X_bias[:, j])
            if ro < -alpha / 2:
                beta[j] = (ro + alpha / 2) / (X_bias[:, j]**2).sum()
            elif ro > alpha / 2:
                beta[j] = (ro - alpha / 2) / (X_bias[:, j]**2).sum()
            else:
                beta[j] = 0
    return beta

alpha = 0.01  # Regularization parameter
beta_lasso = lasso_fit(X_train, y_train, alpha)
y_pred_lasso = ols_predict(X_test, beta_lasso)
mse_lasso = mean_squared_error(y_test, y_pred_lasso)

print("Lasso Coefficients (alpha=0.01):", beta_lasso)
print("Lasso Mean Squared Error:", mse_lasso)
#plotting
plt.scatter(X_test, y_test, label="Actual", color ='purple')
plt.plot(X_test, y_pred_lasso, color='green', label="Lasso Prediction")
plt.xlabel("Feature 1")
plt.ylabel("Target")
plt.title("Lasso Regression")
plt.legend()
plt.show()
```

```
Lasso Coefficients (alpha=0.01): [149.94017248 142.10392022]
Lasso Mean Squared Error: 5547.660528394781
```

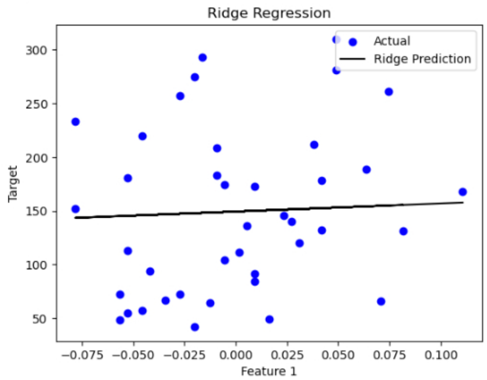


[7]:

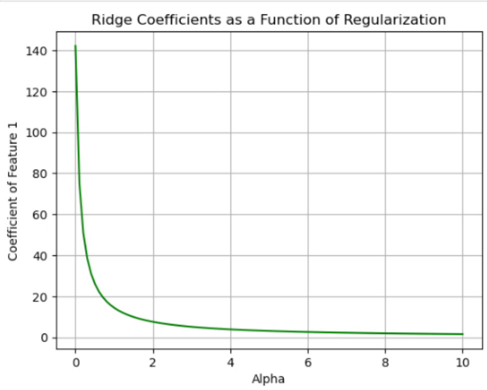
```python
def ridge_fit(X, y, alpha):
    X_bias = np.hstack((np.ones((X.shape[0], 1)), X))
    identity = np.eye(X_bias.shape[1])
    identity[0, 0] = 0
    beta = np.linalg.inv(X_bias.T @ X_bias + alpha * identity) @ X_bias.T @ y
```

```
    return beta

alpha_ridge = 0.1  # Regularization parameter that we can change
beta_ridge = ridge_fit(X_train, y_train, alpha_ridge)
y_pred_ridge = ols_predict(X_test, beta_ridge)
mse_ridge = mean_squared_error(y_test, y_pred_ridge)

print("Ridge Coefficients (alpha=0.1):", beta_ridge)
print("Ridge Mean Squared Error:", mse_ridge)
# plot it!
plt.scatter(X_test, y_test, label="Actual",color="blue")
plt.plot(X_test, y_pred_ridge, color='black', label="Ridge Prediction")
plt.xlabel("Feature 1")
plt.ylabel("Target")
plt.title("Ridge Regression")
plt.legend()
plt.show()
```

```
Ridge Coefficients (alpha=0.1): [149.28742126  75.37946082]
Ridge Mean Squared Error: 5617.113968866777
```



[8]:
```
alphas = np.linspace(0, 10, 100)
coefs = []

for alpha in alphas:
    beta = ridge_fit(X_train, y_train, alpha)
    coefs.append(beta[1])

plt.plot(alphas, coefs, color='green')
plt.xlabel("Alpha")
plt.ylabel("Coefficient of Feature 1")
plt.title("Ridge Coefficients as a Function of Regularization")
plt.grid(True)
plt.show()
```



[ ]: