sp21-bcs-017-A-
Muhammad_Haroon_Shahzad_assignment_1_ML

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1 SP21-BCS-017 SECTION A

1.1 MUHAMMAD HAROON SHAHZAD

1.2 INSTRUCTOR: DR ZEESHAN GILLANI

1.3 Assignmnet 1: Machine Learning

- apply multiple linear regression cost function, and gradient decen
- use 4 different learning rates to check iteration and accuracy
- u can use labs link share and modify code accordingly Github_Link

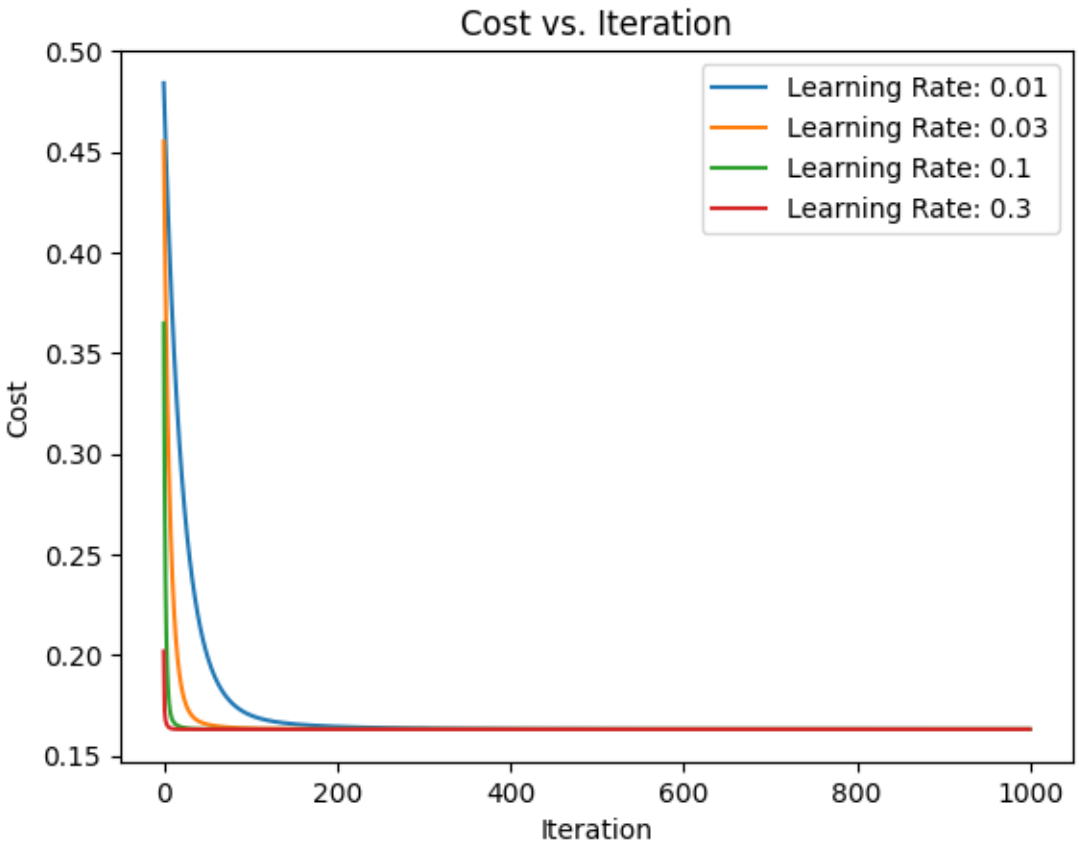
[ ]:
```
import copy
import math
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt

# Load the dataset
data = pd.read_csv('Housing.csv')

# Feature scaling
data = (data - data.mean()) / data.std()

# Extract the features and the target variable
X = data[['area', 'bedrooms', 'bathrooms', 'stories', 'mainroad', 'guestroom',␣
 ↪'basement', 'hotwaterheating', 'airconditioning', 'parking', 'prefarea']].
 ↪values
y = data['price'].values

# Add a column of ones to X to account for the intercept term
X = np.c_[np.ones(X.shape[0]), X]

# Apply multiple linear regression cost function and gradient descent

def compute_cost(X, y, w, b):
    m = X.shape[0]
```

```
    predictions = np.dot(X, w) + b
    cost = np.sum((predictions - y) ** 2) / (2 * m)
    return cost

def compute_gradient(X, y, w, b):
    m = X.shape[0]
    predictions = np.dot(X, w) + b
    errors = predictions - y
    grad_w = np.dot(X.T, errors) / m
    grad_b = np.sum(errors) / m
    return grad_w, grad_b

def gradient_descent(X, y, w, b, alpha, iterations):
    J_history = []
    for i in range(iterations):
        grad_w, grad_b = compute_gradient(X, y, w, b)
        w -= alpha * grad_w
        b -= alpha * grad_b
        cost = compute_cost(X, y, w, b)
        J_history.append(cost)
        if i % 100 == 0:
            print(f'Iteration {i}: Cost {cost}')
    return w, b, J_history

# Different learning rates to test
learning_rates = [0.01, 0.03, 0.1, 0.3]

for alpha in learning_rates:
    # initialize parameters
    initial_w = np.zeros(X.shape[1])
    initial_b = 0.0

    # some gradient descent settings
    iterations = 1000

    # run gradient descent
    w_final, b_final, J_hist = gradient_descent(X, y, initial_w, initial_b,␣
 ↪alpha, iterations)

    print(f"Learning Rate: {alpha}")
    print(f"Final parameters - b: {b_final:.2f}, w: {w_final}")

    # Calculate and print accuracy based on Mean Squared Error
    y_pred = np.dot(X, w_final) + b_final
    mse = np.mean((y_pred - y) ** 2)
    accuracy = 1 - mse / np.var(y)
    print(f"Accuracy: {accuracy}")
```

```
    # plot cost versus iteration
    plt.plot(J_hist, label=f'Learning Rate: {alpha}')

plt.title("Cost vs. Iteration")
plt.xlabel("Iteration")
plt.ylabel("Cost")
plt.legend()
plt.show()
```

```
Iteration 0: Cost 0.4840623686158884
Iteration 100: Cost 0.17009374295868648
Iteration 200: Cost 0.16440533313908606
Iteration 300: Cost 0.16351626112193934
Iteration 400: Cost 0.16324619793358733
Iteration 500: Cost 0.1631554504276159
Iteration 600: Cost 0.16312288813029743
Iteration 700: Cost 0.1631105539775403
Iteration 800: Cost 0.1631056790058378
Iteration 900: Cost 0.16310369061871588
Learning Rate: 0.01
Final parameters - b: 0.00, w: [1.46362025e-16 2.87418870e-01 5.15306090e-02
2.70248426e-01
 2.11017323e-01 8.73246716e-02 6.53554374e-02 9.67589853e-02
 1.00547882e-01 2.19227312e-01 1.37533562e-01 1.49351742e-01]
Accuracy: 0.6731946238161817
Iteration 0: Cost 0.45507918848176016
Iteration 100: Cost 0.16349956550118083
Iteration 200: Cost 0.16312196769925522
Iteration 300: Cost 0.1631036185444531
Iteration 400: Cost 0.1631023535826239
Iteration 500: Cost 0.16310225483060986
Iteration 600: Cost 0.1631022468432009
Iteration 700: Cost 0.1631022461909305
Iteration 800: Cost 0.163102246137526
Iteration 900: Cost 0.1631022461331504
Learning Rate: 0.03
Final parameters - b: 0.00, w: [1.41183701e-16 2.87933326e-01 5.06976970e-02
2.70222552e-01
 2.12013759e-01 8.69553205e-02 6.49451613e-02 9.75219277e-02
 1.00517067e-01 2.18932048e-01 1.37505997e-01 1.49201025e-01]
Accuracy: 0.6731958671236324
Iteration 0: Cost 0.36473887062443394
Iteration 100: Cost 0.16310272752870453
Iteration 200: Cost 0.16310224623109496
Iteration 300: Cost 0.16310224613278057
Iteration 400: Cost 0.16310224613275984
Iteration 500: Cost 0.16310224613275978
```

```
Iteration 600: Cost 0.16310224613275984
Iteration 700: Cost 0.1631022461327598
Iteration 800: Cost 0.16310224613275984
Iteration 900: Cost 0.1631022461327598
Learning Rate: 0.1
Final parameters - b: 0.00, w: [7.05449970e-17 2.87933431e-01 5.06975316e-02
2.70222505e-01
 2.12014007e-01 8.69552383e-02 6.49450785e-02 9.75221083e-02
 1.00517049e-01 2.18931963e-01 1.37506018e-01 1.49200984e-01]
Accuracy: 0.6731958671236982
Iteration 0: Cost 0.20177349913598103
Iteration 100: Cost 0.16310224613276528
Iteration 200: Cost 0.1631022461327598
Iteration 300: Cost 0.16310224613275978
Iteration 400: Cost 0.16310224613275978
Iteration 500: Cost 0.16310224613275978
Iteration 600: Cost 0.16310224613275978
Iteration 700: Cost 0.16310224613275978
Iteration 800: Cost 0.16310224613275978
Iteration 900: Cost 0.16310224613275978
Learning Rate: 0.3
Final parameters - b: 0.00, w: [9.20364702e-17 2.87933431e-01 5.06975316e-02
2.70222505e-01
 2.12014007e-01 8.69552383e-02 6.49450785e-02 9.75221083e-02
 1.00517049e-01 2.18931963e-01 1.37506018e-01 1.49200984e-01]
Accuracy: 0.6731958671236982
```



2 Assumption

changed yes and no attributes to 1 and 0 respectively(category to numeric) The accuracy being the same for different learning rates could indicate that the algorithm has reached its convergence point. In this case, since the learning rates are varied, it appears that the gradient descent is efficient in finding the optimal parameters and the model is best for learnig rates between 0.01 and 0.3