Aayush Jha

22

CSE(DS)

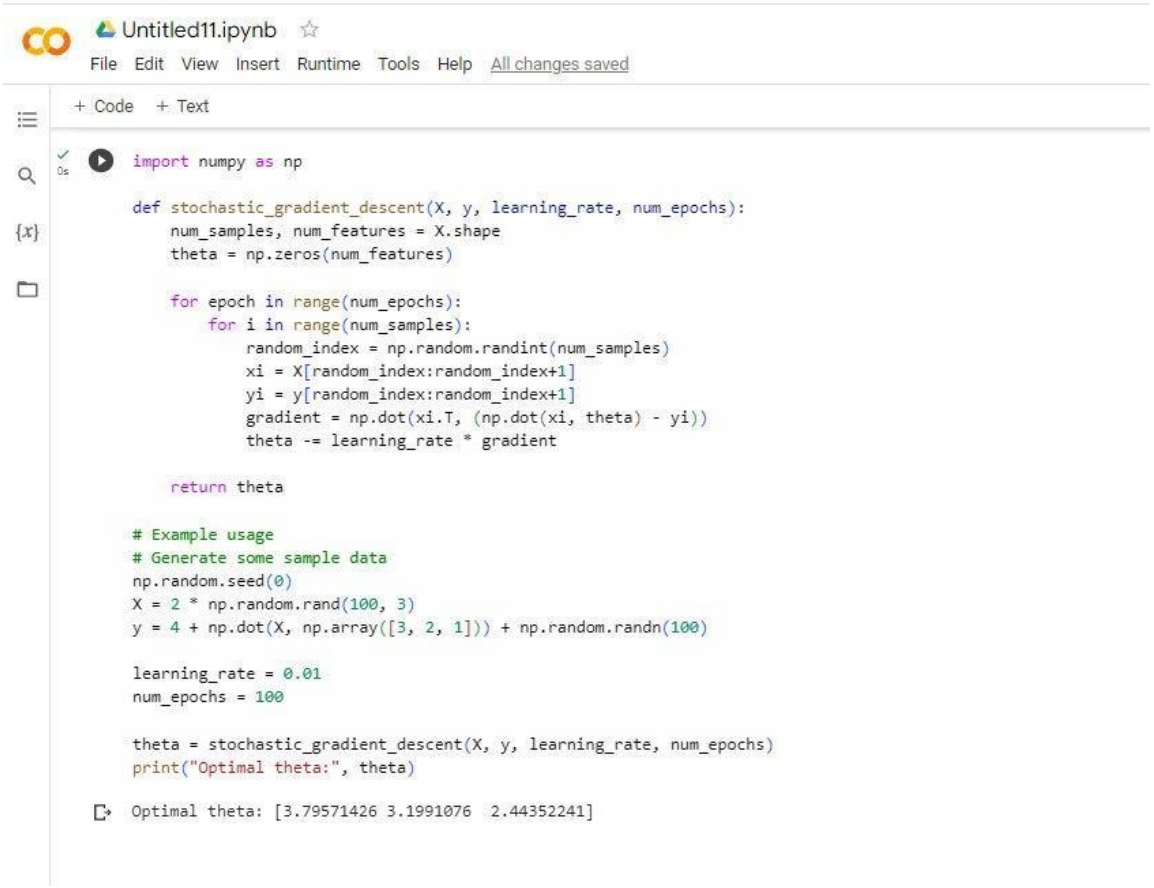
Experiment no 3

Implementation of stochastic gradient descent

```
import numpy as np
def stochastic_gradient_descent(X, y, learning_rate, num_epochs):
num_samples, num_features = X.shape
theta = np.zeros(num_features) for
epoch in range(num_epochs):
for i in range(num_samples):
random_index = np.random.randint(num_samples) xi =
X[random_index:random_index+1]
yi = y[random_index:random_index+1] gradient =
np.dot(xi.T, (np.dot(xi, theta) - yi)) theta -= learning_rate *
gradient
return theta

# Example usage
# Generate some sample data
```

```
np.random.seed(0)
X = 2 * np.random.rand(100, 3)
y = 4 + np.dot(X, np.array([3, 2, 1])) + np.random.randn(100)
learning_rate = 0.01
num_epochs = 100
theta = stochastic_gradient_descent(X, y, learning_rate, num_epochs)
print("Optimal theta:", theta)
```



Implementation of mini batch gradient descent

```
import numpy as np

# Define the function to be minimized and its

gradient def f(x):

    return x**2

def df(x):

    return 2*x

# Define the mini-batch gradient descent function

def minibatch_gradient_descent(x_init, learning_rate, batch_size, num_iterations): x
= x_init
for i in range(num_iterations):

# Generate random mini-batch samples

indices = np.random.choice(len(x), size=batch_size) batch = x[indices]

# Compute the gradient of the mini-batch loss gradient = np.mean(df(batch))

# Update the parameter using the learning rate and mini-batch gradient x -=

learning_rate * gradient
```

```
return x

# Test the mini-batch gradient descent function

x_init = np.array([1.0, 2.0, 3.0, 4.0])

learning_rate = 0.1

batch_size = 2

num_iterations = 100

result = minibatch_gradient_descent(x_init, learning_rate, batch_size,
num_iterations)

print("Result:", result)
```

```python
import numpy as np

# Define the function to be minimized and its gradient
def f(x):
    return x**2

def df(x):
    return 2*x

# Define the mini-batch gradient descent function
def minibatch_gradient_descent(x_init, learning_rate, batch_size, num_iterations):
    x = x_init
    for i in range(num_iterations):
        # Generate random mini-batch samples
        indices = np.random.choice(len(x), size=batch_size)
        batch = x[indices]

        # Compute the gradient of the mini-batch loss
        gradient = np.mean(df(batch))

        # Update the parameter using the learning rate and mini-batch gradient
        x -= learning_rate * gradient

    return x

# Test the mini-batch gradient descent function
x_init = np.array([1.0, 2.0, 3.0, 4.0])
learning_rate = 0.1
batch_size = 2
num_iterations = 100

result = minibatch_gradient_descent(x_init, learning_rate, batch_size, num_iterations)
print("Result:", result)
```

```
Result: [-1.4231927 -0.4231927  0.5768073  1.5768073]
```