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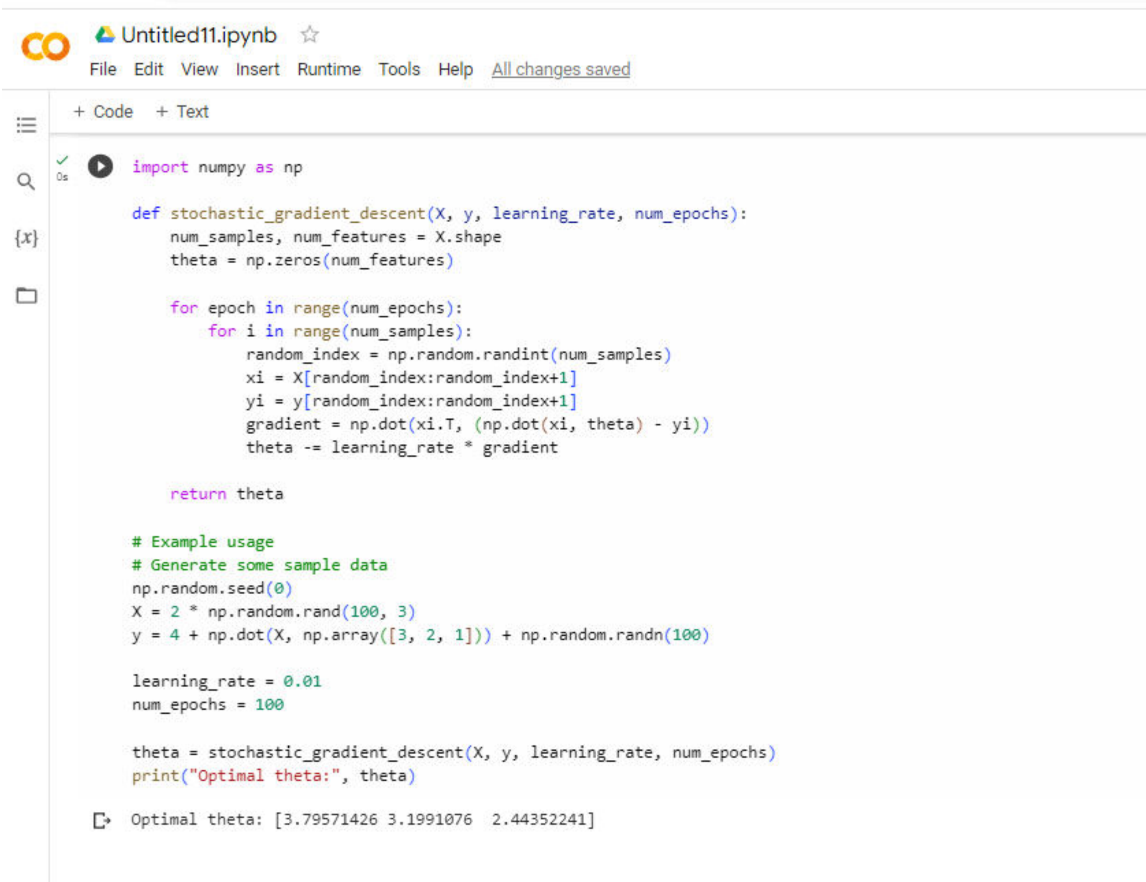
CSE(DS)/23

Experiment no 4

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)
```

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theta = stochastic_gradient_descent(X, y, learning_rate, num_epochs)
print("Optimal theta:", theta)
```

```
Optimal theta: [3.79571426 3.1991076  2.44352241]
```

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)
```

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def f(x):
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# Define the mini-batch gradient descent function
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        x -= learning_rate * gradient

    return x

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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]
```