```
import numpy as np # for mathematical operations

# Assuming X and y are already defined
# Example data (replace with actual data)
X = np.array([[0.5, 1.5], [1.5, 2.0], [3.0, 4.0], [5.0, 6.0]])  # example features
y = np.array([0, 0, 1, 1])  # example labels

# Initialize the weights and bias i.e. 'm' and 'c'
m = np.zeros_like(X[0]) # array with shape equal to no. of features
c = 0
LR = 0.0001  # The learning Rate
epochs = 50 # no. of iterations for optimization

# Define sigmoid function
def sigmoid(z):
    return 1 / (1 + np.exp(-z))

# Performing Gradient Descent Optimization
# for every epoch
for epoch in range(1, epochs + 1):
    # Optionally shuffle the data
    # indices = np.random.permutation(len(X))
    # X, y = X[indices], y[indices]

    # for every data point(X_train, y_train)
    for i in range(len(X)):
        # compute gradient w.r.t 'm'
        gr_wrt_m = X[i] * (y[i] - sigmoid(np.dot(m.T, X[i]) + c))

        # compute gradient w.r.t 'c'
        gr_wrt_c = y[i] - sigmoid(np.dot(m.T, X[i]) + c)

        # Print the gradients
        print(f"Epoch {epoch}, Data Point {i}: Gradient w.r.t m: {gr_wrt_m}, Gradient w.r.t c: {gr_wrt_c}")

        # update m, c
        m = m + LR * gr_wrt_m  # Note the correction here: use '+' instead of '-'
        c = c + LR * gr_wrt_c  # Note the correction here: use '+' instead of '-'

# At the end of all epochs we will be having optimum values of 'm' and 'c'
# So by using those optimum values of 'm' and 'c' we can perform predictions
predictions = []
for i in range(len(X)):
    z = np.dot(m, X[i]) + c
    y_pred = sigmoid(z)
    if y_pred >= 0.5:
        predictions.append(1)
    else:
        predictions.append(0)

# 'predictions' list will contain all the predicted class labels using optimum 'm' and 'c'
print("Predictions:", predictions)
print("Optimum weights (m):", m)
print("Optimum bias (c):", c)
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Epoch 1, Data Point 0: Gradient w.r.t m: [-0.25 -0.75], Gradient w.r.t c: -0.5
Epoch 1, Data Point 1: Gradient w.r.t m: [-0.74991094 -0.99988125], Gradient w.r.t c: -0.4999406250002791
Epoch 1, Data Point 2: Gradient w.r.t m: [1.50082494 2.00109992], Gradient w.r.t c: 0.5002749799332146
Epoch 1, Data Point 3: Gradient w.r.t m: [2.49956097 2.99947317], Gradient w.r.t c: 0.499912194591282
Epoch 2, Data Point 0: Gradient w.r.t m: [-0.25007971 -0.75023912], Gradient w.r.t c: -0.5001594130394253
Epoch 2, Data Point 1: Gradient w.r.t m: [-0.7503235  -1.00043133], Gradient w.r.t c: -0.5002156646235013
Epoch 2, Data Point 2: Gradient w.r.t m: [1.49917499 1.99889998], Gradient w.r.t c: 0.4997249957192015
Epoch 2, Data Point 3: Gradient w.r.t m: [2.49525134 2.9943016 ], Gradient w.r.t c: 0.49905026717994305
Epoch 3, Data Point 0: Gradient w.r.t m: [-0.2501592  -0.75047759], Gradient w.r.t c: -0.50031839321306
Epoch 3, Data Point 1: Gradient w.r.t m: [-0.75073501 -1.00098002], Gradient w.r.t c: -0.5004900080295805
Epoch 3, Data Point 2: Gradient w.r.t m: [1.49752907 1.99670543], Gradient w.r.t c: 0.49917635795833915
Epoch 3, Data Point 3: Gradient w.r.t m: [2.4909521  2.98914252], Gradient w.r.t c: 0.4981904202935221
Epoch 4, Data Point 0: Gradient w.r.t m: [-0.25023847 -0.75071541], Gradient w.r.t c: -0.5004769415459888
Epoch 4, Data Point 1: Gradient w.r.t m: [-0.75114549 -1.00152731], Gradient w.r.t c: -0.5007636567531096
Epoch 4, Data Point 2: Gradient w.r.t m: [1.49588719 1.99451626], Gradient w.r.t c: 0.4986290646801206
Epoch 4, Data Point 3: Gradient w.r.t m: [2.48666327 2.98399592], Gradient w.r.t c: 0.49733265389854286
Epoch 5, Data Point 0: Gradient w.r.t m: [-0.25031753 -0.75095259], Gradient w.r.t c: -0.5006350590631145
Epoch 5, Data Point 1: Gradient w.r.t m: [-0.75155492 -1.00207322], Gradient w.r.t c: -0.5010366123300897
Epoch 5, Data Point 2: Gradient w.r.t m: [1.49424934 1.99233246], Gradient w.r.t c: 0.49808311389680426
Epoch 5, Data Point 3: Gradient w.r.t m: [2.48238484 2.97886181], Gradient w.r.t c: 0.4964769678915857
Epoch 6, Data Point 0: Gradient w.r.t m: [-0.25039637 -0.75118912], Gradient w.r.t c: -0.5007927467891269
Epoch 6, Data Point 1: Gradient w.r.t m: [-0.75196331 -1.00261775], Gradient w.r.t c: -0.5013088762978619
Epoch 6, Data Point 2: Gradient w.r.t m: [1.49261551 1.99015401], Gradient w.r.t c: 0.49753850360367957
Epoch 6, Data Point 3: Gradient w.r.t m: [2.47811681 2.97374017], Gradient w.r.t c: 0.4956233621000381
Epoch 7, Data Point 0: Gradient w.r.t m: [-0.250475   -0.75142501], Gradient w.r.t c: -0.5009500057484719
Epoch 7, Data Point 1: Gradient w.r.t m: [-0.75237068 -1.0031609 ], Gradient w.r.t c: -0.5015804501950418
Epoch 7, Data Point 2: Gradient w.r.t m: [1.4909857  1.98798093], Gradient w.r.t c: 0.4969952317793307
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Epoch 7, Data Point 3: Gradient w.r.t m: [2.47385918 2.96863102], Gradient w.r.t c: 0.4947718362828414
Epoch 8, Data Point 0: Gradient w.r.t m: [-0.25055342 -0.75166026], Gradient w.r.t c: -0.5011068369653207
Epoch 8, Data Point 1: Gradient w.r.t m: [-0.752777   -1.00370267], Gradient w.r.t c: -0.5018513355614526
Epoch 8, Data Point 2: Gradient w.r.t m: [1.48935989 1.98581319], Gradient w.r.t c: 0.4964532963858984
Epoch 8, Data Point 3: Gradient w.r.t m: [2.46961195 2.96353434], Gradient w.r.t c: 0.49392239013123507
Epoch 9, Data Point 0: Gradient w.r.t m: [-0.25063162 -0.75189486], Gradient w.r.t c: -0.5012632414635394
Epoch 9, Data Point 1: Gradient w.r.t m: [-0.7531823  -1.00424307], Gradient w.r.t c: -0.5021215339380594
Epoch 9, Data Point 2: Gradient w.r.t m: [1.48773809 1.98365078], Gradient w.r.t c: 0.4959126953693398
Epoch 9, Data Point 3: Gradient w.r.t m: [2.46537512 2.95845014], Gradient w.r.t c: 0.4930750232694977
Epoch 10, Data Point 0: Gradient w.r.t m: [-0.25070961 -0.75212883], Gradient w.r.t c: -0.5014192202666595
Epoch 10, Data Point 1: Gradient w.r.t m: [-0.75358657 -1.00478209], Gradient w.r.t c: -0.5023910468669054
Epoch 10, Data Point 2: Gradient w.r.t m: [1.48612028 1.98149371], Gradient w.r.t c: 0.4953734266596861
Epoch 10, Data Point 3: Gradient w.r.t m: [2.46114868 2.95337841], Gradient w.r.t c: 0.4922297352556845
Epoch 11, Data Point 0: Gradient w.r.t m: [-0.25078739 -0.75236216], Gradient w.r.t c: -0.5015747743978483
Epoch 11, Data Point 1: Gradient w.r.t m: [-0.75398981 -1.00531975], Gradient w.r.t c: -0.5026598758910473
Epoch 11, Data Point 2: Gradient w.r.t m: [1.48450646 1.97934195], Gradient w.r.t c: 0.4948354881712984
Epoch 11, Data Point 3: Gradient w.r.t m: [2.45693263 2.94831915], Gradient w.r.t c: 0.4913865255823622
Epoch 12, Data Point 0: Gradient w.r.t m: [-0.25086495 -0.75259486], Gradient w.r.t c: -0.501729904879879
Epoch 12, Data Point 1: Gradient w.r.t m: [-0.75439203 -1.00585605], Gradient w.r.t c: -0.5029280225544922
Epoch 12, Data Point 2: Gradient w.r.t m: [1.48289663 1.97719551], Gradient w.r.t c: 0.49429887780312143
Epoch 12, Data Point 3: Gradient w.r.t m: [2.45272697 2.94327236], Gradient w.r.t c: 0.4905453936773403
Epoch 13, Data Point 0: Gradient w.r.t m: [-0.25094231 -0.75282692], Gradient w.r.t c: -0.5018846127351027
Epoch 13, Data Point 1: Gradient w.r.t m: [-0.75479323 -1.00639098], Gradient w.r.t c: -0.5031954884021343
Epoch 13, Data Point 2: Gradient w.r.t m: [1.48129078 1.97505437], Gradient w.r.t c: 0.49376359343893483
Epoch 13, Data Point 3: Gradient w.r.t m: [2.44853169 2.93823803], Gradient w.r.t c: 0.4897063389043991
Epoch 14, Data Point 0: Gradient w.r.t m: [-0.25101945 -0.75305835], Gradient w.r.t c: -0.5020388989854192
Epoch 14, Data Point 1: Gradient w.r.t m: [-0.75519341 -1.00692455], Gradient w.r.t c: -0.5034622749796936
Epoch 14, Data Point 2: Gradient w.r.t m: [1.4796889  1.97291853], Gradient w.r.t c: 0.4932296329476036
Epoch 14, Data Point 3: Gradient w.r.t m: [2.4443468  2.93321616], Gradient w.r.t c: 0.4888693605640141
Epoch 15, Data Point 0: Gradient w.r.t m: [-0.25109638 -0.75328915], Gradient w.r.t c: -0.502192764652249
Epoch 15, Data Point 1: Gradient w.r.t m: [-0.75559258 -1.00745677], Gradient w.r.t c: -0.5037283838336541
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