In this homework, you will write a python implementation of logistic regression. You will test it on two datasets. First we import some libraries that we need.

In [14]:
```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt
```

We define some functions involved. Use the formulations that avoid overflows.

1. sigmoid function sigmoid(t)
2. log of sigmoid(t), called log_sig(t)
3. log of 1-sigmoid = 1/(1+e^t), called log_one_sig(t)
4. cross-entropy loss function given the inputs of label y and prediction y_hat = sigmoid(z), where y, y_hat, and z are vectors of dimension N. (N = # of data points.) You should implement this function with z, rather than y_hat, as the input; namely, the loss function should be

   loss = -y log(sigmoid(z)) - (1-y) log (1-sigmoid(z))

where log(sigmoid(z)) and log (1-sigmoid(z)) should be computed by the functions log_sig(z) and log_one_sig(z) in parts 2 and 3.

In [84]:
```
def sigmoid(t):
      return 1/(1+np.exp(-t))

def custom_loss(y, z):
    return ((-y*log_sig(z)) - ((1-y)*log_one_sig(z)))

def log_sig(t):
      return np.log(sigmoid(t))

def log_one_sig(t):
      return np.log(1-sigmoid(t))
```

Define the model output z=w^T x + b, or z = x^Tw + B, given the data input X (an N-by-n array containing N data points) and the model parameters w (n-dimensional weigth vector) and b (bias).

Note that mathematically it's easier to write the data matrix as an n-by-N matrix, with each column being a data point. In python, the data is more commonly represented as as an N-by-n array.

In [71]:
```
def model(w,b,X):
  # using X as Nxn
  print(f'In model, X: {X.shape}, b: {b}, w: {w.shape}')
  return (X @ w)+b
```

Define the function that computes the gradient of the cross-entropy loss given the label y (N-vector), the model prediction y_hat = sigmoid(z) (N-vector), and the dataset X (an n-by-N or N-by-n array). It's probably easier to return the gradients with respect w and b separately, which can be used to update w and b later on.

In [72]:
```
def gradients(X, y, y_hat):
  # Using X as Nxn
  print(f'grad: y shape: {y.shape}, X shape: {X.shape}')
  return (np.transpose(X) @ (y_hat - y))/X.shape[0]
```

Write the function that minimizes the loss (i.e. training) by the gradient descent algorithm using a fixed number of iteration (*iter*) and learning rate (*lr*). Your function should take *iter* and *lr* as well as the initial weight w, initial bias b, the input data X and the label y as the inputs. It produces new w and b as output. Also compute the loss value at each iteration and output the sequence of the loss.

In [81]:
```
def train(w, b, X, y, iter, lr):
  print(f'>> {X.shape}')
  losslist=list()
  for k in range(iter):
    z = model(w, b, X)
    y_hat = sigmoid(z)
    grad = gradients(X, y, y_hat)
    print(f'gradient shape: {grad.shape}')
    w = w - (lr * grad)
    b = np.mean((b*np.ones(y_hat.shape)) - (lr * (y_hat - y)))
    myloss = custom_loss(y, y_hat)
    losslist.append(np.mean(myloss))
    print(f'Iter: {k} Loss: {losslist[-1]}')
  return w, b, losslist
```

1. Write the function that uses a trained model to produce class prediction (0 or 1) for an input dataset X, i.e. turn the model output z = model(w,b,X) into predicted label y_label (N-vector of 0 or 1).
2. For an input dataset X with a known label y (e.g. a training or testing dataset) and a predicted label y_label, compute the accuracy of prediction (i.e. # correct predictions/N)

In [74]:
```
def predict(z):
  ypred = sigmoid(z)
  ypred[ypred<=0.5]=0
  ypred[ypred>0.5]=1
  ypred = ypred.astype(int)
  ypred = np.squeeze(ypred)
  # print(f'In pred, {ypred.shape}')
  return ypred

def accuracy(y, y_label):
  diff_bool = (y == y_label)
  diff_true = diff_bool[diff_bool==True]
  total_sample = len(diff_bool)
  return (len(diff_true)/total_sample)
```

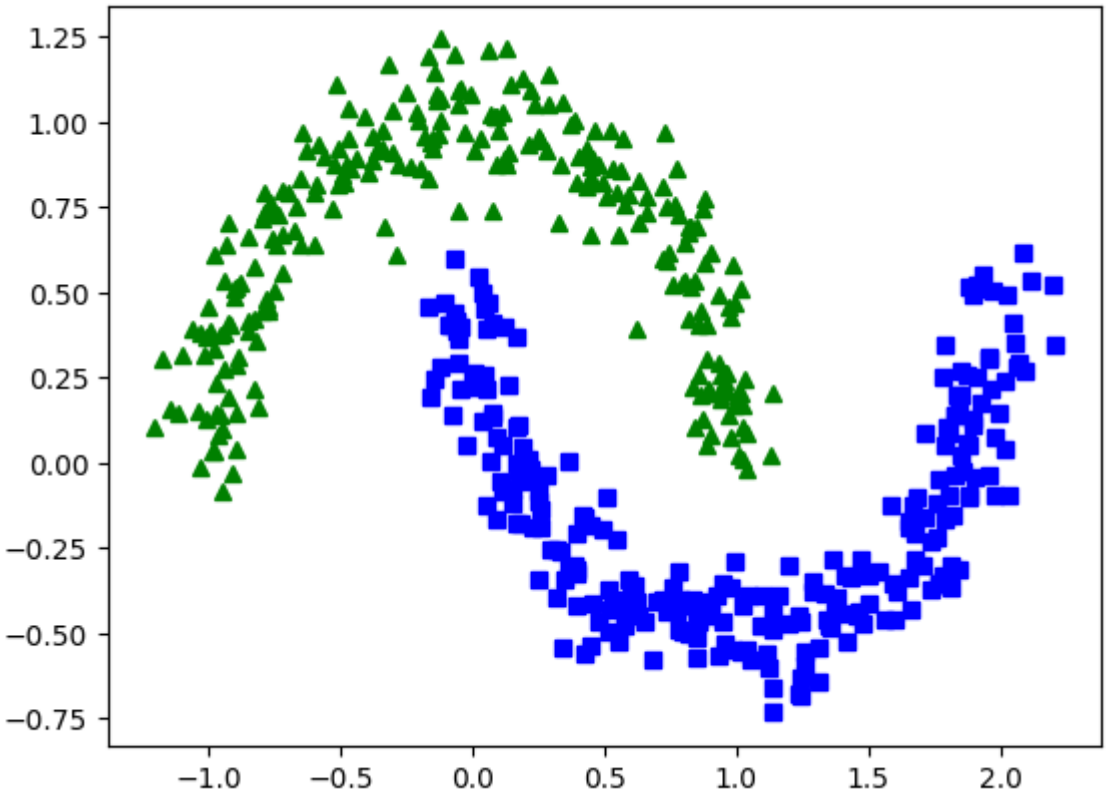
We are ready to test your programs on some datasets. First, we use a synthetic dataset generated using scikit-learn package. We generate a dataset for training and simultaneously a dataset for testing.

In [75]:
```
from sklearn.datasets import make_moons
X_train, y_train = make_moons(n_samples=500, noise=0.1)
X_test, y_test = make_moons(n_samples=1000, noise=0.1)

print(X_train.shape)
plt.figure()
plt.plot(X_train[:, 0][y_train==0], X_train[:, 1][y_train==0], "g^")
plt.plot(X_train[:, 0][y_train==1], X_train[:, 1][y_train==1], "bs")
```

```
(500, 2)
```

Out[75]:
```
[<matplotlib.lines.Line2D at 0x135ea3b20>]
```

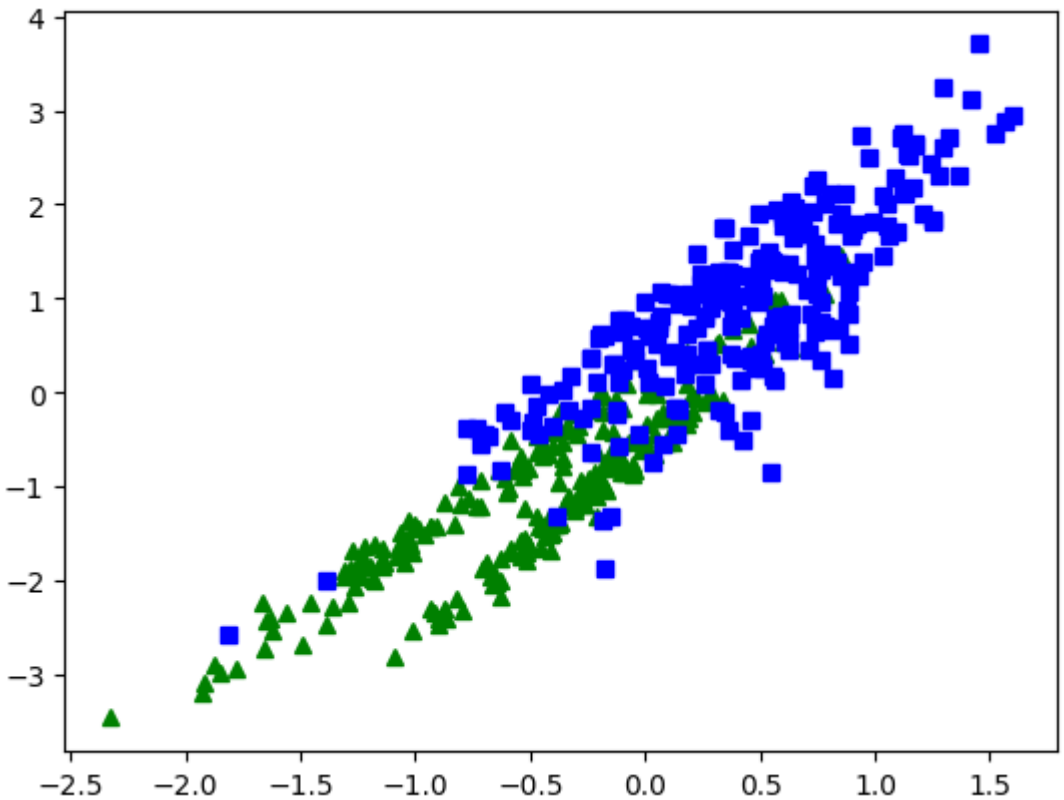


Here is another toy test example you may try but not part of homework.

In [76]:
```
from sklearn.datasets import make_classification
X_train, y_train = make_classification(n_samples=1000, n_features=4)
X_test=X_train[500:,]
y_test=y_train[500:,]
X_train=X_train[:500,]
y_train=y_train[:500,]

plt.figure()
plt.plot(X_train[:, 0][y_train==0], X_train[:, 1][y_train==0], "g^")
plt.plot(X_train[:, 0][y_train==1], X_train[:, 1][y_train==1], "bs")
```

Out[76]:
```
[<matplotlib.lines.Line2D at 0x135ee0ca0>]
```



We now train the model using (X_train, y_train). We initialize weight as a random vector, and b=0. We plot the loss convergence history. You should get the loss down to about 0.2. We compute the prediction accuracy on (X_train, y_train). You should get an accuracy in the 80s.

In [85]:
```
w = np.random.rand(X_train.shape[1],1)  # assuming X is N-by-n.
                                        # if X is n-by-N, use X_train.shape[0]
y_train = y_train.reshape(-1,1)
y_test = y_test.reshape(-1,1)
print(w.shape)
print(X_train.shape)
print(y_train.shape)
b = 0
w, b, loss = train(w, b, X_train, y_train, iter=300, lr=0.1)
plt.figure()
plt.plot(loss)

#training accuracy
z = model(w,b,X_train)
print(accuracy(np.squeeze(y_train), predict(z)))
```

```
(4, 1)
(500, 4)
(500, 1)
>> (500, 4)
In model, X: (500, 4), b: 0, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 0 Loss: 0.6378213276865353
In model, X: (500, 4), b: 0.0020485643707455607, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 1 Loss: 0.6356421975918493
In model, X: (500, 4), b: 0.004086284669720308, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 2 Loss: 0.6336432410606633
In model, X: (500, 4), b: 0.006111220603736788, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 3 Loss: 0.6318033209627104
In model, X: (500, 4), b: 0.008121799010828162, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 4 Loss: 0.6301043693453372
In model, X: (500, 4), b: 0.010116756067035854, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 5 Loss: 0.62853087893227
In model, X: (500, 4), b: 0.012095087534019432, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 6 Loss: 0.627069484779294
In model, X: (500, 4), b: 0.014056006410333477, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 7 Loss: 0.625708620263737
In model, X: (500, 4), b: 0.01599890714490496, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 8 Loss: 0.6244382338906919
In model, X: (500, 4), b: 0.017923335533422288, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 9 Loss: 0.6232495556658812
In model, X: (500, 4), b: 0.019828963464464035, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 10 Loss: 0.6221349038135293
In model, X: (500, 4), b: 0.02171556776563851, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 11 Loss: 0.6210875243465018
In model, X: (500, 4), b: 0.02358301249530592, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 12 Loss: 0.6201014574293101
In model, X: (500, 4), b: 0.025431234119373775, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 13 Loss: 0.6191714256435792
In model, X: (500, 4), b: 0.027260229098894515, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 14 Loss: 0.6182927402098481
In model, X: (500, 4), b: 0.029070043490290978, w: (4, 1)
```

```
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 15 Loss: 0.6174612219781889
In model, X: (500, 4), b: 0.030860764225570558, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 16 Loss: 0.6166731346079869
In model, X: (500, 4), b: 0.03263251179546113, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 17 Loss: 0.6159251278439565
In model, X: (500, 4), b: 0.03438543410505402, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 18 Loss: 0.6152141891854039
In model, X: (500, 4), b: 0.0361197013104491, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 19 Loss: 0.6145376025586353
In model, X: (500, 4), b: 0.03783550147721621, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 20 Loss: 0.6138929128540022
In model, X: (500, 4), b: 0.03953303692826719, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 21 Loss: 0.6132778953918955
In model, X: (500, 4), b: 0.041212521170896056, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 22 Loss: 0.612690529546002
In model, X: (500, 4), b: 0.042874176311080606, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 23 Loss: 0.6121289758851416
In model, X: (500, 4), b: 0.04451823087831281, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 24 Loss: 0.6115915563032345
In model, X: (500, 4), b: 0.04614491799679195, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 25 Loss: 0.611076736695311
In model, X: (500, 4), b: 0.047754473849233293, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 26 Loss: 0.6105831118098575
In model, X: (500, 4), b: 0.04934713638819547, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 27 Loss: 0.6101093919672863
In model, X: (500, 4), b: 0.0509231442570216, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 28 Loss: 0.6096543913833914
In model, X: (500, 4), b: 0.052482735888480174, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 29 Loss: 0.6092170178772411
In model, X: (500, 4), b: 0.054026148754189235, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 30 Loss: 0.608796263776678
In model, X: (500, 4), b: 0.05555361874208534, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
```

```
gradient shape: (4, 1)
Iter: 31 Loss: 0.6083911978626595
In model, X: (500, 4), b: 0.057065379642696805, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 32 Loss: 0.608000958217135
In model, X: (500, 4), b: 0.058561662727915464, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 33 Loss: 0.607624745858806
In model, X: (500, 4), b: 0.06004269640842786, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 34 Loss: 0.6072618190676501
In model, X: (500, 4), b: 0.06150870595804355, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 35 Loss: 0.606911488313013
In model, X: (500, 4), b: 0.06295991329490991, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 36 Loss: 0.6065731117118612
In model, X: (500, 4), b: 0.06439653681108339, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 37 Loss: 0.6062460909537724
In model, X: (500, 4), b: 0.06581879124317962, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 38 Loss: 0.6059298676377387
In model, X: (500, 4), b: 0.06722688757788774, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 39 Loss: 0.6056239199730965
In model, X: (500, 4), b: 0.06862103298703559, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 40 Loss: 0.6053277598030845
In model, X: (500, 4), b: 0.07000143078766036, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 41 Loss: 0.6050409299148426
In model, X: (500, 4), b: 0.07136828042319249, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 42 Loss: 0.6047630016042078
In model, X: (500, 4), b: 0.07272177746241808, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 43 Loss: 0.6044935724676004
In model, X: (500, 4), b: 0.07406211361336124, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 44 Loss: 0.6042322643966692
In model, X: (500, 4), b: 0.07538947674963531, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 45 Loss: 0.6039787217542961
In model, X: (500, 4), b: 0.07670405094716028, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 46 Loss: 0.6037326097131033
In model, X: (500, 4), b: 0.07800601652944292, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
```

```
Iter: 47 Loss: 0.6034936127398066
In model, X: (500, 4), b: 0.0792955501198727, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 48 Loss: 0.6032614332106809
In model, X: (500, 4), b: 0.0805728246997073, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 49 Loss: 0.6030357901450839
In model, X: (500, 4), b: 0.08183800967061038, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 50 Loss: 0.6028164180454392
In model, X: (500, 4), b: 0.08309127092076844, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 51 Loss: 0.6026030658333709
In model, X: (500, 4), b: 0.08433277089375331, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 52 Loss: 0.6023954958728052
In model, X: (500, 4), b: 0.08556266865941835, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 53 Loss: 0.6021934830718378
In model, X: (500, 4), b: 0.08678111998622082, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 54 Loss: 0.6019968140560479
In model, X: (500, 4), b: 0.08798827741445314, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 55 Loss: 0.6018052864066966
In model, X: (500, 4), b: 0.08918429032994322, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 56 Loss: 0.6016187079579363
In model, X: (500, 4), b: 0.09036930503785176, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 57 Loss: 0.6014368961477502
In model, X: (500, 4), b: 0.09154346483625195, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 58 Loss: 0.6012596774178817
In model, X: (500, 4), b: 0.09270691008922753, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 59 Loss: 0.6010868866584785
In model, X: (500, 4), b: 0.09385977829926809, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 60 Loss: 0.600918366693606
In model, X: (500, 4), b: 0.09500220417877808, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 61 Loss: 0.6007539678041482
In model, X: (500, 4), b: 0.0961343197205483, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 62 Loss: 0.6005935472849611
In model, X: (500, 4), b: 0.09725625426706626, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 63 Loss: 0.6004369690334284
```

```
In model, X: (500, 4), b: 0.09836813457856607, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 64 Loss: 0.6002841031668498
In model, X: (500, 4), b: 0.09947008489973883, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 65 Loss: 0.6001348256663198
In model, X: (500, 4), b: 0.1005622270250426, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 66 Loss: 0.5999890180449762
In model, X: (500, 4), b: 0.10164468036256626, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 67 Loss: 0.5998465670386877
In model, X: (500, 4), b: 0.10271756199641423, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 68 Loss: 0.5997073643174227
In model, X: (500, 4), b: 0.10378098674759098, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 69 Loss: 0.5995713062156985
In model, X: (500, 4), b: 0.1048350672333732, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 70 Loss: 0.5994382934806495
In model, X: (500, 4), b: 0.10587991392516587, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 71 Loss: 0.5993082310363789
In model, X: (500, 4), b: 0.10691563520484539, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 72 Loss: 0.5991810277633768
In model, X: (500, 4), b: 0.1079423374195989, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 73 Loss: 0.5990565962918851
In model, X: (500, 4), b: 0.10896012493527334, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 74 Loss: 0.5989348528081889
In model, X: (500, 4), b: 0.10996910018825266, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 75 Loss: 0.5988157168728949
In model, X: (500, 4), b: 0.11096936373588401, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 76 Loss: 0.5986991112503384
In model, X: (500, 4), b: 0.11196101430547759, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 77 Loss: 0.5985849617483261
In model, X: (500, 4), b: 0.11294414884190619, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 78 Loss: 0.598473197067491
In model, X: (500, 4), b: 0.11391886255383277, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 79 Loss: 0.5983637486595853
In model, X: (500, 4), b: 0.11488524895859559, w: (4, 1)
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grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 80 Loss: 0.5982565505941024
In model, X: (500, 4), b: 0.11584339992578169, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 81 Loss: 0.5981515394326528
In model, X: (500, 4), b: 0.11679340571952009, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 82 Loss: 0.5980486541105752
In model, X: (500, 4), b: 0.11773535503952659, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 83 Loss: 0.597947835825298
In model, X: (500, 4), b: 0.11866933506093273, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 84 Loss: 0.5978490279310011
In model, X: (500, 4), b: 0.11959543147293086, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 85 Loss: 0.5977521758391691
In model, X: (500, 4), b: 0.12051372851626817, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 86 Loss: 0.5976572269246492
In model, X: (500, 4), b: 0.12142430901962145, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 87 Loss: 0.597564130436863
In model, X: (500, 4), b: 0.12232725443488489, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 88 Loss: 0.5974728374158408
In model, X: (500, 4), b: 0.12322264487140218, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 89 Loss: 0.5973833006127751
In model, X: (500, 4), b: 0.12411055912917418, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 90 Loss: 0.5972954744148103
In model, X: (500, 4), b: 0.12499107473107264, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 91 Loss: 0.5972093147738067
In model, X: (500, 4), b: 0.12586426795409006, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 92 Loss: 0.5971247791388312
In model, X: (500, 4), b: 0.1267302138596551, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 93 Loss: 0.5970418263921534
In model, X: (500, 4), b: 0.12758898632304236, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 94 Loss: 0.5969604167885297
In model, X: (500, 4), b: 0.1284406580619044, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 95 Loss: 0.5968805118975826
In model, X: (500, 4), b: 0.12928530066395388, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
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gradient shape: (4, 1)
Iter: 96 Loss: 0.5968020745490896
In model, X: (500, 4), b: 0.13012298461382188, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 97 Loss: 0.5967250687810117
In model, X: (500, 4), b: 0.13095377931911917, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 98 Loss: 0.596649459790101
In model, X: (500, 4), b: 0.13177775313572515, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 99 Loss: 0.5965752138849384
In model, X: (500, 4), b: 0.13259497339232934, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 100 Loss: 0.5965022984412633
In model, X: (500, 4), b: 0.13340550641424903, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 101 Loss: 0.5964306818594634
In model, X: (500, 4), b: 0.13420941754654675, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 102 Loss: 0.5963603335241034
In model, X: (500, 4), b: 0.13500677117646953, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 103 Loss: 0.59629122376538
In model, X: (500, 4), b: 0.1357976307552321, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 104 Loss: 0.5962233238223927
In model, X: (500, 4), b: 0.13658205881916496, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 105 Loss: 0.5961566058081377
In model, X: (500, 4), b: 0.137360117010248, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 106 Loss: 0.5960910426761198
In model, X: (500, 4), b: 0.13813186609604913, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 107 Loss: 0.5960266081885078
In model, X: (500, 4), b: 0.13889736598908758, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 108 Loss: 0.5959632768857396
In model, X: (500, 4), b: 0.1396566757656399, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 109 Loss: 0.5959010240575062
In model, X: (500, 4), b: 0.14040985368400719, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 110 Loss: 0.5958398257150385
In model, X: (500, 4), b: 0.14115695720226046, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 111 Loss: 0.5957796585646318
In model, X: (500, 4), b: 0.14189804299548114, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
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Iter: 112 Loss: 0.5957204999823389
In model, X: (500, 4), b: 0.142633166972513, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 113 Loss: 0.5956623279897768
In model, X: (500, 4), b: 0.14336238429224096, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 114 Loss: 0.5956051212309862
In model, X: (500, 4), b: 0.1440857493794125, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 115 Loss: 0.5955488589502903
In model, X: (500, 4), b: 0.14480331594001547, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 116 Loss: 0.5954935209711067
In model, X: (500, 4), b: 0.1455151369762276, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 117 Loss: 0.5954390876756579
In model, X: (500, 4), b: 0.14622126480095013, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 118 Loss: 0.5953855399855424
In model, X: (500, 4), b: 0.14692175105194002, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 119 Loss: 0.5953328593431187
In model, X: (500, 4), b: 0.1476166467055526, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 120 Loss: 0.5952810276936662
In model, X: (500, 4), b: 0.14830600209010758, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 121 Loss: 0.595230027468282
In model, X: (500, 4), b: 0.14898986689889004, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 122 Loss: 0.595179841567482
In model, X: (500, 4), b: 0.1496682902027982, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 123 Loss: 0.595130453345467
In model, X: (500, 4), b: 0.1503413204626487, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 124 Loss: 0.595081846595028
In model, X: (500, 4), b: 0.15100900554115068, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 125 Loss: 0.5950340055330564
In model, X: (500, 4), b: 0.1516713927145586, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 126 Loss: 0.5949869147866327
In model, X: (500, 4), b: 0.15232852868401406, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 127 Loss: 0.5949405593796655
In model, X: (500, 4), b: 0.1529804595865864, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 128 Loss: 0.5948949247200569
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In model, X: (500, 4), b: 0.15362723100602113, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 129 Loss: 0.5948499965873678
In model, X: (500, 4), b: 0.15426888798320562, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 130 Loss: 0.5948057611209633
In model, X: (500, 4), b: 0.15490547502636057, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 131 Loss: 0.5947622048086132
In model, X: (500, 4), b: 0.15553703612096573, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 132 Loss: 0.5947193144755292
In model, X: (500, 4), b: 0.15616361473942827, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 133 Loss: 0.5946770772738191
In model, X: (500, 4), b: 0.15678525385050127, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 134 Loss: 0.5946354806723388
In model, X: (500, 4), b: 0.15740199592846024, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 135 Loss: 0.5945945124469246
In model, X: (500, 4), b: 0.15801388296204522, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 136 Loss: 0.5945541606709889
In model, X: (500, 4), b: 0.15862095646317506, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 137 Loss: 0.5945144137064646
In model, X: (500, 4), b: 0.1592232574754412, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 138 Loss: 0.5944752601950837
In model, X: (500, 4), b: 0.1598208265823875, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 139 Loss: 0.59443668904997
In model, X: (500, 4), b: 0.1604137039155825, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 140 Loss: 0.5943986894475425
In model, X: (500, 4), b: 0.16100192916249026, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 141 Loss: 0.5943612508197058
In model, X: (500, 4), b: 0.16158554157414612, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 142 Loss: 0.5943243628463237
In model, X: (500, 4), b: 0.1621645799726426, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 143 Loss: 0.5942880154479587
In model, X: (500, 4), b: 0.16273908275843182, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 144 Loss: 0.5942521987788694
In model, X: (500, 4), b: 0.1633090879174492, w: (4, 1)
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grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 145 Loss: 0.5942169032202526
In model, X: (500, 4), b: 0.16387463302806407, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 146 Loss: 0.5941821193737237
In model, X: (500, 4), b: 0.16443575526786225, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 147 Loss: 0.5941478380550214
In model, X: (500, 4), b: 0.16499249142026526, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 148 Loss: 0.5941140502879297
In model, X: (500, 4), b: 0.1655448778809914, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 149 Loss: 0.5940807472984102
In model, X: (500, 4), b: 0.16609295066436278, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 150 Loss: 0.5940479205089318
In model, X: (500, 4), b: 0.166636745409463, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 151 Loss: 0.5940155615329946
In model, X: (500, 4), b: 0.16717629738615, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 152 Loss: 0.5939836621698364
In model, X: (500, 4), b: 0.16771164150092785, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 153 Loss: 0.5939522143993181
In model, X: (500, 4), b: 0.16824281230268162, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 154 Loss: 0.5939212103769773
In model, X: (500, 4), b: 0.1687698439882796, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 155 Loss: 0.5938906424292473
In model, X: (500, 4), b: 0.16929277040804616, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 156 Loss: 0.5938605030488322
In model, X: (500, 4), b: 0.16981162507110914, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 157 Loss: 0.5938307848902337
In model, X: (500, 4), b: 0.1703264411506254, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 158 Loss: 0.5938014807654222
In model, X: (500, 4), b: 0.1708372514888877, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 159 Loss: 0.5937725836396496
In model, X: (500, 4), b: 0.17134408860231673, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 160 Loss: 0.5937440866273949
In model, X: (500, 4), b: 0.1718469846863406, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
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gradient shape: (4, 1)
Iter: 161 Loss: 0.5937159829884394
In model, X: (500, 4), b: 0.17234597162016613, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 162 Loss: 0.5936882661240684
In model, X: (500, 4), b: 0.17284108097144388, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 163 Loss: 0.59366092957339
In model, X: (500, 4), b: 0.17333234400083047, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 164 Loss: 0.5936339670097716
In model, X: (500, 4), b: 0.17381979166645073, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 165 Loss: 0.5936073722373867
In model, X: (500, 4), b: 0.17430345462826266, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 166 Loss: 0.5935811391878697
In model, X: (500, 4), b: 0.17478336325232766, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 167 Loss: 0.5935552619170721
In model, X: (500, 4), b: 0.17525954761498866, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 168 Loss: 0.5935297346019214
In model, X: (500, 4), b: 0.17573203750695865, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 169 Loss: 0.5935045515373727
In model, X: (500, 4), b: 0.17620086243732228, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 170 Loss: 0.5934797071334549
In model, X: (500, 4), b: 0.1766660516374523, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 171 Loss: 0.5934551959124054
In model, X: (500, 4), b: 0.17712763406484391, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 172 Loss: 0.5934310125058908
In model, X: (500, 4), b: 0.17758563840686825, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 173 Loss: 0.5934071516523117
In model, X: (500, 4), b: 0.17804009308444824, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 174 Loss: 0.5933836081941857
In model, X: (500, 4), b: 0.17849102625565802, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 175 Loss: 0.5933603770756083
In model, X: (500, 4), b: 0.17893846581924844, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 176 Loss: 0.5933374533397912
In model, X: (500, 4), b: 0.1793824394181002, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
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Iter: 177 Loss: 0.5933148321266681
In model, X: (500, 4), b: 0.17982297444260706, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 178 Loss: 0.5932925086705731
In model, X: (500, 4), b: 0.18026009803399048, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 179 Loss: 0.5932704782979866
In model, X: (500, 4), b: 0.18069383708754758, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 180 Loss: 0.5932487364253436
In model, X: (500, 4), b: 0.18112421825583436, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 181 Loss: 0.5932272785569075
In model, X: (500, 4), b: 0.18155126795178558, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 182 Loss: 0.5932061002827019
In model, X: (500, 4), b: 0.1819750123517732, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 183 Loss: 0.5931851972765051
In model, X: (500, 4), b: 0.18239547739860473, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 184 Loss: 0.593164565293895
In model, X: (500, 4), b: 0.1828126888044631, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 185 Loss: 0.5931442001703555
In model, X: (500, 4), b: 0.18322667205378965, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 186 Loss: 0.593124097819431
In model, X: (500, 4), b: 0.1836374524061115, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 187 Loss: 0.5931042542309344
In model, X: (500, 4), b: 0.18404505489881484, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 188 Loss: 0.5930846654692041
In model, X: (500, 4), b: 0.18444950434986546, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 189 Loss: 0.5930653276714088
In model, X: (500, 4), b: 0.1848508253604779, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 190 Loss: 0.5930462370458993
In model, X: (500, 4), b: 0.18524904231773434, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 191 Loss: 0.5930273898706045
In model, X: (500, 4), b: 0.18564417939715464, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 192 Loss: 0.5930087824914713
In model, X: (500, 4), b: 0.1860362605652188, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 193 Loss: 0.5929904113209462
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In model, X: (500, 4), b: 0.18642530958184278, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 194 Loss: 0.5929722728364988
In model, X: (500, 4), b: 0.18681135000280896, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 195 Loss: 0.5929543635791822
In model, X: (500, 4), b: 0.18719440518215247, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 196 Loss: 0.5929366801522357
In model, X: (500, 4), b: 0.18757449827450434, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 197 Loss: 0.5929192192197201
In model, X: (500, 4), b: 0.18795165223739232, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 198 Loss: 0.5929019775051925
In model, X: (500, 4), b: 0.18832588983350088, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 199 Loss: 0.5928849517904131
In model, X: (500, 4), b: 0.1886972336328909, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 200 Loss: 0.592868138914088
In model, X: (500, 4), b: 0.1890657060151804, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 201 Loss: 0.5928515357706429
In model, X: (500, 4), b: 0.18943132917168706, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 202 Loss: 0.5928351393090303
In model, X: (500, 4), b: 0.18979412510753316, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 203 Loss: 0.592818946531565
In model, X: (500, 4), b: 0.19015411564371446, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 204 Loss: 0.5928029544927916
In model, X: (500, 4), b: 0.1905113224191335, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 205 Loss: 0.5927871602983802
In model, X: (500, 4), b: 0.19086576689259796, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 206 Loss: 0.5927715611040493
In model, X: (500, 4), b: 0.19121747034478534, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 207 Loss: 0.5927561541145169
In model, X: (500, 4), b: 0.1915664538801746, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 208 Loss: 0.5927409365824781
In model, X: (500, 4), b: 0.1919127384289452, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 209 Loss: 0.5927259058076072
In model, X: (500, 4), b: 0.19225634474884487, w: (4, 1)
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grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 210 Loss: 0.5927110591355856
In model, X: (500, 4), b: 0.19259729342702622, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 211 Loss: 0.5926963939571538
In model, X: (500, 4), b: 0.19293560488185363, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 212 Loss: 0.5926819077071862
In model, X: (500, 4), b: 0.19327129936468027, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 213 Loss: 0.5926675978637891
In model, X: (500, 4), b: 0.19360439696159668, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 214 Loss: 0.5926534619474212
In model, X: (500, 4), b: 0.19393491759515097, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 215 Loss: 0.5926394975200343
In model, X: (500, 4), b: 0.19426288102604178, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 216 Loss: 0.5926257021842364
In model, X: (500, 4), b: 0.19458830685478415, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 217 Loss: 0.5926120735824737
In model, X: (500, 4), b: 0.19491121452334925, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 218 Loss: 0.5925986093962332
In model, X: (500, 4), b: 0.19523162331677849, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 219 Loss: 0.5925853073452637
In model, X: (500, 4), b: 0.19554955236477242, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 220 Loss: 0.5925721651868162
In model, X: (500, 4), b: 0.195865020643255, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 221 Loss: 0.5925591807149012
In model, X: (500, 4), b: 0.19617804697591423, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 222 Loss: 0.5925463517595657
In model, X: (500, 4), b: 0.1964886500357189, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 223 Loss: 0.5925336761861837
In model, X: (500, 4), b: 0.19679684834641248, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 224 Loss: 0.5925211518947671
In model, X: (500, 4), b: 0.19710266028398485, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 225 Loss: 0.5925087768192905
In model, X: (500, 4), b: 0.19740610407812148, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
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gradient shape: (4, 1)
Iter: 226 Loss: 0.5924965489270322
In model, X: (500, 4), b: 0.19770719781363166, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 227 Loss: 0.5924844662179306
In model, X: (500, 4), b: 0.19800595943185542, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 228 Loss: 0.5924725267239553
In model, X: (500, 4), b: 0.19830240673204977, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 229 Loss: 0.5924607285084929
In model, X: (500, 4), b: 0.19859655737275506, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 230 Loss: 0.5924490696657462
In model, X: (500, 4), b: 0.1988884288731414, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 231 Loss: 0.5924375483201486
In model, X: (500, 4), b: 0.1991780386143359, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 232 Loss: 0.5924261626257896
In model, X: (500, 4), b: 0.1994654038407308, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 233 Loss: 0.5924149107658551
In model, X: (500, 4), b: 0.19975054166127337, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 234 Loss: 0.5924037909520798
In model, X: (500, 4), b: 0.20003346905073752, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 235 Loss: 0.5923928014242111
In model, X: (500, 4), b: 0.20031420285097765, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 236 Loss: 0.5923819404494866
In model, X: (500, 4), b: 0.2005927597721652, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 237 Loss: 0.5923712063221213
In model, X: (500, 4), b: 0.2008691563940081, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 238 Loss: 0.5923605973628072
In model, X: (500, 4), b: 0.20114340916695364, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 239 Loss: 0.5923501119182252
In model, X: (500, 4), b: 0.2014155344133748, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 240 Loss: 0.5923397483605642
In model, X: (500, 4), b: 0.20168554832874092, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 241 Loss: 0.5923295050870555
In model, X: (500, 4), b: 0.20195346698277217, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
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Iter: 242 Loss: 0.5923193805195123
In model, X: (500, 4), b: 0.20221930632057927, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 243 Loss: 0.5923093731038835
In model, X: (500, 4), b: 0.20248308216378758, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 244 Loss: 0.5922994813098148
In model, X: (500, 4), b: 0.20274481021164678, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 245 Loss: 0.5922897036302194
In model, X: (500, 4), b: 0.20300450604212592, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 246 Loss: 0.5922800385808593
In model, X: (500, 4), b: 0.2032621851129943, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 247 Loss: 0.5922704846999336
In model, X: (500, 4), b: 0.20351786276288855, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 248 Loss: 0.592261040547678
In model, X: (500, 4), b: 0.2037715542123658, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 249 Loss: 0.5922517047059698
In model, X: (500, 4), b: 0.2040232745649438, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 250 Loss: 0.5922424757779443
In model, X: (500, 4), b: 0.20427303880812758, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 251 Loss: 0.5922333523876169
In model, X: (500, 4), b: 0.20452086181442367, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 252 Loss: 0.5922243331795148
In model, X: (500, 4), b: 0.20476675834234112, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 253 Loss: 0.5922154168183157
In model, X: (500, 4), b: 0.20501074303738073, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 254 Loss: 0.5922066019884935
In model, X: (500, 4), b: 0.20525283043301176, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 255 Loss: 0.5921978873939727
In model, X: (500, 4), b: 0.2054930349516368, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 256 Loss: 0.5921892717577885
In model, X: (500, 4), b: 0.2057313709055448, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 257 Loss: 0.5921807538217553
In model, X: (500, 4), b: 0.20596785249785302, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 258 Loss: 0.592172332346141
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In model, X: (500, 4), b: 0.20620249382343728, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 259 Loss: 0.5921640061093484
In model, X: (500, 4), b: 0.2064353088698513, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 260 Loss: 0.5921557739076029
In model, X: (500, 4), b: 0.2066663115182353, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 261 Loss: 0.5921476345546466
In model, X: (500, 4), b: 0.20689551554421376, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 262 Loss: 0.5921395868814392
In model, X: (500, 4), b: 0.2071229346187827, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 263 Loss: 0.5921316297358639
In model, X: (500, 4), b: 0.2073485823091868, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 264 Loss: 0.5921237619824395
In model, X: (500, 4), b: 0.2075724720797863, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 265 Loss: 0.5921159825020398
In model, X: (500, 4), b: 0.20779461729291418, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 266 Loss: 0.5921082901916157
In model, X: (500, 4), b: 0.2080150312097233, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 267 Loss: 0.5921006839639255
In model, X: (500, 4), b: 0.2082337269910242, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 268 Loss: 0.5920931627472692
In model, X: (500, 4), b: 0.20845071769811319, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 269 Loss: 0.5920857254852283
In model, X: (500, 4), b: 0.2086660162935918, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 270 Loss: 0.5920783711364113
In model, X: (500, 4), b: 0.20887963564217643, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 271 Loss: 0.5920710986742027
In model, X: (500, 4), b: 0.20909158851149945, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 272 Loss: 0.5920639070865193
In model, X: (500, 4), b: 0.20930188757290152, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 273 Loss: 0.5920567953755685
In model, X: (500, 4), b: 0.20951054540221528, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 274 Loss: 0.5920497625576138
In model, X: (500, 4), b: 0.20971757448054035, w: (4, 1)
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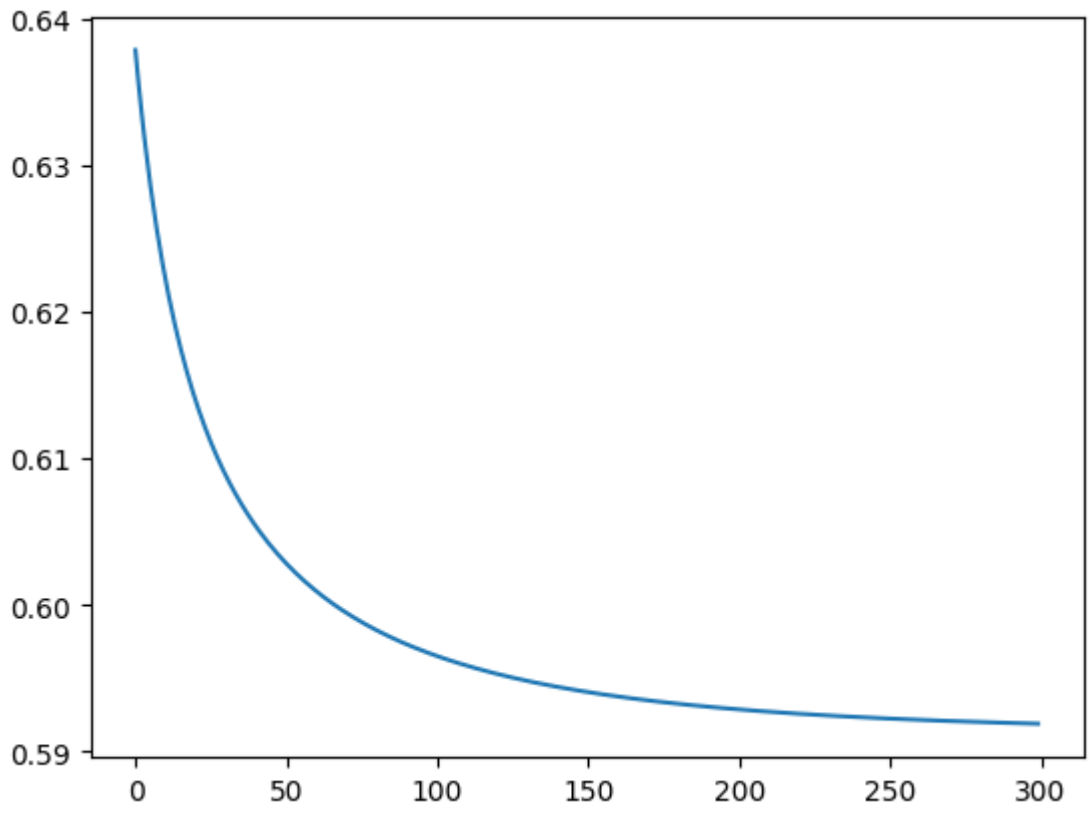
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 275 Loss: 0.5920428076627428
In model, X: (500, 4), b: 0.20992298719501026, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 276 Loss: 0.5920359297346415
In model, X: (500, 4), b: 0.21012679583955104, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 277 Loss: 0.5920291278303713
In model, X: (500, 4), b: 0.21032901261563172, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 278 Loss: 0.5920224010201516
In model, X: (500, 4), b: 0.21052964963300705, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 279 Loss: 0.592015748387146
In model, X: (500, 4), b: 0.21072871891045217, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 280 Loss: 0.5920091690272518
In model, X: (500, 4), b: 0.21092623237648989, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 281 Loss: 0.5920026620488954
In model, X: (500, 4), b: 0.2111222018701102, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 282 Loss: 0.5919962265728298
In model, X: (500, 4), b: 0.21131663914148247, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 283 Loss: 0.5919898617319366
In model, X: (500, 4), b: 0.21150955585266024, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 284 Loss: 0.5919835666710317
In model, X: (500, 4), b: 0.21170096357827897, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 285 Loss: 0.5919773405466754
In model, X: (500, 4), b: 0.21189087380624647, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 286 Loss: 0.5919711825269842
In model, X: (500, 4), b: 0.2120792979384267, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 287 Loss: 0.5919650917914477
In model, X: (500, 4), b: 0.21226624729131638, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 288 Loss: 0.5919590675307491
In model, X: (500, 4), b: 0.212451733096715, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 289 Loss: 0.5919531089465875
In model, X: (500, 4), b: 0.21263576650238822, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 290 Loss: 0.591947215251504
In model, X: (500, 4), b: 0.2128183585727246, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
```

```
gradient shape: (4, 1)
Iter: 291 Loss: 0.5919413856687129
In model, X: (500, 4), b: 0.21299952028938599, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 292 Loss: 0.5919356194319327
In model, X: (500, 4), b: 0.21317926255195152, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 293 Loss: 0.5919299157852235
In model, X: (500, 4), b: 0.21335759617855535, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 294 Loss: 0.5919242739828245
In model, X: (500, 4), b: 0.21353453190651817, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 295 Loss: 0.5919186932889965
In model, X: (500, 4), b: 0.21371008039297282, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 296 Loss: 0.5919131729778663
In model, X: (500, 4), b: 0.21388425221548382, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 297 Loss: 0.5919077123332744
In model, X: (500, 4), b: 0.2140570578726609, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 298 Loss: 0.5919023106486248
In model, X: (500, 4), b: 0.21422850778476693, w: (4, 1)
grad: y shape: (500, 1), X shape: (500, 4)
gradient shape: (4, 1)
Iter: 299 Loss: 0.5918969672267379
In model, X: (500, 4), b: 0.21439861229431995, w: (4, 1)
0.86
```



To see how well our model performs, we compute its accuracy on the testing dataset (X_test, y_test).

In [86]:
```
z = model(w,b,X_test)
y_test=np.squeeze(y_test)
print(accuracy(y_test, predict(z)))
```

```
In model, X: (500, 4), b: 0.21439861229431995, w: (4, 1)
0.902
```

In [87]:
```
mycheck = (y_test==np.transpose(predict(z))[0])
```

In [88]:
```
len(mycheck[mycheck==True])
```

Out[88]:
```
245
```

In [89]:
```
len(mycheck)
```

Out[89]:
```
500
```

In [90]:
```
483/500
```

Out[90]:
```
0.966
```

In [ ]:
```

```

Now, we look at a real-world dataset. The Bank Marketing Data Set is available at UCI's Machine Learning Repository. Colab can read this dataset directly from GitHub using pandas package: pd.read_csv. The data is in the DataFrame format.

In [91]:
```
url = 'https://raw.githubusercontent.com/madmashup/targeted-marketing-predictive-engi
data = pd.read_csv(url)
print(data.shape)
print(list(data.columns))
```

```
(41188, 21)
['age', 'job', 'marital', 'education', 'default', 'housing', 'loan', 'contact', 'mont
h', 'day_of_week', 'duration', 'campaign', 'pdays', 'previous', 'poutcome', 'emp_var_
rate', 'cons_price_idx', 'cons_conf_idx', 'euribor3m', 'nr_employed', 'y']
```

This dataset is pretty large and cause my machine to crash. I remove some fileds. This Webpage has a good description of this dataset. Note that you are not allowed to use any existing model such as those used in that Webpage for this homework.

In [92]:
```
cat_vars=['default','education','contact','month','day_of_week',]
data=data.drop(cat_vars, axis=1)
print(list(data.columns))
print(data.shape)
```

```
['age', 'job', 'marital', 'housing', 'loan', 'duration', 'campaign', 'pdays', 'previo
us', 'poutcome', 'emp_var_rate', 'cons_price_idx', 'cons_conf_idx', 'euribor3m', 'nr_
employed', 'y']
(41188, 16)
```

Some data columns have k class labels. This is best represented as k columns.

In [93]:
```
cat_vars=['job','marital','housing','loan','poutcome']
for va in cat_vars:
    #cat_pre='var'+'_'+var
    print(va)
    #print(data[va])
    cat_list = pd.get_dummies(data[va])
    data1=pd.concat([data,cat_list], axis=1)
    data=data1.drop(va, axis=1)
    #print(list(cat_list.columns))
    #print(list(data.columns))
```

```
    #print(data.shape)

print(data.shape)
print(list(data.columns))
```

```
job
marital
housing
loan
poutcome
(41188, 36)
['age', 'duration', 'campaign', 'pdays', 'previous', 'emp_var_rate', 'cons_price_id
x', 'cons_conf_idx', 'euribor3m', 'nr_employed', 'y', 'admin.', 'blue-collar', 'entre
preneur', 'housemaid', 'management', 'retired', 'self-employed', 'services', 'studen
t', 'technician', 'unemployed', 'unknown', 'divorced', 'married', 'single', 'unknow
n', 'no', 'unknown', 'yes', 'no', 'unknown', 'yes', 'failure', 'nonexistent', 'succes
s']
```

We now split the data into input data X and the label y. We covert them to numpy and split them into training and testing datasets with 30% for testing.

In [94]:
```
X = data.loc[:, data.columns != 'y']
y = data.loc[:, data.columns == 'y']
columns = X.columns
X=X.to_numpy()
y=y.to_numpy()

X_train1, X_test1, y_train1, y_test1 = train_test_split(X, y, test_size=0.3, random_s

print(X_train1.shape)
print(X_test1.shape)
print(columns)
```

```
(28831, 35)
(12357, 35)
Index(['age', 'duration', 'campaign', 'pdays', 'previous', 'emp_var_rate',
       'cons_price_idx', 'cons_conf_idx', 'euribor3m', 'nr_employed', 'admin.',
       'blue-collar', 'entrepreneur', 'housemaid', 'management', 'retired',
       'self-employed', 'services', 'student', 'technician', 'unemployed',
       'unknown', 'divorced', 'married', 'single', 'unknown', 'no', 'unknown',
       'yes', 'no', 'unknown', 'yes', 'failure', 'nonexistent', 'success'],
      dtype='object')
```

Now, train and test as before.

In [98]:
```
w1 = np.random.rand(X_train1.shape[1],1)  # assuming X is N-by-n.
                                          # if X is n-by-N, use X_train.shape[0]
y_train1 = y_train1.reshape(-1,1)
y_test1 = y_test1.reshape(-1,1)
print(w1.shape)
print(X_train1.shape)
print(y_train1.shape)
b1 = 0
w1, b1, loss1 = train(w1, b1, X_train1, y_train1, iter=300, lr=0.01)
plt.figure()
plt.plot(loss1)

#training accuracy
z1 = model(w1,b1,X_train1)
print(accuracy(np.squeeze(y_train1), predict(z1)))
```

```
(35, 1)
(28831, 35)
(28831, 1)
>> (28831, 35)
In model, X: (28831, 35), b: 0, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 0 Loss: 1.2000502137573408
In model, X: (28831, 35), b: -0.008867885262391177, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 1 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.007735770524782355, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 2 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.006603655787173532, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 3 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.005471541049564709, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 4 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.004339426311955884, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 5 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.003207311574347061, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 6 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0020751968367382365, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 7 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0009430820991294124, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 8 Loss: 0.6931471805599453
In model, X: (28831, 35), b: 0.0001890326384794114, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 9 Loss: 1.2000502137573408
In model, X: (28831, 35), b: -0.008678852623911765, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 10 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.007546737886302942, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 11 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.00641462314869412, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 12 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.005282508411085295, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 13 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.00415039367347647, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 14 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.003018278935867647, w: (35, 1)
```

```
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 15 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0018861641982588228, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 16 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0007540494606499991, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 17 Loss: 0.6931686891620388
In model, X: (28831, 35), b: 0.00037771842808088l, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 18 Loss: 1.2000502137573408
In model, X: (28831, 35), b: -0.008490166834310297, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 19 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.007358052096701472, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 20 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.006225937359092647, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 21 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.005093822621483822, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 22 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.003961707883874998, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 23 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0028295931462661733, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 24 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0016974784086573494, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 25 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0005653636710485258, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 26 Loss: 0.6932367033154039
In model, X: (28831, 35), b: 0.0005636294266588033, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 27 Loss: 1.2000502137573408
In model, X: (28831, 35), b: -0.008304255835732372, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 28 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0071721410981235465, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 29 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.006040026360514721, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 30 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.004907911622905896, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
```

```
gradient shape: (35, 1)
Iter: 31 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.003775796885297071, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 32 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0026436821476882462, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 33 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0015115674100794221, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 34 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0003794526724705983, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 35 Loss: 0.6931431136932739
In model, X: (28831, 35), b: 0.0007443376920675724, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 36 Loss: 1.2000502137573408
In model, X: (28831, 35), b: -0.008123547570323603, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 37 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.006991432832714779, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 38 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.005859318095105955, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 39 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.004727203357497129, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 40 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.003595088619888305, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 41 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0024629738822794806, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 42 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0013308591446706563, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 43 Loss: 0.6931901977641324
In model, X: (28831, 35), b: -0.00019943810481772012, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 44 Loss: 0.6931890407249585
In model, X: (28831, 35), b: 0.0009118657001144708, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 45 Loss: 1.2000502137573408
In model, X: (28831, 35), b: -0.007956019562276706, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 46 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.006823904824667883, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
```

```
Iter: 47 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.005691790087059058, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 48 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.004559675349450233, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 49 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0034275606118414088, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 50 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0022954458742325845, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 51 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0011633311366237604, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 52 Loss: 0.6931506689070297
In model, X: (28831, 35), b: -3.295064340465604e-05, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 53 Loss: 0.6932783338873897
In model, X: (28831, 35), b: 0.001062457659380873, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 54 Loss: 1.2000502137573408
In model, X: (28831, 35), b: -0.0078054276030103, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 55 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.006673312865401475, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 56 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.00554119812779265, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 57 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.004409083390183825, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 58 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.003276968652575001, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 59 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.002144853914966176, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
/var/folders/br/p4vyyhqs7kg9vnb50rbzwr4r0000gp/T/ipykernel_45782/1126415571.py:2: Run
timeWarning: overflow encountered in exp
  return 1/(1+np.exp(-t))
```

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Iter: 60 Loss: 0.6931686891620388
In model, X: (28831, 35), b: -0.0010130860262352957, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 61 Loss: 0.6932318593460958
In model, X: (28831, 35), b: 0.00011486652483820181, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 62 Loss: 0.6929724177800447
In model, X: (28831, 35), b: 0.0011821205241968145, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 63 Loss: 1.1059471510730665
In model, X: (28831, 35), b: -0.006160034107111594, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 64 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.005027919369502768, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 65 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0038958046318939444, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 66 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0027636898942851196, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 67 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0016315751566762951, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 68 Loss: 0.6931770214784314
In model, X: (28831, 35), b: -0.0005005009657013031, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 69 Loss: 0.6931382697239657
In model, X: (28831, 35), b: 0.000622248852203036, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 70 Loss: 0.692783476512843
In model, X: (28831, 35), b: 0.0013832425299528121, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 71 Loss: 1.175703868020218
In model, X: (28831, 35), b: -0.007092312781492399, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 72 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0059601980438835755, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 73 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.004828083306274752, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 74 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.003695968568665928, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 75 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0025638538310571043, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 76 Loss: 0.6931686891620388
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In model, X: (28831, 35), b: -0.0014320859423262243, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 77 Loss: 0.6931721775091231
In model, X: (28831, 35), b: -0.00030205229798506346, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 78 Loss: 0.69323128082917
In model, X: (28831, 35), b: 0.000815841635727017, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 79 Loss: 0.6928638743594868
In model, X: (28831, 35), b: 0.0014274285604569642, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 80 Loss: 0.9005118715537896
In model, X: (28831, 35), b: -0.0024342827840389035, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 81 Loss: 0.6931686891620388
In model, X: (28831, 35), b: -0.0013025148953080233, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 82 Loss: 0.6932151947133104
In model, X: (28831, 35), b: -0.00017317494872275046, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 83 Loss: 0.6932070645393719
In model, X: (28831, 35), b: 0.0009395161804093157, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 84 Loss: 0.6934459756617546
In model, X: (28831, 35), b: 0.0014230232339419561, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 85 Loss: 0.805060695647638
In model, X: (28831, 35), b: -0.0007195900575472586, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 86 Loss: 0.6932006628053856
In model, X: (28831, 35), b: 0.0004066282491365194, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 87 Loss: 0.6930279160339219
In model, X: (28831, 35), b: 0.0014561746383225374, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 88 Loss: 0.7952105537239551
In model, X: (28831, 35), b: -0.0005035450441456748, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 89 Loss: 0.6931826425503766
In model, X: (28831, 35), b: 0.0006212858670263276, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 90 Loss: 0.6926889548454888
In model, X: (28831, 35), b: 0.0016052961337546024, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 91 Loss: 0.9071455918824672
In model, X: (28831, 35), b: -0.0023732622161371374, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 92 Loss: 0.6931686891620388
In model, X: (28831, 35), b: -0.0012414943274062572, w: (35, 1)
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grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 93 Loss: 0.6931936861112169
In model, X: (28831, 35), b: -0.00011180753194304069, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 94 Loss: 0.6932312808265088
In model, X: (28831, 35), b: 0.0010060864016700843, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 95 Loss: 0.6923417761779058
In model, X: (28831, 35), b: 0.0016769260159405276, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 96 Loss: 0.8875935426381538
In model, X: (28831, 35), b: -0.0019621715451547386, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 97 Loss: 0.6931901977641324
In model, X: (28831, 35), b: -0.0008307505053018028, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 98 Loss: 0.6932318593460958
In model, X: (28831, 35), b: 0.0002972020457716948, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 99 Loss: 0.6933258461343492
In model, X: (28831, 35), b: 0.001395672442220848, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 100 Loss: 0.7091336438398373
In model, X: (28831, 35), b: 0.0012155976787952816, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 101 Loss: 0.6938428131412431
In model, X: (28831, 35), b: 0.001589184173899398, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 102 Loss: 0.752213636861691
In model, X: (28831, 35), b: 0.0004487668288073263 4, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 103 Loss: 0.693094169086786
In model, X: (28831, 35), b: 0.0015338603197716295, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 104 Loss: 0.7254169590827818
In model, X: (28831, 35), b: 0.0009497366939260403, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 105 Loss: 0.6928690194651853
In model, X: (28831, 35), b: 0.0018407922538335396, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 106 Loss: 0.9452115206481002
In model, X: (28831, 35), b: -0.0028010273006747704, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 107 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0016689125630659466, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 108 Loss: 0.6931770214784314
In model, X: (28831, 35), b: -0.0005378383720909541, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
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gradient shape: (35, 1)
Iter: 109 Loss: 0.6932270153945643
In model, X: (28831, 35), b: 0.0005890736330097124, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 110 Loss: 0.6930576750340497
In model, X: (28831, 35), b: 0.0016622240613680765, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 111 Loss: 0.7306351745952171
In model, X: (28831, 35), b: 0.0009708388529779267, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 112 Loss: 0.6927471440254439
In model, X: (28831, 35), b: 0.0019152975242683588, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 113 Loss: 0.881301910622697
In model, X: (28831, 35), b: -0.0016069033567922173, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 114 Loss: 0.6931770214784314
In model, X: (28831, 35), b: -0.00047582916581722506, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 115 Loss: 0.6932401916624883
In model, X: (28831, 35), b: 0.0006514296875003844, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 116 Loss: 0.6930458543667662
In model, X: (28831, 35), b: 0.0017270080580564235, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 117 Loss: 0.7241767425994797
In model, X: (28831, 35), b: 0.0011723988609966829, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 118 Loss: 0.6923756230393682
In model, X: (28831, 35), b: 0.002019430279529396, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 119 Loss: 0.900482866796448
In model, X: (28831, 35), b: -0.0018381175616875296, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 120 Loss: 0.6931686891620388
In model, X: (28831, 35), b: -0.0007063496729566498, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 121 Loss: 0.6932103507440021
In model, X: (28831, 35), b: 0.0004219497269947912, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 122 Loss: 0.6932272139598373
In model, X: (28831, 35), b: 0.0015315192875372 63, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 123 Loss: 0.6947971372577968
In model, X: (28831, 35), b: 0.0018628934577650754, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 124 Loss: 0.7349416131549268
In model, X: (28831, 35), b: 0.0010808885130255243, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
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Iter: 125 Loss: 0.6924307179678414
In model, X: (28831, 35), b: 0.0020617896590876764, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 126 Loss: 0.8333973140449643
In model, X: (28831, 35), b: -0.000595874677828567, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 127 Loss: 0.6932103507440021
In model, X: (28831, 35), b: 0.0005324247221228741, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 128 Loss: 0.6931745088170339
In model, X: (28831, 35), b: 0.0016406068871535702, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 129 Loss: 0.6969524695464019
In model, X: (28831, 35), b: 0.001891361052498232, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 130 Loss: 0.7221004578554737
In model, X: (28831, 35), b: 0.0013802315166563449, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 131 Loss: 0.6923772999871217
In model, X: (28831, 35), b: 0.002182442967972158, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 132 Loss: 0.8901864774222403
In model, X: (28831, 35), b: -0.001498467761241325, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 133 Loss: 0.6931901977641324
In model, X: (28831, 35), b: -0.0003670467213883889, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 134 Loss: 0.6932318593460958
In model, X: (28831, 35), b: 0.0007609058296851082, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 135 Loss: 0.6932863172772074
In model, X: (28831, 35), b: 0.001858335679499755, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 136 Loss: 0.7053077328434769
In model, X: (28831, 35), b: 0.0017940360809169302, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 137 Loss: 0.6999825773606568
In model, X: (28831, 35), b: 0.0019194272327901873, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 138 Loss: 0.7106721356800753
In model, X: (28831, 35), b: 0.0016961146977783259, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 139 Loss: 0.6936531313207909
In model, X: (28831, 35), b: 0.0020822902356730094, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 140 Loss: 0.7462577437294311
In model, X: (28831, 35), b: 0.0010636197073726412, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 141 Loss: 0.6928741128568209
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In model, X: (28831, 35), b: 0.002124635188381011, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 142 Loss: 0.7523196385867872
In model, X: (28831, 35), b: 0.000986660472562062, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 143 Loss: 0.6930367449515432
In model, X: (28831, 35), b: 0.0020702163672587427, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 144 Loss: 0.7255182988500402
In model, X: (28831, 35), b: 0.0014846275686540595, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 145 Loss: 0.6924002928041355
In model, X: (28831, 35), b: 0.0023599358199716805, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 146 Loss: 0.9227055432156429
In model, X: (28831, 35), b: -0.001886879279738289, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 147 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0007547645421294651, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 148 Loss: 0.6931770214784314
In model, X: (28831, 35), b: 0.0003763096488455274, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 149 Loss: 0.6931646222953675
In model, X: (28831, 35), b: 0.001499753164505754, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 150 Loss: 0.6923956404953627
In model, X: (28831, 35), b: 0.002415782489161676, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 151 Loss: 0.874487598464517
In model, X: (28831, 35), b: -0.0009754035044660175, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 152 Loss: 0.6931770214784314
In model, X: (28831, 35), b: 0.0001556706865089749, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 153 Loss: 0.6932006628053856
In model, X: (28831, 35), b: 0.001281888993192753, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 154 Loss: 0.6928755366838816
In model, X: (28831, 35), b: 0.002328332024783311, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 155 Loss: 0.7548343838665447
In model, X: (28831, 35), b: 0.0011395453421866593, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 156 Loss: 0.6930727854615614
In model, X: (28831, 35), b: 0.002225876027906891, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 157 Loss: 0.7166870167339561
In model, X: (28831, 35), b: 0.00184380968825967, w: (35, 1)
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grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 158 Loss: 0.6911155687835676
In model, X: (28831, 35), b: 0.0024549781384571668, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 159 Loss: 0.805285804048675
In model, X: (28831, 35), b: 0.00031488279243672366, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 160 Loss: 0.6932089951217784
In model, X: (28831, 35), b: 0.0014404074013646133, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 161 Loss: 0.6927023124850086
In model, X: (28831, 35), b: 0.0024695080222407635, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 162 Loss: 0.7833891796881106
In model, X: (28831, 35), b: 0.000734995862658621, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 163 Loss: 0.6931979515609381
In model, X: (28831, 35), b: 0.0018556645872952965, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 164 Loss: 0.6915703910249903
In model, X: (28831, 35), b: 0.002579159878614052, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 165 Loss: 0.8403076684890325
In model, X: (28831, 35), b: -0.0002015324607120539, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 166 Loss: 0.6931936861112169
In model, X: (28831, 35), b: 0.0009281543347511629, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 167 Loss: 0.6931785756837051
In model, X: (28831, 35), b: 0.002044660872852512, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 168 Loss: 0.692257931494446
In model, X: (28831, 35), b: 0.002508769215130785, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 169 Loss: 0.7552642266391844
In model, X: (28831, 35), b: 0.0013139247866215623, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 170 Loss: 0.693090805715235
In model, X: (28831, 35), b: 0.0024016428678718376, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 171 Loss: 0.7157354192062101
In model, X: (28831, 35), b: 0.002046342018599179, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 172 Loss: 0.6910232023545229
In model, X: (28831, 35), b: 0.002594237123707874, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 173 Loss: 0.7807482276527385
In model, X: (28831, 35), b: 0.0009138924558830194, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
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gradient shape: (35, 1)
Iter: 174 Loss: 0.6931715989895371
In model, X: (28831, 35), b: 0.0020338674827637925, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 175 Loss: 0.6909433316484216
In model, X: (28831, 35), b: 0.002675191161797081, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 176 Loss: 0.8122349072265242
In model, X: (28831, 35), b: 0.0004091154210379261, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 177 Loss: 0.6932401916624883
In model, X: (28831, 35), b: 0.0015363742743555355, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 178 Loss: 0.6928538311570047
In model, X: (28831, 35), b: 0.002600506631887359, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 179 Loss: 0.7422765997195341
In model, X: (28831, 35), b: 0.0016700446229016882, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 180 Loss: 0.6925759721181235
In model, X: (28831, 35), b: 0.0027067759190763565, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 181 Loss: 0.7829608355182428
In model, X: (28831, 35), b: 0.0009836686739565545, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 182 Loss: 0.6931764429588446
In model, X: (28831, 35), b: 0.002104684247471174, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 183 Loss: 0.6910922972338364
In model, X: (28831, 35), b: 0.0028028859093103416, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 184 Loss: 0.830124852535272
In model, X: (28831, 35), b: 0.00020908308268098106, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 185 Loss: 0.6932367033154039
In model, X: (28831, 35), b: 0.0013380761803883099, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 186 Loss: 0.6932223699905514
In model, X: (28831, 35), b: 0.0024466051942965035, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 187 Loss: 0.6992894901583615
In model, X: (28831, 35), b: 0.002608234181297669, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 188 Loss: 0.7145907921534611
In model, X: (28831, 35), b: 0.0022808972610443524, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 189 Loss: 0.6922438997191497
In model, X: (28831, 35), b: 0.0027731498507013075, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
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Iter: 190 Loss: 0.7646097538298853
In model, X: (28831, 35), b: 0.0013987607205337954, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 191 Loss: 0.6932008613884357
In model, X: (28831, 35), b: 0.0025076365833203796, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 192 Loss: 0.7001541597777378
In model, X: (28831, 35), b: 0.002639059220958306, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 193 Loss: 0.7123902552162769
In model, X: (28831, 35), b: 0.002366805430034174, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 194 Loss: 0.6940594638590334
In model, X: (28831, 35), b: 0.0027889295766280243, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 195 Loss: 0.7519993291419558
In model, X: (28831, 35), b: 0.0016597103515073636, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 196 Loss: 0.6931483548286821
In model, X: (28831, 35), b: 0.0027498563748849783, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 197 Loss: 0.7279835221766593
In model, X: (28831, 35), b: 0.0021159537302128362, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 198 Loss: 0.6916346708925157
In model, X: (28831, 35), b: 0.003027472578811734, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 199 Loss: 0.9529235300822314
In model, X: (28831, 35), b: -0.0017402278846082645, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 200 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.0006081131469994406, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 201 Loss: 0.6931686891620388
In model, X: (28831, 35), b: 0.0005236547417314392, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 202 Loss: 0.6932235270297029
In model, X: (28831, 35), b: 0.0016523009905608243, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 203 Loss: 0.693216947501634
In model, X: (28831, 35), b: 0.0027497308403752604, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 204 Loss: 0.7083862447843966
In model, X: (28831, 35), b: 0.002596835925203908, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 205 Loss: 0.6973984167519992
In model, X: (28831, 35), b: 0.0028639118939721895, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 206 Loss: 0.7276251183935899
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In model, X: (28831, 35), b: 0.0022391313542434524, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 207 Loss: 0.6917208472546046
In model, X: (28831, 35), b: 0.0031365010316952847, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 208 Loss: 0.9349461140571997
In model, X: (28831, 35), b: -0.0013171730831580417, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 209 Loss: 0.6931471805599453
In model, X: (28831, 35), b: -0.00018505834554921773, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 210 Loss: 0.6931770214784314
In model, X: (28831, 35), b: 0.0009460158454257749, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 211 Loss: 0.6932270153767874
In model, X: (28831, 35), b: 0.0020729278498654406, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 212 Loss: 0.692499892996633
In model, X: (28831, 35), b: 0.0031041654956384186, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 213 Loss: 0.7900143907154722
In model, X: (28831, 35), b: 0.001252291772803852, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 214 Loss: 0.6931646222953675
In model, X: (28831, 35), b: 0.002375735288464078, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 215 Loss: 0.6916852653948135
In model, X: (28831, 35), b: 0.003231064811441128, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 216 Loss: 0.8744008649746431
In model, X: (28831, 35), b: -0.00015015371705027526, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 217 Loss: 0.6931770214784314
In model, X: (28831, 35), b: 0.0009809204739247169, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 218 Loss: 0.6932401916624883
In model, X: (28831, 35), b: 0.0021081793272423256, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 219 Loss: 0.6925862385763156
In model, X: (28831, 35), b: 0.0031570503341446245, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 220 Loss: 0.7575594150020278
In model, X: (28831, 35), b: 0.0019213730741696688, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 221 Loss: 0.6931545544202141
In model, X: (28831, 35), b: 0.0030153344352046654, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 222 Loss: 0.710518111786163
In model, X: (28831, 35), b: 0.002800096140887267, w: (35, 1)
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grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 223 Loss: 0.696061604106915
In model, X: (28831, 35), b: 0.0031357684006891357, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 224 Loss: 0.7346304272461369
In model, X: (28831, 35), b: 0.0023633486861841715, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 225 Loss: 0.6918798327897971
In model, X: (28831, 35), b: 0.003335196816942817, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 226 Loss: 0.8507743386610876
In model, X: (28831, 35), b: 0.0003714148668002939, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 227 Loss: 0.6931770214784314
In model, X: (28831, 35), b: 0.001502489057775286, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 228 Loss: 0.6931729546117601
In model, X: (28831, 35), b: 0.0026252388756796254, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 229 Loss: 0.6908194077053051
In model, X: (28831, 35), b: 0.003366480787087206, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 230 Loss: 0.821936219161782
In model, X: (28831, 35), b: 0.0009253272836150 23, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 231 Loss: 0.6932103507440021
In model, X: (28831, 35), b: 0.0020536266835664645, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 232 Loss: 0.693167730705915
In model, X: (28831, 35), b: 0.0031479348934794053, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 233 Loss: 0.710008359598001
In model, X: (28831, 35), b: 0.002949503613670975, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 234 Loss: 0.6963127900054308
In model, X: (28831, 35), b: 0.0032721113894108146, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 235 Loss: 0.7346521569883991
In model, X: (28831, 35), b: 0.002499327724324232, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 236 Loss: 0.6917241661758325
In model, X: (28831, 35), b: 0.003469811038422731, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 237 Loss: 0.8514424010129223
In model, X: (28831, 35), b: 0.0004953421807766816, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 238 Loss: 0.6931770214784314
In model, X: (28831, 35), b: 0.0016264163717516736, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
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gradient shape: (35, 1)
Iter: 239 Loss: 0.693186130897461
In model, X: (28831, 35), b: 0.0027495130385339567, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 240 Loss: 0.6907956326197049
In model, X: (28831, 35), b: 0.003501872669734066, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 241 Loss: 0.8228903926424336
In model, X: (28831, 35), b: 0.0010433735978391 64, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 242 Loss: 0.6932235270297029
In model, X: (28831, 35), b: 0.0021720198466685494, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 243 Loss: 0.6931593983895225
In model, X: (28831, 35), b: 0.0032670217543373787, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 244 Loss: 0.7078669529504177
In model, X: (28831, 35), b: 0.0031303597749119754, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 245 Loss: 0.6977096265763285
In model, X: (28831, 35), b: 0.0033778553477197154, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 246 Loss: 0.7254561252408648
In model, X: (28831, 35), b: 0.0027975413562976712, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 247 Loss: 0.6908714404567851
In model, X: (28831, 35), b: 0.0035958905253328298, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 248 Loss: 0.8485181775068906
In model, X: (28831, 35), b: 0.0006740696365383313, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 249 Loss: 0.6931770214784314
In model, X: (28831, 35), b: 0.0018051438275133234, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 250 Loss: 0.6931597783260592
In model, X: (28831, 35), b: 0.002927546796539719, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 251 Loss: 0.6904727533639572
In model, X: (28831, 35), b: 0.003589353276530841, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 252 Loss: 0.7917317065805222
In model, X: (28831, 35), b: 0.0017075608651750303, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 253 Loss: 0.6932041511524701
In model, X: (28831, 35), b: 0.0028320449274690895, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 254 Loss: 0.6911768242662557
In model, X: (28831, 35), b: 0.003702302041944935, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
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Iter: 255 Loss: 0.8632168042848207
In model, X: (28831, 35), b: 0.0005182587758651847, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 256 Loss: 0.6931770214784314
In model, X: (28831, 35), b: 0.001649332966840177, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 257 Loss: 0.6931874865196846
In model, X: (28831, 35), b: 0.0027752044246460105, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 258 Loss: 0.6916133953832909
In model, X: (28831, 35), b: 0.003740975162456907, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 259 Loss: 0.8321321030631786
In model, X: (28831, 35), b: 0.0011165222788147922, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 260 Loss: 0.6931936861112169
In model, X: (28831, 35), b: 0.0022462090742780085, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 261 Loss: 0.693136335582155
In model, X: (28831, 35), b: 0.003356125483698424, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 262 Loss: 0.6978280430001946
In model, X: (28831, 35), b: 0.003598928711785919, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 263 Loss: 0.7246748958366752
In model, X: (28831, 35), b: 0.0030387217599047193, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 264 Loss: 0.6903975162451219
In model, X: (28831, 35), b: 0.003781640797215168, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 265 Loss: 0.8092010603381762
In model, X: (28831, 35), b: 0.0015767525357607733, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 266 Loss: 0.6932401916624883
In model, X: (28831, 35), b: 0.002704011389078382, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 267 Loss: 0.6925036925150262
In model, X: (28831, 35), b: 0.0037525355471027242, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 268 Loss: 0.7594154458200343
In model, X: (28831, 35), b: 0.002485891971048632, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 269 Loss: 0.6930435230626621
In model, X: (28831, 35), b: 0.0035833218208630685, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 270 Loss: 0.7068992753962461
In model, X: (28831, 35), b: 0.00347544025996874, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 271 Loss: 0.6984082187569985
```

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In model, X: (28831, 35), b: 0.00368651092522013, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 272 Loss: 0.7218346563051554
In model, X: (28831, 35), b: 0.003189550005008924, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 273 Loss: 0.6907028525678842
In model, X: (28831, 35), b: 0.003843671219535113, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 274 Loss: 0.7868422448893375
In model, X: (28831, 35), b: 0.0020518971685508417, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 275 Loss: 0.6932256597545636
In model, X: (28831, 35), b: 0.0031760343819669567, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 276 Loss: 0.6902978952255941
In model, X: (28831, 35), b: 0.003917239257394535, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 277 Loss: 0.8186878072624444
In model, X: (28831, 35), b: 0.0015365021535366317, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 278 Loss: 0.6932367033154039
In model, X: (28831, 35), b: 0.0026654952512439596, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 279 Loss: 0.6930658087673924
In model, X: (28831, 35), b: 0.0037552944257436298, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 280 Loss: 0.7162605971683529
In model, X: (28831, 35), b: 0.0033886804765002818, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 281 Loss: 0.6937943748923673
In model, X: (28831, 35), b: 0.003892320070291487, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 282 Loss: 0.7617642981480439
In model, X: (28831, 35), b: 0.0025829398184704423, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 283 Loss: 0.6930857631642123
In model, X: (28831, 35), b: 0.0036869597969658124, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 284 Loss: 0.7024554457753757
In model, X: (28831, 35), b: 0.003716429053451933, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 285 Loss: 0.7047722362763233
In model, X: (28831, 35), b: 0.0036736393493050387, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 286 Loss: 0.7005642136865975
In model, X: (28831, 35), b: 0.003783944693788421, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 287 Loss: 0.7121514378617632
In model, X: (28831, 35), b: 0.003522729539728958, w: (35, 1)
```

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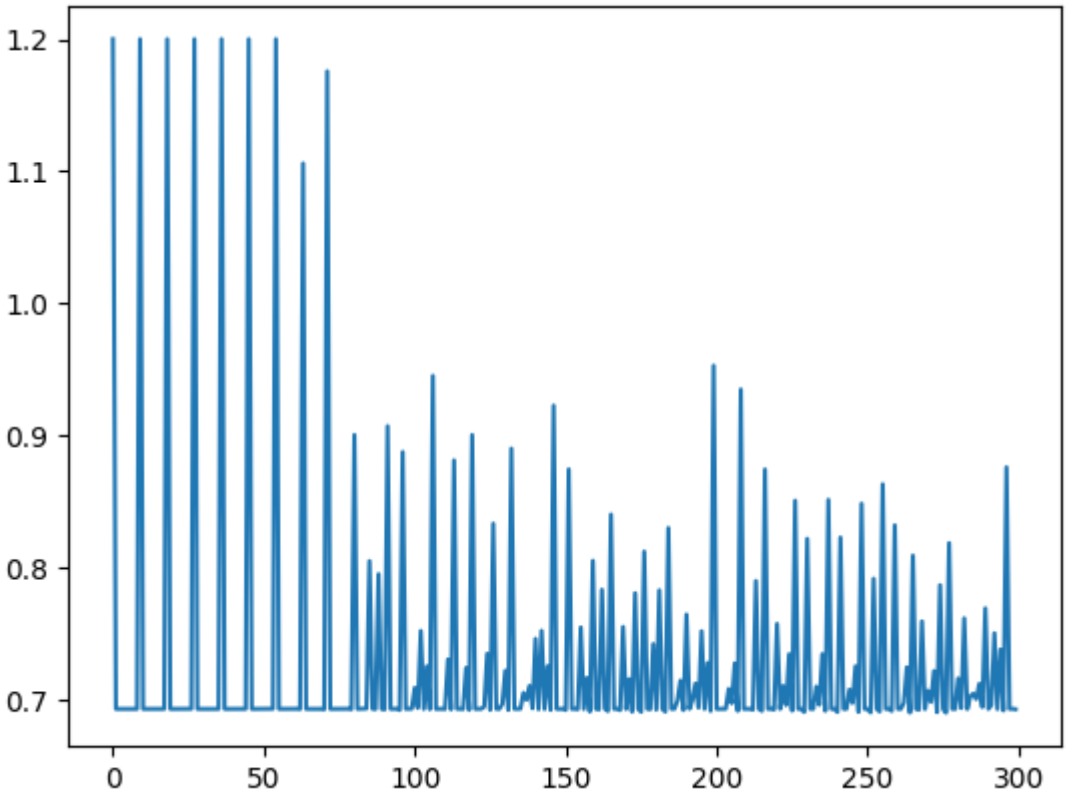
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 288 Loss: 0.6945506706993698
In model, X: (28831, 35), b: 0.00395149815703972, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 289 Loss: 0.7693155679346246
In model, X: (28831, 35), b: 0.0024941464882238373, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 290 Loss: 0.6931584227038353
In model, X: (28831, 35), b: 0.0036137746662266825, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 291 Loss: 0.6960531763792652
In model, X: (28831, 35), b: 0.003949524455864888, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 292 Loss: 0.750451229684446
In model, X: (28831, 35), b: 0.0028592578726762555, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 293 Loss: 0.6930264053510857
In model, X: (28831, 35), b: 0.003948021664612707, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 294 Loss: 0.7380804023623576
In model, X: (28831, 35), b: 0.003112103146717489, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 295 Loss: 0.6919999088355354
In model, X: (28831, 35), b: 0.004135569369398284, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 296 Loss: 0.8760390106950952
In model, X: (28831, 35), b: 0.0007297612619625318, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 297 Loss: 0.6931686891620388
In model, X: (28831, 35), b: 0.0018615291506934115, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 298 Loss: 0.6932367033154039
In model, X: (28831, 35), b: 0.0029905222484007394, w: (35, 1)
grad: y shape: (28831, 1), X shape: (28831, 35)
gradient shape: (35, 1)
Iter: 299 Loss: 0.6929001431211401
In model, X: (28831, 35), b: 0.004069569298309052, w: (35, 1)
0.8235579757899483
```



In [96]:
```
z1 = model(w1,b1,X_test1)
y_test1=np.squeeze(y_test1)
print(accuracy(y_test1, predict(z1)))
```

```
In model, X: (12357, 35), b: 0.03818846728930764, w: (35, 1)
0.9083920045318443
/var/folders/br/p4vyyhqs7kg9vnb50rbzwr4r0000gp/T/ipykernel_45782/1126415571.py:2: Run
timeWarning: overflow encountered in exp
  return 1/(1+np.exp(-t))
```

In [ ]:

In [ ]: