



IBM Developer SKILLS NETWORK

Logistic Regression and Bad Initialization Value

Objective

- How bad initialization value can affects the accuracy of model. .

Table of Contents

In this lab, you will see what happens when you use the root mean square error cost or total loss function and select a bad initialization value for the parameter values.

- [Make Some Data](#)
- [Create the Model and Cost Function the PyTorch way](#)
- [Train the Model:Batch Gradient Descent](#)

Estimated Time Needed: **30 min**

Preparation

We'll need the following libraries:

In [1]:

```
# Import the libraries we need for this lab

import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits import mplot3d
import torch
from torch.utils.data import Dataset, DataLoader
import torch.nn as nn
```

Helper functions

The class `plot_error_surfaces` is just to help you visualize the data space and the Parameter space during training and has nothing to do with Pytorch.

In [2]:

```

# Create class for plotting and the function for plotting

class plot_error_surfaces(object):

    # Construtor
    def __init__(self, w_range, b_range, X, Y, n_samples = 30, go = True):
        W = np.linspace(-w_range, w_range, n_samples)
        B = np.linspace(-b_range, b_range, n_samples)
        w, b = np.meshgrid(W, B)
        Z = np.zeros((30, 30))
        count1 = 0
        self.y = Y.numpy()
        self.x = X.numpy()
        for wl, bl in zip(w, b):
            count2 = 0
            for w2, b2 in zip(wl, bl):
                Z[count1, count2] = np.mean((self.y - (1 / (1 + np.exp(-1*w2 * self.x - b2)))) ** 2)
                count2 += 1
            count1 += 1
        self.Z = Z
        self.w = w
        self.b = b
        self.W = []
        self.B = []
        self.LOSS = []
        self.n = 0
        if go == True:
            plt.figure()
            plt.figure(figsize=(7.5, 5))
            plt.axes(projection='3d').plot_surface(self.w, self.b, self.Z, rstride=1, cstride=1, cmap=cm.coolwarm)
            plt.title('Loss Surface')
            plt.xlabel('w')
            plt.ylabel('b')
            plt.show()
            plt.figure()
            plt.title('Loss Surface Contour')
            plt.xlabel('w')
            plt.ylabel('b')
            plt.contour(self.w, self.b, self.Z)
            plt.show()

    # Setter
    def set_para_loss(self, model, loss):
        self.n = self.n + 1
        self.W.append(list(model.parameters())[0].item())
        self.B.append(list(model.parameters())[1].item())
        self.LOSS.append(loss)

    # Plot diagram
    def final_plot(self):
        ax = plt.axes(projection='3d')
        ax.plot_wireframe(self.w, self.b, self.Z)
        ax.scatter(self.W, self.B, self.LOSS, c='r', marker='x', s=200, alpha=1)
        plt.figure()
        plt.contour(self.w, self.b, self.Z)
        plt.scatter(self.W, self.B, c='r', marker='x')
        plt.xlabel('w')
        plt.ylabel('b')
        plt.show()

```

```

# Plot diagram
def plot_ps(self):
    plt.subplot(121)
    plt.ylim
    plt.plot(self.x, self.y, 'ro', label="training points")
    plt.plot(self.x, self.W[-1] * self.x + self.B[-1], label="estimated line")
    plt.plot(self.x, 1 / (1 + np.exp(-1 * (self.W[-1] * self.x + self.B[-1]))), label='sigmoid')
    plt.xlabel('x')
    plt.ylabel('y')
    plt.ylim((-0.1, 2))
    plt.title('Data Space Iteration: ' + str(self.n))
    plt.show()
    plt.subplot(122)
    plt.contour(self.w, self.b, self.Z)
    plt.scatter(self.W, self.B, c='r', marker='x')
    plt.title('Loss Surface Contour Iteration' + str(self.n))
    plt.xlabel('w')
    plt.ylabel('b')

# Plot the diagram

def PlotStuff(X, Y, model, epoch, leg=True):
    plt.plot(X.numpy(), model(X).detach().numpy(), label=('epoch ' + str(epoch)))
    plt.plot(X.numpy(), Y.numpy(), 'r')
    if leg == True:
        plt.legend()
    else:
        pass

```

Set the random seed:

In [3]:

```

# Set random seed

torch.manual_seed(0)

```

Out[3]:

<torch._C.Generator at 0x1721b050cf0>

Get Some Data

Create the Data class

In [4]:

```
# Create the data class

class Data(Dataset):

    # Constructor
    def __init__(self):
        self.x = torch.arange(-1, 1, 0.1).view(-1, 1)
        self.y = torch.zeros(self.x.shape[0], 1)
        self.y[self.x[:, 0] > 0.2] = 1
        self.len = self.x.shape[0]

    # Getter
    def __getitem__(self, index):
        return self.x[index], self.y[index]

    # Get Length
    def __len__(self):
        return self.len
```

Make Data object

In [5]:

```
# Create Data object

data_set = Data()
```

Create the Model and Total Loss Function (Cost)

Create a custom module for logistic regression:

In [6]:

```
# Create logistic_regression class

class logistic_regression(nn.Module):

    # Constructor
    def __init__(self, n_inputs):
        super(logistic_regression, self).__init__()
        self.linear = nn.Linear(n_inputs, 1)

    # Prediction
    def forward(self, x):
        yhat = torch.sigmoid(self.linear(x))
        return yhat
```

Create a logistic regression object or model:

In [7]:

```
# Create the logistic_regression result

model = logistic_regression(1)
```

Replace the random initialized variable values with some predetermined values that will not converge:

In [8]:

```
# Set the weight and bias

model.state_dict()['linear.weight'].data[0] = torch.tensor([[ -5]])
model.state_dict()['linear.bias'].data[0] = torch.tensor([[ -10]])
print("The parameters: ", model.state_dict())
```

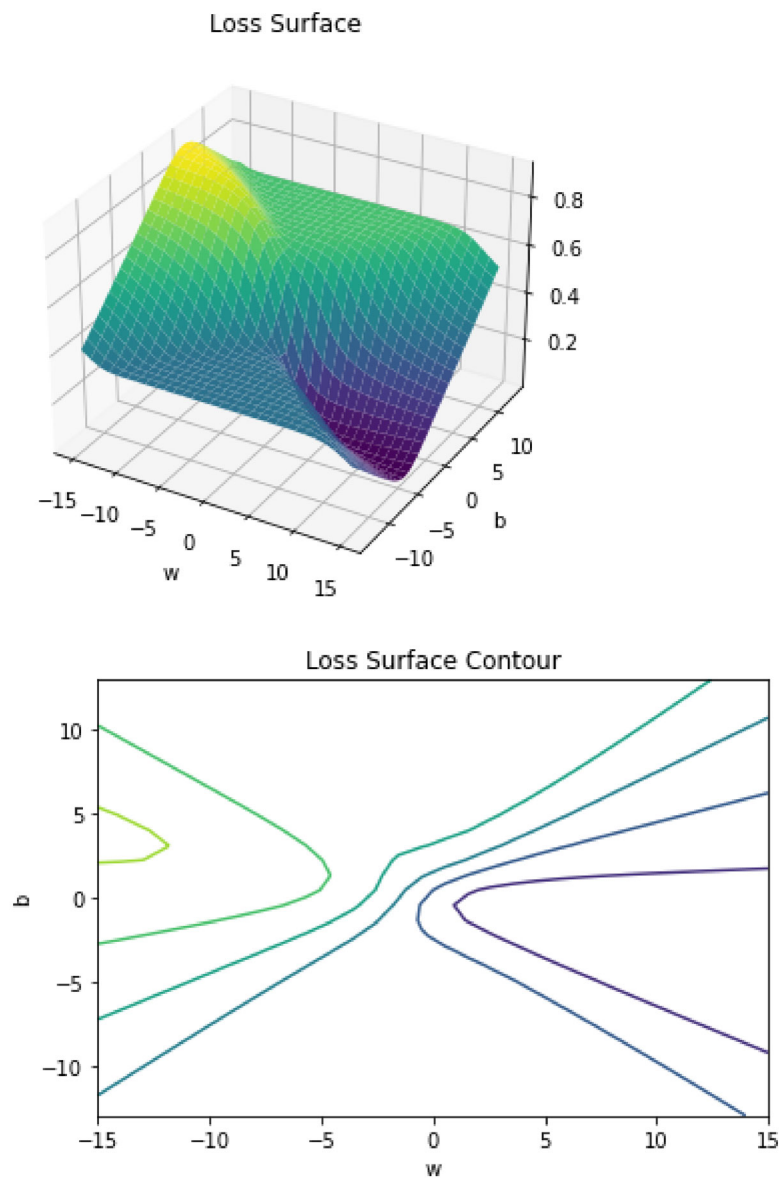
```
The parameters: OrderedDict([('linear.weight', tensor([[ -5.]])), ('linear.bias', tensor([[ -10.]]))])
```

Create a `plot_error_surfaces` object to visualize the data space and the parameter space during training:

In [9]:

```
# Create the plot_error_surfaces object  
get_surface = plot_error_surfaces(15, 13, data_set[:,0], data_set[:,1], 30)
```

<Figure size 432x288 with 0 Axes>



Define the dataloader, the cost or criterion function, the optimizer:

In [10]:

```
# Create dataloader object, criterion function and optimizer.

trainloader = DataLoader(dataset=data_set, batch_size=3)
criterion_rms = nn.MSELoss()
learning_rate = 2
optimizer = torch.optim.SGD(model.parameters(), lr=learning_rate)
```

Train the Model via Batch Gradient Descent

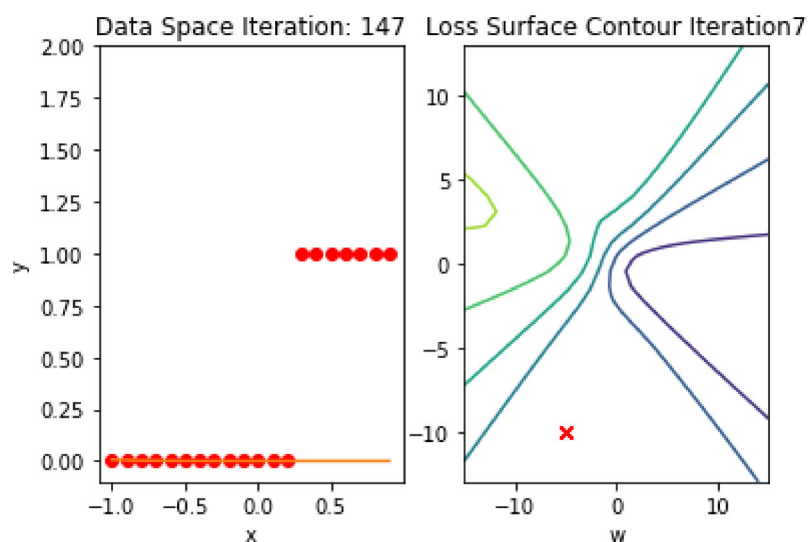
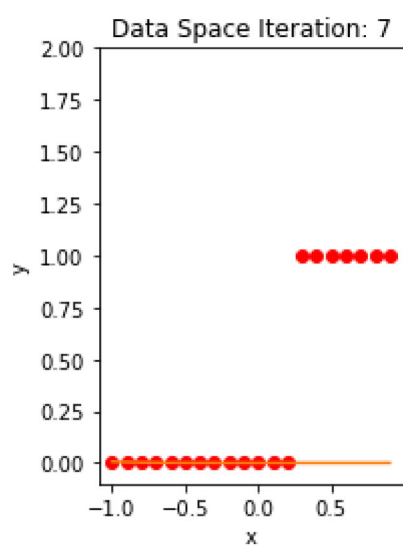
Train the model

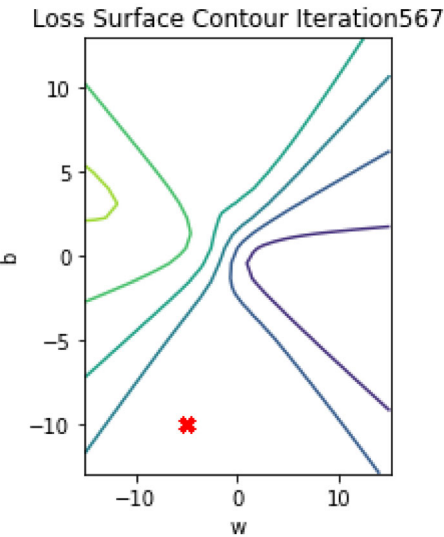
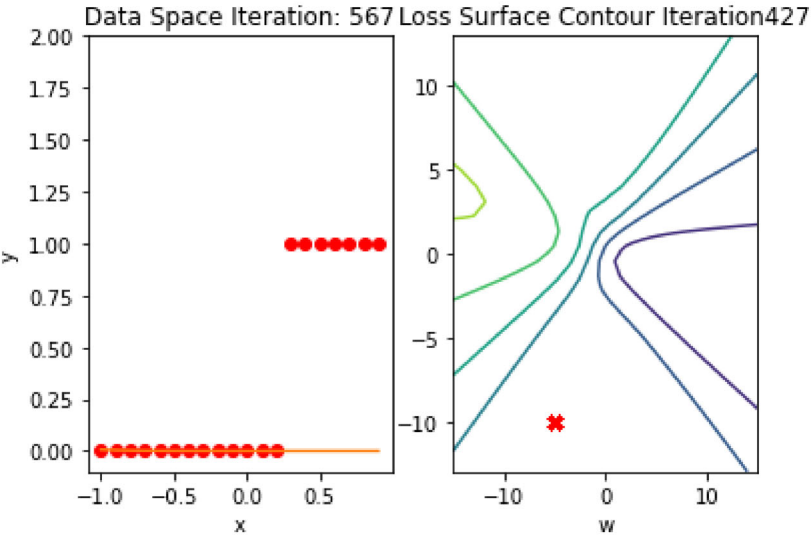
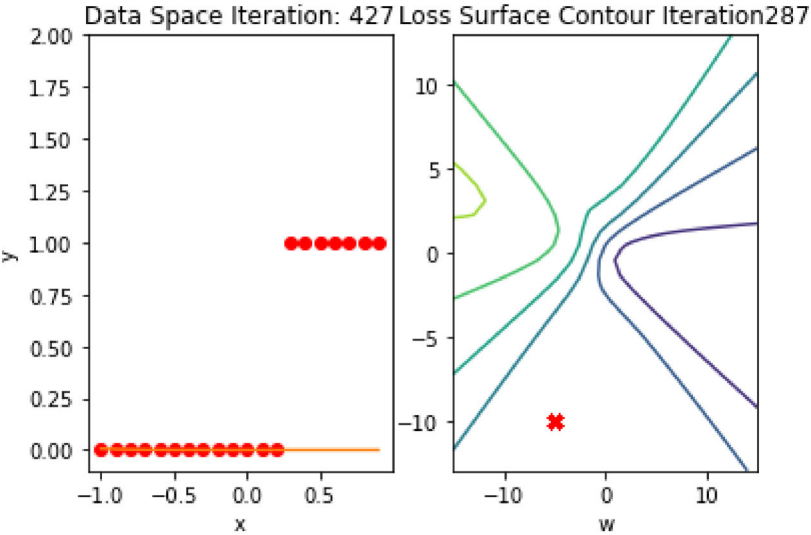
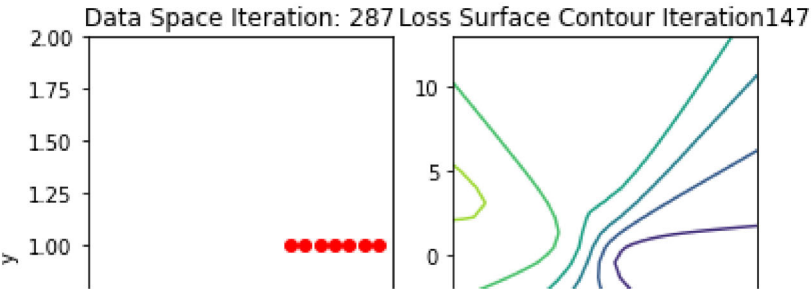
In [11]:

```
# Train the model

def train_model(epochs):
    for epoch in range(epochs):
        for x, y in trainloader:
            yhat = model(x)
            loss = criterion_rms(yhat, y)
            optimizer.zero_grad()
            loss.backward()
            optimizer.step()
            get_surface.set_para_loss(model, loss.tolist())
        if epoch % 20 == 0:
            get_surface.plot_ps()

train_model(100)
```





Get the actual class of each sample and calculate the accuracy on the test data:

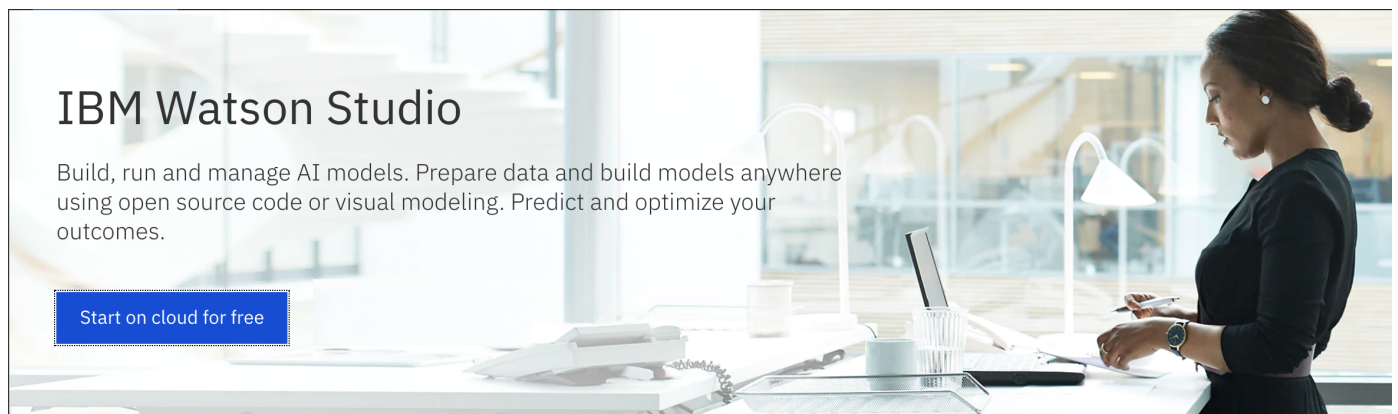
In [12]:

```
# Make the Prediction

yhat = model(data_set.x)
label = yhat > 0.5
print("The accuracy: ", torch.mean((label == data_set.y.type(torch.ByteTensor)).type(torch.float)))
```

The accuracy: tensor(0.6500)

Accuracy is 60% compared to 100% in the last lab using a good Initialization value.



(https://dataplatform.cloud.ibm.com/registration/stepone?context=cpdaas&apps=data_science_experience,watson_machine_learning)

About the Authors:

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Change Log

| Date (YYYY-MM-DD) | Version | Changed By | Change Description |
|-------------------|---------|------------|---|
| 2020-09-23 | 2.0 | Shubham | Migrated Lab to Markdown and added to course repo in GitLab |

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