04

April 15, 2020

[1]:
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[2]:
```
import matplotlib.pyplot as plt
import math
import numpy as np
import random
import torch
from torch.utils.data import Dataset, DataLoader
import torchvision.transforms as transforms
import torchvision
import os
from random import *
```

[3]:
```
import csv

# Load Dataset

trainData = []
testData = []
with open('data_train.csv', newline='') as myfile:
    reader  = csv.reader(myfile, delimiter=',')
    ct = 1
    print("Train datas")
    for i in reader:
        #print('[', ct,']', 'x =', i[0], ', y = ', i[1], ', z = ', i[2], ', h = ', i[3])
        trainData.append( [ float(i[0]), float(i[1]),float(i[2]),float(i[3]) ] )
        # x = i[0] y = i[1] z = i[2] h = i[3]
        ct += 1

with open('data_test.csv', newline='') as myfile:
    reader  = csv.reader(myfile, delimiter=',')
    ct = 1
    for i in reader:
```

```
        #print('[', ct, ']', 'x =', i[0], ', y = ', i[1], ', z = ', i[2], ', h
↪= ', i[3])
        testData.append([ float(i[0]) , float(i[1]),float(i[2]),float(i[3])])
        ct += 1
```

Train datas

[4]:
```
# Load Dataset-2
train_x = []
train_y = []
train_z = []
train_yh = []

for i in trainData :
    train_x.append(i[0])
    train_y.append(i[1])
    train_z.append(i[2])
    train_yh.append(i[3])

test_x = []
test_y = []
test_z = []
test_yh = []
for i in testData :
    test_x.append(i[0])
    test_y.append(i[1])
    test_z.append(i[2])
    test_yh.append(i[3])
```

[5]:
```
# Convert data to tensor
train_x = torch.FloatTensor(train_x)
train_y = torch.FloatTensor(train_y)
train_z = torch.FloatTensor(train_z)
train_h = torch.FloatTensor(train_yh)

test_x = torch.FloatTensor(test_x)
test_y = torch.FloatTensor(test_y)
test_z = torch.FloatTensor(test_z)
test_h = torch.FloatTensor(test_yh)
```

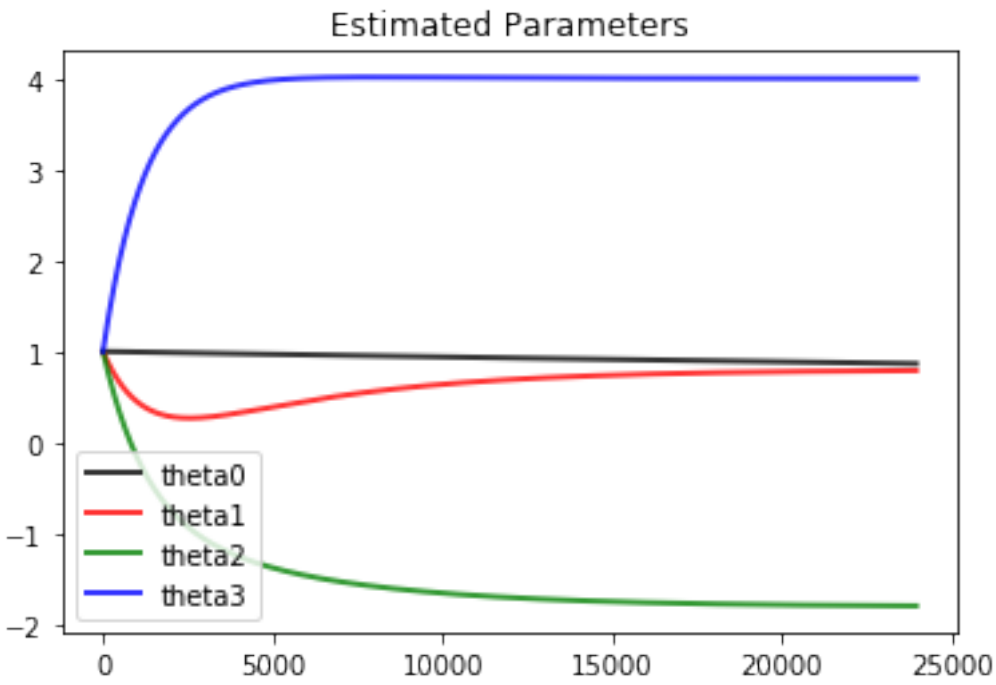
[6]:
```
# Initialize thetas
th0 = torch.FloatTensor([1.0])
th1 = torch.FloatTensor([1.0])
th2 = torch.FloatTensor([1.0])
th3 = torch.FloatTensor([1.0])

# Setting Step-size. (Learning-rate)
```

```
lr = 0.00001

# Setting converge value
loss_conv = 1e-8 # loss converge standard

# Lists for logging
loss_log = []
th0_log = []
th1_log = []
th2_log = []
th3_log = []
epoch_log = []
conv_count = 0 # Variable To count converge
epoch = 0 # Inital epoch value

test_loss_log = []


while (True) :
    epoch +=1
    epoch_log.append(epoch)

    ## Training
    # Get Train yh
    yh = th0 + th1*train_x+th2*train_y + th3*train_z
    m = len(yh)
    # Get Training Loss
    loss = (1/(2*m)) * torch.sum((yh - train_h)**2)
    # Logging
    loss_log.append(loss)
    th0_log.append(th0)
    th1_log.append(th1)
    th2_log.append(th2)
    th3_log.append(th3)


    ## Testing
    # Get Test yh
    test_yh = th0 + th1*test_x + th2*test_y + th3*test_z
    # Get Test loss
    test_m = len(test_yh)
    test_loss = (1/(2*test_m)) * torch.sum((test_yh - test_h)**2)
    test_loss_log.append(test_loss)


    # Updating Parameters - Gradient Descent
    th0 = th0 - lr * (1/m) * torch.sum((yh-train_h))
```

```
    th1 = th1 - lr * (1/m) * torch.sum((yh-train_h)*train_x)
    th2 = th2 - lr * (1/m) * torch.sum((yh-train_h)*train_y)
    th3 = th3 - lr * (1/m) * torch.sum((yh-train_h)*train_z)


    ## Does Train Loss Converged?
    if len(loss_log) > 2 :
        if abs(loss_log[-1] - loss_log[-2]) < loss_conv :
            conv_count += 1
        else :
            conv_count = 0

    # For monitor
    '''
    if epoch %1000 == 0 :
        print("epoch {}, th0 {:.5f}, th1 {:.5f}, th2 {:5f}, th3 {:5f}, loss {:.
↪10f}".format(epoch,th0.item(),th1.item(),th2.item(),th3.item(),loss_log[-1]))
    '''
    ## Escape if Training loss is converged
    if conv_count > 3 :
        print("Loss is converged")
        print("epoch {}, th0 {:.5f}, th1 {:.5f}, th2 {:5f}, th3 {:5f}, loss {:.
↪10f}".format(epoch,th0.item(),th1.item(),th2.item(),th3.item(),loss_log[-1]))

        break
```

```
Loss is converged
epoch 23969, th0 0.86621, th1 0.79049, th2 -1.797193, th3 4.002856, loss
103.9825515747
```

[7]:
```
# 1. Plot the estimated parameters using the training dataset
plot0, = plt.plot(epoch_log,th0_log, color='black',linewidth=2,alpha=0.8)
plot1, = plt.plot(epoch_log,th1_log, color='red',linewidth=2,alpha=0.8)
plot2, = plt.plot(epoch_log,th2_log, color='green',linewidth=2,alpha=0.8)
plot3, = plt.plot(epoch_log,th3_log, color='blue',linewidth=2,alpha=0.8)

plt.title("Estimated Parameters")
plt.legend([plot0,plot1,plot2,plot3],["theta0","theta1",'theta2','theta3'])
plt.show()


print("th0:",th0_log[-1].item(),"\nth1:",th1_log[-1].item(),"\nth2:
↪",th2_log[-1].item(),"\nth3:",th3_log[-1].item())
```



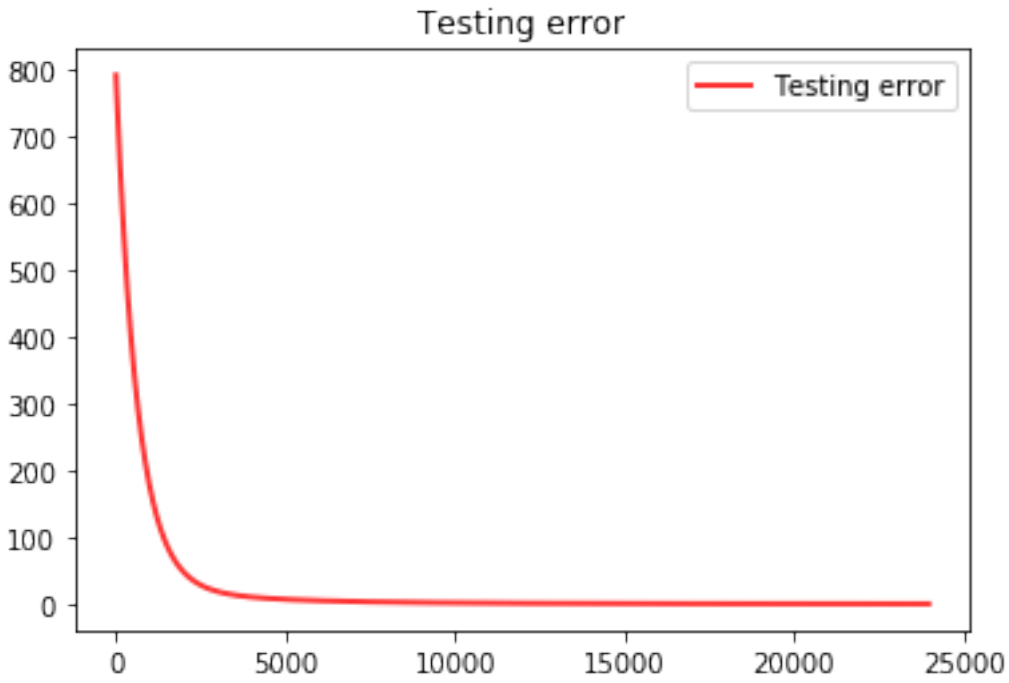

```
th0: 0.8662112355232239
th1: 0.790483295917511
th2: -1.7971913814544678
th3: 4.002856731414795
```

[8]:
```
# 2. Plot the training error using the training dataset
plt.title("Training error")
plot, = plt.plot(epoch_log,loss_log, color='blue',linewidth=2,alpha=0.8)
plt.legend([plot],["Trainging error"])
print("Converged Training loss : {:.5f}".format(loss_log[-1].item()))
```

```
Converged Training loss : 103.98255
```

[9]:
```
# 3. Plot the testing error at every iteration of gradient descent until␣
 ↪convergence
plt.title("Testing error")
plot, = plt.plot(epoch_log,test_loss_log, color='red',linewidth=2,alpha=0.8)
plt.legend([plot],["Testing error"])
print("Last Testing Loss : {:.5f}".format(test_loss_log[-1].item()))
```

```
Last Testing Loss : 0.91189
```


Testing error
Testing error
800
700
600
500
400
300
200
100
0
0
5000
10000
15000
20000
25000