HW1-2 Classification-1106

November 7, 2019

[1]:
```
#author = 0712238@NCTU, Maxwill Lin, YT Lin
#last update = 2019.11.07
#usage = HW1 of Deep Learning 2019 fall @ NCTU
#classification part
#preprocess
#NN(2D) architectur = NN([34, 17, 2, 1],activations=['relu', 'relu',␣
↪'sigmoid'], usage = 'classification')
#NN2(3D) architectur = NN([34, 17, 3, 1],activations=['relu', 'relu',␣
↪'sigmoid'], usage = 'classification')
#train and test with split data set
#learning curve + train/test CE + train/test accuracy/error rate
#visualization with 2D/3D scatters
#save files

#2019.11.06-07 some bug fixed, improvement on weight init, experiments
```

[3]:
```
import numpy as np
import math
import pandas as pd
from model import *
import csv
import matplotlib.pyplot as plt
import pickle
```

[4]:
```
df =  pd.read_csv("ionosphere_csv.csv")
df
```

[4]:

	a01	a02	a03	a04	a05	a06	a07	a08	a09	\
0	1	0	0.99539	-0.05889	0.85243	0.02306	0.83398	-0.37708	1.00000	
1	1	0	1.00000	-0.18829	0.93035	-0.36156	-0.10868	-0.93597	1.00000	
2	1	0	1.00000	-0.03365	1.00000	0.00485	1.00000	-0.12062	0.88965	
3	1	0	1.00000	-0.45161	1.00000	1.00000	0.71216	-1.00000	0.00000	
4	1	0	1.00000	-0.02401	0.94140	0.06531	0.92106	-0.23255	0.77152	
..	…	…	…	…	…	…	…	…	…	
346	1	0	0.83508	0.08298	0.73739	-0.14706	0.84349	-0.05567	0.90441	
347	1	0	0.95113	0.00419	0.95183	-0.02723	0.93438	-0.01920	0.94590	
348	1	0	0.94701	-0.00034	0.93207	-0.03227	0.95177	-0.03431	0.95584	

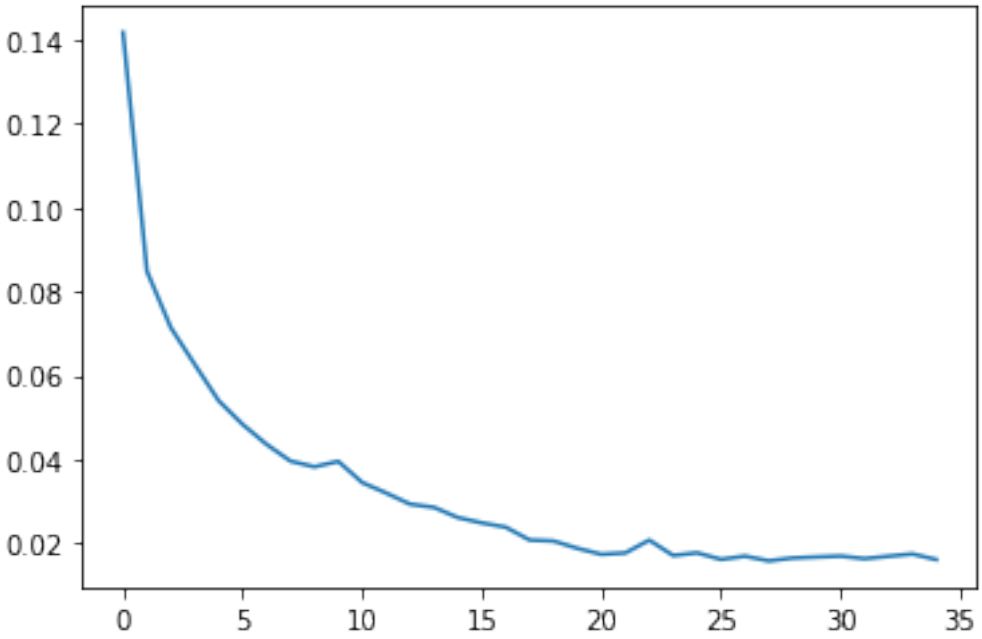
```
349    1    0  0.90608 -0.01657  0.98122 -0.01989  0.95691 -0.03646  0.85746
350    1    0  0.84710  0.13533  0.73638 -0.06151  0.87873  0.08260  0.88928

          a10  …      a26      a27      a28      a29      a30      a31  \
0     0.03760  … -0.51171  0.41078 -0.46168  0.21266 -0.34090  0.42267
1    -0.04549  … -0.26569 -0.20468 -0.18401 -0.19040 -0.11593 -0.16626
2     0.01198  … -0.40220  0.58984 -0.22145  0.43100 -0.17365  0.60436
3     0.00000  …  0.90695  0.51613  1.00000  1.00000 -0.20099  0.25682
4    -0.16399  … -0.65158  0.13290 -0.53206  0.02431 -0.62197 -0.05707
..        …  …      …       …       …       …       …       …
346  -0.04622  … -0.04202  0.83479  0.00123  1.00000  0.12815  0.86660
347   0.01606  …  0.01361  0.93522  0.04925  0.93159  0.08168  0.94066
348   0.02446  …  0.03193  0.92489  0.02542  0.92120  0.02242  0.92459
349   0.00110  … -0.02099  0.89147 -0.07760  0.82983 -0.17238  0.96022
350  -0.09139  … -0.15114  0.81147 -0.04822  0.78207 -0.00703  0.75747

          a32      a33      a34  class
0    -0.54487  0.18641 -0.45300      g
1    -0.06288 -0.13738 -0.02447      b
2    -0.24180  0.56045 -0.38238      g
3     1.00000 -0.32382  1.00000      b
4    -0.59573 -0.04608 -0.65697      g
..        …      …       …    …
346  -0.10714  0.90546 -0.04307      g
347  -0.00035  0.91483  0.04712      g
348   0.00442  0.92697 -0.00577      g
349  -0.03757  0.87403 -0.16243      g
350  -0.06678  0.85764 -0.06151      g

[351 rows x 35 columns]
```

[5]:
```python
def normalize(X):
    s = [ np.mean(dim) for dim in X.T]
    X = np.asarray([np.divide(x, s) for x in X])
    return X

y = df["class"].values
y = np.asarray([[float(yi == 'g')] for yi in y])
#print(y.shape) (351,1)
X = df.drop(["class"], axis=1).values

def partition(X, y, ratio=0.8):
    n = X.shape[0]
    indices = np.arange(n)
    np.random.shuffle(indices)
    X = X[indices]
    y = y[indices]
```

```
    p = int(n*ratio)
    train_X = X[:p]
    test_X = X[p:]
    train_y = y[:p]
    test_y = y[p:]
    return train_X, train_y, test_X, test_y

train_X, train_y, test_X, test_y = partition(X, y, ratio=0.8)
```

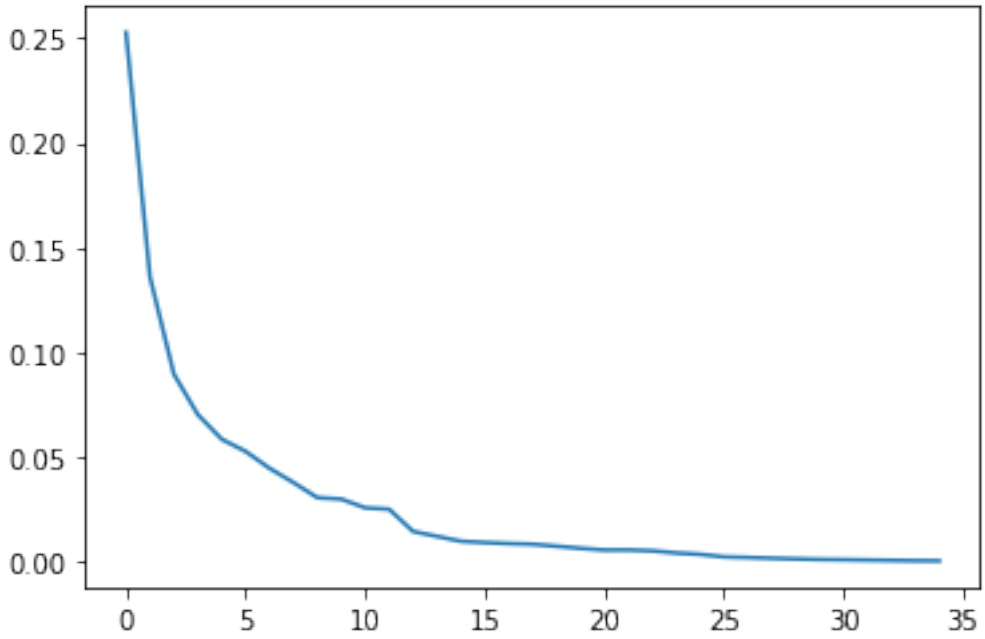
[6]:
```
nn = NN([34, 17, 2, 1],activations=['selu','selu', 'sigmoid'], usage =␣
 ↪'classification')
#the network architecture is as the constructer

learning_curve = nn.train(train_X, train_y, epochs=35, batch_size=10, lr = .10)

train_CE = nn.calc_error(train_X, train_y)
train_accuracy = nn.calc_accuracy(train_X, train_y)
test_CE = nn.calc_error(test_X, test_y)
test_accuracy = nn.calc_accuracy(test_X, test_y)

plt.plot(np.arange(len(learning_curve)), learning_curve)
print('train_CE = ', train_CE, '\n', 'test_RMS = ', test_CE)
print('train_Accuracy = ', train_accuracy, '\n', 'test_Accuracy = ',␣
 ↪test_accuracy)
print('train_ErrorRate = ', 1-train_accuracy, '\n', 'test_ErrorRate = ',␣
 ↪1-test_accuracy)
```

```
train_CE =  0.024920143567069595
 test_RMS =  0.08990445742151205
train_Accuracy =  0.9821428571428571
 test_Accuracy =  0.9014084507042254
train_ErrorRate =  0.017857142857142905
 test_ErrorRate =  0.09859154929577463
```



[12]:
```
nn2 = NN([34, 17, 3, 1],activations=['selu', 'selu', 'sigmoid'], usage =␣
 ↪'classification')
#the network architecture is as the constructer

learning_curve = nn2.train(train_X, train_y, epochs=35, batch_size=10, lr = .1)

train_CE = nn2.calc_error(train_X, train_y)
train_accuracy = nn2.calc_accuracy(train_X, train_y)
test_CE = nn2.calc_error(test_X, test_y)
test_accuracy = nn2.calc_accuracy(test_X, test_y)

plt.plot(np.arange(len(learning_curve)), learning_curve)

print('train_CE = ', train_CE, '\n', 'test_RMS = ', test_CE)
print('train_Accuracy = ', train_accuracy, '\n', 'test_Accuracy = ',␣
 ↪test_accuracy)
print('train_ErrorRate = ', 1-train_accuracy, '\n', 'test_ErrorRate = ',␣
 ↪1-test_accuracy)
```

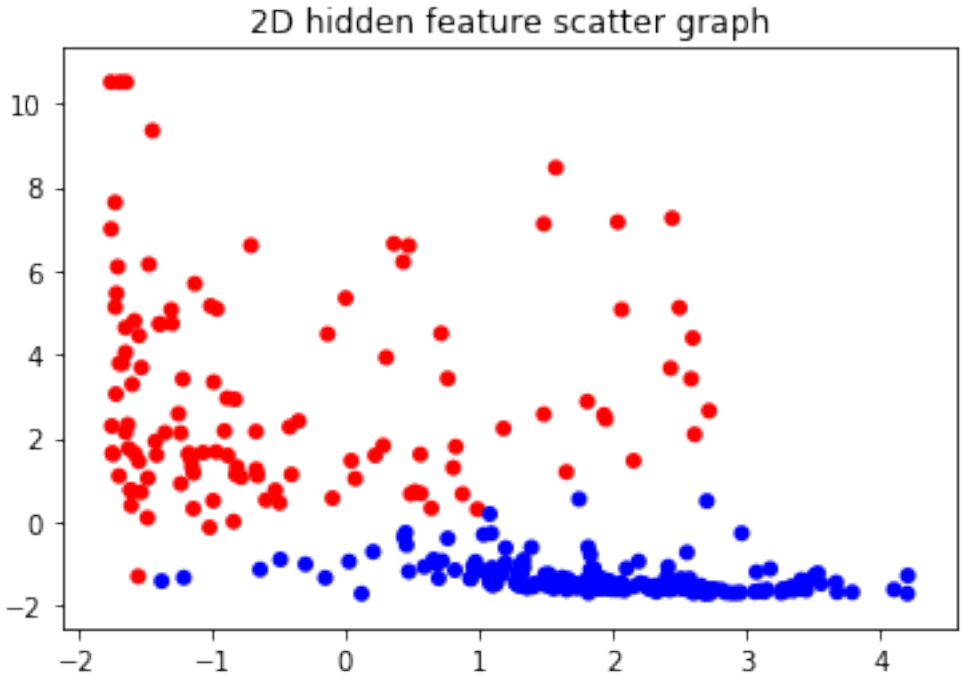
```
train_CE =  0.015531460916366376
 test_RMS =  0.11901994990265738
train_Accuracy =  0.9892857142857143
 test_Accuracy =  0.9014084507042254
train_ErrorRate =  0.010714285714285676
 test_ErrorRate =  0.09859154929577463
```

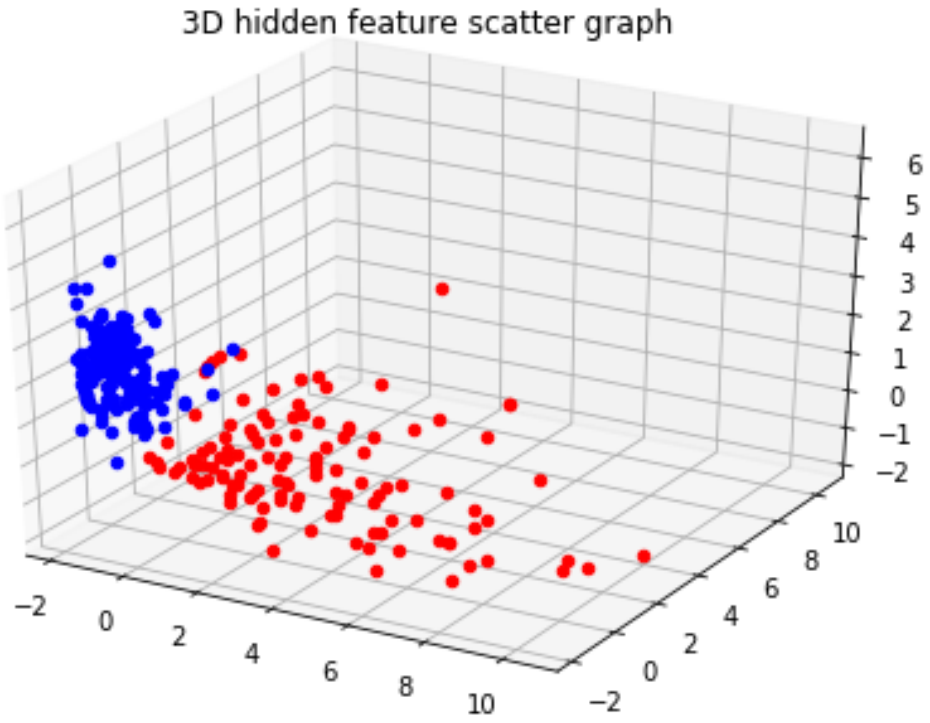


[13]:
```
def plot2D(nn, X):
    _, a_s = nn.feedforward(X.T)
    cos = a_s[-2]
    label = a_s[-1]
    n = a_s[-2].shape[1]
    assert(a_s[-2].shape[0] == 2)
    colors = ("red", "blue")
    groups = ("good", "bad")

    for i in range(n):
        k = int(label[0][i]>=0.5)
        plt.scatter(cos[0][i], cos[1][i], c=colors[k], edgecolors='none')

    plt.title('2D hidden feature scatter graph')
    plt.show()

from mpl_toolkits.mplot3d import Axes3D

def plot3D(nn, X):
    _, a_s = nn.feedforward(X.T)
    cos = a_s[-2]
    label = a_s[-1]
    n = a_s[-2].shape[1]
    assert(a_s[-2].shape[0] == 3)
    colors = ("red", "blue")
    groups = ("good", "bad")
```

```
    fig = plt.figure()
    ax = Axes3D(fig)
    for i in range(n):
        k = int(label[0][i]>=0.5)
        ax.scatter(cos[0][i], cos[1][i], cos[2][i], c=colors[k])

    plt.title('3D hidden feature scatter graph')
    plt.show()
```

[14]:
```
plot2D(nn, X)
plot3D(nn2, X)
```





[16]:
```
def save_file(name):
    pathcsv = "./predictions/"
    file_train_csv = pathcsv + "class_train_pred_"+name+".csv"
    file_test_csv = pathcsv + "class_test_pred_"+name+".csv"
    pathnn = "./savedmodels/"
    savefilename = pathnn + "nn_"+name+"_2D"
    savefilename2 = pathnn + "nn_"+name+"_3D"

    with open(file_train_csv, 'w', newline='') as csvFile:
        writer = csv.writer(csvFile)
        writer.writerow(['prediction', 'label'])
        for i in range(train_X.shape[0]):
            writer.writerow([nn.prediction(np.asarray([train_X[i]]))[0][0],␣
↪train_y[i][0]])
    with open(file_test_csv, 'w', newline='') as csvFile:
        writer = csv.writer(csvFile)
        writer.writerow(['prediction', 'label'])
        for i in range(test_X.shape[0]):
            writer.writerow([nn.prediction(np.asarray([test_X[i]]))[0][0],␣
↪test_y[i][0]])

    with open(savefilename, 'wb') as fo:
        pickle.dump(nn, fo)
```

```
    with open(savefilename2, 'wb') as fo:
        pickle.dump(nn2, fo)

save_file("1107_1")
```

[ ]: