# excise11-ML

May 26, 2018

```
In [29]: import numpy as np
         import pandas as pd
         import matplotlib.pyplot as plt
         %matplotlib inline

In [30]: class HiddenLayer:
             def __init__(self,n_in_units,n_out_units):
                 "first layer structure"
                 self.n_in_units=n_in_units
                 self.n_out_units=n_out_units

                 self.next_units=[]
                 self.potential=[]
                 self.delta=[]
                 self.out=[]
                 np.random.seed(0)
                 self.weights = np.random.rand(self.n_in_units, n_out_units) # later need transp

             def sigmoid(self,a):
                 return 1/(1+np.exp(-a))


             def forward_pass(self,input_units): #compute output
                 "computer hiddenlayer units' activation value"
                 self.potential=input_units.dot(self.weights)
                 self.next_units=self.sigmoid(self.potential)
                 self.out=np.insert(self.next_units,0,1,axis=1)

             def back_prop(self,pre_unit,next_delta,next_weights,stepsize):
                 "compute delta: using deriviate of sigmoid function"
                 "gradient descent: #average gradient"
                 self.delta= self.out * (1-self.out)*(next_delta.dot(next_weights.T))
                 self.weights = self.weights -(stepsize * pre_unit.T.dot(self.delta[:,1:]))/pre_

In [31]: class OutLayer(HiddenLayer):
             def _init_(self,n_in_units,n_out_units):
                 "output layer constructure"
                 HiddenLayer._init_(self,n_in_units,n_out_units)
```

```
        self.out=0
        self.predict=[]

    def forward_pass(self, input_units):
        self.out=input_units.dot(self.weights)


    def backward_prop(self,pred_unit,true_unit,stepsize,pre_units):
        self.delta= 2*(pred_unit- true_unit)
        self.weights = self.weights - stepsize * pre_units.T.dot(self.delta) / pre_unit



    def mse(self,true_unit):
        "computing float value of output, not after threshold"
        return np.mean(np.square(self.out - true_unit))

    def predict_unit(self):
        "use for feed backward"
        return np.where(self.out > 0.5, 1, 0)

    def predict_unit_continous(self):
        "use for feed backward"
        self.predict=np.where(self.out >0,1,self.out)
        self.predict=np.where(self.predict<0,-1,self.predict)
        return self.predict
```

XOR TASK:

```
In [8]: X = np.array([[1, 0, 0], [1, 1, 0], [1, 0, 1], [1, 1, 1]]) #as in the front as bias
        Y = np.array([[1],[0], [0], [1]])
```

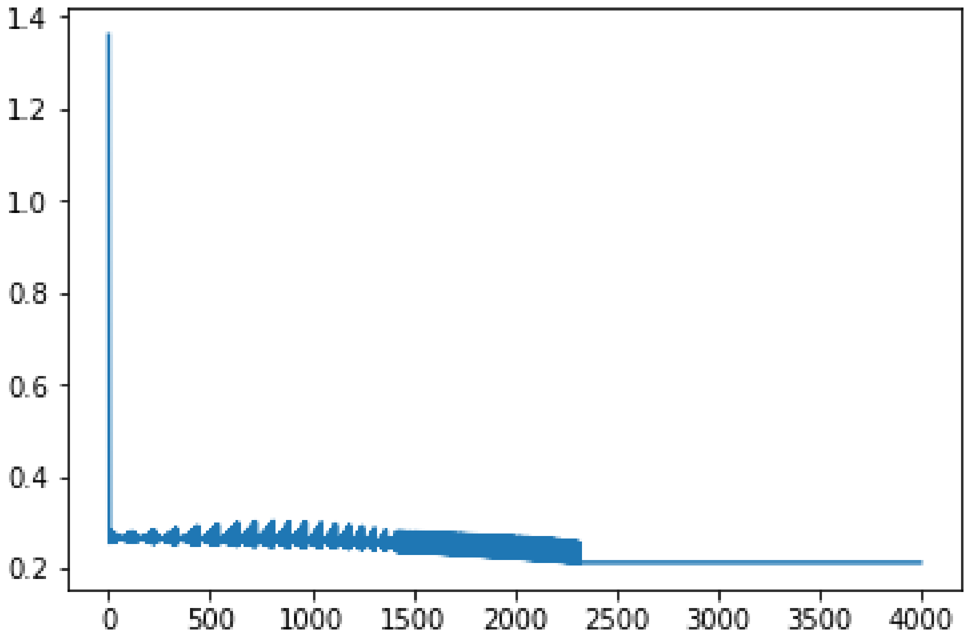
```
In [11]: epochs=4000
         stepsize=0.1
         error=[]
         n_in_units=2
         n_out_units=1
         hiddenlayer=HiddenLayer(X.shape[1],n_in_units)
         outlayer=OutLayer(n_in_units+1,n_out_units)
         #extra one dim is bias term
```

```
In [12]: for epoch in range(epochs):
             hiddenlayer.forward_pass(X)
             outlayer.forward_pass(hiddenlayer.out)


             pred_unit=outlayer.predict_unit()
```

```
            out=outlayer.out

            outlayer.backward_prop(pred_unit,Y,stepsize,hiddenlayer.out)
            #outlayer.backward_prop(pred_unit,Y,stepsize,hiddenlayer.next_units)

            #hiddenlayer.back_prop(X,hiddenlayer.next_units,outlayer.weights,stepsize)
            hiddenlayer.back_prop(X,outlayer.delta,outlayer.weights,stepsize)
            error.append(outlayer.mse(Y))
```

```
In [13]: plt.plot(error)
```

```
Out[13]: [<matplotlib.lines.Line2D at 0x106f40438>]
```



Bounes Task 1: Continous value

```
In [32]: n=10
         y=np.zeros(n)
         data=np.random.uniform(low=-1, high=1, size=(n, 2))
         data=np.insert(data,0,1,axis=1)
         y[data[:, 1] * data[:, 2]==0]=0
         y[data[:, 1] * data[:, 2]>0]=1
         y[data[:, 1] * data[:, 2]<0]=-1
         y=y.reshape(n,1)
```

```
In [90]: epochs=80000
         stepsize=0.015
         error=[]
         n_in_units=3
         n_out_units=1
         hiddenlayer=HiddenLayer(data.shape[1],n_in_units)
         outlayer=OutLayer(n_in_units+1,n_out_units)
```

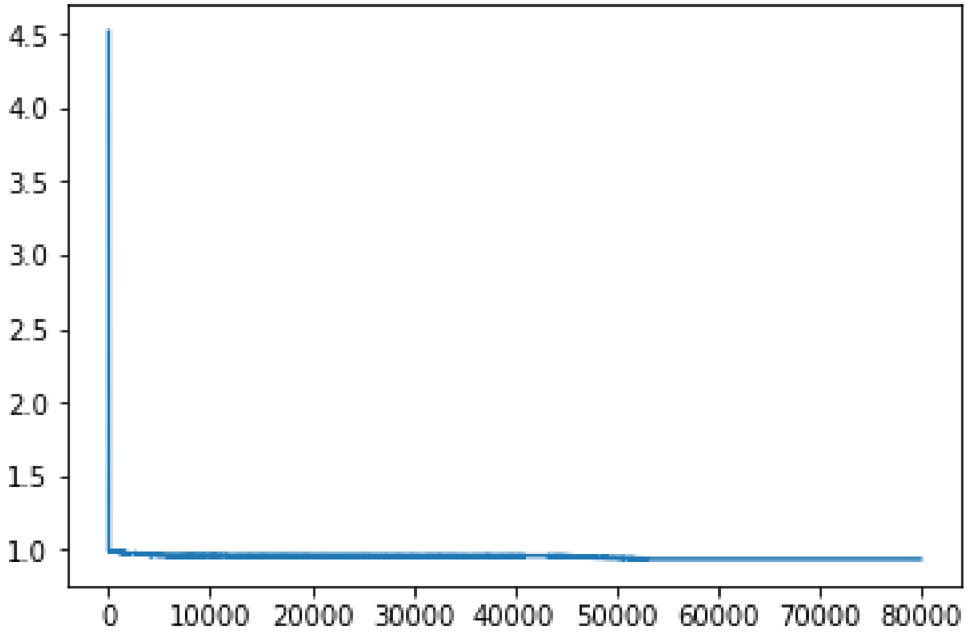
```
In [91]: for epoch in range(epochs):
             hiddenlayer.forward_pass(data)
             outlayer.forward_pass(hiddenlayer.out)

             pred_unit=outlayer.predict_unit_continous()
             out=outlayer.out
             outlayer.backward_prop(pred_unit,y,stepsize,hiddenlayer.out)
             hiddenlayer.back_prop(data,outlayer.delta,outlayer.weights,stepsize)
             error.append(outlayer.mse(y))
```

```
In [101]: print("final predict:",out.T,"\ntrue result:",y.T)
```

```
final predict: [[-0.03904699 -0.01451859 -0.00058122  0.0002173   0.01898803  0.01611626
  -0.0703888   0.05680999  0.08459035 -0.02222008]]
true result: [[-1. -1. -1.  1.  1.  1. -1.  1.  1. -1.]]
```

```
In [92]: plt.plot(error)
```

```
Out[92]: [<matplotlib.lines.Line2D at 0x1106deef0>]
```


4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0
10000
20000
30000
40000
50000
60000
70000
80000