BLG 454E Learning From Data (Spring 2018)

Homework 4

1 Question 1

In this question i wrote a neural network with one hidden layer. It classify for 10 different classes. Writing a neural network was a challenging job but it predicts with markable accuracy.

1.1 Part a

You can see the iteration numbers and their cross entropy errors in Figure 1 and Figure 2. After some iteration (probably convergence) error doesn't change so much. Moreover it starts to increase. I used 0.1 for learning rate, changing the learning rate would change the error changes but overall the trend would be the same.

```
[arch@arch HW4]$ python question1.py
How many iteration do you want?200
What learning rate do you want?0.1
Iteration 1 Cross entropy error :  6471.159309358832
Iteration 2 Cross entropy error :  5007.0685224913095
Iteration 3 Cross entropy error :  4466.363240071894
Iteration 4 Cross entropy error :  4187.202810038404
Iteration 5 Cross entropy error :  4021.914908757707
Iteration 6 Cross entropy error :  3915.695631163501
Iteration 7 Cross entropy error :  3843.035881453732
Iteration 8 Cross entropy error :  3790.855244693312
Iteration 9 Cross entropy error :  3751.94409873004
Iteration 10 Cross entropy error :  3722.074822665613
Iteration 50 Cross entropy error :  3634.4170996411926
Iteration 100 Cross entropy error :  3744.844896760708
Iteration 200 Cross entropy error :  3905.892898519001
```

Figure 1: Cross entropy errors

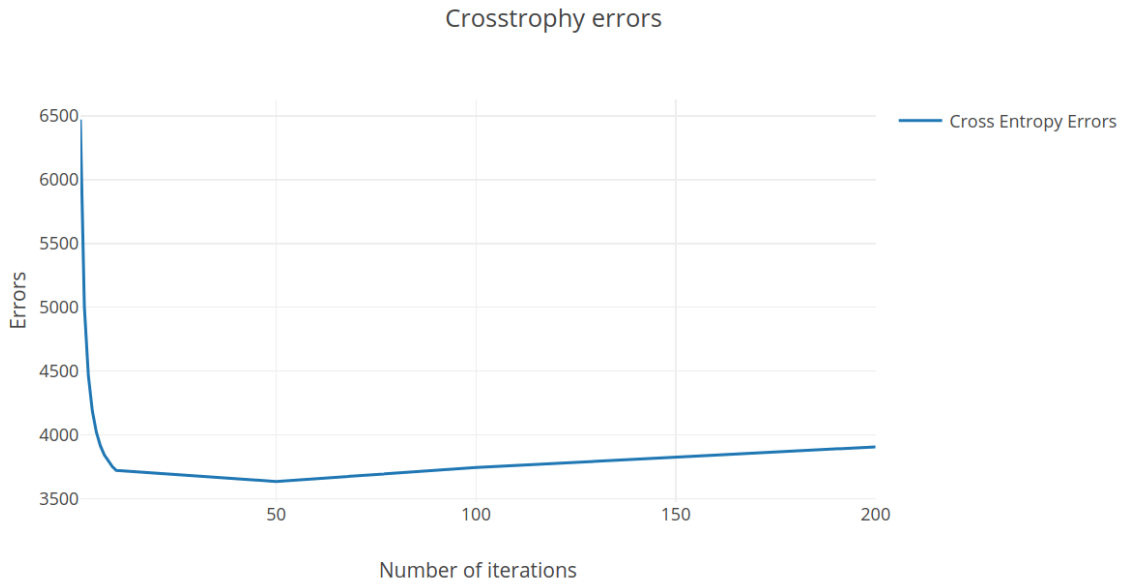


Figure 2: Cross entropy errors plot

1.2 Part b

I run the network multiple times and predicted for test dataset and the accuracies are generally between 62% and 75% and you can see the one of the examples from my tests in Figure .

```
[arch@arch HW4]$ python question1.py
How many iteration do you want?10
What learning rate do you want?0.1
Iteration 1 Cross entropy error :  6750.859828690074
Iteration 2 Cross entropy error :  5391.115657489554
Iteration 3 Cross entropy error :  4829.9661090370555
Iteration 4 Cross entropy error :  4553.523411470706
Iteration 5 Cross entropy error :  4389.712758554428
Iteration 6 Cross entropy error :  4281.821893436302
Iteration 7 Cross entropy error :  4205.450429269904
Iteration 8 Cross entropy error :  4148.432710986802
Iteration 9 Cross entropy error :  4104.067417051015
Iteration 10 Cross entropy error :  4068.3813177130164
Accuracy =  66.33533873921004 %
```

Figure 3: Accuracy example with 66%

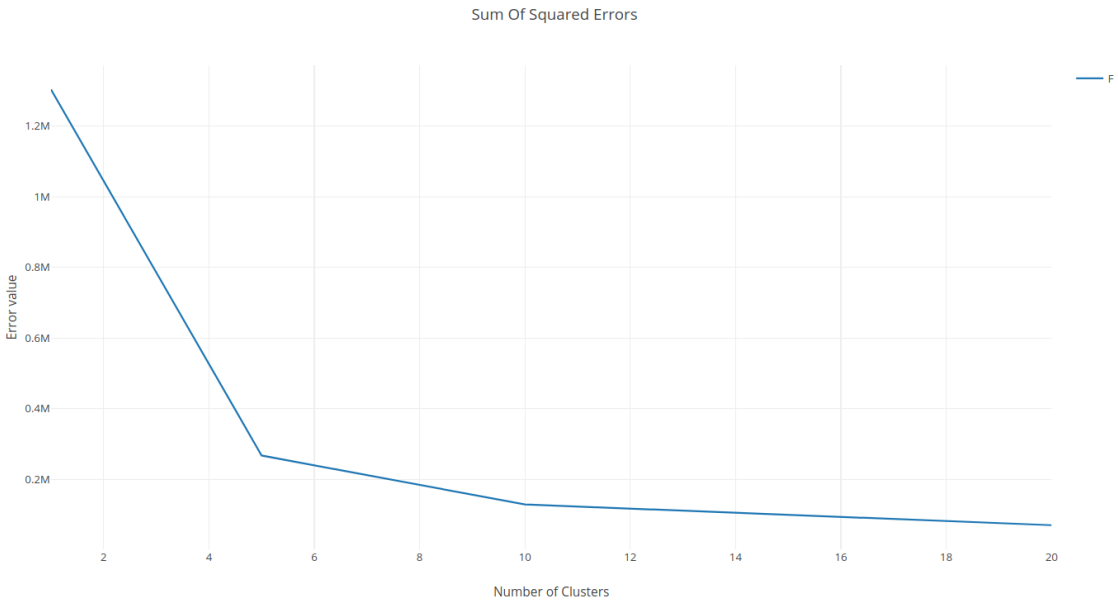
2 Question 2

2.1 Part a

I created a sum of squares method in my python implementation and then i measured sum of squares for k=1,5,10,20 you can see the sum of squared errors below. I considered elbow method to choose appropiate k value and i chose k=10. But i want to say that 5 could be another choice for this problem but from elbow method i choose 10 since after the k=10 error wouldn't change significantly.

A	Sum of Squared er...
1	1303746.061
5	266995.127
10	128400.815
20	69754.886

(a) Sum of square errors for different k



(b) Visualization of errors

2.2 Part b

Since i choose k=10 i will first give clustering results of k-means algorithm. Every color represents one class and the stars shows class means.

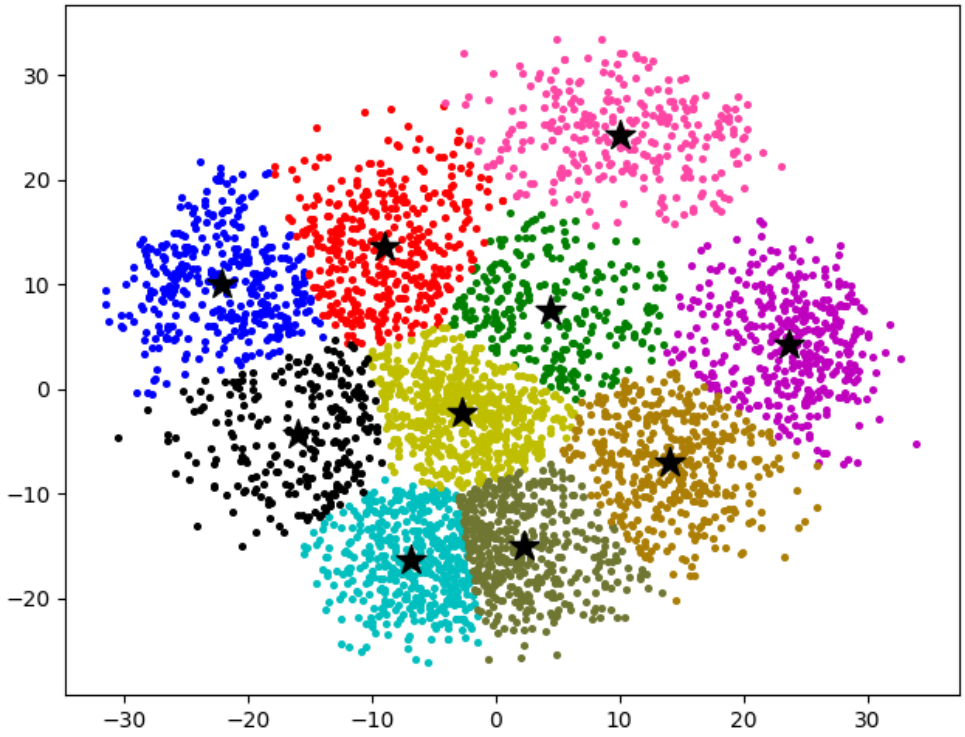


Figure 4: Clustering results of k=10