Deep Learning for Computer Vision (DS-265) Assignment 1 Report

Rishav Saha

February 23, 2024

1 Single Layer Classifier

1.1 Observation and Analysis

- Bias is an important factor as it can boost the performance by a good margin.
- Calculating gradient doesn't always mean to calculate the whole thing. For instance, the gradient of softmax can easily be calculated as softmax*(1-softmax) for the same index weights.
- Hyperparameter tuning:
  - Best Epoch Size = 10
  - Best Batch Size = 64
- Though our Test accuracy is comparatively less, it can be significantly boosted by increasing the layers.
- Test Accuracy: 73.43 %
- Linear Classifier of Scikit Learn has a better accuracy of 92.4 % on the test dataset.
- Best Performing Class: 0 (Checked on the whole test dataset).

2 Scalar Backpropagation

2.1 Observations and Analysis

- We are calculating the gradient of the final function value with respect to all the sub-function elements.
- Example results:

```
For x: 2 , y: 4 , z: 1
Grad x :0.284 , Grad_y :0.204 , Grad_z:-0.131
For x: 9 , y: 14 , z: 3
Grad x :-0.824 , Grad_y :0.273 , Grad_z:0.0197
For x: 128 , y: 42 , z: 666
Grad x :-7.204e-16 , Grad_y :-3.99e-16 , Grad_z:0.0
For x: 52 , y: 14 , z: 8
Grad x :8.763e-16 , Grad_y :-1.214e-16 , Grad_z:-3.998e-22
```

3 Linear Classifier

3.1 Observations and Analysis

- Mean accuracy has increased in this case for the same MNIST dataset.
- Accuracy is a bit on the higher side, most probably the model is overfitting and regularization is needed.
- In the hidden layers, we are using ReLU. ReLU and its derivative both being simple to calculate make the computation easy.
- Here also we are using a cross-entropy loss because we are using softmax activation, which goes better with multi-class classification.

4 Convolution Module with Numpy

4.1 Observations and Analysis

- This is the Gaussian blur filter.
- Tried this question with a custom box filter also but using a Gaussian filter keeps the image a bit smooth and preserves a bit more details.

5 Training a Convolution Layer

5.1 Observation and Analysis

- The L2 distance between C and C_0 is 5661470.045074505.