FALL 2025 EEP 596: Computer Vision
Homework 4 REPORT
Van Tha Bik Lian
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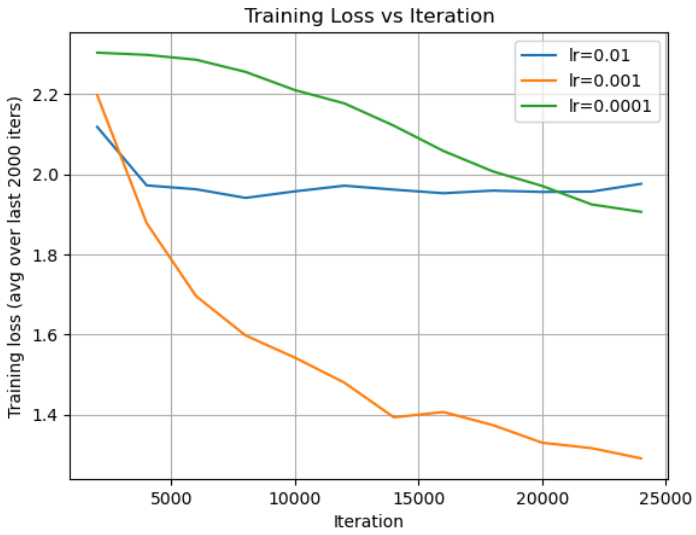
1. **CIFAR-10 dataset**
    a. num_train_batches 5
    b. num_test_batcges 1
    c. num_img_per_batch 10000
    d. num_train_img 50000
    e. num_test_img 10000
    f. size_batch_bytes 30010 KB
    g. size_img_bytes: 3 KB
    h. size_batchimg_bytes 30000 KB

```
Downloading https://www.cs.toronto.edu/~kriz/cifar-10-python.tar.gz to ./cifar10/cifar-10-python.tar.gz
100.0%
Extracting ./cifar10/cifar-10-python.tar.gz to ./cifar10
Batch images shape: torch.Size([4, 3, 32, 32])
Batch labels: tensor([5, 0, 2, 9])
Files already downloaded and verified
```



The figures compare learning rates [0.1, 0.001, 0.0001]

Learning rate = 0.01

- Loss stays around 2.1 → 1.95
  - barely improves through two epochs
- Training error stays between 66 – 76 %
- Test error around 68–78%
- fluctuates rather than steadily improving
- Step size was too large → unstable updates
  - Update overshoots minima
  - The network oscillates and never settles
- accuracy plateaus near 25-30%

Learning rate = 0.001

- Loss drops smoothly from 2.19 → 1.29 over two epochs
- Both training and testing errors dropped significantly
  - training error went from 75 % → 47 % (~53 % accuracy)
  - Test error went from 73 % → 48 % (~ 52 % accuracy).
- So with lr=0.001, the network learns quickly and generalizes the best within 2 epochs

Learning rate = 0.0001

- Loss decreases slowly from 2.30 → 1.90
  - training error went from ~92% to ~68% (~ 32% accuracy)
  - test error from ~89% to ~68%
- Still much worse than lr=0.001 after the same number of iterations
  - lr = 0.0001 is too small; it learns, but too slowly for just 2 epochs