

# Report:

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According to [https://paperswithcode.com/sota/image-classification-on-cifar-10?tag\\_filter=3](https://paperswithcode.com/sota/image-classification-on-cifar-10?tag_filter=3), previous ResNet implementations to classify the CIFAR-10 Dataset in the past three years have all been above 94% accuracy. As such, the most reasonable state of the art accuracy I have chosen for the CIFAR-10 Dataset was 94% as well. At the beginning of this project, I tried reusing my entire MNIST model (only changing the number of input channels to 3) to classify CIFAR-10. This was an incredibly slow process, but I did manage to gain above 80% accuracy after a *long* while (I did not record how many iterations it took), but did have a high loss (I also did not record this, but it was like double digits?). Implementing group norm and residual blocks greatly increased the speed it took to train my model and decreased my loss. In my experiments, I have only considered using random horizontal flips and contrasts for my data augmentation as well as combinations of the two. In training, implementing random flips per batch held the fastest training time to reach 94% accuracy (2584 iterations), so I decided to only use flips for the validation and test data augmentation. In earlier versions of my model, I did not consider using dropout for optimization. This led to my initial loss to start at 5 and slowly decrease. After implementing 50% dropout after every residual block, the initial loss started at about 2.5. However, this did not seem to have any impact on the speed of the model's accuracy calculations. Reconsiderations: If I were to restart this project, I would move the dropout into every hidden layer of my conv2d instead. I realize now that dropping out only three times probably increased the chances of losing *important* nodes. I also read another paper stating that cropping and padding the input images led to the best performance, so I would like to try implementing this as well.

## CIFAR10

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### FIRST TRAINING ATTEMPT:

- only tested on one batch
- NO data augmentation implemented
- NO checkpoints created .
- num\_iters: 3000
- Loss => 0.9513286352157593, Accuracy => 79% (top\_k\_accuracy\_score NOT implemented this run)
- num\_params: 10212

### TRAINING ATTEMPT (flip all images):

- tested with all batches.
- data augmentation implemented (flipped all images).
- NO checkpoints created.
- top\_k\_accuracy\_score implemented.
- num\_params: 10212
- Accuracy: 94%. Loss: 1.719804048538208. Steps Taken: 1540.

### TRAINING ATTEMPT (random contrast .25-.75):

- num\_params: 10212
- Accuracy: 94%. Loss: 1.6880838871002197. Steps Taken: 2584.

- Flipping all images held better results than random contrast augmentation.

#### TRAINING ATTEMPT:

- randomly flipped images per batch.
- regular top 1 accuracy implemented.
- num\_params: 93036 -----STEP\_SIZE: 0.0017530329257123027, BATCH\_SIZE: 300, LAYER\_DEPTH: 100 -  
--- Accuracy: 95%. Loss: 0.6582032442092896. Steps Taken: 3348.

#### TRAINING ATTEMPT:

- hidden\_activation implemented after residual blocks
- num\_params: 93036 -----STEP\_SIZE: 0.0018448037536866258, BATCH\_SIZE: 300, LAYER\_DEPTH: 100 -  
--- Accuracy: 94%. Loss: 0.6479944586753845. Steps Taken: 3297.

#### VALIDATION ATTEMPTS (flip all images):

-----STEP\_SIZE: 0.009847429569214134, BATCH\_SIZE: 300, LAYER\_DEPTH: 32 ----- Accuracy: 96%. Loss: 1.9272381067276. Steps Taken: 1623. Params: 10212 -----STEP\_SIZE: 0.013495658872986245, BATCH\_SIZE: 300, LAYER\_DEPTH: 40 ----- Accuracy: 95%. Loss: 1.9217915534973145. Steps Taken: 1308. Params: 15636  
num\_params: 93036 -----STEP\_SIZE: 0.00030043174171295287, BATCH\_SIZE: 300, LAYER\_DEPTH: 100 -----  
Accuracy: 99%. Loss: 0.22409528493881226. Steps Taken: 5111.

#### FINAL CIFAR-10 VALIDATION & TEST ACCURACY

- num\_params: 93036
- VALIDATION: Accuracy: 94%. Loss: 0.5527652502059937. Steps Taken: 3725
- TEST: Accuracy: 94%. Loss: 0.3788861334323883. Steps Taken: 5371.

## CIFAR100

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#### First Training Attempt:

Loss => 3.1740922927856445, Accuracy => 49%, step\_size => 0.0001: 6000

Step 9998; Loss => 2.2778358459472656, Accuracy => 90%

#### FINAL CIFAR-100 VALID & TEST SCORE:

- num\_params: 93306
- VALIDATION: Accuracy: 96%. Loss: 2.0371298789978027. Steps Taken: 8624.
- TEST: Accuracy: 94%. Loss: 2.0722837448120117. Steps Taken: 9559.