5 Some Other Variants

We train and run models on variations of the MNIST dataset - namely, DoubleMNIST and Permuted MNIST.

Arnav Negi

DoubleMNIST

The DoubleMNIST dataset contains images with two handwritten digits, and the task is to correctly identify and classify each digit within the image.

We preprocess the dataset to exclude the case with repeated digits. Hence we have to classify 2 labels (multilabel task) which are two distinct digits.

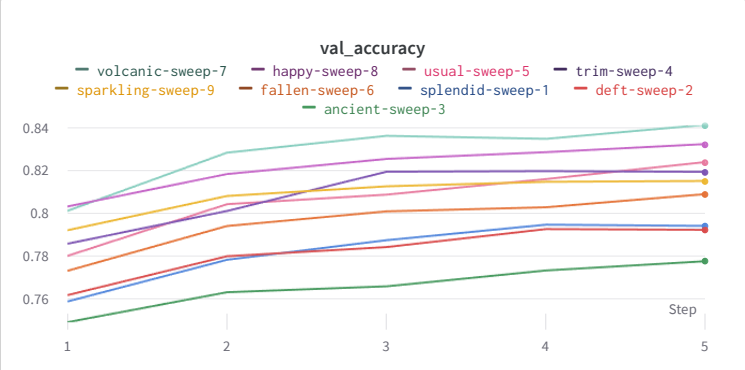
MLP model

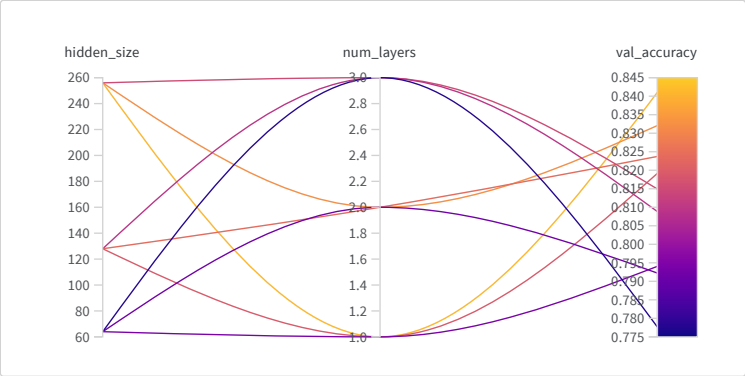
The model has a sigmoid in the output layer instead of softmax, and then takes the 2 largest activations for the 2 digits. The labels are one hot encoded.

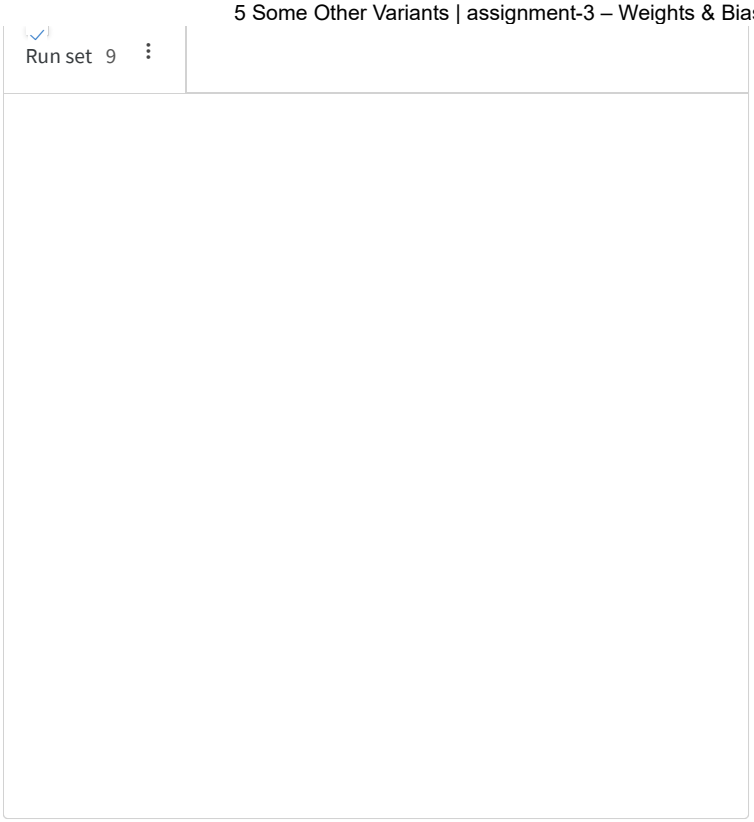
The hyperparameters are as follows

- hidden layers
- neurons in hidden layers

We hyperparameter tune for the same:







As we can see, the best model gives a validation accuracy of 84% and has

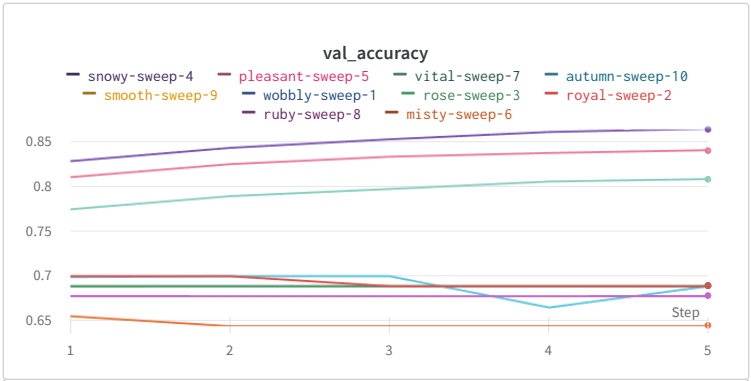
- 1 hidden layer
- 256 neurons per layer

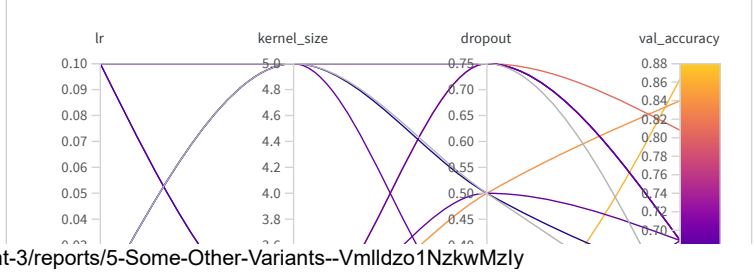
CNN model

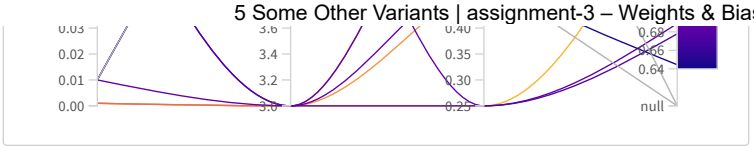
The hyperparameters are as follows

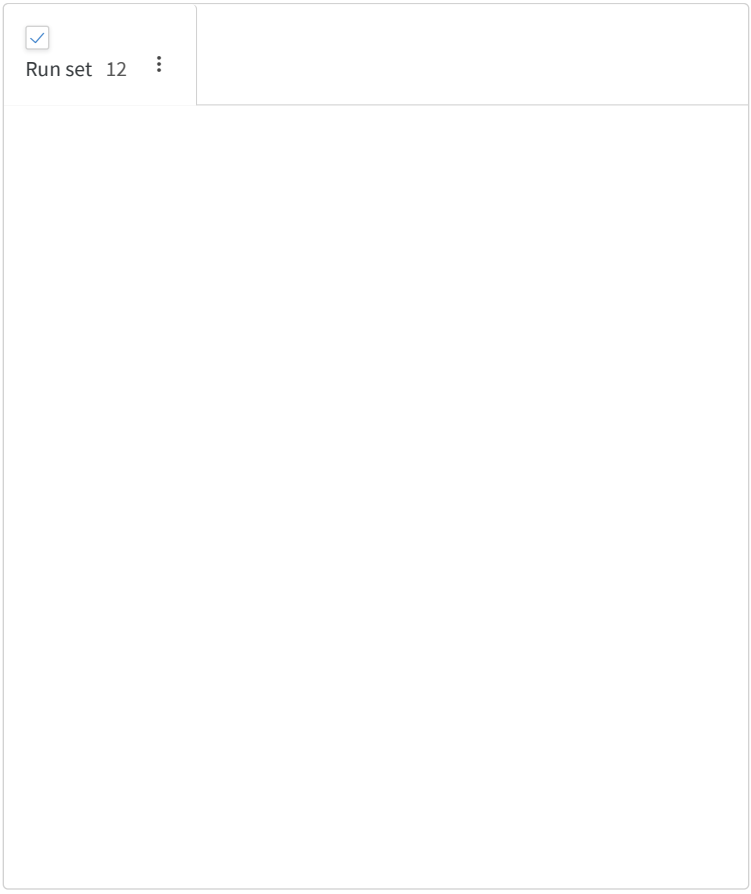
- learning rate
- kernel size
- dropout rate

We hyperparameter tune for the same:









The best model gives 86.39% validation accuracy and has

- lr = 0.001
- kernel size = 3
- dropout rate = 0.25

On test set it gives

```
]:
## Evaluate model
predicted_labels = test_multi_model(model, test_loader)
```

```
100%|██████████| 563/563 [00:02<00:00, 212.72it/s]
Accuracy:  0.8767539964476021
```

Testing on Single digit MNIST

on single digit task, the mdoels perform very poorly.

On the MNIST test data our best CNN model (trained on doubleMNIST) gives 7.73% accuracy, which is lower than random.

```
:
test_on_single_digit(model, test_loader)
```

```
100%|██████████| 313/313 [00:04<00:00, 62.65it/s]
Accuracy:  0.0773
```

Permuted MNIST

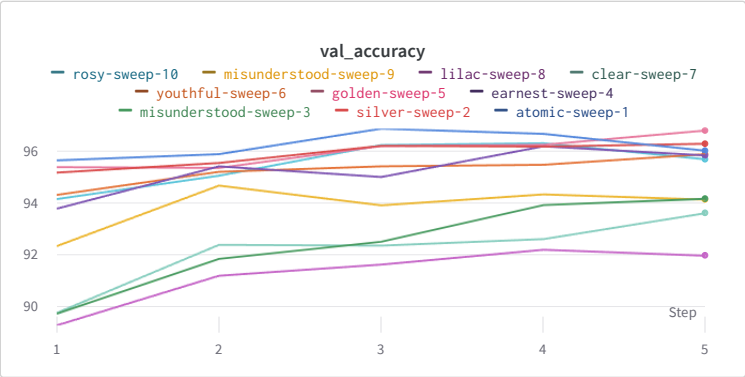
The Permuted MNIST dataset is a variation of the original MNIST dataset where the pixels of each image are randomly permuted. This permutation makes the task significantly more challenging.

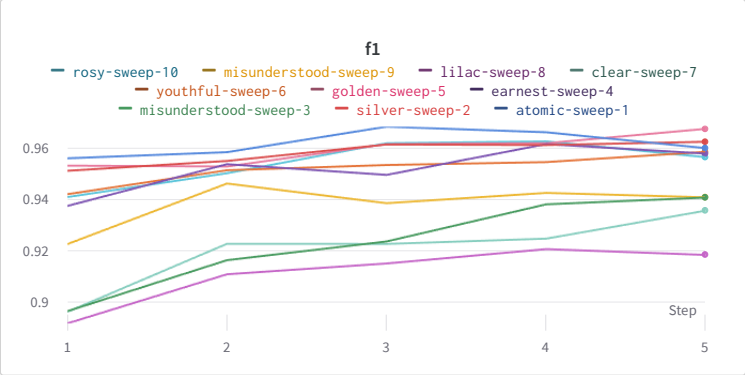
MLP Model

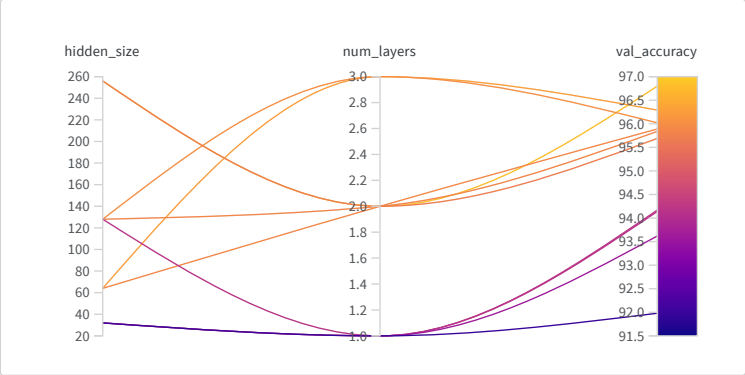
The hyperparameters are as follows

- hidden layers
- neurons in hidden layers

We hyperparameter tune for the same:







Run set 10

The best model gives 96.8% validation accuracy and has

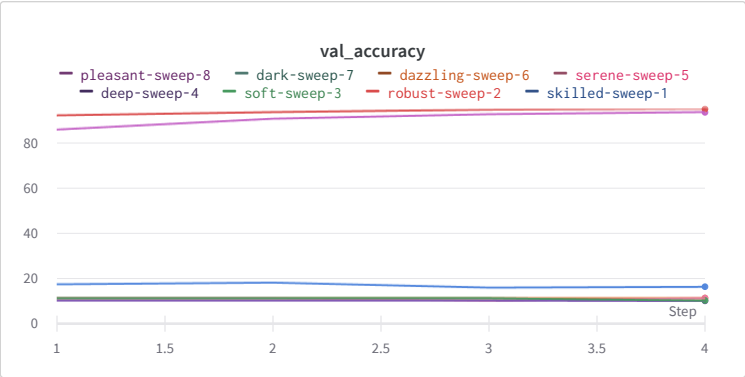
- 256 neurons each in
- 2 hidden layers

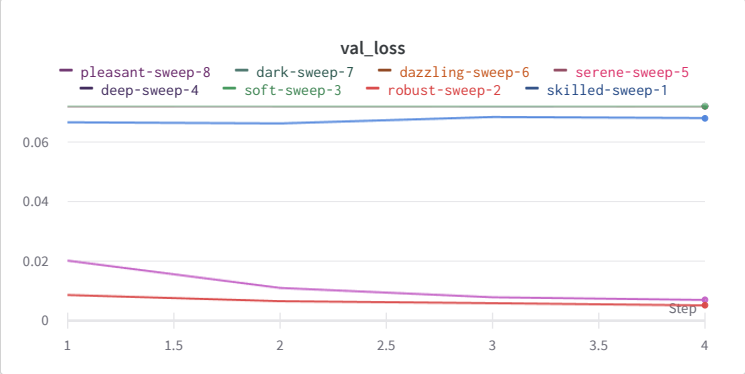
CNN

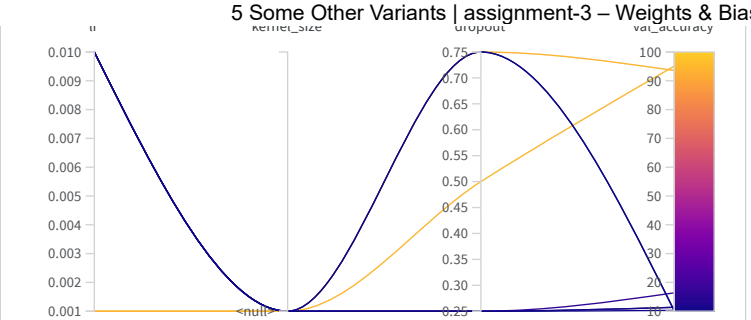
The hyperparameters are as follows

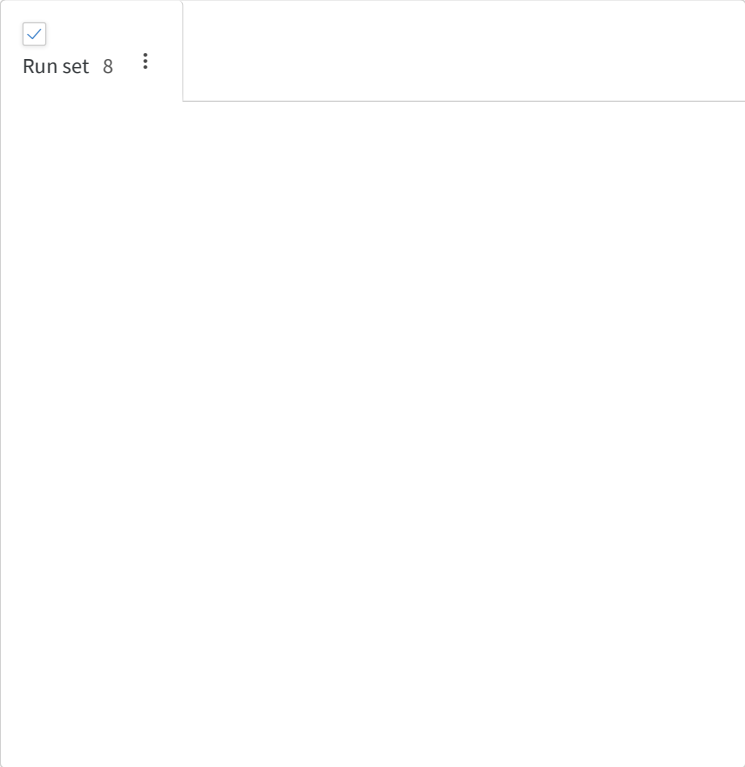
- learning rate
- kernel size
- dropout rate

We hyperparameter tune for the same:









The best model gives 95% accuracy and has

- kernel size = 5
- learning rate = 0.001
- dropout = 0.5

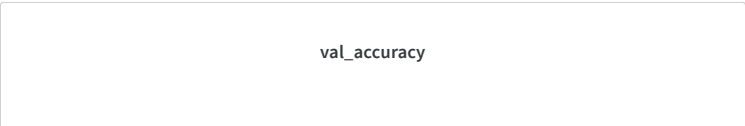
Analysis

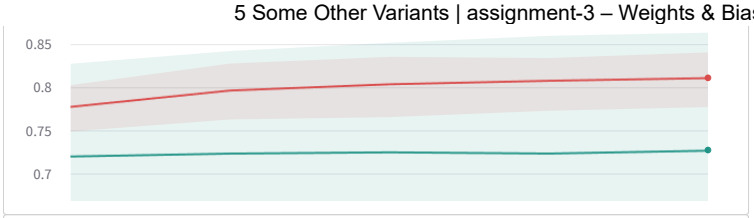
However other hyperparameters perform very poorly. So MLP performs better on this task, while CNNs performed better on the previous task.

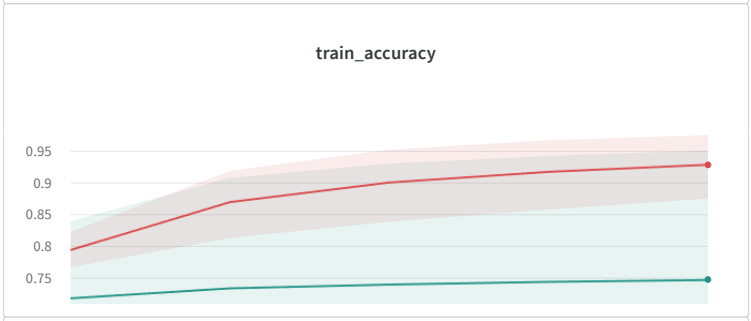
Moreover, CNNs are very slow to train and may need GPU for these tasks, especially since the DoubleMNIST dataset was much larger and had larger size images.

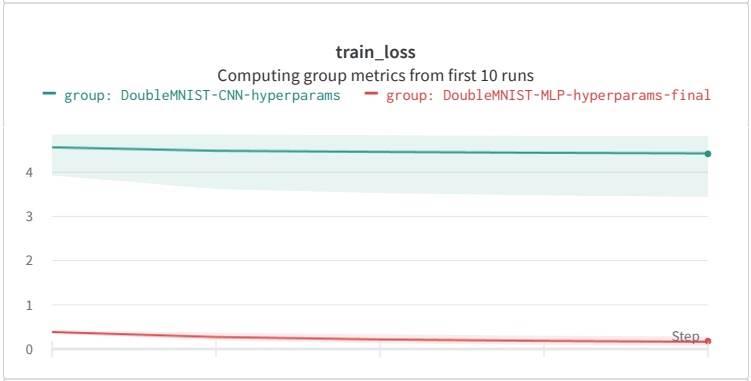
Overfitting:

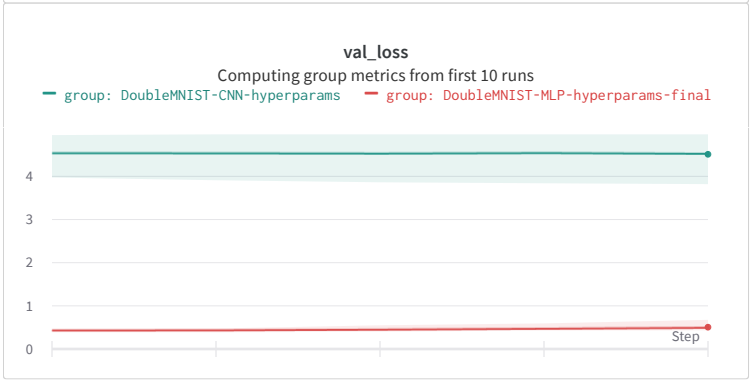
CNNs are less prone to overfitting than MLPs. MLPs have more parameters and hence overfit more

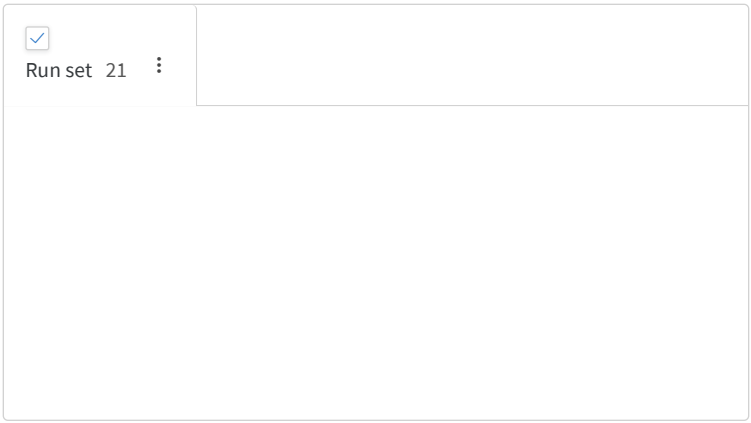












Created with ❤️ on Weights & Biases.

https://wandb.ai/arnav-team/assignment-3/reports/5-Some-Other-Variants--Vmlldzo1NzkwMzIy