CS 203: Software Tools and Techniques for AI
Assignment 1

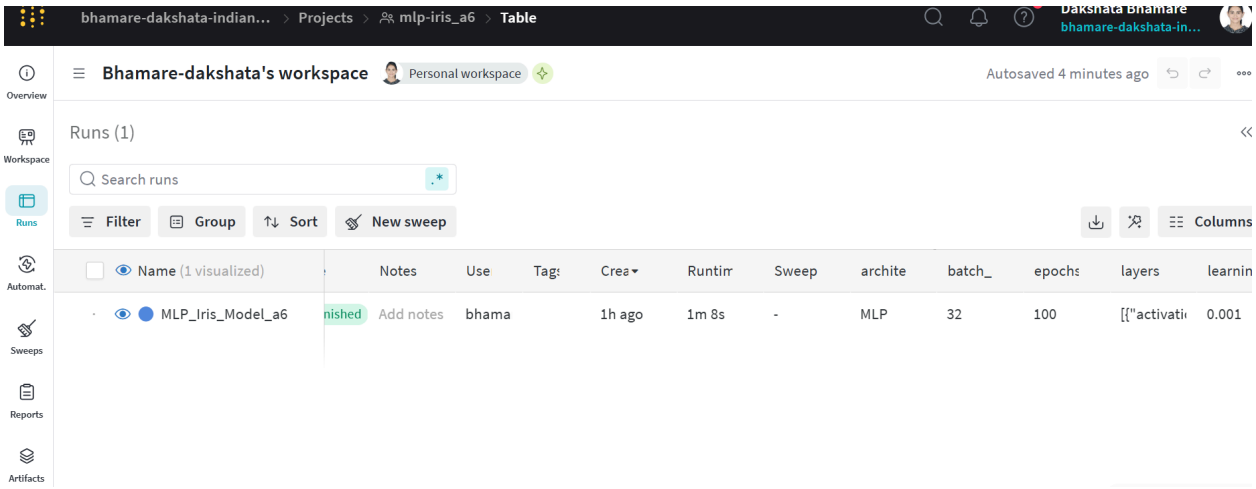
Chinmay Pendse (23110245)
Bhamare Dakshata(23210027)

GitHub repository: Assignment_6

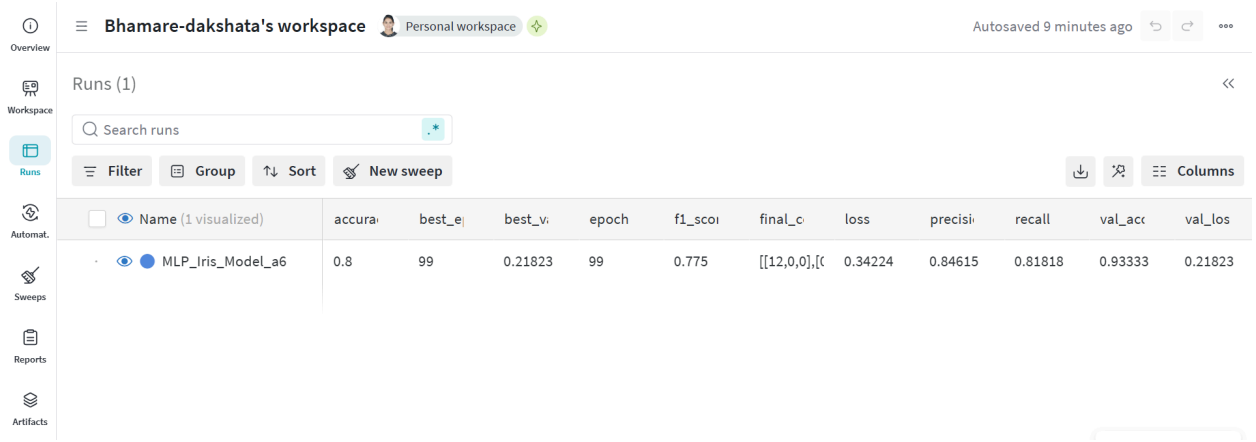
Section 1: Screenshots of the W&B dashboard displaying:

- Model architecture.
- Hyperparameters.
- Logged metrics.
- Final evaluation results.
- Confusion matrix visualization.
- Training and validation loss curves.

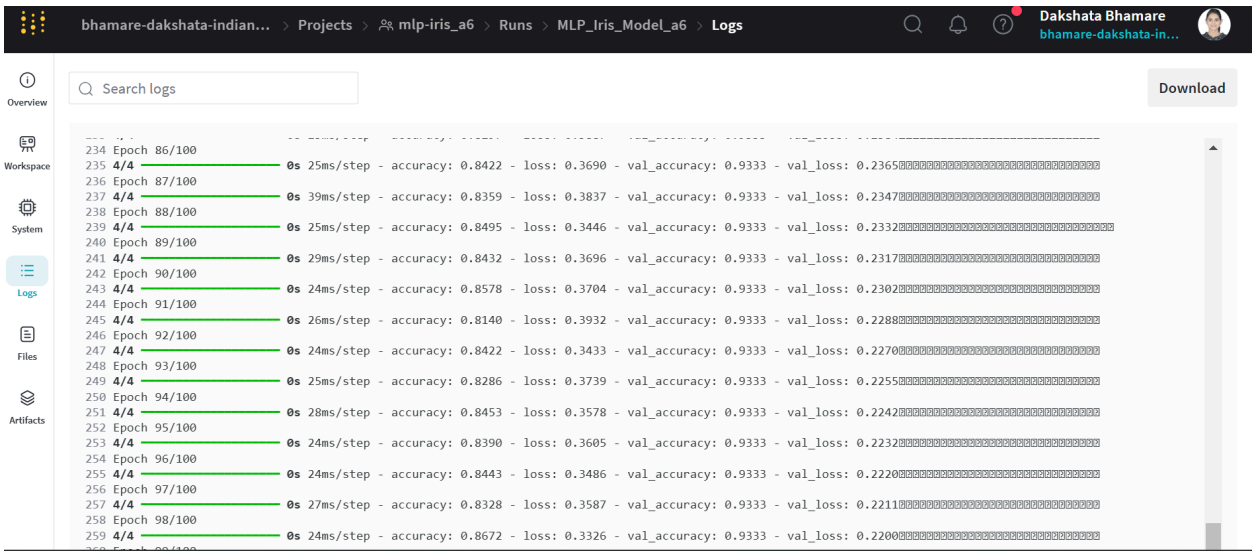
1) This screenshot displays the structure of your neural network, including the layers, number of epochs and hyperparameters. It helps visualize how data flows through the model.



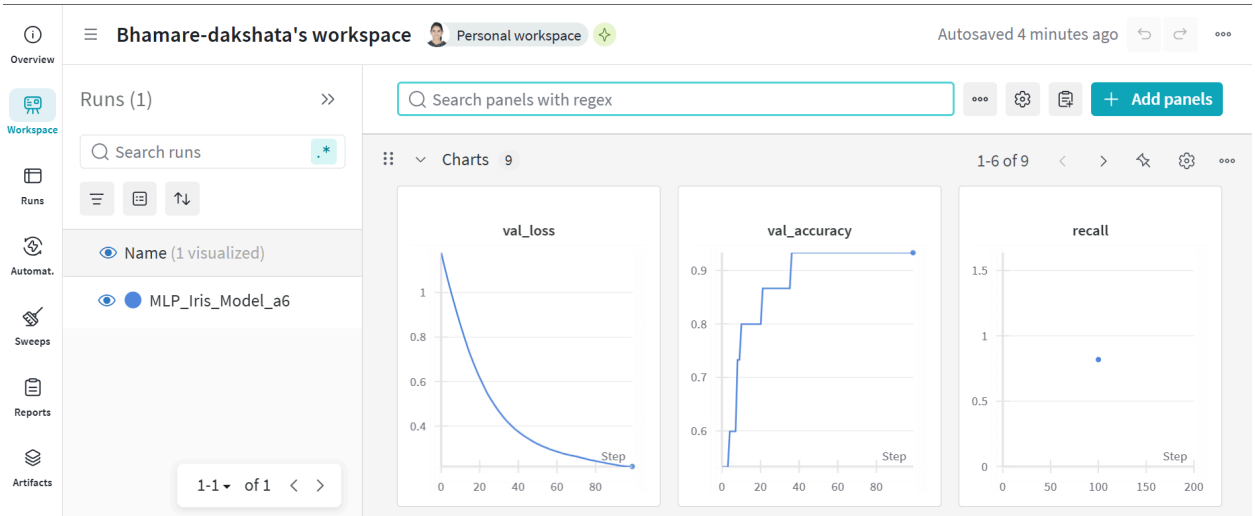
2) Other evaluation results, such as precision, recall, and f1- score, are shown in the next screenshot.

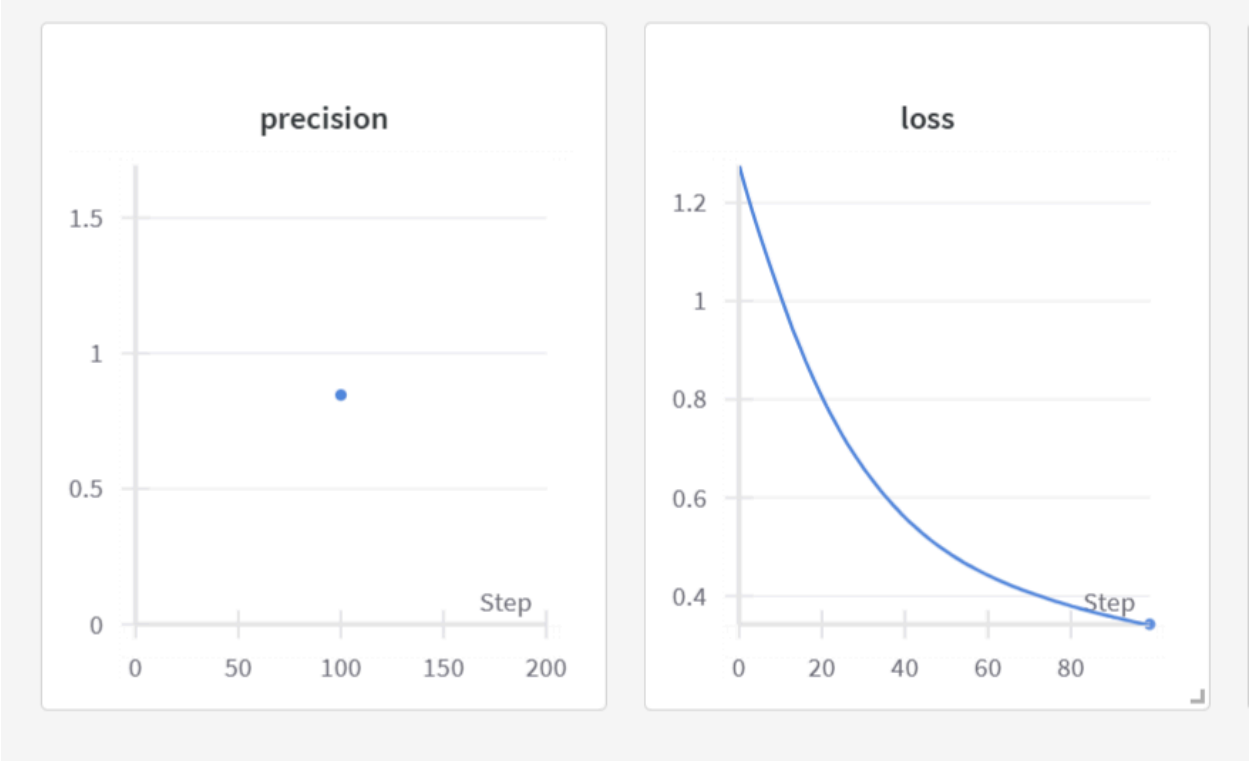


3) Next, the Screenshot captures logged matrics showing validation loss and accuracy.



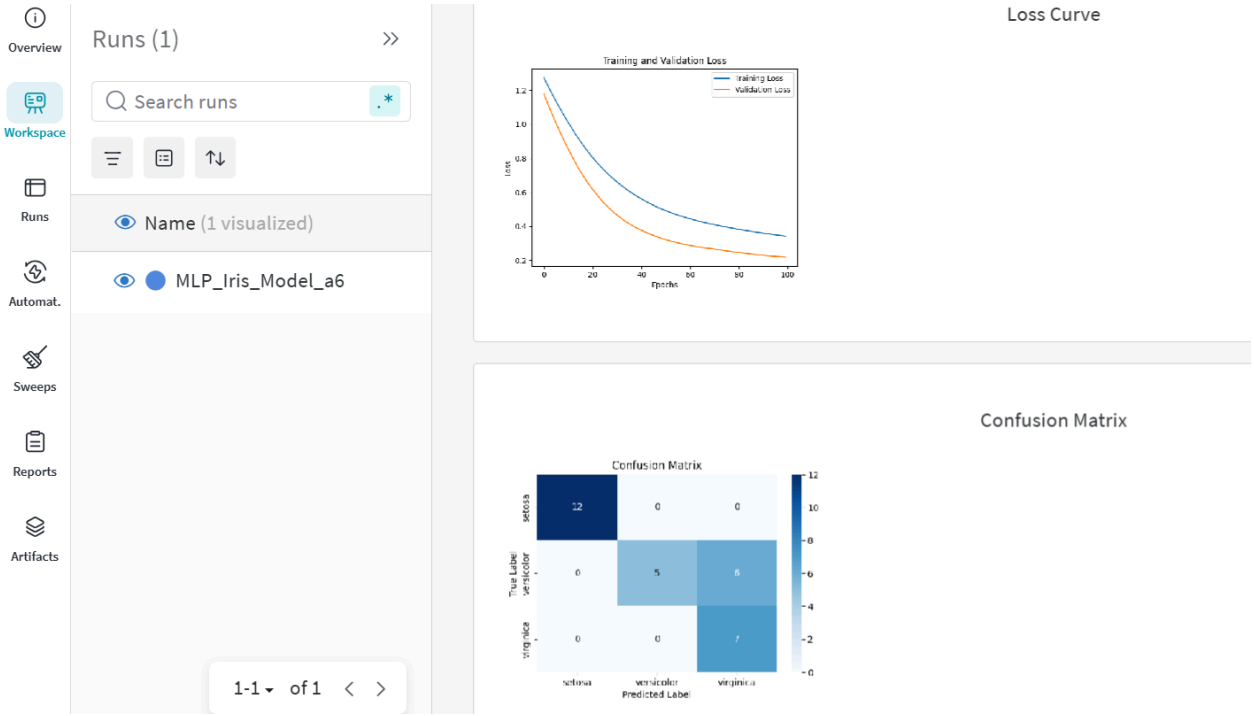
4) The next two Screenshots capture graphs for accuracy, precision, recall and loss.





5) **Confusion Matrix Visualization** – shows the model's classification performance, highlighting correctly and incorrectly classified instances for each category.

Training and Validation Loss Curves – show the progression of training and validation loss over epochs, helping diagnose underfitting, overfitting, or convergence issues.

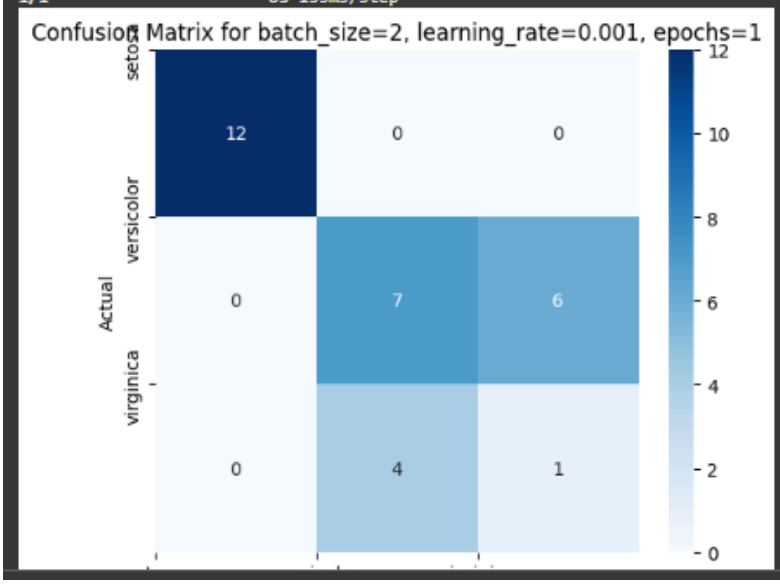


Section 2: Hyperparameter Optimization and Automated Hyperparameter Search

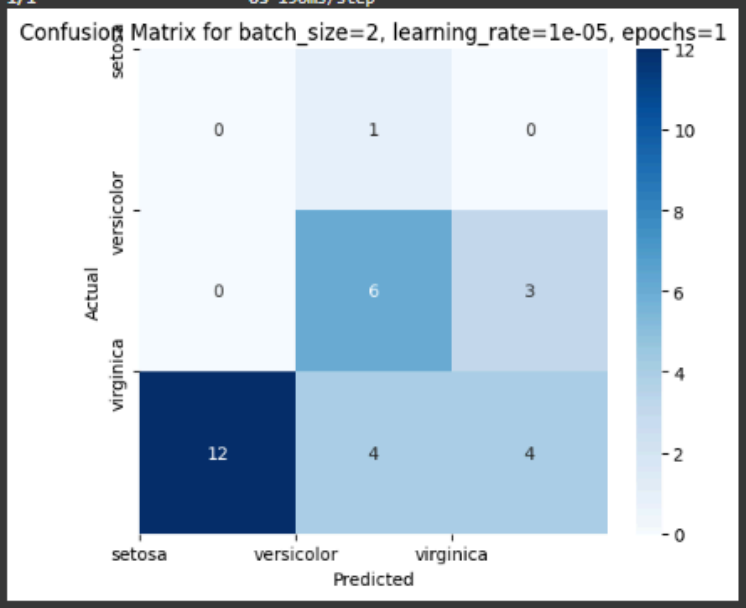
1. Task 1

In this task, we trained the model by generating a parameter grid that stores all the values given in the assignment. Then, using the Keras module, we trained our model to classify the three using different epochs, learning rates and batch sizes. The confusion matrix for all of the cases is as follows.

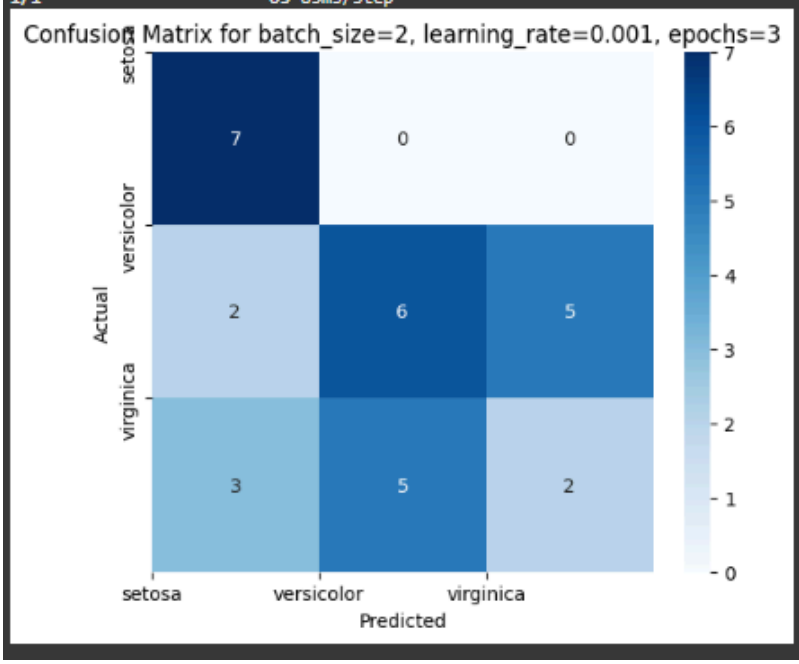
```
53/53 ━━━━━━━━━━━━━━━━━━━━ 2s 13ms/step - accuracy: 0.5972 - loss: 1.1253 - val_accuracy: 0.6000 - val_loss: 0.9946
WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or `keras.saving.save_model(model)`. This file fo
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 155ms/step
```



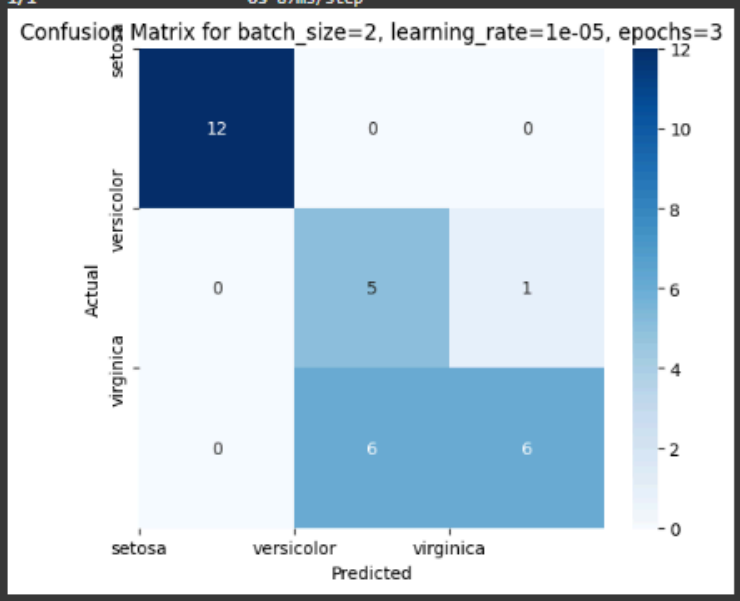
```
Training with: batch_size=2, learning_rate=1e-05, epochs=1
53/53 ━━━━━━━━━━━━━━━━━━━━ 4s 21ms/step - accuracy: 0.3445 - loss: 1.5097 - val_accuracy: 0.2667 - val_loss: 1.3821
WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or `keras.saving.save_model(model)`. This file format
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 190ms/step
```



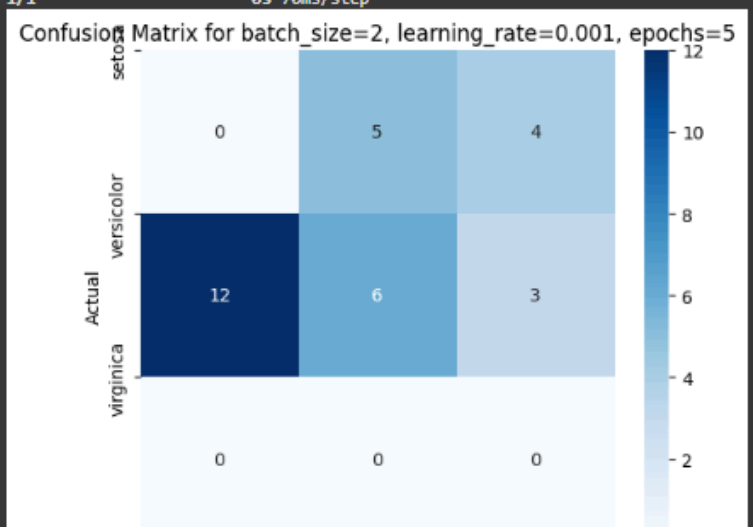

```
Training with: batch_size=2, learning_rate=0.001, epochs=3
53/53 ━━━━━━━━━━━━━━━━━━━━ 2s 13ms/step - accuracy: 0.1074 - loss: 1.3483 - val_accuracy: 0.3333 - val_loss: 1.1058
WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or `keras.saving.save_model(model)`. This file
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 85ms/step
```



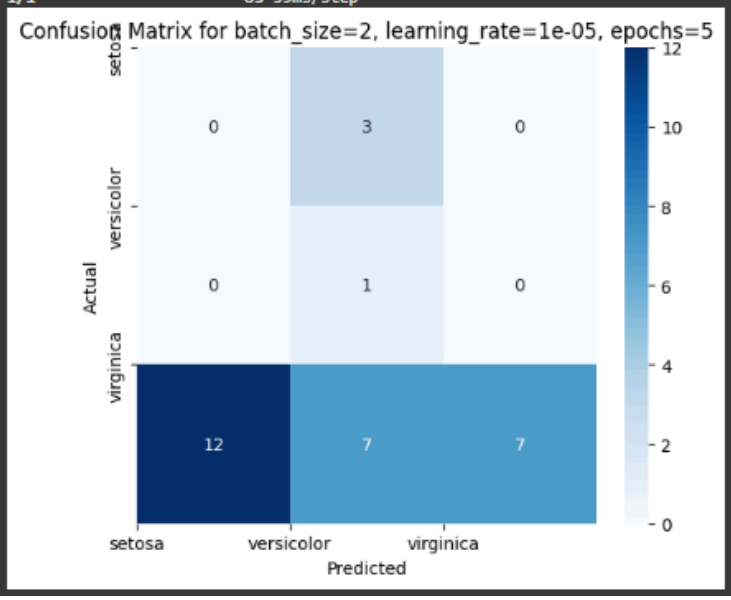
```
53/53 ━━━━━━━━━━━━━━━━━━━━ 2s 10ms/step - accuracy: 0.6201 - loss: 0.9331 - val_accuracy: 0.8000 - val_loss: 0.7872
WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or `keras.saving.save_model(model)`. This file forma
WARNING:tensorflow:5 out of the last 5 calls to <function TensorFlowTrainer.make_predict_function.<locals>.one_step_on_data_di
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 87ms/step
```



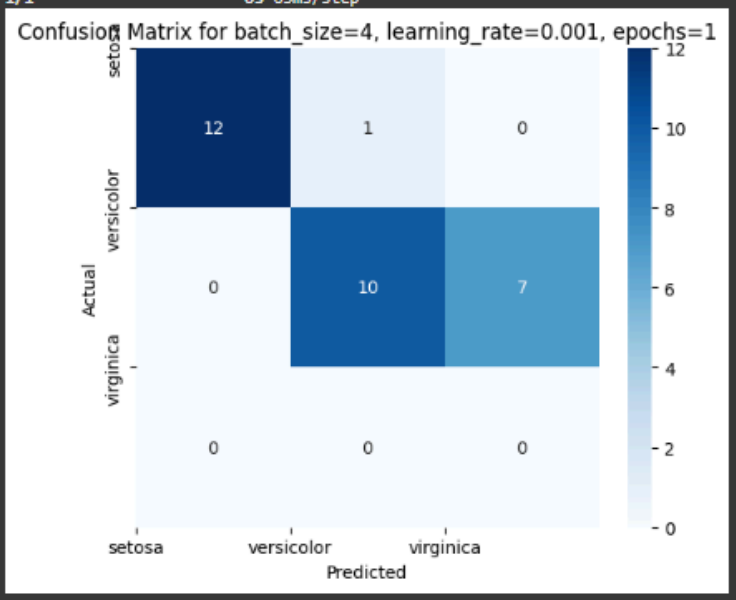
```
53/53 ━━━━━━━━━━━━━━━━━━━━ 1s 6ms/step - accuracy: 0.2456 - loss: 1.7193 - val_accuracy: 0.0667 - val_loss: 1.6039
WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or `keras.saving.save_model(model)`. This file form
WARNING:tensorflow:6 out of the last 6 calls to <function TensorFlowTrainer.make_predict_function.<locals>.one_step_on_data_
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 70ms/step
```



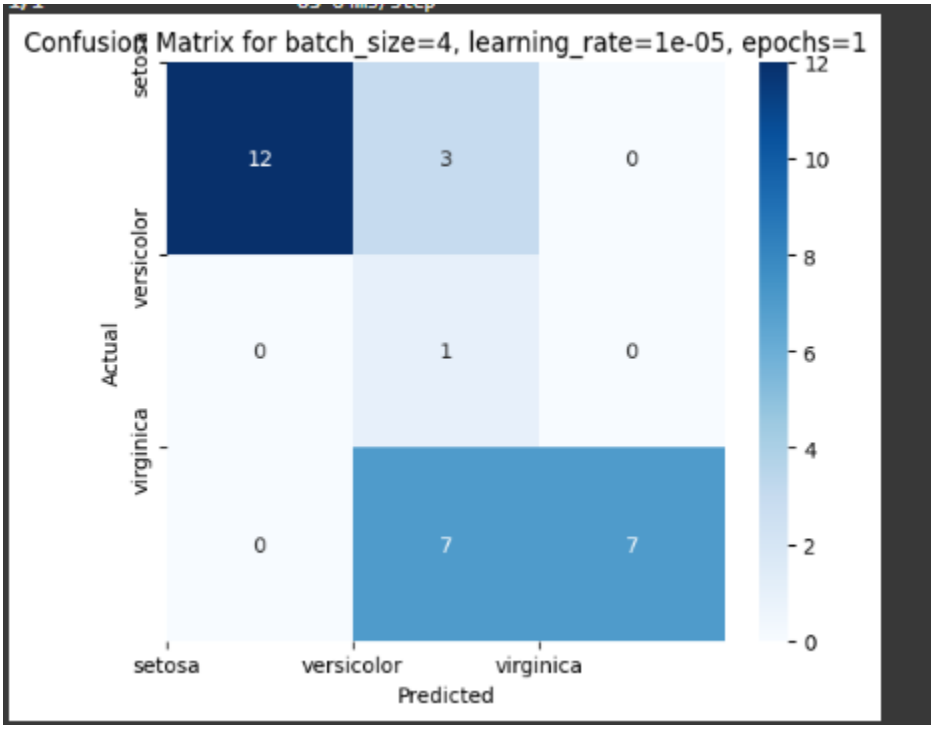

```
Training with: batch_size=2, learning_rate=1e-05, epochs=5
53/53 ━━━━━━━━━━━━━━━━━━━━ 1s 7ms/step - accuracy: 0.1055 - loss: 1.2576 - val_accuracy: 0.2000 - val_loss: 1.0719
WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or `keras.saving.save_model(model)`. This file forma
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step
```

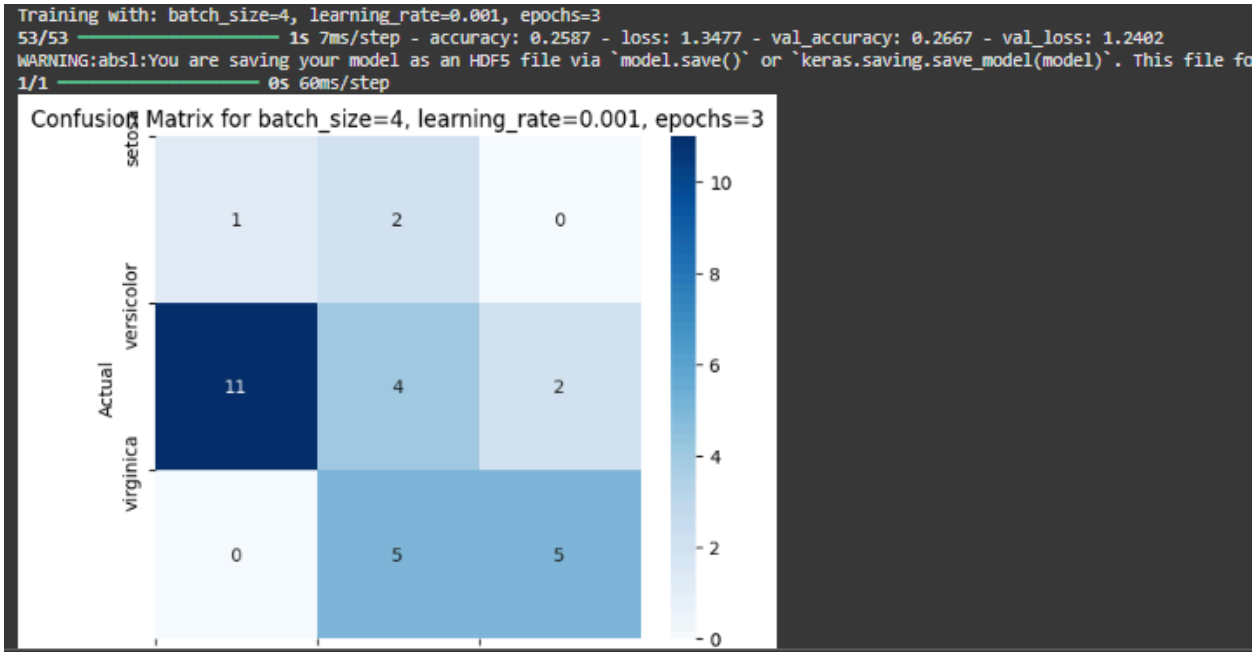


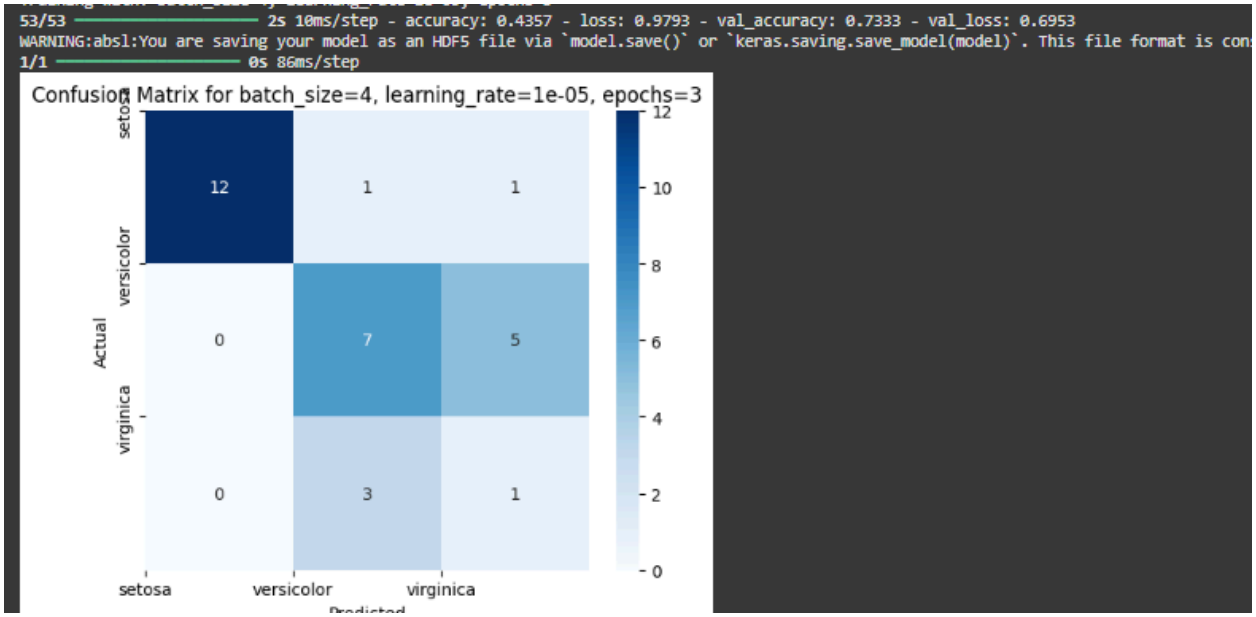
```
53/53 ━━━━━━━━━━━━━━━━━━━━ 1s 6ms/step - accuracy: 0.5408 - loss: 1.2154 - val_accuracy: 0.6000 - val_loss: 1.0161
WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or `keras.saving.save_model(model)`. This file format
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 63ms/step
```



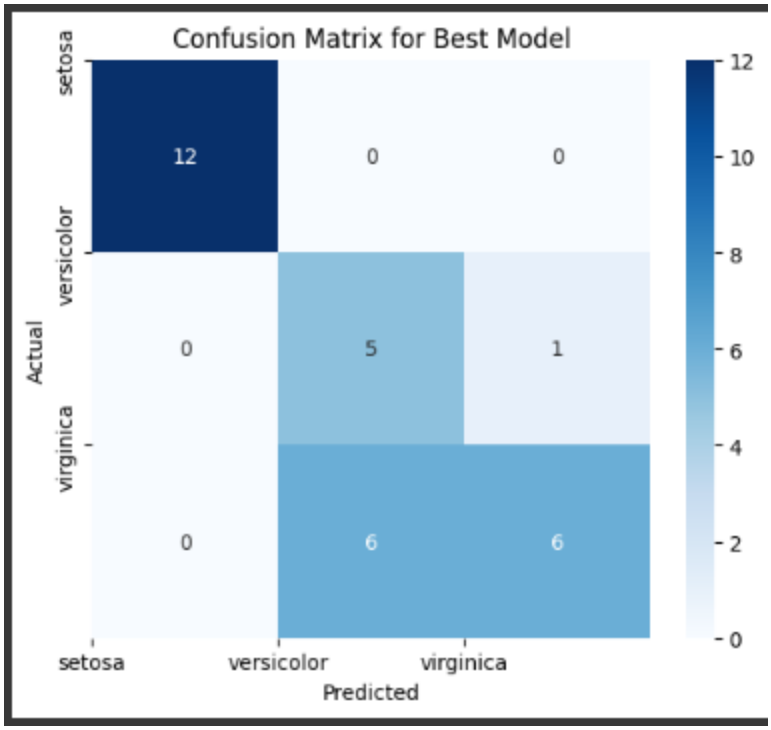

```
Training with: batch_size=4, learning_rate=1e-05, epochs=1
53/53 ━━━━━━━━━━━━━━━━━━━━ 1s 6ms/step - accuracy: 0.4956 - loss: 0.9257 - val_accuracy: 0.8667 - val_loss: 0.6306
WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or `keras.saving.save_model(model)`. This file format is con
```







Now, from all this, we have the best possible model. Based on the accuracies and the losses, we compared all of them and found the best model.



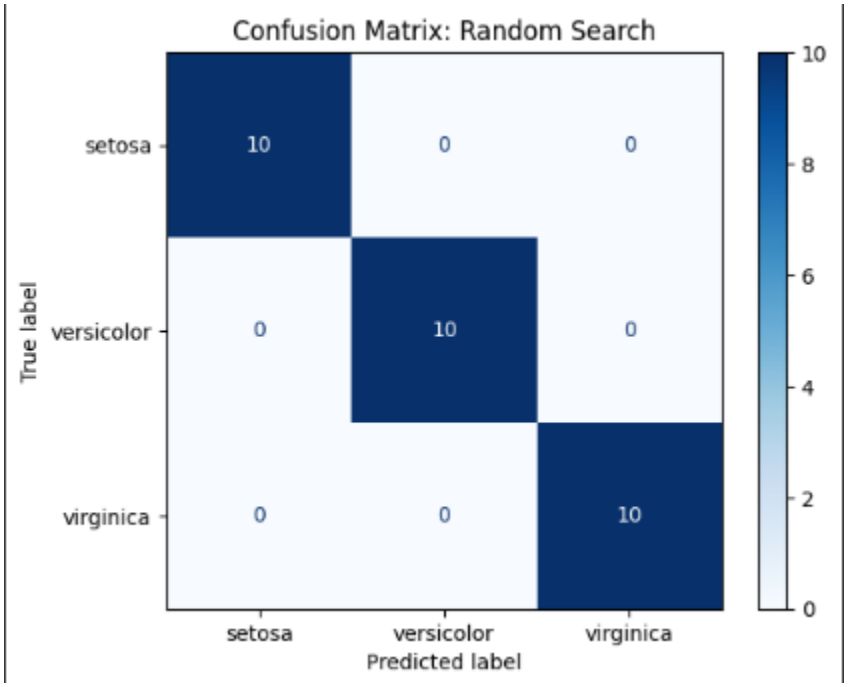
Sample Predictions

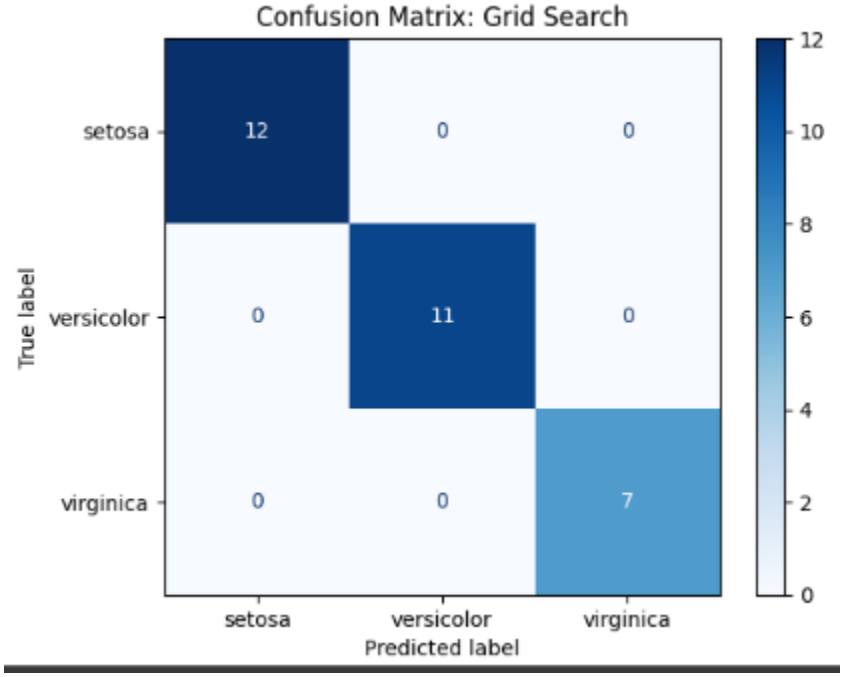
```
Sample Predictions:

Input: [-1.25747488  0.21701605 -1.32533157 -1.40568508]
Prediction: 0, Truth: 0

Input: [-0.53399618  0.93659559 -1.38370397 -1.13511325]
Prediction: 0, Truth: 0

Input: [-0.05167705 -0.74242333  0.01723376 -0.05282593]
Prediction: 1, Truth: 1

Input: [-1.49863445  1.41631528 -1.675566   -1.40568508]
Prediction: 0, Truth: 0

Input: [-0.53399618  2.13589481 -1.50044878 -1.13511325]
Prediction: 0, Truth: 0
```

2. **Task 2**

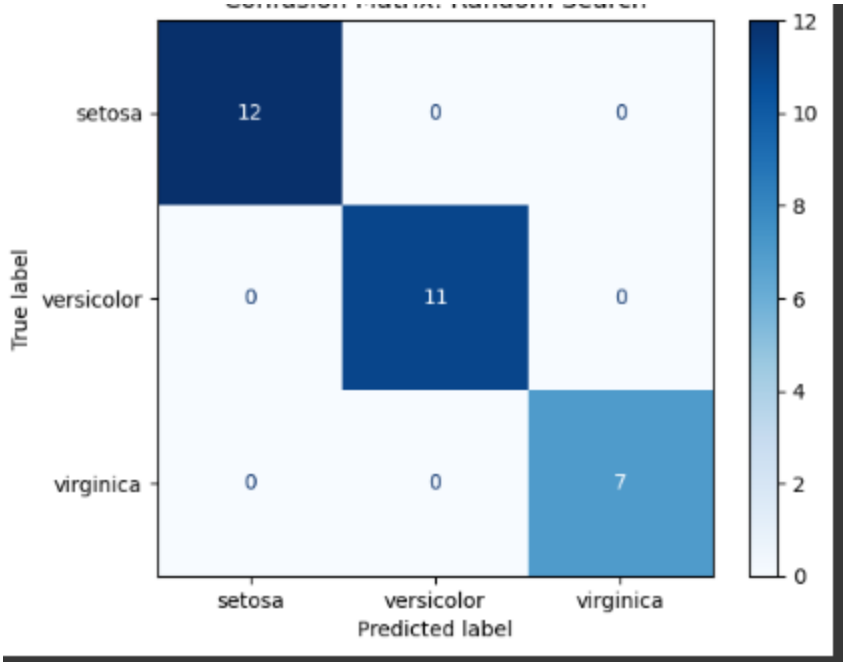
   For this task, we have used Autogloun TabularPredicto, where we manually define the hyperparameters search_method to grid, random, auto (for Bayesian (as the

documentation mentions that auto refers to Bayesian)), and hyperband. Then, we get the following results.



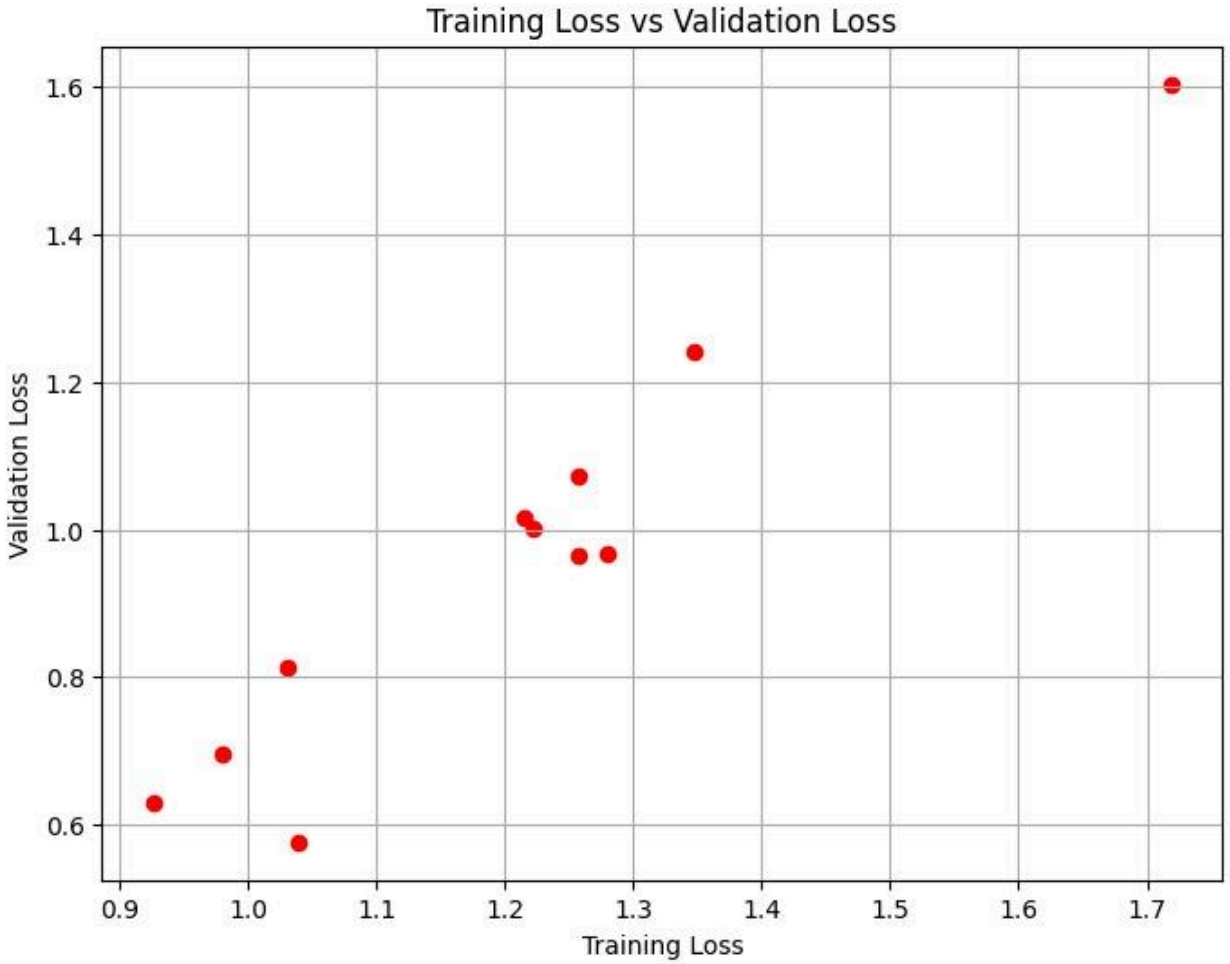


Hyperband Search



As per the theory, the accuracies follow the order of
Hyperband > Grid > Random
However, since our dataset is small, we are getting 100 % accuracy everywhere, or this might be because the model is overfitting.

From the output which we got during the training, We manually listed down the losses and plotted them to obtain this



From this, we understand the difference between manual and automated tuning

Manual Tuning

- We need to adjust hyperparameters manually based on intuition
- Simple but slow and inefficient for complex models.
- Requires trial-and-error runs

Automated Search

- Uses algorithms (e.g., bayesian, grid, or random search) to find the best hyperparameters.
- Faster and avoids human bias
- Works well for deep learning or large models where manual tuning is impractical.