DL-Ops Assignment-5 Report

Task: Implement a Neural Network using the IRIS dataset.

Objectives:

Question

- Implement a Neural Network using the IRIS dataset.
- Perform backpropagation using early stopping.
- You can choose the activation and loss functions at your convenience, Which gives the best performance.

Structure:

├── Dockerfile
├── engine.py
├── main.py
├── models.py
├── plotting.py
├── ReadMe.md
├── requirements.txt
└── results.png

Procedure:

- Import required packages. (PyTorch, NumPy, Matplotlib, torchmetrics …etc.)
- Checking GPU availability.
- Setting up devices.
- Get Dataset form sklearn.datasets.
- Make train test split using sklearn.model_selection.
- Converting numpy arrays to torch tensors.
- Creating Dataloaders for training loop.
- Creating model arch. As per question.
- Creating early stopping class.
- Training the model for 100 epochs, but due to early stopping stoped at the 25th - 50th epoch.
- Training Results:

[INFO] current used device: cuda
Training: 0%| | 0/100 [00:00<?, ?it/s]Epoch: 1 | train_loss: 1.5696 | train_acc: 0.3333 | test_loss: 1.3287 | test_acc: 0.3333
Training: 1%|█ | 1/100 [00:00<01:30, 1.10it/s]Epoch: 2 | train_loss: 1.3006 | train_acc: 0.3667 | test_loss: 1.1434 | test_acc: 0.6667
Training: 2%|██ | 2/100 [00:01<00:52, 1.85it/s]Epoch: 3 | train_loss: 1.1260 | train_acc: 0.5667 | test_loss: 1.0098 | test_acc: 0.7000

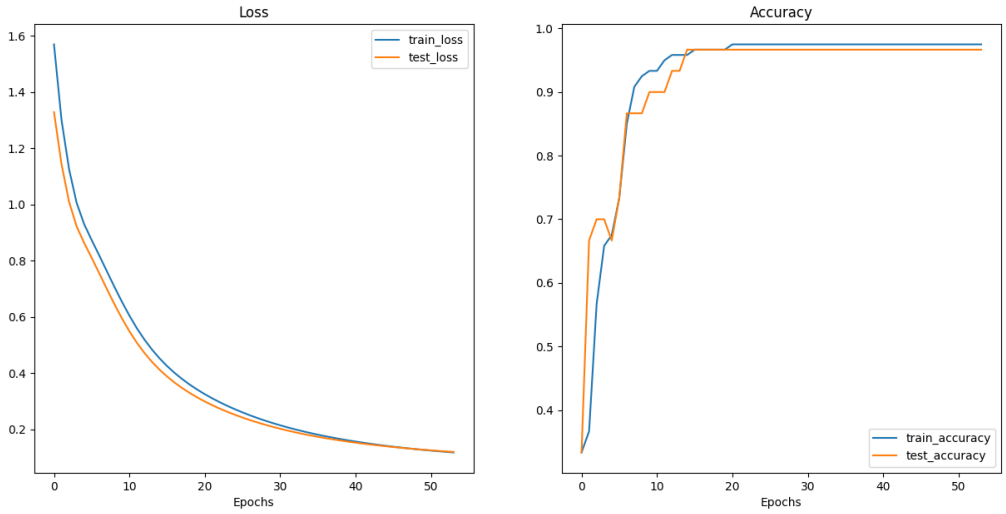
Training: 3%|▉ | 3/100 [00:01<00:40, 2.40it/s]Epoch: 4 | train_loss: 1.0063 | train_acc: 0.6583 | test_loss: 0.9225 | test_acc: 0.7000
Training: 4%|▉ | 4/100 [00:01<00:34, 2.77it/s]Epoch: 5 | train_loss: 0.9302 | train_acc: 0.6750 | test_loss: 0.8633 | test_acc: 0.6667
Training: 5%|▉ | 5/100 [00:02<00:31, 3.04it/s]Epoch: 6 | train_loss: 0.8735 | train_acc: 0.7333 | test_loss: 0.8102 | test_acc: 0.7333
Training: 6%|▉ | 6/100 [00:02<00:28, 3.27it/s]Epoch: 7 | train_loss: 0.8191 | train_acc: 0.8500 | test_loss: 0.7558 | test_acc: 0.8667
Training: 7%|▉ | 7/100 [00:02<00:27, 3.38it/s]Epoch: 8 | train_loss: 0.7635 | train_acc: 0.9083 | test_loss: 0.7004 | test_acc: 0.8667
Training: 8%|▉ | 8/100 [00:02<00:26, 3.47it/s]Epoch: 9 | train_loss: 0.7081 | train_acc: 0.9250 | test_loss: 0.6463 | test_acc: 0.8667
Training: 9%|▉ | 9/100 [00:03<00:25, 3.52it/s]Epoch: 10 | train_loss: 0.6548 | train_acc: 0.9333 | test_loss: 0.5955 | test_acc: 0.9000
Training: 10%|▉ | 10/100 [00:03<00:25, 3.55it/s]Epoch: 11 | train_loss: 0.6050 | train_acc: 0.9333 | test_loss: 0.5493 | test_acc: 0.9000
Training: 11%|▉ | 11/100 [00:03<00:24, 3.60it/s]Epoch: 12 | train_loss: 0.5596 | train_acc: 0.9500 | test_loss: 0.5082 | test_acc: 0.9000
Training: 12%|▉ | 12/100 [00:03<00:24, 3.62it/s]Epoch: 13 | train_loss: 0.5196 | train_acc: 0.9583 | test_loss: 0.4720 | test_acc: 0.9333
Training: 13%|▉ | 13/100 [00:04<00:23, 3.63it/s]Epoch: 14 | train_loss: 0.4841 | train_acc: 0.9583 | test_loss: 0.4404 | test_acc: 0.9333
Training: 14%|▉ | 14/100 [00:04<00:23, 3.66it/s]Epoch: 15 | train_loss: 0.4530 | train_acc: 0.9583 | test_loss: 0.4127 | test_acc: 0.9667
Training: 15%|▉ | 15/100 [00:04<00:23, 3.67it/s]Epoch: 16 | train_loss: 0.4255 | train_acc: 0.9667 | test_loss: 0.3883 | test_acc: 0.9667
Training: 16%|▉ | 16/100 [00:04<00:22, 3.66it/s]Epoch: 17 | train_loss: 0.4011 | train_acc: 0.9667 | test_loss: 0.3667 | test_acc: 0.9667

Training: 17%|
| 17/100 [00:05<00:22, 3.64it/s]Epoch: 18 | train_loss: 0.3794 | train_acc: 0.9667 | test_loss: 0.3473 | test_acc: 0.9667
Training: 18%|
| 18/100 [00:05<00:22, 3.64it/s]Epoch: 19 | train_loss: 0.3597 | train_acc: 0.9667 | test_loss: 0.3300 | test_acc: 0.9667
Training: 19%|
| 19/100 [00:05<00:22, 3.65it/s]Epoch: 20 | train_loss: 0.3419 | train_acc: 0.9667 | test_loss: 0.3141 | test_acc: 0.9667
Training: 20%|
| 20/100 [00:06<00:21, 3.64it/s]Epoch: 21 | train_loss: 0.3256 | train_acc: 0.9750 | test_loss: 0.2997 | test_acc: 0.9667
Training: 21%|
| 21/100 [00:06<00:21, 3.65it/s]Epoch: 22 | train_loss: 0.3106 | train_acc: 0.9750 | test_loss: 0.2864 | test_acc: 0.9667
Training: 22%|
| 22/100 [00:06<00:21, 3.66it/s]Epoch: 23 | train_loss: 0.2968 | train_acc: 0.9750 | test_loss: 0.2741 | test_acc: 0.9667
Training: 23%|
| 23/100 [00:06<00:21, 3.66it/s]Epoch: 24 | train_loss: 0.2839 | train_acc: 0.9750 | test_loss: 0.2628 | test_acc: 0.9667
Training: 24%|
| 24/100 [00:07<00:20, 3.67it/s]Epoch: 25 | train_loss: 0.2720 | train_acc: 0.9750 | test_loss: 0.2523 | test_acc: 0.9667
Training: 25%|
| 25/100 [00:07<00:20, 3.66it/s]Epoch: 26 | train_loss: 0.2609 | train_acc: 0.9750 | test_loss: 0.2425 | test_acc: 0.9667
Training: 26%|
| 26/100 [00:07<00:20, 3.66it/s]Epoch: 27 | train_loss: 0.2504 | train_acc: 0.9750 | test_loss: 0.2334 | test_acc: 0.9667
Training: 27%|
| 27/100 [00:08<00:19, 3.67it/s]Epoch: 28 | train_loss: 0.2406 | train_acc: 0.9750 | test_loss: 0.2249 | test_acc: 0.9667
Training: 28%|
| 28/100 [00:08<00:19, 3.67it/s]Epoch: 29 | train_loss: 0.2315 | train_acc: 0.9750 | test_loss: 0.2170 | test_acc: 0.9667
Training: 29%|
| 29/100 [00:08<00:19, 3.67it/s]Epoch: 30 | train_loss: 0.2229 | train_acc: 0.9750 | test_loss: 0.2096 | test_acc: 0.9667
Training: 30%|
| 30/100 [00:08<00:19, 3.64it/s]Epoch: 31 | train_loss: 0.2149 | train_acc: 0.9750 | test_loss: 0.2027 | test_acc: 0.9667

Training: 31%|
| 31/100 [00:09<00:18, 3.65it/s]Epoch: 32 | train_loss: 0.2074 | train_acc: 0.9750 | test_loss: 0.1962 | test_acc: 0.9667
Training: 32%|
| 32/100 [00:09<00:18, 3.66it/s]Epoch: 33 | train_loss: 0.2003 | train_acc: 0.9750 | test_loss: 0.1901 | test_acc: 0.9667
Training: 33%|
| 33/100 [00:09<00:18, 3.68it/s]Epoch: 34 | train_loss: 0.1937 | train_acc: 0.9750 | test_loss: 0.1843 | test_acc: 0.9667
Training: 34%|
| 34/100 [00:09<00:17, 3.69it/s]Epoch: 35 | train_loss: 0.1874 | train_acc: 0.9750 | test_loss: 0.1790 | test_acc: 0.9667
Training: 35%|
| 35/100 [00:10<00:17, 3.70it/s]Epoch: 36 | train_loss: 0.1816 | train_acc: 0.9750 | test_loss: 0.1740 | test_acc: 0.9667
Training: 36%|
| 36/100 [00:10<00:17, 3.69it/s]Epoch: 37 | train_loss: 0.1761 | train_acc: 0.9750 | test_loss: 0.1693 | test_acc: 0.9667
Training: 37%|
| 37/100 [00:10<00:17, 3.69it/s]Epoch: 38 | train_loss: 0.1709 | train_acc: 0.9750 | test_loss: 0.1649 | test_acc: 0.9667
Training: 38%|
| 38/100 [00:10<00:16, 3.68it/s]Epoch: 39 | train_loss: 0.1661 | train_acc: 0.9750 | test_loss: 0.1608 | test_acc: 0.9667
Training: 39%|
| 39/100 [00:11<00:16, 3.68it/s]Epoch: 40 | train_loss: 0.1615 | train_acc: 0.9750 | test_loss: 0.1569 | test_acc: 0.9667
Training: 40%|
| 40/100 [00:11<00:16, 3.67it/s]Epoch: 41 | train_loss: 0.1571 | train_acc: 0.9750 | test_loss: 0.1532 | test_acc: 0.9667
Training: 41%|
| 41/100 [00:11<00:16, 3.65it/s]Epoch: 42 | train_loss: 0.1530 | train_acc: 0.9750 | test_loss: 0.1497 | test_acc: 0.9667
Training: 42%|
| 42/100 [00:12<00:15, 3.64it/s]Epoch: 43 | train_loss: 0.1492 | train_acc: 0.9750 | test_loss: 0.1465 | test_acc: 0.9667
Training: 43%|
| 43/100 [00:12<00:15, 3.65it/s]Epoch: 44 | train_loss: 0.1455 | train_acc: 0.9750 | test_loss: 0.1434 | test_acc: 0.9667
Training: 44%|
| 44/100 [00:12<00:15, 3.65it/s]Epoch: 45 | train_loss: 0.1421 | train_acc: 0.9750 | test_loss: 0.1404 | test_acc: 0.9667

Training: 45%|
| 45/100 [00:12<00:14, 3.68it/s]Epoch: 46 | train_loss: 0.1388 | train_acc: 0.9750 | test_loss: 0.1377 | test_acc: 0.9667
Training: 46%|
| 46/100 [00:13<00:14, 3.68it/s]Epoch: 47 | train_loss: 0.1357 | train_acc: 0.9750 | test_loss: 0.1351 | test_acc: 0.9667
Training:
47%|
| 47/100 [00:13<00:14, 3.68it/s]Epoch: 48 | train_loss: 0.1328 | train_acc: 0.9750 | test_loss: 0.1326 | test_acc: 0.9667
Training:
48%|
| 48/100 [00:13<00:14, 3.69it/s]Epoch: 49 | train_loss: 0.1301 | train_acc: 0.9750 | test_loss: 0.1302 | test_acc: 0.9667
Training:
49%|
| 49/100 [00:13<00:13, 3.68it/s]Epoch: 50 | train_loss: 0.1275 | train_acc: 0.9750 | test_loss: 0.1280 | test_acc: 0.9667
Training:
50%|
| 50/100 [00:14<00:13, 3.68it/s]Epoch: 51 | train_loss: 0.1250 | train_acc: 0.9750 | test_loss: 0.1259 | test_acc: 0.9667
Training:
51%|
| 51/100 [00:14<00:13, 3.67it/s]Epoch: 52 | train_loss: 0.1227 | train_acc: 0.9750 | test_loss: 0.1239 | test_acc: 0.9667
Training:
52%|
| 52/100 [00:14<00:13, 3.68it/s]Epoch: 53 | train_loss: 0.1205 | train_acc: 0.9750 | test_loss: 0.1220 | test_acc: 0.9667
Training:
53%|
| 53/100 [00:15<00:12, 3.69it/s]Epoch: 54 | train_loss: 0.1184 | train_acc: 0.9750 | test_loss: 0.1202 | test_acc: 0.9667
We are at epoch: 53 and we are stopping the training

- **Plot:**



- Dockerization
- Create a Docker file for build purposes.
- Build the Docker Image.
- Run the Docker image.
- Results:

```
(bikash) planck@planck:/DATA1/bikash_dutta/DL_OPs/Ass5$ docker run -it ass_1_docker
WARNING: Running pip as the 'root' user can result in broken permissions and conflicting behaviour with the system package manager. It is recommended to use
 a virtual environment instead: https://pip.pypa.io/warnings/venv
[INFO] current used device: {device}
Training:   0%|                                                                                                                                | 0/100 [00:00<?, ?it/s]
Epoch: 1 | train_loss: 1.4587 | train_acc: 0.3333 | test_loss: 1.4133 | test_acc: 0.3333
Training:   1%|▌                                                                                                                       | 1/100 [00:00<00:12,  7.67it/s]
Epoch: 2 | train_loss: 1.2469 | train_acc: 0.3333 | test_loss: 1.2324 | test_acc: 0.3333
Training:   2%|█                                                                                                                       | 2/100 [00:00<00:12,  7.90it/s]
Epoch: 3 | train_loss: 1.1211 | train_acc: 0.3333 | test_loss: 1.1084 | test_acc: 0.3333
Training:   3%|█▌                                                                                                                      | 3/100 [00:00<00:12,  7.99it/s]
Epoch: 4 | train_loss: 1.0269 | train_acc: 0.3333 | test_loss: 1.0148 | test_acc: 0.4667
Training:   4%|██                                                                                                                      | 4/100 [00:00<00:11,  8.01it/s]
Epoch: 5 | train_loss: 0.9521 | train_acc: 0.3583 | test_loss: 0.9408 | test_acc: 0.5000
Training:   5%|██▌                                                                                                                     | 5/100 [00:00<00:11,  8.05it/s]
Epoch: 6 | train_loss: 0.8924 | train_acc: 0.3917 | test_loss: 0.8829 | test_acc: 0.5333
Training:   6%|███                                                                                                                     | 6/100 [00:00<00:11,  8.08it/s]
Epoch: 7 | train_loss: 0.8447 | train_acc: 0.4917 | test_loss: 0.8359 | test_acc: 0.5667
Training:   7%|███▌                                                                                                                    | 7/100 [00:00<00:11,  8.09it/s]
Epoch: 8 | train_loss: 0.8044 | train_acc: 0.5667 | test_loss: 0.7977 | test_acc: 0.6000
Training:   8%|████                                                                                                                    | 8/100 [00:00<00:11,  8.11it/s]
Epoch: 9 | train_loss: 0.7686 | train_acc: 0.6250 | test_loss: 0.7625 | test_acc: 0.6000
Training:   9%|████▌                                                                                                                   | 9/100 [00:01<00:11,  8.12it/s]
Epoch: 10 | train_loss: 0.7340 | train_acc: 0.6417 | test_loss: 0.7272 | test_acc: 0.6333
Training:  10%|█████                                                                                                                  | 10/100 [00:01<00:11,  8.14it/s]
Epoch: 11 | train_loss: 0.6974 | train_acc: 0.6583 | test_loss: 0.6888 | test_acc: 0.6333
Training:  11%|█████▌                                                                                                                 | 11/100 [00:01<00:10,  8.11it/s]
Epoch: 12 | train_loss: 0.6564 | train_acc: 0.6583 | test_loss: 0.6440 | test_acc: 0.6333
Training:  12%|██████                                                                                                                 | 12/100 [00:01<00:10,  8.10it/s]
Epoch: 13 | train_loss: 0.6091 | train_acc: 0.6667 | test_loss: 0.5921 | test_acc: 0.6333
Training:  13%|██████▌                                                                                                                | 13/100 [00:01<00:10,  8.12it/s]
Epoch: 14 | train_loss: 0.5541 | train_acc: 0.6750 | test_loss: 0.5280 | test_acc: 0.6333
Training:  14%|███████                                                                                                                | 14/100 [00:01<00:10,  8.13it/s]
Epoch: 15 | train_loss: 0.4979 | train_acc: 0.8750 | test_loss: 0.4715 | test_acc: 0.9667
Training:  15%|███████▌                                                                                                               | 15/100 [00:01<00:10,  8.14it/s]
Epoch: 16 | train_loss: 0.4488 | train_acc: 0.9583 | test_loss: 0.4234 | test_acc: 1.0000
Training:  16%|████████                                                                                                               | 16/100 [00:01<00:10,  8.15it/s]
Epoch: 17 | train_loss: 0.4084 | train_acc: 0.9583 | test_loss: 0.3832 | test_acc: 1.0000
Training:  17%|████████▌                                                                                                              | 17/100 [00:02<00:10,  8.15it/s]
Epoch: 18 | train_loss: 0.3745 | train_acc: 0.9667 | test_loss: 0.3536 | test_acc: 0.9667
Training:  18%|█████████                                                                                                              | 18/100 [00:02<00:10,  8.16it/s]
```

NOTE:- Please refer to Readme for more on Docker.