

Report DL-Week 1(23CS60R53):

https://drive.google.com/drive/folders/1SZQZWHoh_Fgeillf5Sq6c_b7xeKvdJi9?usp=sharing

Used Optum for hyperparameter tuning and saved the model state in a dictionary of the model with the least validation loss. Evaluate.py takes this dictionary and Creates an instance of the model class with the saved state and performs evaluation.

Hyperparameter Tuning Report For CNN (On Validation Loss):

```
Running CNN.py...
[2024-03-13 13:16:28.886] A new study created in memory with name: no-name-673a51af-7b6b-47ba-92b7-49fcb0a1c24d
100% [00:00:00:00, 6/6 [00:08:00:00, 1.40s/it]] [2024-03-13 13:16:37.706] Trial 0 finished with value: 0.009700619190369013 and parameters: {'kernel_size': 9, 'stride': 10, 'padding': 4, 'batch_size': 32, 'learning_rate': 0.00096128483236834, 'epochs': 6}. Best is trial 0 with value: 0.009700619190369013.
100% [00:00:00:00, 7/7 [00:19:00:00, 2.77s/it]] [2024-03-13 13:16:57.101] Trial 1 finished with value: 0.020435014672858534 and parameters: {'kernel_size': 10, 'stride': 10, 'padding': 5, 'batch_size': 16, 'learning_rate': 0.005077114151952239, 'epochs': 7}. Best is trial 0 with value: 0.009700619190369013.
100% [00:00:00:00, 8/8 [00:16:00:00, 2.72s/it]] [2024-03-13 13:17:11.412] Trial 2 finished with value: 0.02037156677712043 and parameters: {'kernel_size': 9, 'stride': 4, 'padding': 0, 'batch_size': 16, 'learning_rate': 8.7340936028087e-05, 'epochs': 6}. Best is trial 0 with value: 0.009700619190369013.
100% [00:00:00:00, 9/9 [00:16:00:00, 1.83s/it]] [2024-03-13 13:17:29.910] Trial 3 finished with value: 0.02260290951520767 and parameters: {'kernel_size': 3, 'stride': 10, 'padding': 4, 'batch_size': 16, 'learning_rate': 0.012892802558634263, 'epochs': 9}. Best is trial 0 with value: 0.009700619190369013.
100% [00:00:00:00, 10/10 [00:23:00:00, 2.66s/it]] [2024-03-13 13:17:51.403] Trial 4 finished with value: 0.009590290070929617 and parameters: {'kernel_size': 8, 'stride': 3, 'padding': 1, 'batch_size': 32, 'learning_rate': 2.667538966863576e-05, 'epochs': 9}. Best is trial 0 with value: 0.009700619190369013.
100% [00:00:00:00, 11/11 [00:15:00:00, 1.53s/it]] [2024-03-13 13:18:09.212] Trial 5 finished with value: 0.009899578341313128 and parameters: {'kernel_size': 5, 'stride': 5, 'padding': 3, 'batch_size': 32, 'learning_rate': 0.020951736428894974, 'epochs': 10}. Best is trial 0 with value: 0.009700619190369013.
100% [00:00:00:00, 12/12 [00:13:00:00, 2.18s/it]] [2024-03-13 13:18:22.405] Trial 6 finished with value: 0.009690290070929617 and parameters: {'kernel_size': 8, 'stride': 8, 'padding': 2, 'batch_size': 32, 'learning_rate': 0.028493642032012414, 'epochs': 6}. Best is trial 6 with value: 0.009690290070929617.
100% [00:00:00:00, 13/13 [00:12:00:00, 1.81s/it]] [2024-03-13 13:18:34.971] Trial 7 finished with value: 0.00586629746320113 and parameters: {'kernel_size': 9, 'stride': 4, 'padding': 3, 'batch_size': 64, 'learning_rate': 5.280991379083166e-05, 'epochs': 7}. Best is trial 7 with value: 0.00586629746320113.
100% [00:00:00:00, 14/14 [00:15:00:00, 1.54s/it]] [2024-03-13 13:18:50.398] Trial 8 finished with value: 0.004690951376028781 and parameters: {'kernel_size': 9, 'stride': 6, 'padding': 2, 'batch_size': 64, 'learning_rate': 0.019700219604702435, 'epochs': 10}. Best is trial 8 with value: 0.004690951376028781.
100% [00:00:00:00, 15/15 [00:19:00:00, 2.21s/it]] [2024-03-13 13:19:10.231] Trial 9 finished with value: 0.009538209725944501 and parameters: {'kernel_size': 9, 'stride': 6, 'padding': 4, 'batch_size': 32, 'learning_rate': 0.0005615467527651747, 'epochs': 9}. Best is trial 8 with value: 0.004690951376028781.
100% [00:00:00:00, 16/16 [00:09:00:00, 1.05s/it]] [2024-03-13 13:19:19.887] Trial 10 finished with value: 0.005397318458219744 and parameters: {'kernel_size': 6, 'stride': 7, 'padding': 1, 'batch_size': 64, 'learning_rate': 0.06528575847852486, 'epochs': 10}. Best is trial 8 with value: 0.004690951376028781.
100% [00:00:00:00, 17/17 [00:09:00:00, 1.10s/it]] [2024-03-13 13:19:28.483] Trial 11 finished with value: 0.005007930212425736 and parameters: {'kernel_size': 6, 'stride': 7, 'padding': 1, 'batch_size': 64, 'learning_rate': 0.00037809952836863, 'epochs': 10}. Best is trial 8 with value: 0.004690951376028781.
100% [00:00:00:00, 18/18 [00:07:00:00, 1.05s/it]] [2024-03-13 13:19:36.690] Trial 12 finished with value: 0.00538209725944501 and parameters: {'kernel_size': 6, 'stride': 8, 'padding': 1, 'batch_size': 64, 'learning_rate': 0.09448656866900387, 'epochs': 8}. Best is trial 8 with value: 0.004690951376028781.
100% [00:00:00:00, 19/19 [00:09:00:00, 1.10s/it]] [2024-03-13 13:19:45.777] Trial 13 finished with value: 0.00473565879576611 and parameters: {'kernel_size': 5, 'stride': 7, 'padding': 2, 'batch_size': 64, 'learning_rate': 0.004691791489772885, 'epochs': 8}. Best is trial 8 with value: 0.004690951376028781.
100% [00:00:00:00, 20/20 [00:07:00:00, 1.02s/it]] [2024-03-13 13:19:53.680] Trial 14 finished with value: 0.005911144350722151 and parameters: {'kernel_size': 4, 'stride': 6, 'padding': 2, 'batch_size': 64, 'learning_rate': 0.019700219604702435, 'epochs': 10}. Best Hyperparameters: {'kernel_size': 9, 'stride': 6, 'padding': 2, 'batch_size': 64, 'learning_rate': 0.019700219604702435, 'epochs': 10}
100% [00:00:00:00, 21/21 [00:15:00:00, 1.51s/it]] CNN.py finished.
```

Hyperparameter Tuning Report For DNN (On Validation Loss):

```
Running DNN.py...
[2024-03-13 13:28:11.469] A new study created in memory with name: no-name-8c260bce-4362-41d0-bd4b-d49813f4047f
100% [00:00:00:00, 9/9 [00:20:00:00, 2.28s/it]] [2024-03-13 13:28:32.513] Trial 0 finished with value: 0.02150394584772722 and parameters: {'learning_rate': 4.102330832572964e-05, 'units_layer1': 10, 'units_layer2': 4, 'batch_size': 32, 'activation_1': 'LeakyReLU', 'activation_2': 'ReLU', 'epochs': 9}. Best is trial 0 with value: 0.02150394584772722.
100% [00:00:00:00, 10/10 [00:22:00:00, 2.47s/it]] [2024-03-13 13:28:54.707] Trial 1 finished with value: 0.02051683743045915 and parameters: {'learning_rate': 2.9547928928641535e-05, 'units_layer1': 10, 'units_layer2': 13, 'batch_size': 32, 'activation_1': 'ReLU', 'activation_2': 'LeakyReLU', 'epochs': 9}. Best is trial 1 with value: 0.02051683743045915.
100% [00:00:00:00, 11/11 [00:19:00:00, 1.95s/it]] [2024-03-13 13:29:14.254] Trial 2 finished with value: 0.004023019350924582 and parameters: {'learning_rate': 0.0014127394957113, 'units_layer1': 7, 'units_layer2': 4, 'batch_size': 64, 'activation_1': 'LeakyReLU', 'activation_2': 'LeakyReLU', 'epochs': 10}. Best is trial 2 with value: 0.004023019350924582.
100% [00:00:00:00, 12/12 [00:13:00:00, 2.63s/it]] [2024-03-13 13:29:27.413] Trial 3 finished with value: 0.0334419685478835 and parameters: {'learning_rate': 0.03108998574536054, 'units_layer1': 6, 'units_layer2': 10, 'batch_size': 16, 'activation_1': 'LeakyReLU', 'activation_2': 'LeakyReLU', 'epochs': 5}. Best is trial 2 with value: 0.004023019350924582.
100% [00:00:00:00, 13/13 [00:21:00:00, 3.88s/it]] [2024-03-13 13:29:40.902] Trial 4 finished with value: 0.05182537675720292 and parameters: {'learning_rate': 0.00086820468333403, 'units_layer1': 12, 'units_layer2': 13, 'batch_size': 16, 'activation_1': 'LeakyReLU', 'activation_2': 'LeakyReLU', 'epochs': 7}. Best is trial 2 with value: 0.004023019350924582.
100% [00:00:00:00, 14/14 [00:16:00:00, 2.39s/it]] [2024-03-13 13:29:55.643] Trial 5 finished with value: 0.026112124254507093 and parameters: {'learning_rate': 1.922528336428142e-05, 'units_layer1': 5, 'units_layer2': 7, 'batch_size': 32, 'activation_1': 'LeakyReLU', 'activation_2': 'ReLU', 'epochs': 7}. Best is trial 2 with value: 0.004023019350924582.
100% [00:00:00:00, 15/15 [00:15:00:00, 2.28s/it]] [2024-03-13 13:29:57.607] Trial 6 finished with value: 0.026374889171520495 and parameters: {'learning_rate': 8.871446653500849e-05, 'units_layer1': 9, 'units_layer2': 8, 'batch_size': 7, 'activation_1': 'LeakyReLU', 'activation_2': 'LeakyReLU', 'epochs': 7}. Best is trial 2 with value: 0.004023019350924582.
100% [00:00:00:00, 16/16 [00:20:00:00, 2.33s/it]] [2024-03-13 13:29:57.575] Trial 7 finished with value: 0.031924688399129444 and parameters: {'learning_rate': 0.0015111713660403, 'units_layer1': 12, 'units_layer2': 11, 'batch_size': 32, 'activation_1': 'ReLU', 'activation_2': 'ReLU', 'epochs': 9}. Best is trial 2 with value: 0.004023019350924582.
100% [00:00:00:00, 17/17 [00:24:00:00, 2.75s/it]] [2024-03-13 13:29:57.362] Trial 8 finished with value: 0.06484299265988255 and parameters: {'learning_rate': 2.517439366783152e-05, 'units_layer1': 13, 'units_layer2': 15, 'batch_size': 16, 'activation_1': 'ReLU', 'activation_2': 'LeakyReLU', 'epochs': 9}. Best is trial 2 with value: 0.004023019350924582.
100% [00:00:00:00, 18/18 [00:13:00:00, 2.68s/it]] [2024-03-13 13:29:57.758] Trial 9 finished with value: 0.04294860198268058 and parameters: {'learning_rate': 0.0213925255749854, 'units_layer1': 15, 'units_layer2': 15, 'batch_size': 16, 'activation_1': 'ReLU', 'activation_2': 'ReLU', 'epochs': 5}. Best is trial 2 with value: 0.004023019350924582.
100% [00:00:00:00, 19/19 [00:17:00:00, 1.76s/it]] [2024-03-13 13:29:58.378] Trial 10 finished with value: 0.015066303228591746 and parameters: {'learning_rate': 0.0016578888270261886, 'units_layer1': 7, 'units_layer2': 4, 'batch_size': 64, 'activation_1': 'LeakyReLU', 'activation_2': 'LeakyReLU', 'epochs': 10}. Best is trial 2 with value: 0.004023019350924582.
100% [00:00:00:00, 20/20 [00:10:00:00, 1.73s/it]] [2024-03-13 13:29:58.888] Trial 11 finished with value: 0.01839511897718344 and parameters: {'learning_rate': 0.00283026920874, 'units_layer1': 7, 'units_layer2': 4, 'batch_size': 64, 'activation_1': 'LeakyReLU', 'activation_2': 'LeakyReLU', 'epochs': 10}. Best is trial 2 with value: 0.004023019350924582.
100% [00:00:00:00, 21/21 [00:17:00:00, 1.73s/it]] [2024-03-13 13:29:59.316] Trial 12 finished with value: 0.019814994601204343 and parameters: {'learning_rate': 0.000340012165579739, 'units_layer1': 4, 'units_layer2': 6, 'batch_size': 64, 'activation_1': 'LeakyReLU', 'activation_2': 'LeakyReLU', 'epochs': 10}. Best is trial 2 with value: 0.004023019350924582.
100% [00:00:00:00, 22/22 [00:17:00:00, 1.76s/it]] [2024-03-13 13:29:59.888] Trial 13 finished with value: 0.0225340702368792 and parameters: {'learning_rate': 0.006966271870724249, 'units_layer1': 7, 'units_layer2': 6, 'batch_size': 64, 'activation_1': 'LeakyReLU', 'activation_2': 'LeakyReLU', 'epochs': 10}. Best is trial 2 with value: 0.004023019350924582.
100% [00:00:00:00, 23/23 [00:14:00:00, 1.81s/it]] [2024-03-13 13:29:59.392] Trial 14 finished with value: 0.02291516177981016 and parameters: {'learning_rate': 0.0003583195958518643, 'units_layer1': 8, 'units_layer2': 9, 'batch_size': 64, 'activation_1': 'LeakyReLU', 'activation_2': 'LeakyReLU', 'epochs': 8}. Best is trial 2 with value: 0.004023019350924582.
100% [00:00:00:00, 24/24 [00:15:00:00, 1.58s/it]] DNN.py finished.
```

Hyperparameter Tuning Report For LSTM (On Validation Loss):

```
Running LSTM.py...
[1 2024-03-13 13:25:03.369] A new study created in memory with name: no-name-55c0eb12-8199-45f6-8947-cd940f84f536
[1 2024-03-13 13:25:19.220] Trial 0 finished with value: 0.01894585277955487 and parameters: {'hidden_size': 127, 'num_layers': 1, 'learning_rate': 0.0027717967247789604, 'epochs': 9, 'batch_size': 16}. Best is trial 0 with value: 0.01894585277955487.
[1 2024-03-13 13:25:32.300] Trial 1 finished with value: 0.020504544914331876 and parameters: {'hidden_size': 102, 'num_layers': 1, 'learning_rate': 0.036879293079886905, 'epochs': 9, 'batch_size': 16}. Best is trial 0 with value: 0.01894585277955487.
[1 2024-03-13 13:25:40.343] Trial 2 finished with value: 0.010346765310134528 and parameters: {'hidden_size': 78, 'num_layers': 2, 'learning_rate': 0.00017418817813337514, 'epochs': 7, 'batch_size': 32}. Best is trial 2 with value: 0.010346765310134528.
[1 2024-03-13 13:25:48.673] Trial 3 finished with value: 0.010141051602813433 and parameters: {'hidden_size': 68, 'num_layers': 3, 'learning_rate': 0.00041200610078494205, 'epochs': 6, 'batch_size': 32}. Best is trial 3 with value: 0.010141051602813433.
[1 2024-03-13 13:26:01.168] Trial 4 finished with value: 0.011190772218243132 and parameters: {'hidden_size': 102, 'num_layers': 3, 'learning_rate': 4.778128064030619e-05, 'epochs': 8, 'batch_size': 32}. Best is trial 3 with value: 0.010141051602813433.
[1 2024-03-13 13:26:06.599] Trial 5 finished with value: 0.004962205929013918 and parameters: {'hidden_size': 128, 'num_layers': 2, 'learning_rate': 0.06522283540561837, 'epochs': 7, 'batch_size': 64}. Best is trial 5 with value: 0.004962205929013918.
[1 2024-03-13 13:26:20.427] Trial 6 finished with value: 0.020290816146528945 and parameters: {'hidden_size': 76, 'num_layers': 2, 'learning_rate': 0.0710811139253326, 'epochs': 7, 'batch_size': 16}. Best is trial 5 with value: 0.004962205929013918.
[1 2024-03-13 13:26:32.484] Trial 7 finished with value: 0.01915423574172101 and parameters: {'hidden_size': 102, 'num_layers': 1, 'learning_rate': 0.005378800688023417, 'epochs': 8, 'batch_size': 16}. Best is trial 5 with value: 0.004962205929013918.
[1 2024-03-13 13:26:44.915] Trial 8 finished with value: 0.01004945974586145 and parameters: {'hidden_size': 91, 'num_layers': 3, 'learning_rate': 0.0006936585927215221, 'epochs': 8, 'batch_size': 32}. Best is trial 5 with value: 0.004962205929013918.
[1 2024-03-13 13:27:01.526] Trial 9 finished with value: 0.021612349890594212 and parameters: {'hidden_size': 64, 'num_layers': 2, 'learning_rate': 5.486378889049691e-05, 'epochs': 9, 'batch_size': 16}. Best is trial 5 with value: 0.004962205929013918.
[1 2024-03-13 13:27:05.427] Trial 10 finished with value: 0.004770830301743634 and parameters: {'hidden_size': 128, 'num_layers': 2, 'learning_rate': 0.011420050101072514, 'epochs': 5, 'batch_size': 64}. Best is trial 10 with value: 0.004770830301743634.
[1 2024-03-13 13:27:09.159] Trial 11 finished with value: 0.005464239994872291 and parameters: {'hidden_size': 128, 'num_layers': 2, 'learning_rate': 0.014222385003942791, 'epochs': 5, 'batch_size': 64}. Best is trial 10 with value: 0.004770830301743634.
[1 2024-03-13 13:27:12.014] Trial 12 finished with value: 0.005021560149935057 and parameters: {'hidden_size': 116, 'num_layers': 2, 'learning_rate': 0.09518735788069832, 'epochs': 5, 'batch_size': 64}. Best is trial 10 with value: 0.004770830301743634.
[1 2024-03-13 13:27:17.002] Trial 13 finished with value: 0.0048835171984051755 and parameters: {'hidden_size': 115, 'num_layers': 2, 'learning_rate': 0.01655772765113853, 'epochs': 6, 'batch_size': 64}. Best is trial 10 with value: 0.004770830301743634.
[1 2024-03-13 13:27:22.995] Trial 14 finished with value: 0.0048504345400153465 and parameters: {'hidden_size': 115, 'num_layers': 3, 'learning_rate': 0.007021724404957443, 'epochs': 6, 'batch_size': 64}. Best is trial 10 with value: 0.004770830301743634.
Best Hyperparameters: {'hidden_size': 128, 'num_layers': 2, 'learning_rate': 0.011420050101072514, 'epochs': 5, 'batch_size': 64}
LSTM.py finished.
```

Evaluation Report:

Classification Report for DNN:				
	precision	recall	f1-score	support
fake	0.94	0.89	0.92	496
real	0.91	0.95	0.93	564
accuracy			0.93	1060
macro avg	0.93	0.92	0.92	1060
weighted avg	0.93	0.93	0.93	1060

Classification Report for CNN:				
	precision	recall	f1-score	support
fake	0.80	0.91	0.85	496
real	0.91	0.80	0.85	564
accuracy			0.85	1060
macro avg	0.86	0.85	0.85	1060
weighted avg	0.86	0.85	0.85	1060

Classification Report for LSTM:				
	precision	recall	f1-score	support
fake	0.89	0.71	0.79	496
real	0.79	0.93	0.85	564
accuracy			0.83	1060
macro avg	0.84	0.82	0.82	1060
weighted avg	0.84	0.83	0.82	1060