

XRAY - TASK 1 - BINARY CLASSIFICATION

Dataset - I have used the FracAtlas Dataset.

Brief about FracAtlas Dataset

- Dataset features 4,083 X-ray images focusing on the hand, leg, hip, and shoulder regions, with patient ages ranging from 8 months to 78 years.
- Expert radiologists reviewed and annotated the images for fractures, with the dataset containing a mix of fracture severities and types, as well as orthopedic fixation devices.
- Images come in different views (frontal, lateral, oblique)
- Available in JPG format, with annotations in COCO JSON format for segmentation and localization tasks

Data Preprocessing

1. Resizing each image to 224 * 224 Pixels
2. Images are converted into Tensors
3. Normalization is done to the tensors by adjusting their mean and standard deviation

Train Test Validation Split

Train - 70 %

Validation - 15 %

Test - 15 %

Transfer Learning

I've adjusted the architecture of EfficientNet Model by adding dropout for regularization and reconfiguration of final fully connected layer to a specified number of output classes into two class.

EfficientNet Model Training

A function train model is defined to train and validate a given neural network model across multiple epochs. It tracks training loss, training accuracy, and validation accuracy, returning the trained model and the best validation accuracy achieved.

Bayesian Optimization with Optuna:

Optuna, a hyperparameter optimization framework, is used to systematically and efficiently search for the best hyperparameters.

The objective function, which Optuna will optimize, sets up and trains the model using different hyperparameters in each trial.

Hyperparameter Tuning:

Optuna trials explore different values for learning rate , batch size, number of epochs, optimizer type (Adam or SGD), dropout rate, and weight decay.

Each trial involves setting up the data loaders with the current batch size, initializing the model, and applying the selected hyperparameters.

The model is then trained and evaluated, and the best validation accuracy is returned as the objective value for that trial.

Optimization Execution:

An Optuna study is created to maximize the objective function (validation accuracy).

The study performs a specified number of trials (25), each testing a different set of hyperparameters.

After all trials, the study identifies the set of hyperparameters that yielded the best validation accuracy.

Training with Best Hyperparameters:

Once the optimal hyperparameters are found, the code sets up the model, optimizer, and data loaders using these best hyperparameters.

The model is then trained and validated with this optimal configuration.

Inferring the Best Model with Test Data:

Using the Best Hyperparameter, I've trained the model. Test data is tested with that best model and got good results.

Results:

Optuna Study Results

number	params_batch_size	params_dropout_rate	params_epochs	params_lr	params_optimizer	params_weight_dec
0	32	0.31098	2	0.003266	Adam	0.005486
1	64	0.45285	2	0.009361	SGD	0.001812
2	32	0.371842	3	0.005344	Adam	0.002219
3	32	0.304134	3	0.001079	Adam	0.003123
4	32	0.347145	3	0.004587	Adam	0.001018
5	32	0.495627	2	0.004261	Adam	0.004231
6	32	0.444204	3	0.001999	SGD	0.005732
7	64	0.375265	3	0.001357	Adam	0.003032
8	64	0.399777	3	0.001094	Adam	0.001055
9	32	0.447843	2	0.002748	Adam	0.005757
10	64	0.359461	3	0.001631	SGD	0.006994
11	64	0.398967	3	0.001005	Adam	0.001057
12	64	0.401319	3	0.001025	Adam	0.001725
13	64	0.412615	3	0.001019	Adam	0.001469
14	64	0.401015	3	0.001561	Adam	0.001456
15	64	0.413201	3	0.002018	SGD	0.002098
16	64	0.334783	3	0.001327	Adam	0.001315
17	64	0.383463	3	0.001017	Adam	0.009102
18	64	0.427044	2	0.00178	SGD	0.00125
19	64	0.381358	3	0.001348	Adam	0.001667
20	64	0.340088	3	0.002156	Adam	0.002311
21	64	0.372056	3	0.001336	Adam	0.002768
22	64	0.392188	3	0.001313	Adam	0.003564
23	64	0.364512	3	0.001007	Adam	0.001814
24	64	0.357668	3	0.001013	Adam	0.001774

11 th Trail's combination is considered as the best hyperparameters.

The train accuracy is higher than other trails and other combinations.

Best Hyperparameters

Batch size - 64

Dropout - 0.398

Epochs - 3

Learning Rate - 0.001

Optimizer - Adam

Weight Decay - 0.001

Train Loss - 8.096

Train accuracy - 0.9367

Validation Accuracy - 0.884

Using the test dataset, I got the accuracy of 86.6 %

Results and Notebook are uploaded in the Github
Still have to add some information in this report
Currently this is a Brief report.