

1.) Differences of Yolov8 from all the previous version:

- Anchor-free design:

Detects the centre of objects directly instead of using pre-defined anchor-boxes. Helps to address the scenarios where the object can be too much thin or too much flat which will be difficult for the anchor box to detect

- Multi-scale prediction:

Uses 3 different scales, 20,40 and 80. These three scales allow detection of large and small objects.

- Mosaic Augmentation:

Applies Mosaic Augmentation (new image from multiple images combined) and stops this augmentation during last 10 epochs)

- Uses DFL-Loss: Helps to improve detection in challenging scenarios like blurry images

- Faster Speed

- Higher mAP

2.) How our Yolov8 model works:

- Total train images were 2531 but used 2287 since some were corrupted and there were duplicates.
- Applies some preprocessing like Mosaic Augmentation, Median Blur, CLAHE
- Model summary: 225 layers, 11135987 parameters
- Optimizer: “SGD with momentum=0.937” Learning rate=0.01, Dropout=0.5 , batchsize=16, image_size = 640x640.
- Uses fully convolutional layers , pooling layers and residual blocks with skip connections.
- There are 3 detection layers and each layers works at different scales to detect objects of different sizes
- Applies non-max suppression with a threshold of 0.7
- Computes the box-loss:(Error in predicting the coordinates of bounding boxes) cls-loss:(Error in classifying the object correctly)
dfl-loss:(Distribution Focal loss, helps to improve detection in challenging scenarios like blurry images) Total Loss = Box-loss + Cls-loss + Dfl-loss
- Trained for 25 epochs where the last 10 epochs were done without mosaic augmentation.
- Evaluated: F1-confidence curve, Precision-confidence curve, Recall confidence curve, Precision-Recall curve, Confusion Matrix, mAP and (loss, mAP, recall, precision) vs epochs curves

3.) Concepts about the graphs and evaluation metrics:

- Recall, Precision, F1-score .
- Recall-confidence curve: Shows how recall changes with higher confidence thresholds. Higher thresholds leads to fewer correct predictions
- Precision-confidence curve: Shows precision at different confidence thresholds. Precision will be high for high thresholds as only confident predictions are considered valid
- Precision-recall curve: Area under this graph gives mAP
- mAP50 and mAP50-95: mAP50 refers to IoU threshold=0.5 for selecting as correct predictions and mAP50-95 calculates over a range of thresholds from 0.5 to 0.95

4.) Our approach for hyperparameter tuning:

- Compared a pretrained model vs a new one from scratch
- Compared different optimizers
- Compared different learning rates
- Compared different batch sizes