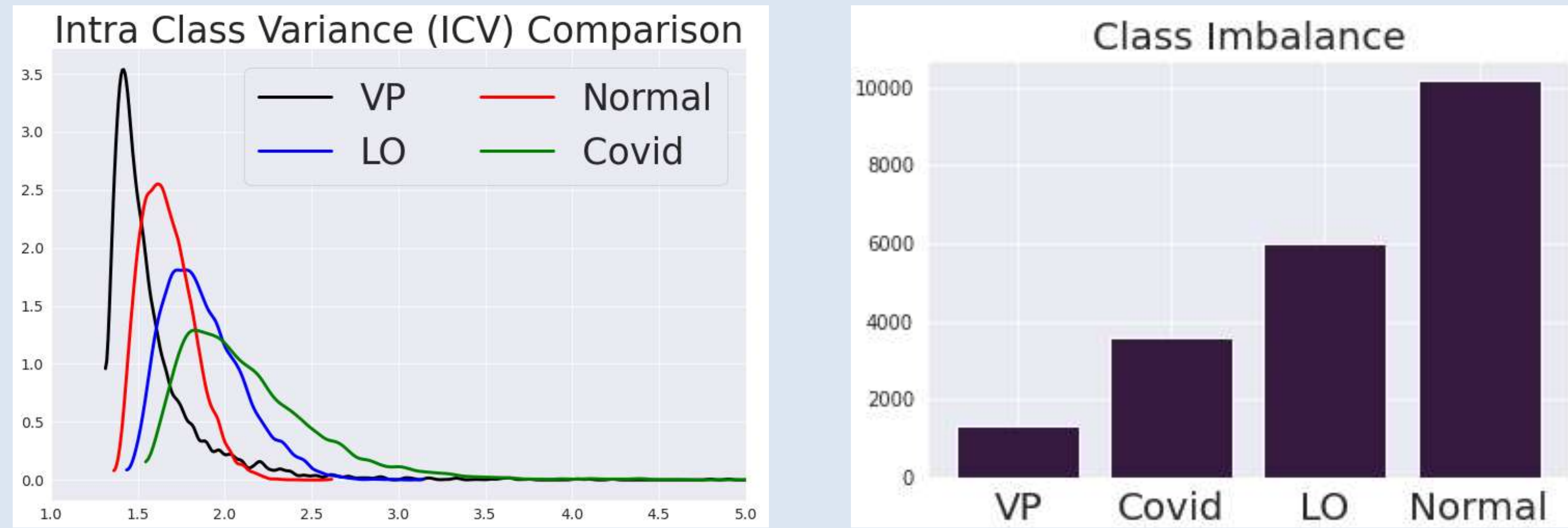


Custom Weighted Balanced Loss Function for Covid 19 Detection from an Imbalanced CXR Dataset

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Challenges in Dataset



Proposed Loss Function

$$L_{CWBCCE}(y, p) = -\frac{1}{N} * \sum_{i=1}^N \sum_{c=1}^K \beta_c * \log(p_{i,c})$$

$$\beta_c = \frac{1}{K} \left[1 + \left(\frac{1}{K} \sum_{c=1}^K \mu(r_c) - \mu(r_c) \right) \right] \text{ It handles intra-class variance}$$

$$\beta_c = \frac{1}{K} \left[1 + \left(\frac{1}{K} \sum_{c=1}^K \mu(r_c) - \mu(r_c) \right) + \frac{\frac{\sum_c n_c}{K} - n_c}{\sum_c n_c} \right]$$

$$\beta_c = \frac{1}{K} \left[1 + \left(\frac{1}{K} \sum_{c=1}^K \mu(r_c) - \mu(r_c) \right) + \frac{\left(\frac{\sum_c n_c}{K} - n_c \right)^\gamma}{\sum_c n_c} \right]$$

It handles both intra-class variance and class imbalance

Results

Table1: Ablation Study of loss functions with ResNet-18 model on testing dataset

Loss function	F1 Score	Accuracy	Precision	Recall	AUC
CCE	0.91	0.90	0.89	0.93	0.925
WCCE	0.88	0.88	0.90	0.87	0.928
Sigmoid	0.92	0.91	0.91	0.92	0.937
Balanced Loss function by Cui et al.[1]	0.92	0.91	0.92	0.92	0.940
Custom Weighted BCCE - I	0.92	0.91	0.92	0.92	0.945
Custom Weighted BCCE - II	0.91	0.90	0.92	0.90	0.944
Custom Weighted BCCE - III (proposed)	0.93	0.92	0.93	0.94	0.951

Conclusions

- Three Custom Weighted Balanced CCE (CWBCCE) utilized empirically.
- Results in the Table-I showed that proposed loss function CWBCCE-III, outperformed other loss functions for imbalanced CXR (testing) dataset.

References

1. T Cui, Yin, et al. "Class-balanced loss based on effective number of samples." in Proc. IEEE/CVF Conf. Computer Vision and Pattern Recognition, 2019, pp. 9268-9277
2. T. Wu, Q. Huang, Z. Liu, Y. Wang, and D. Lin, "Distribution-balanced loss for multi-label classification in long-tailed datasets". In European Conference on Computer Vision, Aug.2020, pp. 162-178.