Classification-Reconstruction Learning for Open-Set Recognition: Supplementary Material

Anonymous CVPR submission

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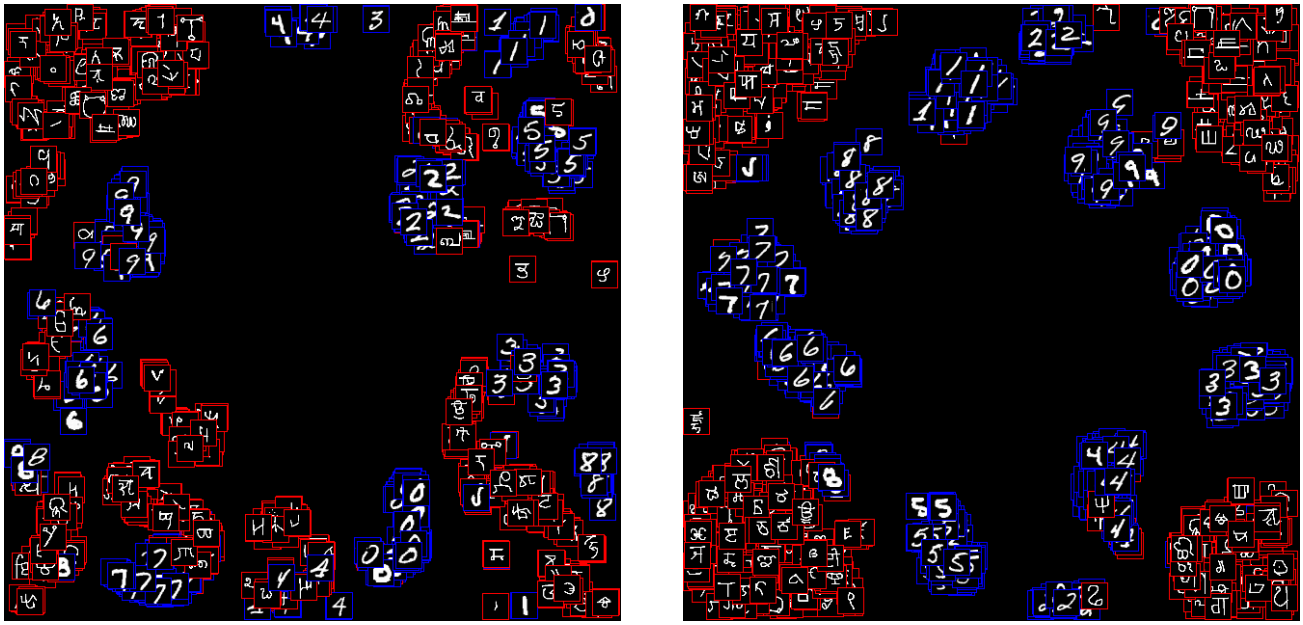
1. Visualizing learned representations

We additionally visualize the learned representations by using t-distributed stochastic neighbor embedding (t-SNE) [3]. Figure 1 shows distributions of the representations extracted from known- and unknown-class images in the test sets, embedded into two-dimensional planes. Here we compare the distributions of the prediction $\boldsymbol{y}$ from the supervised net and that of the concatenation of the prediction and the latent variable $[\boldsymbol{y}, \boldsymbol{z}]$ from our DHRNet. Their usages are shown in Eqns. (4) and (6) of the main text. While the existing deep open-set classifiers [1, 2, 4] exploit only $\boldsymbol{y}$, our CROSR exploits $[\boldsymbol{y}, \boldsymbol{z}]$. With the latent representation, the clusters of knowns and unknowns are more clearly separated, and this suggests that the representations learned by our DHRNet are preferable for open-set classification.

References

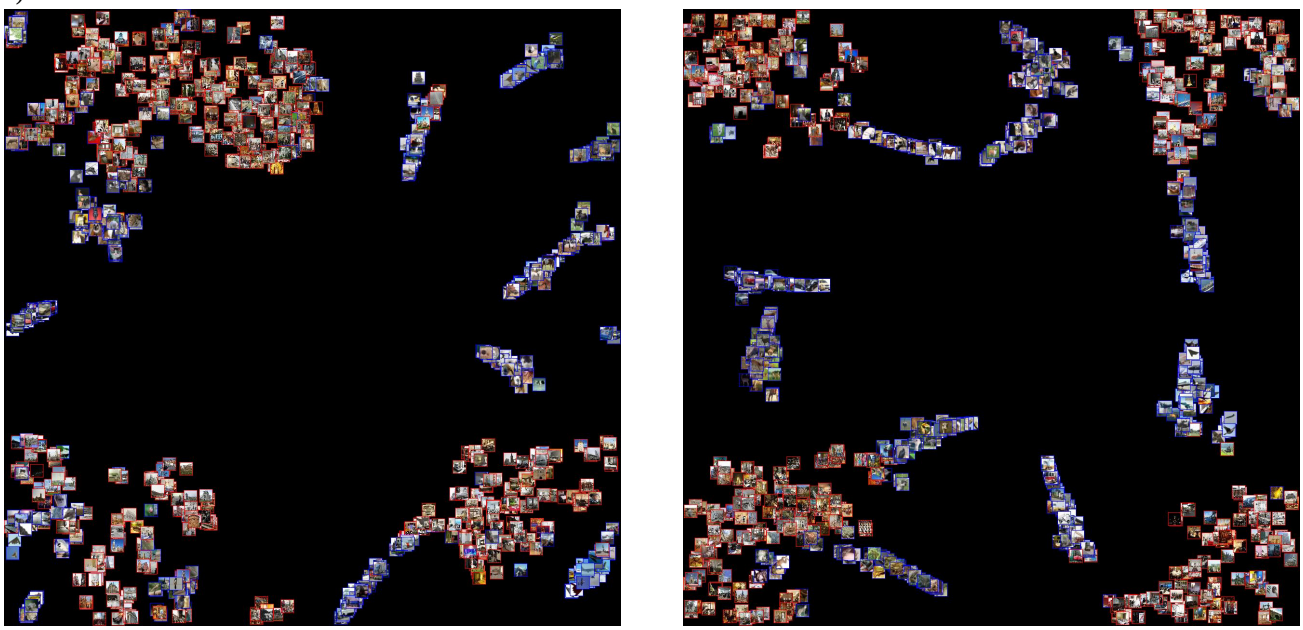
[1] A. Bendale and T. Boult. Towards open world recognition. In *CVPR*, pages 1893–1902, 2015. 1
[2] Z. Ge, S. Demyanov, Z. Chen, and R. Garnavi. Generative OpenMax for multi-class open set classification. *BMVC*, 2017. 1
[3] L. v. d. Maaten and G. Hinton. Visualizing data using t-SNE. *JMLR*, 9(Nov):2579–2605, 2008. 1
[4] L. Shu, H. Xu, and B. Liu. DOC: Deep open classification of text documents. In *EMNLP*, 2017. 1

A) MNIST-Omniglot



a) Supervised net b) DHRNet (ours)

B) CIFAR10-LSUN



a) Supervised net b) DHRNet (ours)

Figure 1. Distributions of the known- and unknown-class images from the test sets over the representation spaces. Images with blue frames are known samples, and ones with red are unknowns. With the representations from our DHRNet, which contain both the prediction $\boldsymbol{y}$ and reconstruction latent variables $\boldsymbol{z}$, the clusters of knowns and unknowns are more clearly separated.