PARN: Position-Aware Relation Networks for Few-Shot Learning
(Supplementary Material)

Ziyang Wu[1], Yuwei Li[2], Lihua Guo[3] and Kui Jia[4]

School of Electronic and Information Engineering,
South China University of Technology, Guangzhou, China
{eezywu[1], 201821010824[2]}@mail.scut.edu.cn, {guolihua[3], kuijia[4]}@scut.edu.cn

These supplementary materials include some additional experimental results on CUB and Tiered-Imagenet for a new experimental setting. Besides, the feature extractor used in the paper is a shallow network that contains four convolutional layers. Here we also provide additional results of deeper networks on Mini-Imagenet.

1. Results for the new setting

Under the setting of meta-learning that a model can adapt to unseen classes with good performance, most of existing papers mainly focus on the results of novel classes. However, it is also interesting to observe the performance of this kind of models on base classes. Besides, a more realistic setting of mixing base and novel classes in the testing set is much more indicative of the real-world performance of the model. We conduct experiments based on the new setting on CUB and Tiered-Imagenet (the latter contains 608 classes and is more challenging). Results are shown in A. Note that all the feature extraction backbones are four simple convolutional layers. As we can see, since the models are trained on base classes, the accuracies of base classes are better than that of novel classes. Besides, our method outperforms others on both base and novel classes, which further confirms the efficacy of our proposed method.

2. Results of deeper networks

In Table 4 in the paper, fair comparisons are made among methods (including ours) that simply use four convolutional layers as the backbone. we further evaluate our method with the ResNet12 backbone, and compare with [1, 3, 4, 5] where either ResNet12 or deeper ResNet18 were used as their backbones. As shown in B, our 1-shot result outperforms all others, no matter what backbones are used; our 5-shot result is only slightly lower than CloserLook [1]. These comparisons show the efficacy of our method across different backbone networks.

Method	CUB		Tiered-Imagenet	
	base	novel	base	novel
MatchingNet [26]	76.72%	75.64%	70.77%	67.47%
MAML [6]	73.31%	72.57%	69.90%	66.28%
ProtoNet [23]	75.77%	74.46%	74.26%	70.15%
Relation Net [24]	81.31%	77.41%	75.90%	70.82%
CloserLook [1]	-	79.34%	-	-
TPN [2]	-	-	-	72.85%
Ours	**86.46%**	**81.64%**	**79.66%**	**74.21%**

Table A: 5-way 5-shot accuracies of base classes and novel classes on CUB and Tiered-Imagenet.

Model	5-way 1-shot	5-way 5-shot
SNAIL [3] (ResNet18)	$55.71 \pm 0.99\%$	$68.88 \pm 0.92\%$
TADAM [4] (ResNet12)	$54.4 \pm 0.3\%$	$74.6 \pm 0.3\%$
Δ-encoder [5](ResNet18)	59.9%	69.7%
CloserLook [1] (ResNet18)	$51.87 \pm 0.77\%$	$\mathbf{75.68 \pm 0.63\%}$
Ours (ResNet12)	$\mathbf{60.53 \pm 0.9\%}$	$74.76 \pm 0.67\%$

Table B: Comparisons with other recent state-of-the-arts that use ResNet backbone on Mini-Imagenet. Note that for a fair comparison, we take the results of TADAM under the same setting (not pretrained on the whole training set) as ours.

References

[1] Wei Yu Chen, Yen Cheng Liu, Zsolt Kira, Yu Chiang Frank Wang, and Jia Bin Huang. A closer look at few-shot classification. In *International Conference on Learning Representations (ICLR)*, 2019.

[2] Yanbin Liu, Juho Lee, Minseop Park, Saehoon Kim, Eunho Yang, Sung Ju Hwang, and Yi Yang. Learning to propagate labels: Transductive propagation network for few-shot learning. In *International Conference on Learning Representations (ICLR)*, 2019.

[3] Nikhil Mishra, Mostafa Rohaninejad, Xi Chen, and Pieter Abbeel. A simple neural attentive meta-learner. In *International Conference on Learning Representations (ICLR)*, 2018.

[4] Boris N. Oreshkin, Pau Rodríguez López, and Alexandre Lacoste. TADAM: task dependent adaptive metric for improved

few-shot learning. In *Advances in Neural Information Processing Systems (NeurIPS)*, 2018.

[5] Eli Schwartz, Leonid Karlinsky, Joseph Shtok, Sivan Harary, Mattias Marder, Abhishek Kumar, Rogério Schmidt Feris, Raja Giryes, and Alexander M. Bronstein. Delta-encoder: an effective sample synthesis method for few-shot object recognition. In *Advances in Neural Information Processing Systems (NeurIPS)*, 2018.