Supplementary Material for Few-Shot Incremental Learning with Continually Evolved Classifiers

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A. Introduction

In our supplementary material, we present more details about the experiments in our paper.

B. Detailed Result

In Section 5.4 Fig. 7, we have provided the comparison with the state-of-the-art methods in the form of line charts. Here, we present the detailed numbers in Table A. The results show that our method significantly outperforms the baselines and achieves new state-of-the-art performance on all the three datasets.

References

[1] Francisco M Castro, Manuel J Marín-Jiménez, Nicolás Guil, Cordelia Schmid, and Karteek Alahari. End-to-end incremental learning. In *Proceedings of the European conference on computer vision (ECCV)*, pages 233–248, 2018. 2

[2] Saihui Hou, Xinyu Pan, Chen Change Loy, Zilei Wang, and Dahua Lin. Learning a unified classifier incrementally via rebalancing. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, pages 831–839, 2019. 2

[3] Sylvestre-Alvise Rebuffi, Alexander Kolesnikov, Georg Sperl, and Christoph H. Lampert. iCaRL: incremental classifier and representation learning. In *IEEE Conf. Comput. Vis. Pattern Recog.*, 2017. 2

[4] Xiaoyu Tao, Xiaopeng Hong, Xinyuan Chang, Songlin Dong, Xing Wei, and Yihong Gong. Few-shot class-incremental learning. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, 2020. 2

[5] Oriol Vinyals, Charles Blundell, Tim Lillicrap, Koray Kavukcuoglu, and Daan Wierstra. Matching networks for one shot learning. In *NIPS*, 2016. 2

[6] Chi Zhang, Yujun Cai, Guosheng Lin, and Chunhua Shen. Deepemd: Few-shot image classification with differentiable earth mover's distance and structured classifiers. In *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, June 2020. 2

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Method	Acc. in each session (%) ↑									PD ↓	our relative improvement
	0	1	2	3	4	5	6	7	8		
Ft-CNN	64.1	36.91	15.37	9.8	6.67	3.8	3.7	3.14	2.65	61.45	**+37.52**
iCaRL* [3]	64.1	53.28	41.69	34.13	27.93	25.06	20.41	15.48	13.73	50.37	**+26.44**
EEIL* [1]	64.1	53.11	43.71	35.15	28.96	24.98	21.01	17.26	15.85	48.25	**+24.32**
NCM* [2]	64.1	53.05	43.96	36.97	31.61	26.73	21.23	16.78	13.54	50.56	**+26.63**
TOPIC [4]	64.1	55.88	47.07	45.16	40.11	36.38	33.96	31.55	29.37	34.73	**+10.80**
Decoupled-Cosine [5]‡	74.55	67.43	63.63	59.55	56.11	53.80	51.68	49.67	47.68	26.87	**+2.94**
Decoupled-DeepEMD [6]‡	69.75	65.06	61.2	57.21	53.88	51.40	48.80	46.84	44.41	25.34	**+1.41**
CEC (Ours)	**73.07**	**68.88**	**65.26**	**61.19**	**58.09**	**55.57**	**53.22**	**51.34**	**49.14**	**23.93**	

(a) CIFAR100 results using 5-way 5-shot FSCIL setting

Method	Acc. in each session (%) ↑									PD ↓	our relative improvement
	0	1	2	3	4	5	6	7	8		
Ft-CNN	61.31	27.22	16.37	6.08	2.54	1.56	1.93	2.6	1.4	59.91	**+35.54**
iCaRL* [3]	61.31	46.32	42.94	37.63	30.49	24	20.89	18.8	17.21	44.10	**+19.73**
EEIL* [1]	61.31	46.58	44	37.29	33.14	27.12	24.1	21.57	19.58	41.73	**+17.36**
NCM* [2]	61.31	47.8	39.31	31.91	25.68	21.35	18.67	17.24	14.17	47.14	**+22.77**
TOPIC [4]	61.31	50.09	45.17	41.16	37.48	35.52	32.19	29.46	24.42	36.89	**+12.52**
Decoupled-Cosine [5]‡	70.37	65.45	61.41	58.00	54.81	51.89	49.10	47.27	45.63	24.74	**+0.37**
Decoupled-DeepEMD [6]‡	69.77	64.59	60.21	56.63	53.16	50.13	47.49	45.42	43.41	26.36	**+1.99**
CEC (Ours)	**72.00**	**66.83**	**62.97**	**59.43**	**56.70**	**53.73**	**51.19**	**49.24**	**47.63**	**24.37**	

(b) miniImageNet results using 5-way 5-shot FSCIL setting

Method	Acc. in each session (%) ↑											PD ↓	our relative improvement
	0	1	2	3	4	5	6	7	8	9	10		
Ft-CNN	68.68	43.7	25.05	17.72	18.08	16.95	15.1	10.6	8.93	8.93	8.47	60.21	**+36.64**
iCaRL* [3]	68.68	52.65	48.61	44.16	36.62	29.52	27.83	26.26	24.01	23.89	21.16	47.52	**+23.95**
EEIL* [1]	68.68	53.63	47.91	44.2	36.3	27.46	25.93	24.7	23.95	24.13	22.11	46.57	**+23.00**
NCM* [2]	68.68	57.12	44.21	28.78	26.71	25.66	24.62	21.52	20.12	20.06	19.87	48.81	**+25.24**
TOPIC [4]	68.68	62.49	54.81	49.99	45.25	41.4	38.35	35.36	32.22	28.31	26.28	42.40	**+18.83**
Decoupled-Cosine [5]‡	75.52	70.95	66.46	61.20	60.86	56.88	55.40	53.49	51.94	50.93	49.31	26.21	**+2.64**
Decoupled-DeepEMD [6]‡	75.35	70.69	66.68	62.34	59.76	56.54	54.61	52.52	50.73	49.20	47.60	27.75	**+4.18**
CEC (Ours)	**75.85**	**71.94**	**68.50**	**63.5**	**62.43**	**58.27**	**57.73**	**55.81**	**54.83**	**53.52**	**52.28**	**23.57**	

‡ Our implementation.

(c) CUB200 results using 10-way 5-shot FSCIL setting

Table A: Comparison with the state-of-the-art on (a) CIFAR100, (b) miniImagenet and (c) CUB200 datasets. * indicates results copied from TOPIC [4]. ‡ indicates our implementation for the method under FSCIL setting. Our method outperforms the state-of-the-art results with large advantages on three benchmarks.