Dataset	Metrics	Source	TPT	Ours
Flower	Acc(%)	66.99	69.18	**72.97**
	Time cost(s)	9.80	385.19	52.41
DTD	Acc(%)	44.39	**46.87**	44.75
	Time cost(s)	7.07	193.18	30.72
Pets	Acc(%)	88.17	87.17	**89.64**
	Time cost(s)	4.64	370.27	31.54
UCF101	Acc(%)	65.03	**67.75**	67.22
	Time cost(s)	10.85	462.21	53.92
Caltech101	Acc(%)	92.94	93.93	**94.07**
	Time cost(s)	9.84	308.33	39.32
Food101	Acc(%)	83.81	**84.77**	84.72
	Time cost(s)	55.18	5128.25	330.30
EuroSAT	Acc(%)	41.22	42.92	**47.20**
	Time cost(s)	18.73	1354.51	51.46

Table 1: The time consumption and accuracy in other datasets with ViT-B/16.

Experimental Details

All experiments are repeatedly conducted with one NVIDIA A800 GPU with a random seed setting from 0 to 4. In this section, we introduce experimental settings and baseline implementations as follows.

For experimental settings, we directly choose CIFAR-C and TinyImageNet-C datasets, which contain 15 different corruptions, as our test sets to evaluate the performance of pre-trained CLIP model without any training process. We split up 15 different domains to conduct 15 independent experiments, alleviating model bias and adapting to data bias each domain separately.

For all comparison methods, we referred to their official implementation and reported hyperparameters in their original paper. When the hyperparameters on the corresponding dataset are not provided for one method, we will further tune the hyperparameters for it. Following previous study, each method is optimized by Adam Optimizer if not specifically stated and adopts the pre-trained CLIP where the visual backbone model is ViT-B/16. The details are shown as follows:

- CLIP sets ”a photo of a” as their hand-crafted prompt for all datasets.
- TPT sets ”a photo of a” to their hand-crafted prompt and the learning rate to 0.005 for all datasets. The number of augmented views is set to 64 and we set the number of confidence selections to 6, which are used to update the prompt, for all datasets. Moerover, after updating the model with a single sample and providing predictions, we reset the model back to its initial state.
- Different from TPT, TPT-Continual continuously updates the prompt with all the samples in a single domain.
- ADAPROMPT sets the learning rate to 0.005 and buffer size to 64 for all datasets. The confidence threshold is set to 0.7 for all datasets. Moreover, we set three distinct hand-crafted prompts for ensembling, which are ”an image of a”,”a colorful image of a” and ”a noisy picture of a”.

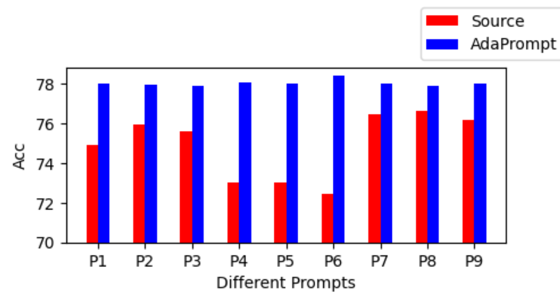

Figure 1: Average performance of different hand-crafted prompts on the CIFAR-10-C dataset.

Detailed Results

Detailed results with CIFAR-C and TinyImageNet-C datasets. For space reasons, we only present the results on the CIFAR-C and TinyImageNet-C datasets omit the standard deviation term in the paper. Here we first give the detailed results of CIFAR-C with corruption level 3 and 5 in Table 2. Then we present the TinyImageNet-C dataset with corruption level 3 in Table 3.

Comparison of performance and time for more datasets. Futhermore, additional experiments are conducted, as shown in Table 1. The results indicate that our proposed method achieves competitive or superior performance compared to the TPT method.

The performance of different hand-crafted prompts. Because the choice of prompts affects the performance, we select several different prompts and measured their impact on performance in Figure 1. In this figure, the specific content corresponding to hand-crafted prompt is as follows:

- P1: ”a photo of a”.
- P2: ”an image of a”.
- P3: ”a picture of a”.
- P4: ”a colorful photo of a”.
- P5: ”a colorful image of a”.
- P6: ”a colorful picture of a”.
- P7: ”a noisy photo of a”.
- P8: ”a noisy image of a”.
- P9: ”a noisy picture of a”.

As we can see, no matter how prompts are chosen, our method can consistently improve performance as shown in Figure 1.

Dataset	Methods	Noise			Blur				Weather				Digital				Avg.
		Gauss.	Shot	Impul.	Defoc.	Glass	Motion	Zoom	Snow	Frost	Fog	Brit.	Contr.	Elastic	Pixel	JPEG	
CIFAR10-C(S=3)	Source	50.03 ± 0.00	61.74 ± 0.00	78.59 ± 0.00	85.46 ± 0.00	54.26 ± 0.00	77.15 ± 0.00	81.57 ± 0.00	81.01 ± 0.00	81.13 ± 0.00	86.60 ± 0.00	88.92 ± 0.00	87.11 ± 0.00	80.27 ± 0.00	75.18 ± 0.00	69.51 ± 0.00	75.90
	TPT	52.86 ± 0.17	63.32 ± 0.10	78.97 ± 0.10	85.25 ± 0.11	53.95 ± 0.16	77.06 ± 0.14	81.35 ± 0.06	81.18 ± 0.12	81.02 ± 0.14	86.49 ± 0.07	88.67 ± 0.07	87.70 ± 0.08	80.75 ± 0.19	75.98 ± 0.18	69.82 ± 0.10	76.29
	TPT-Continual	10.04 ± 0.03	10.10 ± 0.08	10.11 ± 0.04	10.21 ± 0.12	10.03 ± 0.02	10.10 ± 0.04	10.11 ± 0.03	10.16 ± 0.12	10.19 ± 0.07	10.27 ± 0.10	10.28 ± 0.10	10.19 ± 0.07	10.16 ± 0.06	10.11 ± 0.01	10.09 ± 0.03	10.15
	AdaPrompt	**54.50** ± 0.53	**64.92** ± 1.05	**81.36** ± 0.37	**87.69** ± 0.24	**59.29** ± 0.55	**78.52** ± 0.49	**84.29** ± 0.18	**84.52** ± 0.48	**84.60** ± 0.33	**89.10** ± 0.28	**91.53** ± 0.19	**89.28** ± 0.36	**83.46** ± 0.38	**81.54** ± 0.82	**72.67** ± 0.74	**79.15**
CIFAR10-C(S=5)	Source	38.00 ± 0.00	43.14 ± 0.00	56.70 ± 0.00	72.88 ± 0.00	42.59 ± 0.00	70.96 ± 0.00	74.66 ± 0.00	74.74 ± 0.00	78.40 ± 0.00	71.66 ± 0.00	85.00 ± 0.00	63.00 ± 0.00	55.40 ± 0.00	48.09 ± 0.00	60.30 ± 0.00	62.37
	TPT	40.08 ± 0.15	44.74 ± 0.08	59.08 ± 0.20	72.10 ± 0.13	43.18 ± 0.22	70.14 ± 0.07	74.89 ± 0.11	75.32 ± 0.12	78.33 ± 0.21	72.54 ± 0.11	85.12 ± 0.11	**70.80** ± 0.08	57.10 ± 0.16	52.24 ± 0.21	61.55 ± 0.07	63.81
	TPT-Continual	10.01 ± 0.02	10.04 ± 0.02	10.06 ± 0.03	10.09 ± 0.05	10.03 ± 0.04	10.15 ± 0.04	10.08 ± 0.04	10.14 ± 0.11	10.13 ± 0.08	10.17 ± 0.10	10.18 ± 0.07	10.09 ± 0.03	10.04 ± 0.02	10.06 ± 0.02	10.07 ± 0.04	10.09
	AdaPrompt	**42.48** ± 0.46	**47.89** ± 0.55	**60.59** ± 0.85	**74.98** ± 0.38	**47.51** ± 1.28	**72.54** ± 0.13	**78.30** ± 1.06	**78.26** ± 1.11	**80.19** ± 0.56	**73.14** ± 0.86	**88.06** ± 0.30	67.95 ± 0.46	**58.88** ± 1.05	**57.21** ± 1.93	**63.83** ± 0.83	**66.12**
CIFAR100-C(S=3)	Source	27.81 ± 0.00	33.81 ± 0.00	47.30 ± 0.00	60.10 ± 0.00	29.35 ± 0.00	48.69 ± 0.00	56.08 ± 0.00	53.90 ± 0.00	53.12 ± 0.00	60.77 ± 0.00	64.88 ± 0.00	59.77 ± 0.00	52.53 ± 0.00	51.09 ± 0.00	39.68 ± 0.00	49.26
	TPT	25.54 ± 0.11	32.22 ± 0.16	47.63 ± 0.15	**60.55** ± 0.16	29.21 ± 0.15	48.86 ± 0.23	55.96 ± 0.20	55.41 ± 0.22	53.89 ± 0.09	**61.64** ± 0.20	65.39 ± 0.08	61.18 ± 0.11	53.43 ± 0.17	51.94 ± 0.18	40.17 ± 0.10	49.54
	TPT-Continual	1.02 ± 0.01	1.06 ± 0.03	1.06 ± 0.02	1.11 ± 0.07	1.03 ± 0.01	1.05 ± 0.01	1.07 ± 0.04	1.13 ± 0.06	1.12 ± 0.03	1.12 ± 0.03	1.15 ± 0.03	1.13 ± 0.06	1.09 ± 0.07	1.08 ± 0.02	1.06 ± 0.03	1.09
	AdaPrompt	**28.61** ± 0.30	**35.30** ± 0.50	**50.51** ± 0.84	60.54 ± 0.29	**30.38** ± 0.25	**49.69** ± 0.48	**57.22** ± 0.44	**56.34** ± 0.57	**55.05** ± 0.31	61.33 ± 0.50	**66.64** ± 0.22	**61.58** ± 0.29	**55.01** ± 0.42	**53.29** ± 0.30	**42.40** ± 0.27	**50.93**
CIFAR100-C(S=5)	Source	19.60 ± 0.00	21.36 ± 0.00	25.31 ± 0.00	42.52 ± 0.00	20.06 ± 0.00	**43.15** ± 0.00	47.89 ± 0.00	48.35 ± 0.00	49.72 ± 0.00	41.64 ± 0.00	57.02 ± 0.00	34.54 ± 0.00	29.21 ± 0.00	23.94 ± 0.00	32.46 ± 0.00	35.78
	TPT	17.31 ± 0.06	19.04 ± 0.16	25.65 ± 0.07	42.73 ± 0.05	19.97 ± 0.09	42.63 ± 0.10	48.12 ± 0.15	**49.19** ± 0.15	50.43 ± 0.20	**42.71** ± 0.19	57.58 ± 0.14	**38.06** ± 0.10	30.05 ± 0.18	25.15 ± 0.21	32.43 ± 0.19	36.07
	TPT-Continual	1.01 ± 0.01	1.02 ± 0.01	1.03 ± 0.01	1.07 ± 0.04	1.02 ± 0.01	1.05 ± 0.02	1.10 ± 0.05	1.05 ± 0.02	1.10 ± 0.06	1.07 ± 0.04	1.11 ± 0.02	1.05 ± 0.02	1.04 ± 0.02	1.03 ± 0.01	1.05 ± 0.02	1.05
	AdaPrompt	**21.92** ± 0.15	**23.95** ± 0.21	**30.06** ± 0.52	**43.07** ± 1.21	**20.91** ± 0.30	42.46 ± 0.64	**48.72** ± 0.80	48.95 ± 0.54	**50.89** ± 0.62	42.45 ± 0.39	**59.07** ± 0.78	36.84 ± 0.39	**30.56** ± 0.61	**27.50** ± 0.57	**34.29** ± 0.53	**37.44**

Table 2: Detailed results of CIFAR-C datasets with corruption level 3 and 5

Methods	Noise			Blur				Weather				Digital				Avg.
	Gauss.	Shot	Impul.	Defoc.	Glass	Motion	Zoom	Snow	Frost	Fog	Brit.	Contr.	Elastic	Pixel	JPEG	
Source	15.72 ± 0.00	23.44 ± 0.00	17.47 ± 0.00	32.43 ± 0.00	11.88 ± 0.00	31.97 ± 0.00	30.99 ± 0.00	29.69 ± 0.00	32.98 ± 0.00	35.81 ± 0.00	43.95 ± 0.00	22.56 ± 0.00	38.14 ± 0.00	26.38 ± 0.00	37.54 ± 0.00	28.73
TPT	16.29 ± 0.17	23.86 ± 0.09	17.58 ± 0.03	32.65 ± 0.13	12.51 ± 0.08	32.31 ± 0.15	31.57 ± 0.22	30.90 ± 0.06	33.25 ± 0.08	36.36 ± 0.14	43.62 ± 0.11	23.00 ± 0.15	38.74 ± 0.14	27.72 ± 0.19	37.56 ± 0.14	29.20
TPT-Continual	0.52 ± 0.01	0.52 ± 0.01	0.52 ± 0.01	0.58 ± 0.04	0.52 ± 0.01	0.54 ± 0.03	0.54 ± 0.02	0.55 ± 0.03	0.55 ± 0.02	0.58 ± 0.03	0.60 ± 0.03	0.52 ± 0.01	0.58 ± 0.02	0.55 ± 0.02	0.64 ± 0.06	0.55
AdaPrompt	**17.52** ± 0.20	**26.47** ± 0.37	**20.76** ± 0.27	**34.39** ± 0.39	**14.45** ± 0.35	**33.98** ± 0.41	**33.32** ± 0.27	**32.82** ± 0.35	**36.30** ± 0.29	**37.97** ± 0.34	**46.80** ± 0.46	**25.52** ± 0.18	**40.78** ± 0.37	**29.42** ± 0.23	**40.72** ± 0.41	**31.42**

Table 3: Detailed results of TinyImageNet-C datasets with corruption level 3