

Factorized Bilinear Models for Image Recognition

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1. More Exploration Experiments of Factorized Bilinear Models

We study the effect of different kernel sizes in Factorized Bilinear (FB) Models. We also present comparisons with Dropout and our DropFactor in FB models.

1.1. Effect of Kernel Size

Tab. 1 shows the results of different kernel sizes (1x1 and 3x3) for FB layers. We conduct experiments on CIFAR-100 dataset [1] with two FB networks In5b-FBN and Conv-FBN as described in the paper. We insert a 1x1 FB layer and 3x3 FB layer, respectively, for both two FBNs. The results of 3x3 kernel size are still better than the baseline. This demonstrates that our FB models can generalize to model interactions with larger kernel size. However, it also leads to more severe over-fitting than 1x1 at least on CIFAR-100 and has 9 times parameters than an 1x1 FB layer. Thus, incorporating 1x1 FB layer can achieve more efficient and effective performance.

Method	Kernel Size	Error
Inception-BN	-	24.70
In5b-FBN	1x1	22.63
	3x3	23.87
Conv-FBN	1x1	21.98
	3x3	23.08

Table 1. Results of different kernel sizes in the FB layers on the CIFAR-100 dataset.

1.2. Comparisons with Dropout and DropFactor

Our DropFactor scheme shares similar idea with Dropout [2], which is also a simple yet effective regularization to prevent over-fitting. We evaluate the performance of Dropout with our specific designed DropFactor for Factorized Bilinear models. Tab. 2 illustrates the results of two methods on the CIFAR-100 dataset. We adopt the Inception-BN and ResNet-164 networks as the base networks in this experiments. The FBN models are constructed

by inserting the FB layers in the base networks. As shown in the table, Dropout and DropFactor both improve the performance individually over the original FBN model. DropFactor achieves even better results and combining them does not get further improvement. This demonstrates the effectiveness of DropFactor scheme to reduce the over-fitting of FB models.

Network	Method	Error
Inception-BN	Baseline	24.70
	FBN	23.55
	FBN + Dropout	23.19
	FBN + DropFactor	21.98
	FBN + Dropout + DropFactor	22.71
ResNet-164	Baseline	23.64
	FBN	23.39
	FBN + Dropout	22.97
	FBN + DropFactor	22.50
	FBN + Dropout + DropFactor	22.60

Table 2. Results of Dropout and DropFactor on the CIFAR-100 dataset.

References

- [1] A. Krizhevsky. Learning multiple layers of features from tiny images. *Tech Report*, 2009. 1
- [2] N. Srivastava, G. E. Hinton, A. Krizhevsky, I. Sutskever, and R. Salakhutdinov. Dropout: a simple way to prevent neural networks from overfitting. *Journal of Machine Learning Research*, 15(1):1929–1958, 2014. 1

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