PolyNet: A Novel Design of Ultra-Deep Networks

CU-DeepLink Team*

Multimedia Lab, CUHK & SenseTime Inc.

香港中文大學 The Chinese University of Hong Kong

商湯科技 SENSETIME

Overview

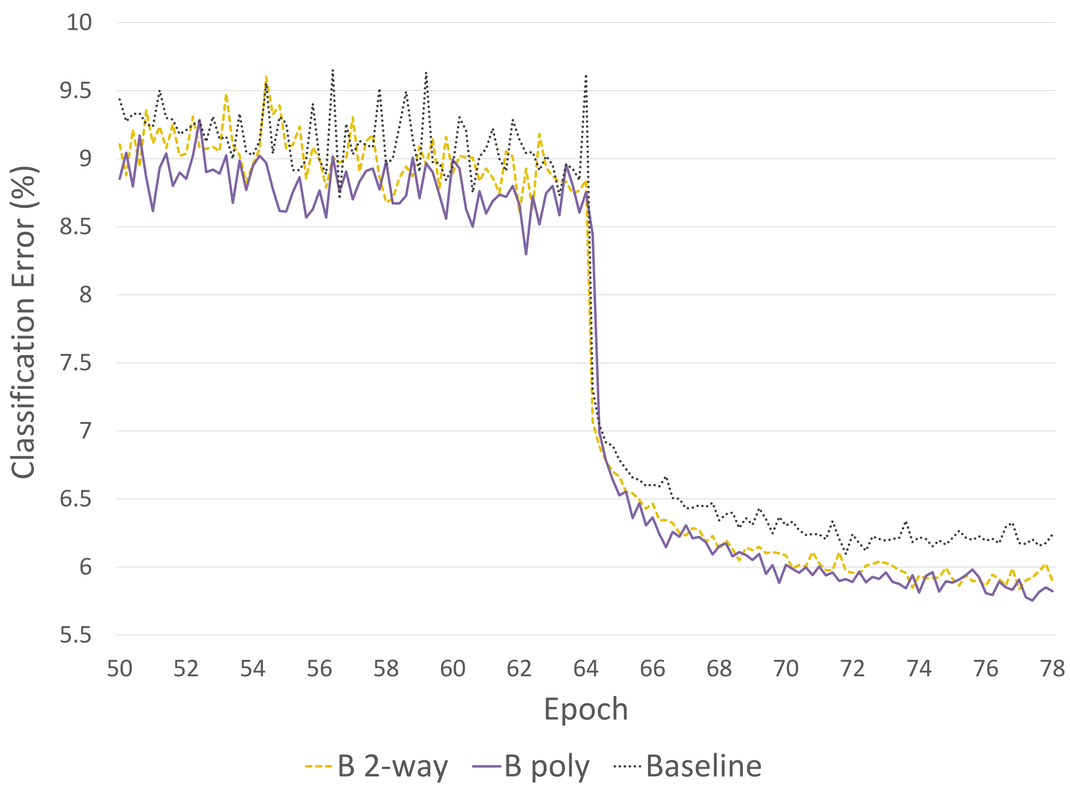
- Our study suggests the significance of **structural diversity** in deep network design.
- Our **PolyNet** design yields higher accuracy than Inception-ResNet given the same computation budget.
- Our best PolyNet model achieves 4.25% classification error on the ImageNet validation set, substantially better than the state-of-the-art.

Performance

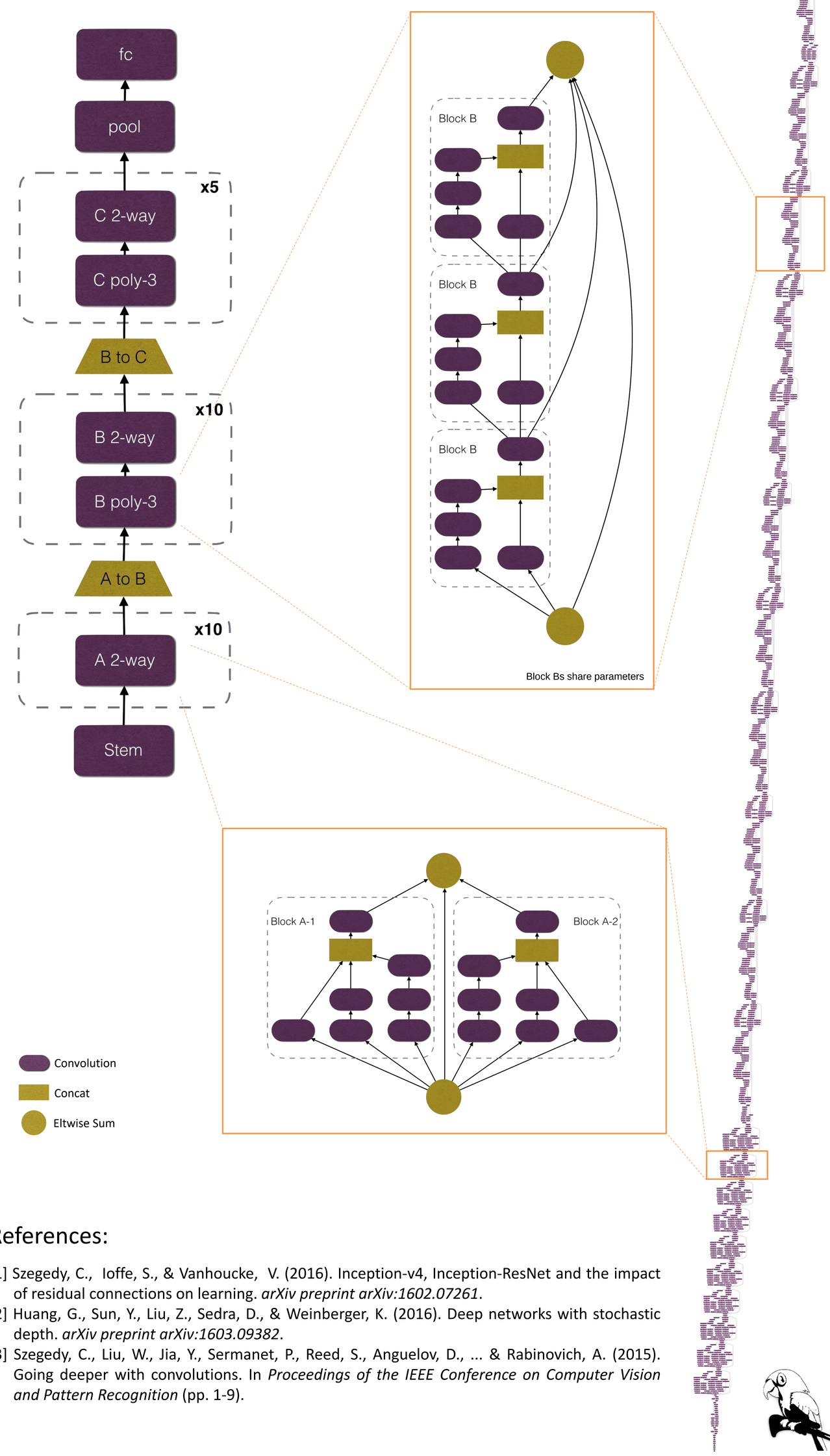
Type	Structure	Top-1 Error	Top-5 Error
IR-v2	5-10-5	20.50	5.05
IR-v2	10-20-10	20.03	4.83
IR-v2	20-56-20	19.10	4.48
PolyNet G5	Poly & 2-way	**18.71**	**4.25**

Ablation Study

- Inception-ResNet-v2 [1] is the base model
- Two effective ways to extend the structure : Poly and K-way, were evaluated



PolyNet G5 Structure



Technical Details

- Data augmentation: random crop.
- Optimization: RMS-Prop.
- Ultra-deep models are initialized via block insertion, where new blocks are initialized using Xavier.
- Distributed training on 4 machine, each with 8 TitanX GPUs, using synchronous scheme.
- Overfitting observed for ultra-deep networks, and tackled by adaptive stochastic depth [2].
- Multi-crop: 144 crops [3] with selective pooling
- Ensemble: weighted combination of PolyNets and ResNets.

Parrots: Our Deep Learning Framework

- Developed by us from scratch
- Very low memory consumption
- Highly optimized pre-processing and I/O pipeline
- Efficient distributed training on multiple machines

References:

[1] Szegedy, C., Ioffe, S., & Vanhoucke, V. (2016). Inception-v4, Inception-ResNet and the impact of residual connections on learning. *arXiv preprint arXiv:1602.07261*.

[2] Huang, G., Sun, Y., Liu, Z., Sedra, D., & Weinberger, K. (2016). Deep networks with stochastic depth. *arXiv preprint arXiv:1603.09382*.

[3] Szegedy, C., Liu, W., Jia, Y., Sermanet, P., Reed, S., Anguelov, D., ... & Rabinovich, A. (2015). Going deeper with convolutions. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition* (pp. 1-9).

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* CU-DeepLink Team Members:
Xingcheng Zhang, Zhizhong Li, Shuo Yang, Yuanjun Xiong, Yubin Deng, Xiaoxiao Li, Kai Chen, Yingrui Wang, Chen Huang, Tong Xiao, Wansen Feng, Xinyu Pan, Yunxiang Ge, Hang Song, Yujun Shen, Boyang Deng, Ruohui Wang
Supervisor: Dahua Lin, Chen Change Loy, Wenzhi Liu, Shengen Yan