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Homework 2

(1) Motivation – Why do the authors want to work on this problem

Researchers at the time had found evidence [2, 3] that network depth is of crucial importance. However, working with deeper networks revealed an exploding gradient problem[4] and degradation of training accuracy[5] as the network gets deeper. The authors propose a residual learning framework[1] to address this degradation problem.

(2) Contributions – What are the accomplishments they achieved in this paper (others did not achieve)?

Through use of the authors residual learning framework that solves the degradation problem for deep networks, their deep residual nets made accuracy gains that were substantially better than previous networks on the ImageNet and CIFAR-10 datasets while also being less complex than previous networks.

(3) Formulations – How do they solve the problems as mentioned/discussed in the introduction or related literature?

The authors solve the problem of degradation by inserting shortcut connections between layers. They consider three different shortcut types,

- ResNetA - zero-padding shortcuts are used for increasing dimensions[1]
- ResNetB - projection shortcuts are used for increasing dimensions, and other shortcuts are identity[1]
- ResNetC - all shortcuts are projections[1]

While ResNetC provided the best error rate the authors argue that ResNetB is a better choice give the minor difference in error rate, but increased memory usage and complexity due to additional parameters.

(4) Justification – Do the experiments/simulations support their claimed accomplishments?

From a scientific perspective it would appear their results are justified given they implement their change/experiments on established architectures. Thus they are controlling their experiments.

(5) Your Own Thoughts – What are you most impressed with in this paper?

I really respect the thoroughness of their approach. Without being an expert it sounds like from their description under the implementation section they brought together all the latest information on neural networks and were able to isolate the problem under those assumptions. That allowed the authors to tackle the unintuitive result of having a worse training and test errors for deeper networks.

**References**

[1] Kaiming He, Xiangyu Zhang, Shaoqing Ren, Jian Sun. Deep Residual Learning for Image Recognition.

[2] K. Simonyan and A. Zisserman. Very deep convolutional networks for large-scale image recognition. In ICLR, 2015.

[3] C. Szegedy, W. Liu, Y. Jia, P. Sermanet, S. Reed, D. Anguelov, D. Erhan, V. Vanhoucke, and A. Rabinovich. Going deeper with convolutions. In CVPR, 2015.

[4] X. Glorot and Y. Bengio. Understanding the difficulty of training deep feedforward neural networks. In AISTATS, 2010.

[5] K. He and J. Sun. Convolutional neural networks at constrained time cost. In CVPR, 2015.