Squeeze-and-Excitation Networks - Jie Hu and al.

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Overview

Motivation

- CNNs merge spatial and channel-wise information.
- Traditional architectures treat all channels equally.
- However, not all channels are equally informative.
- Goal: dynamically recalibrate channel importance.

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Squeeze-and-Excitation Block (SE)

Two main operations:

1. **Squeeze:**
   - Global average pooling across spatial dimensions.
   - Converts feature maps into a channel descriptor.
2. **Excitation:**
   - Two FC layers with ReLU and sigmoid.
   - Learns weights for each channel.

Final step: multiply input feature maps by these learned weights.

Integration into Existing Architectures

- SE blocks are lightweight and modular.
- Can be inserted into existing networks like:
  - ResNet (SE-ResNet)
  - Inception (SE-Inception)
  - ResNeXt, MobileNet, ShuffleNet...
- Minimal computational overhead.

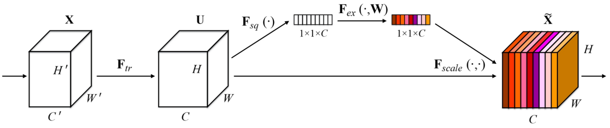

Figure: SE block integration schema

Performance on ImageNet

- SE-ResNet-50: 6.62% top-5 error **vs.** 7.48% for ResNet-50.
- Comparable to deeper ResNet-101 with half the FLOPs.
- SE blocks improve performance across all depths.

Beyond ImageNet

- **CIFAR-10/100:** consistent error reduction ($\tilde{1}$–3%).
- **COCO (object detection):** +2% AP on Faster R-CNN.
- **Places365:** better top-1 and top-5 accuracy.
- **ILSVRC 2017:** 1^{st} place, 2.251% top-5 error.

Ablation Studies

- **Squeeze:** global avg pooling better than max pooling.
- **Excitation:** sigmoid superior to tanh or ReLU.
- **Reduction ratio r:** best trade-off at $r = 16$.
- **Position:** works best before residual sum.

What Does SE Learn?

- Early SE blocks are class-agnostic.
- Later SE blocks are class-discriminative.
- SE blocks can reveal feature importance per class or input.

Conclusion

- SE blocks enhance CNNs by modelling inter-channel dependencies.
- Simple, plug-and-play module with minimal cost.
- Achieves state-of-the-art performance across many tasks.
- Insightful tool for channel-wise attention and possible pruning.

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