Scale&Shift Invariance CNN

UPPSALA UNIVERSITET

Team:

Ruoqi Zhang
ruoqi.zhang.6242@student.uu.se

Wei Peng
wei.peng.2320@student.uu.se

Supervisor:

Natasa Sladoje
natasa.sladoje@it.uu.se

Joakim Lindblad
joakim@cb.uu.se

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Department of Information Technology

Project Goals

1. Implement the 3 methods:
   - **SI-ConvNet** by A. Kanazawa et al. [1]
   - **SS-CNN** by R. Ghosh et al. [2]
   - **Antialiased-CNN** by R. Zhang [3]
2. Compare the 3 methods on MNIST-Scale dataset and FMNIST-Scale dataset.
3. Evaluate the performance of the 3 methods w.r.t. different training size.

Datasets

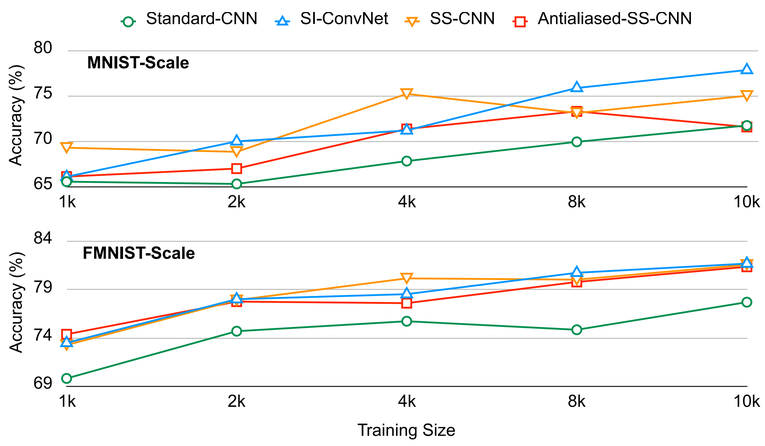
- **MNIST-Scale (28x28)**: scaled MNIST dataset with a random scale factor in (0.3, 1). Train on the original MNIST. Test on 10k MNIST-Scale.

MNIST MNIST-Scale

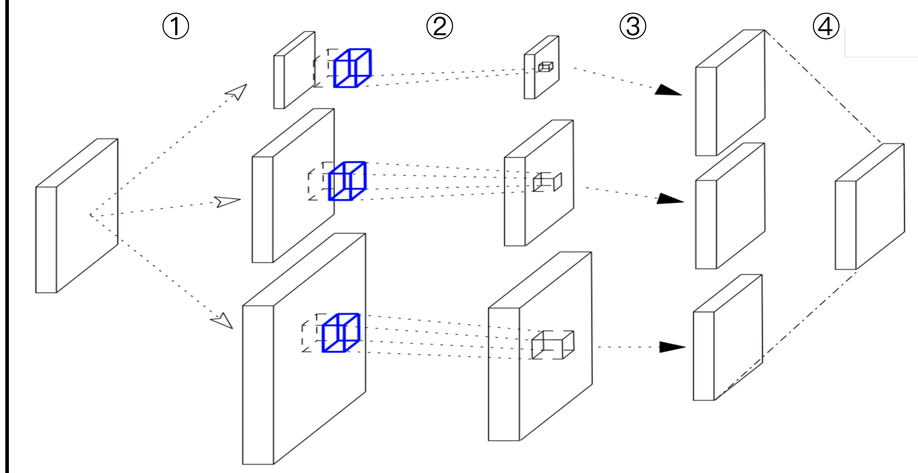
- **FMNIST-Scale (60k, 28x28)**: scaled Fashion-MNIST dataset with a random scale factor in (0.3, 1). Train on the original Fashion-MNIST. Test on 10k FMNIST-Scale.

FMNIST FMNIST-Scale

Results

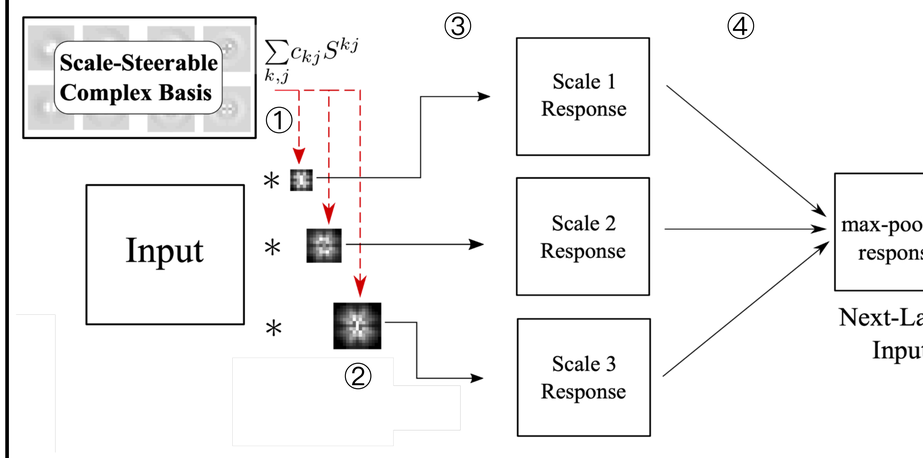


Methods



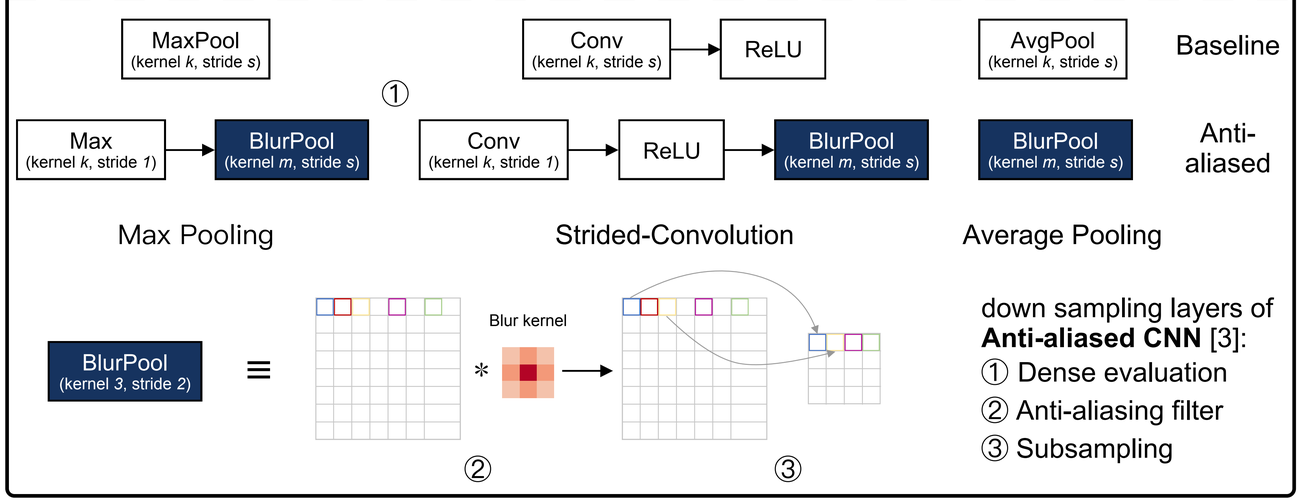
a scale-invariant layer of **SI-ConvNet** [1]:

① Scale input
② Convolution
③ Undo scaling
④ Max-pool over scales



a scale-invariant layer of **SS-CNN** [2]:

① Each filter is a linear combination of the scale steerable basis
② Rescale the filter via phase manipulation
③ Convolution
④ Max-pool over scales



down sampling layers of **Anti-aliased CNN** [3]:

① Dense evaluation
② Anti-aliasing filter
③ Subsampling

[1] Kanazawa A, Sharma A, Jacobs D. Locally Scale-Invariant Convolutional Neural Networks[J]. arXiv preprint arXiv:1412.5104, 2014.
[2] Ghosh R, Gupta A K. Scale Steerable Filters for Locally Scale-Invariant Convolutional Neural Networks[J]. arXiv preprint arXiv:1906.03861, 2019.
[3] Zhang R. Making convolutional networks shift-invariant again[J]. arXiv preprint arXiv:1904.11486, 2019.