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Lecture 2: Deep Network Learning through Receptive Fields Optimization for Data Representation

Abstract: Most characteristic property of Deep Learning (DL) is that layers develop sparse receptive fields also called filters or dictionaries that build features layerwise. A practical bottleneck of DL is that filters' learning and sparse encoding for data representation are computationally expensive. Only a handful of recent ad-hoc approaches train autoencoders or DL layers in ways that enforce controlled sparsity. This lecture reports on work aimed at closing this gap and outlines comprehensive and systematic evaluation of unsupervised learning of the parts extraction process from data that is performed by receptive fields. Of special significance are here latent visual dictionary items for classes of images. The catalogue of distinctive part-based items of interest could be strokes, versions of strokes or other characteristic input field, isolated edges and/or their orientation, spots, shades or other detailed features that needs to be detectable. A number of criteria for a systematic review of data representation based on parts are evaluated.

Dynamic reduction and reconciliation of filters that is undertaken concurrently with their unsupervised learning. This clustering of filters here is an on-line process with the goal of reaching a predetermined number of filter clusters. The training here is on-line and enforces the usual sparsity of regularized filters that are developed. Similarly, dynamic compression and reconciliation of the filter vectors has beeb performed during network training. This on-line training objective is to reduce the filter vectors size and agglomerate subfields of input data, while sparsity of filters is enforced via usual regularization. Experiments with MNIST, ORL face and NORB object datasets compare the auto-encoding for accuracy for various conditions.