

E9 205 Machine Learning for Signal Processing

Understanding Deep Networks

08-11-2019

Instructor - Sriram Ganapathy (sriramg@iisc.ac.in.in)



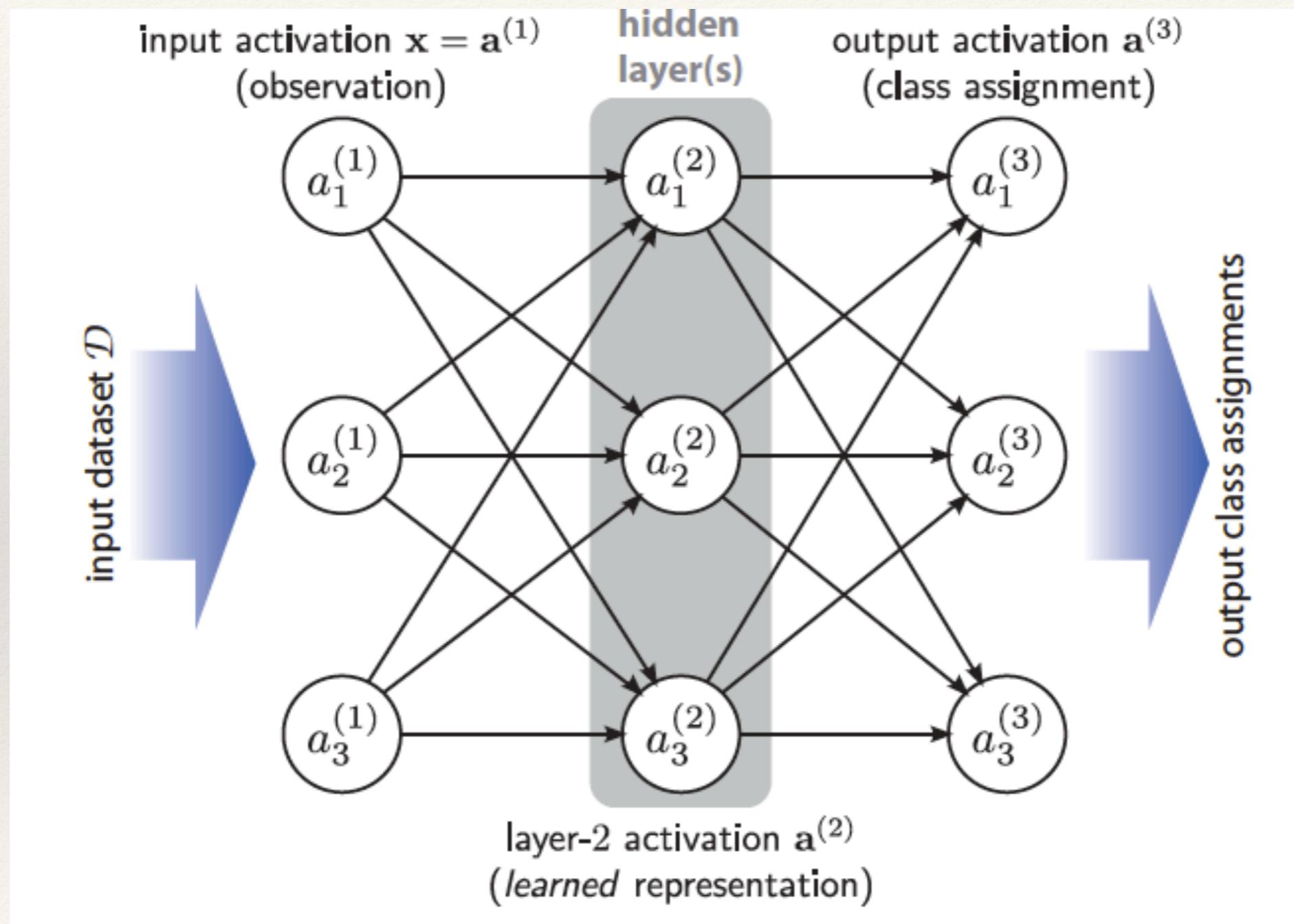
Understanding Deep Networks

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Visualizing the Hidden Activity of Artificial Neural Networks

Paulo E. Rauber, Samuel G. Fadel, Alexandre X. Falcão, and Alexandru C. Telea

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SVHN dataset



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CIFAR-10

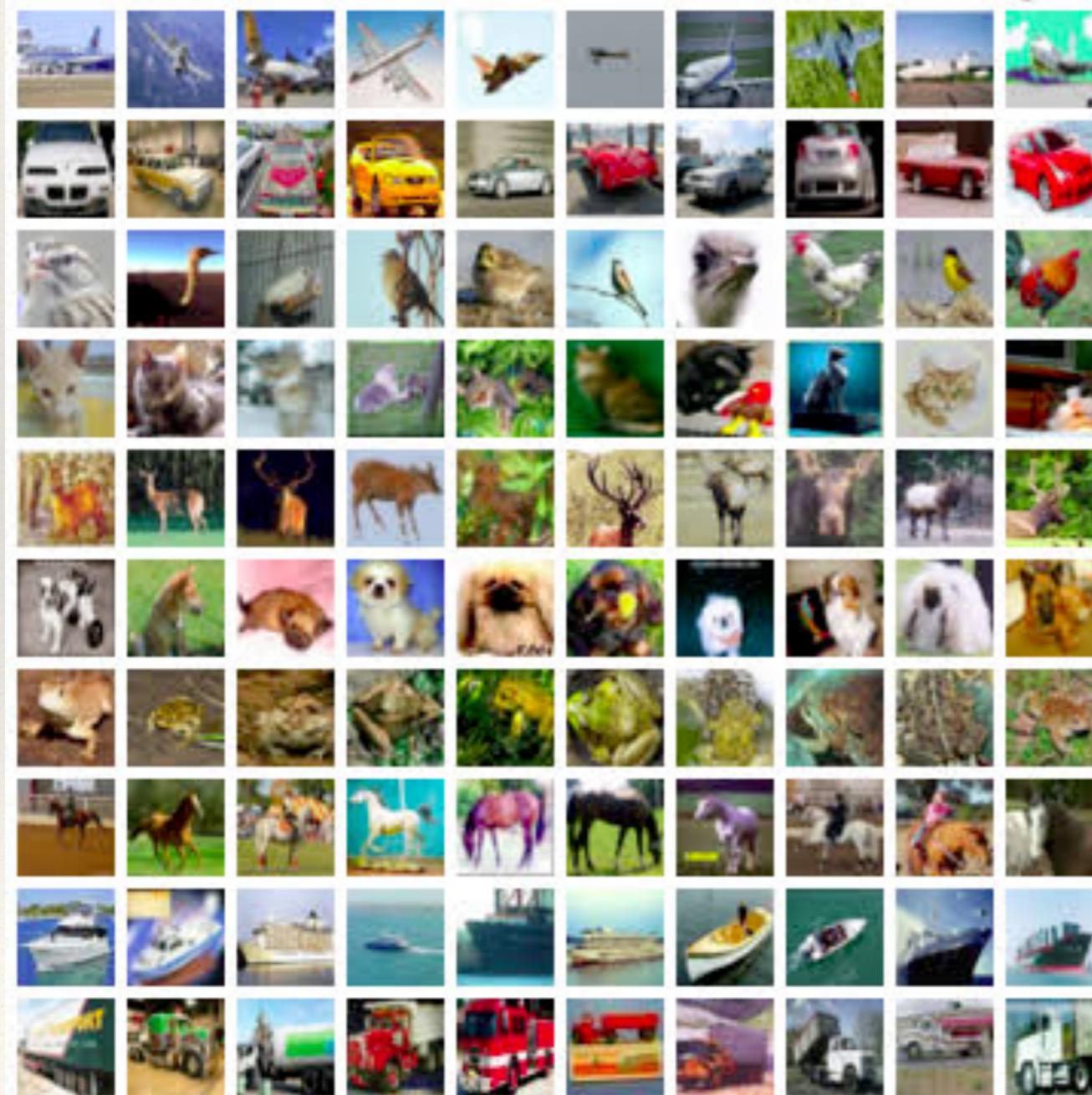
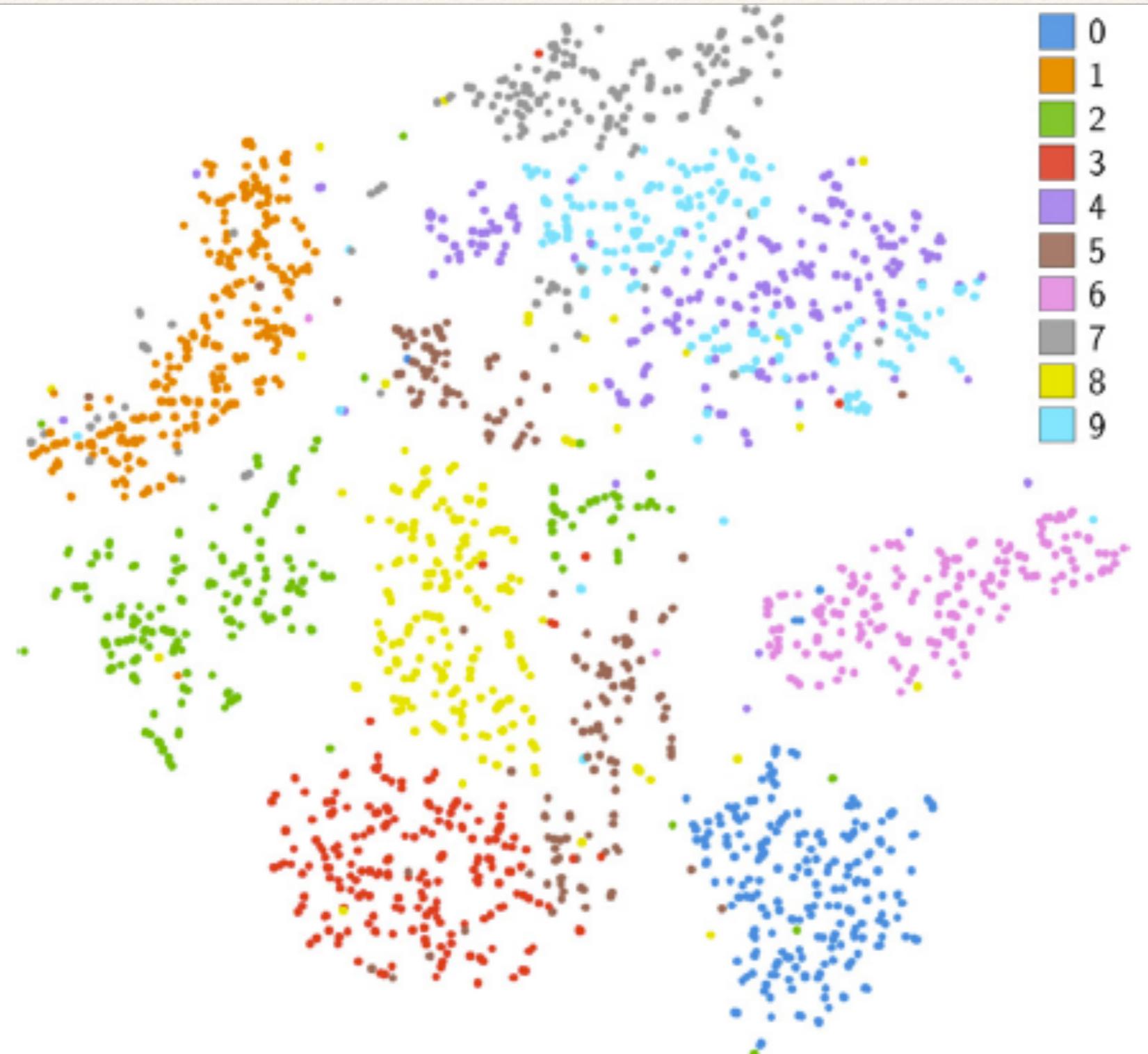


Table 1. Test Set Accuracies for our Two Architectures

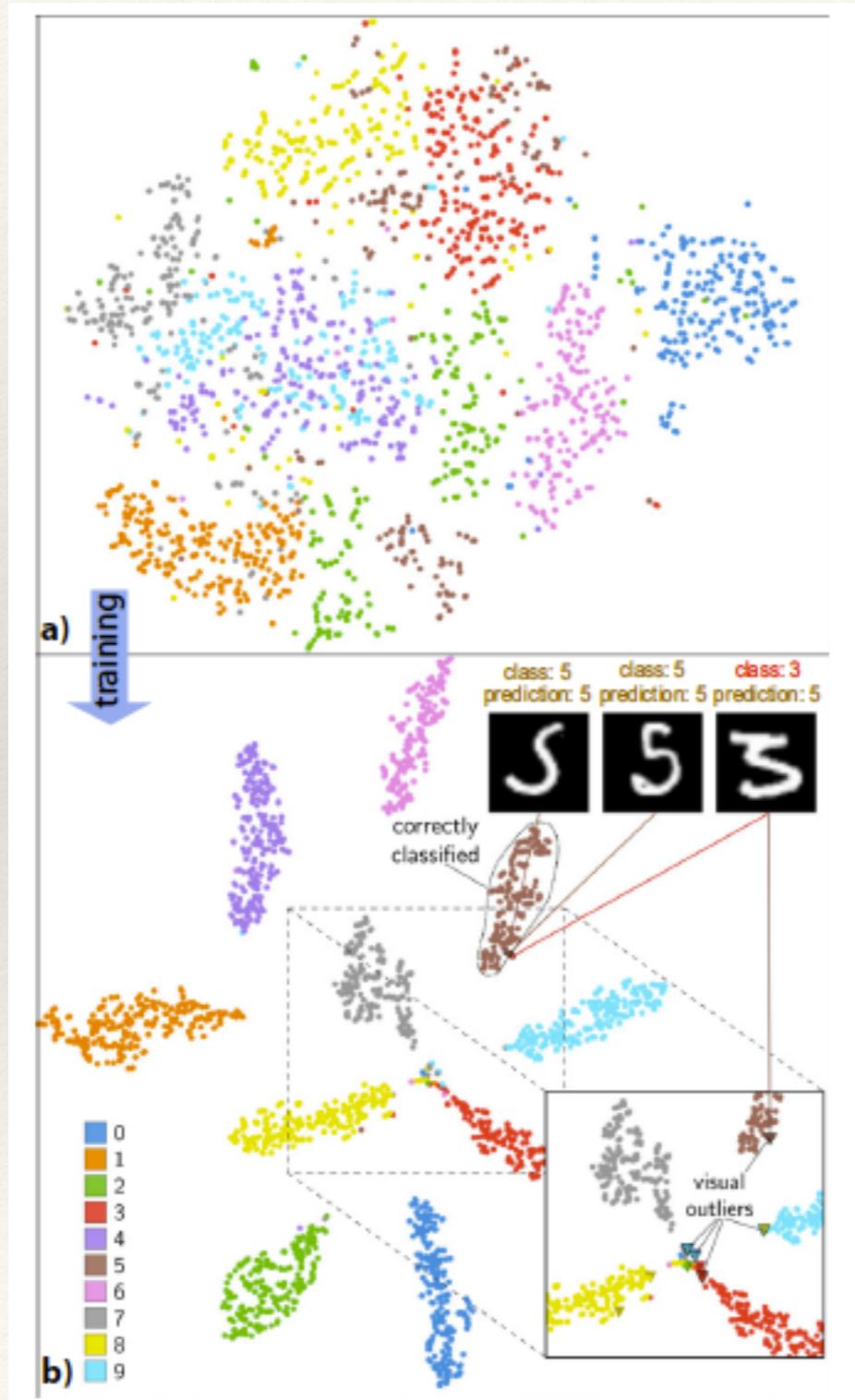
Model Dataset	MLP	CNN	State-of-the-art
MNIST	98.52%	99.62%	99.79% [47]
SVHN	77.38%	93.76%	98.08% [23]
CIFAR-10	52.91%	79.19%	91.78% [23]

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tSNE
projection
of MNIST
Images

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tSNE
projection
of last layer
of the neural network.

Fig. 3. Projection of the last MLP hidden layer activations, MNIST test subset. a) Before training (NH: 83.78%). b) After training (NH: 98.36%, AC: 99.15%). Inset shows classification of visual outliers.

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Fig. 4. Projection of the last MLP hidden layer activations before training, SVHN test subset (NH: 20.94%). Poor class separation is visible.

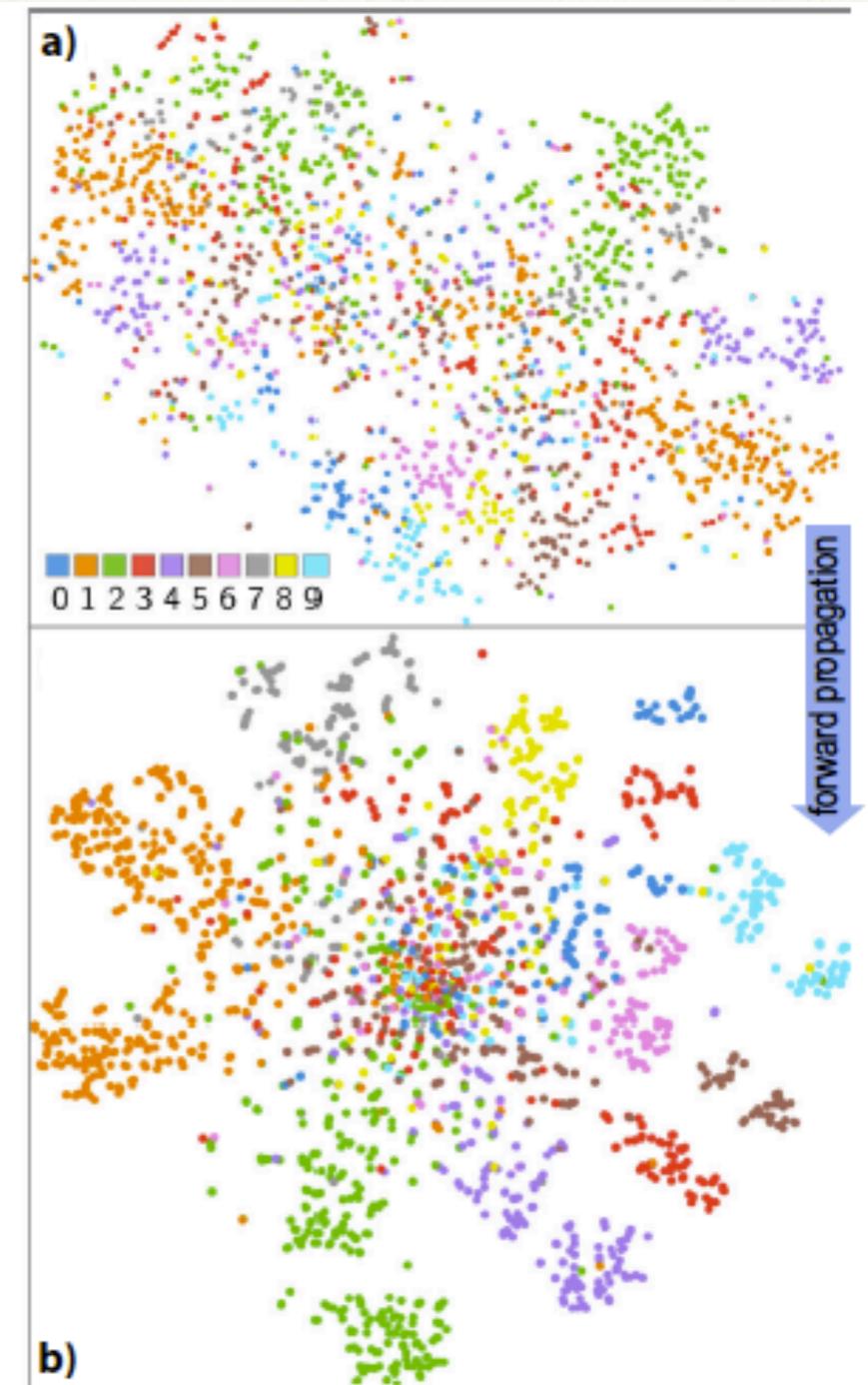


Fig. 5. Projection of the MLP hidden layer activations after training, SVHN test subset. a) First hidden layer (NH: 52.78%). b) Last hidden layer (NH: 67%).

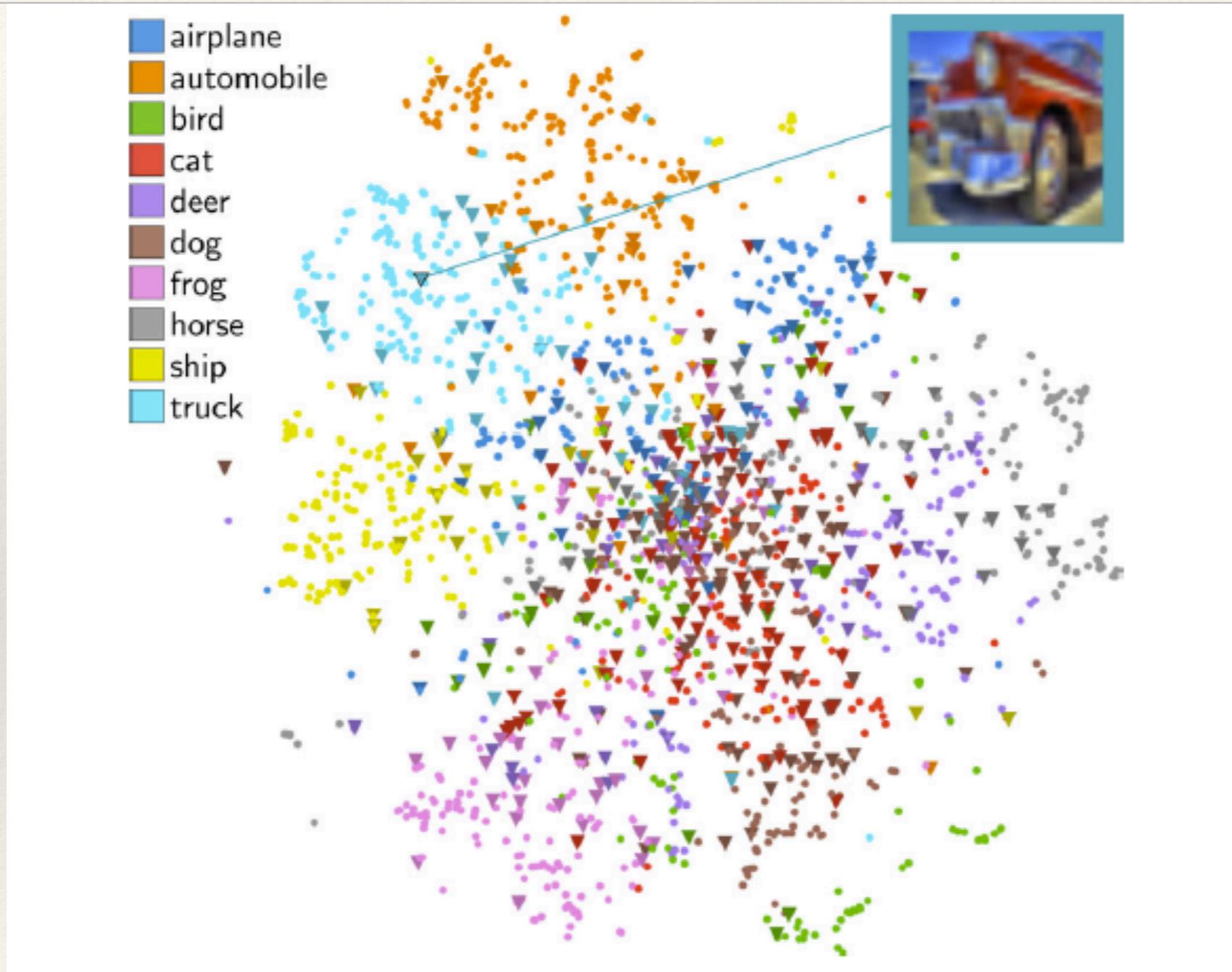
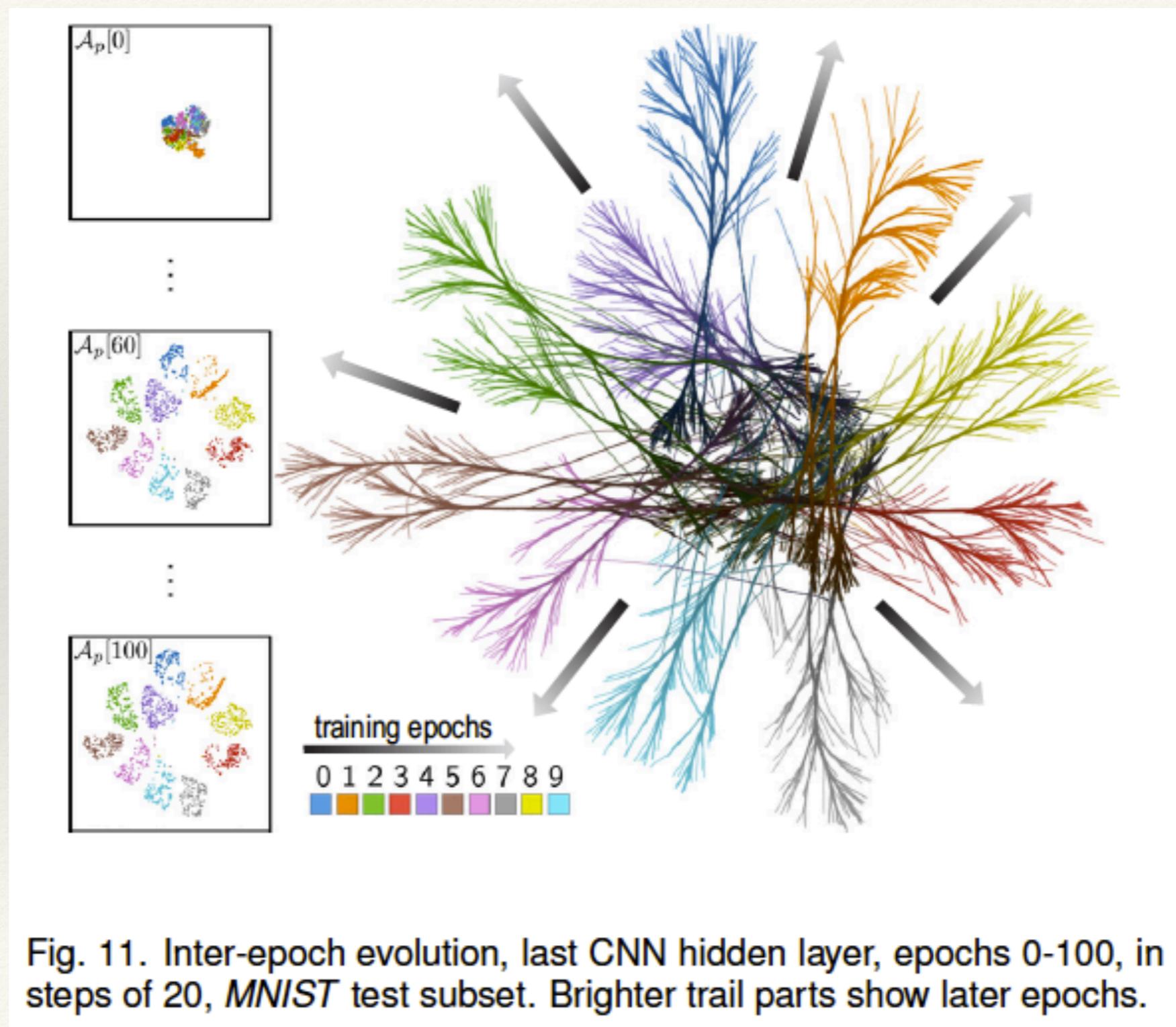


Fig. 9. Projection of last CNN hidden layer activations after training, CIFAR-10 test subset (NH: 53.43%, AC: 78.7%).

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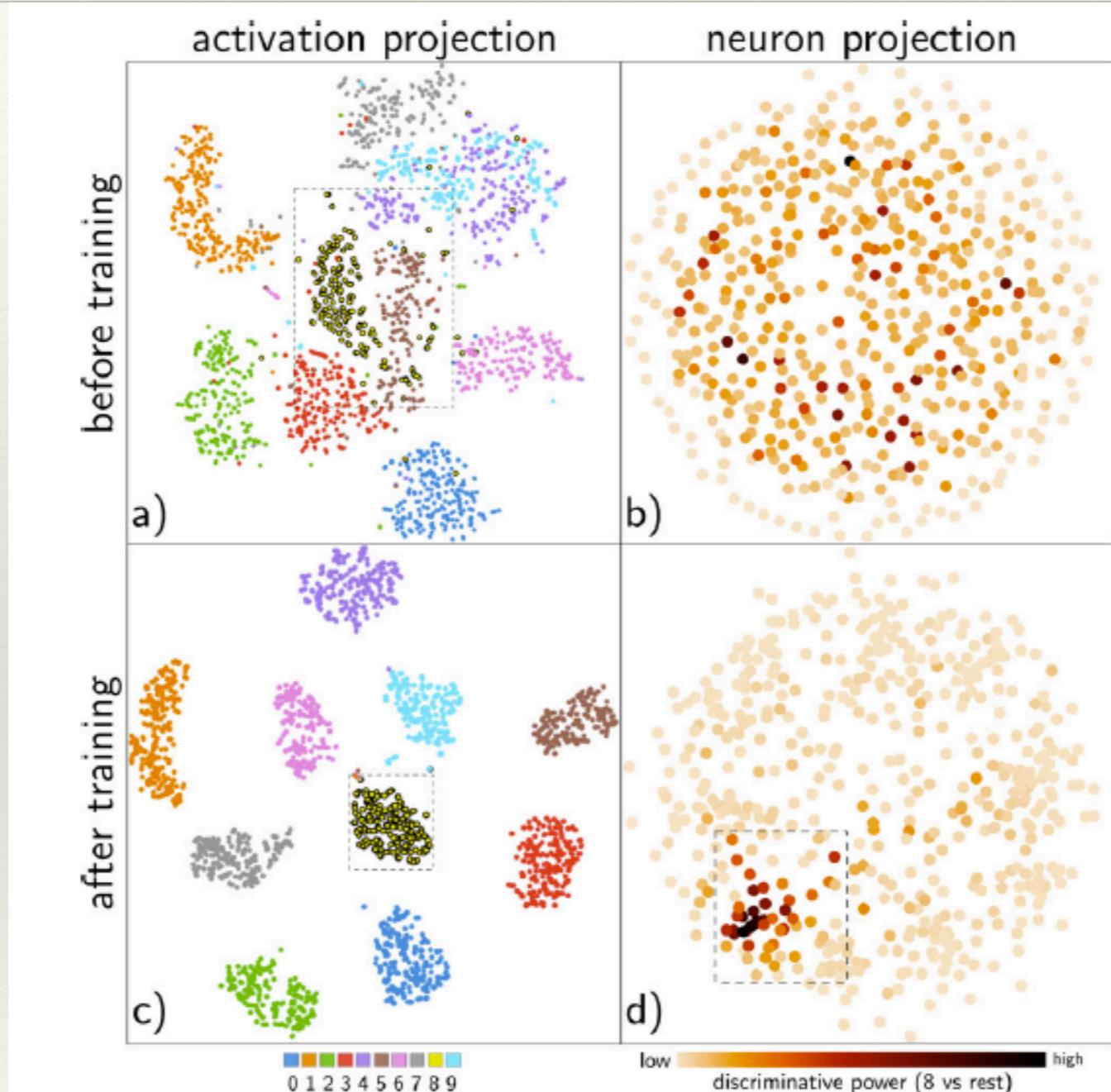


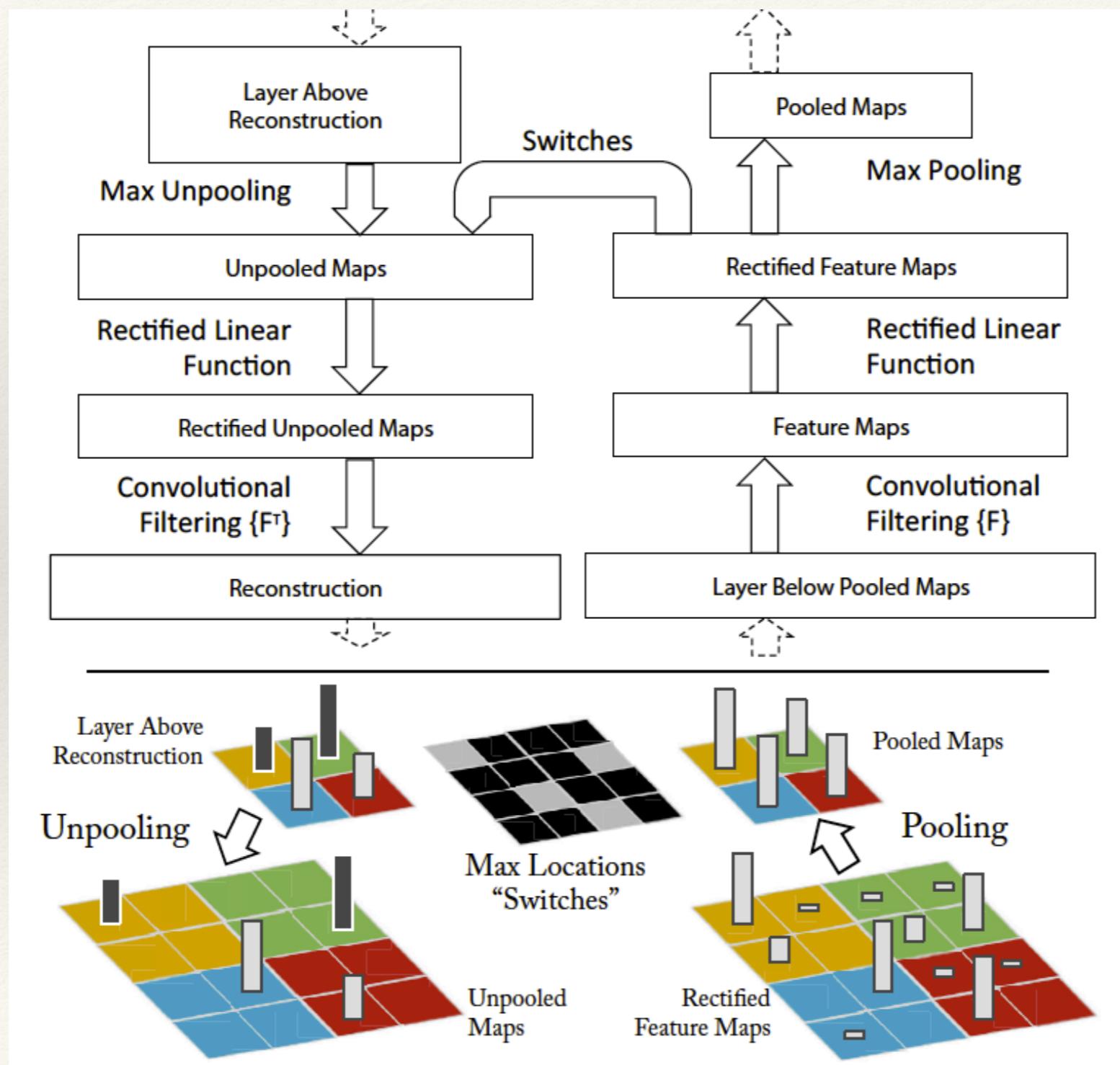
Fig. 12. Activation and neuron projections of last CNN hidden layer activations before and after training, *MNIST* test subset. Neuron projection colors show the neurons' power to discriminate class 8 vs rest.

Visualizing and Understanding Convolutional Networks

Matthew D. Zeiler and Rob Fergus

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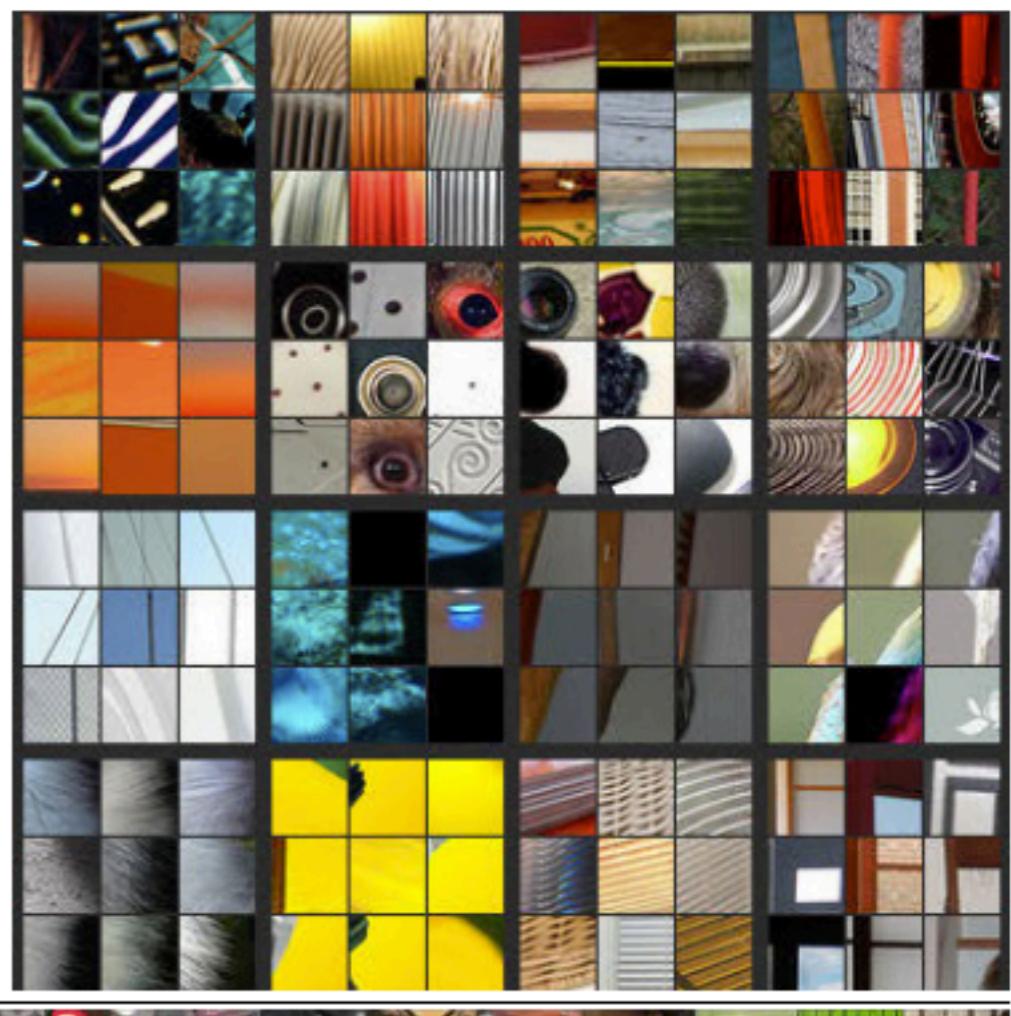
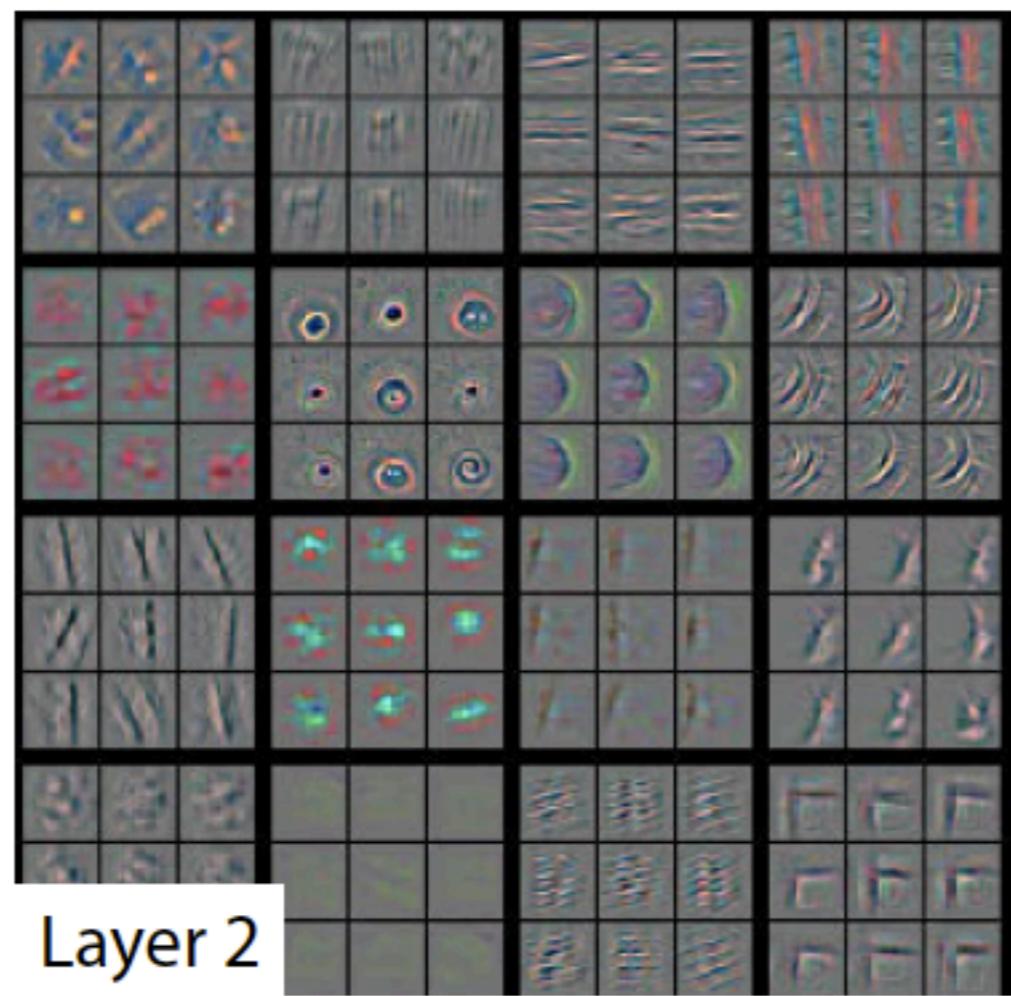
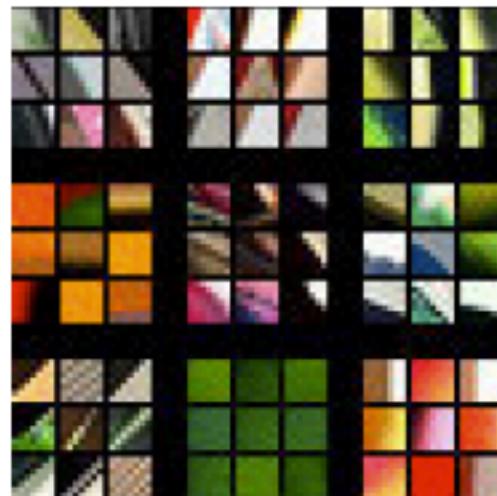
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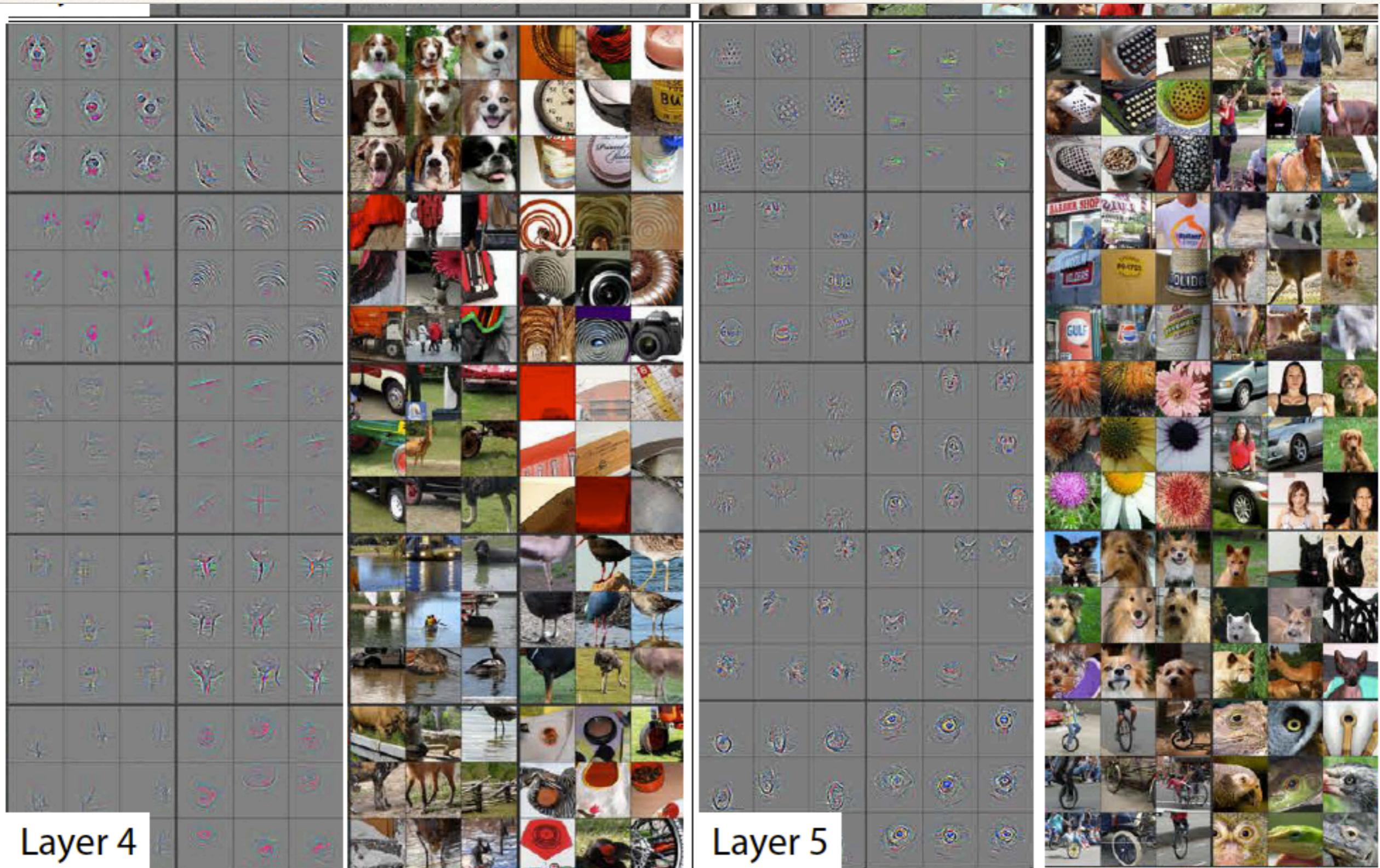
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Layer 1

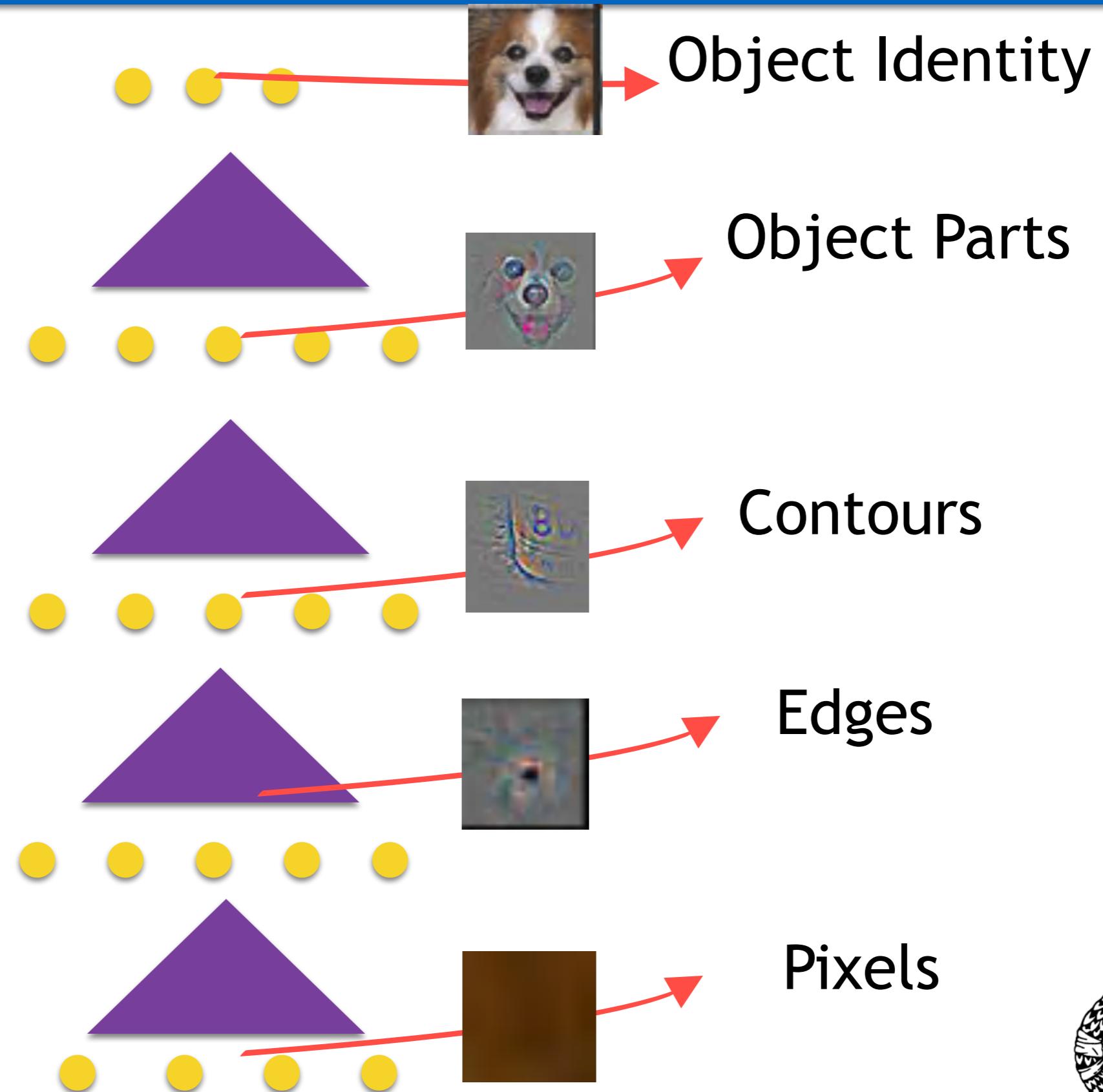


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Representation Learning in Deep Networks

[Zeiler, 2014]



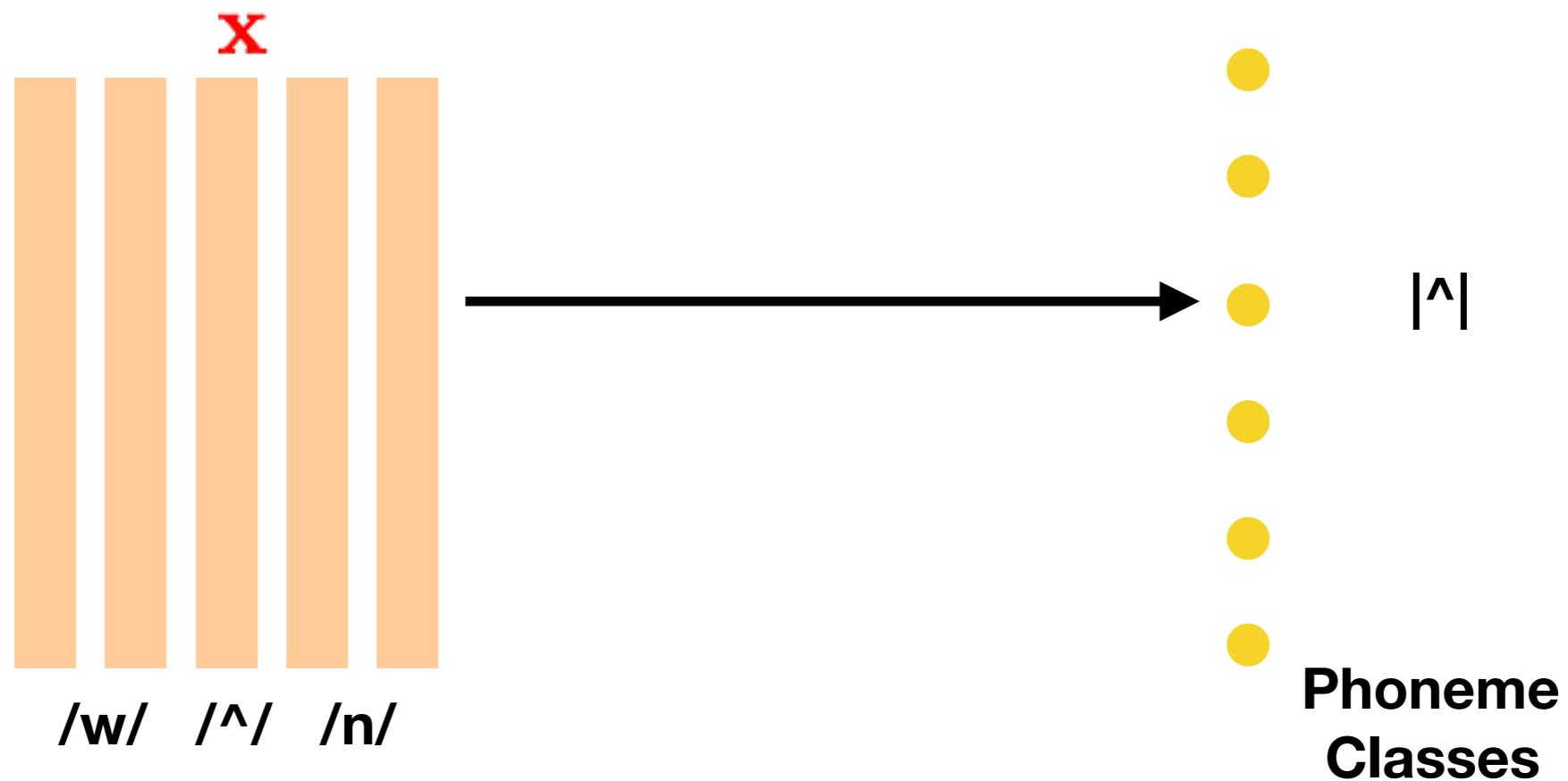
UNDERSTANDING HOW DEEP BELIEF NETWORKS PERFORM ACOUSTIC MODELLING

Abdel-rahman Mohamed, Geoffrey Hinton, and Gerald Penn

Department of Computer Science, University of Toronto

Speech Recognition

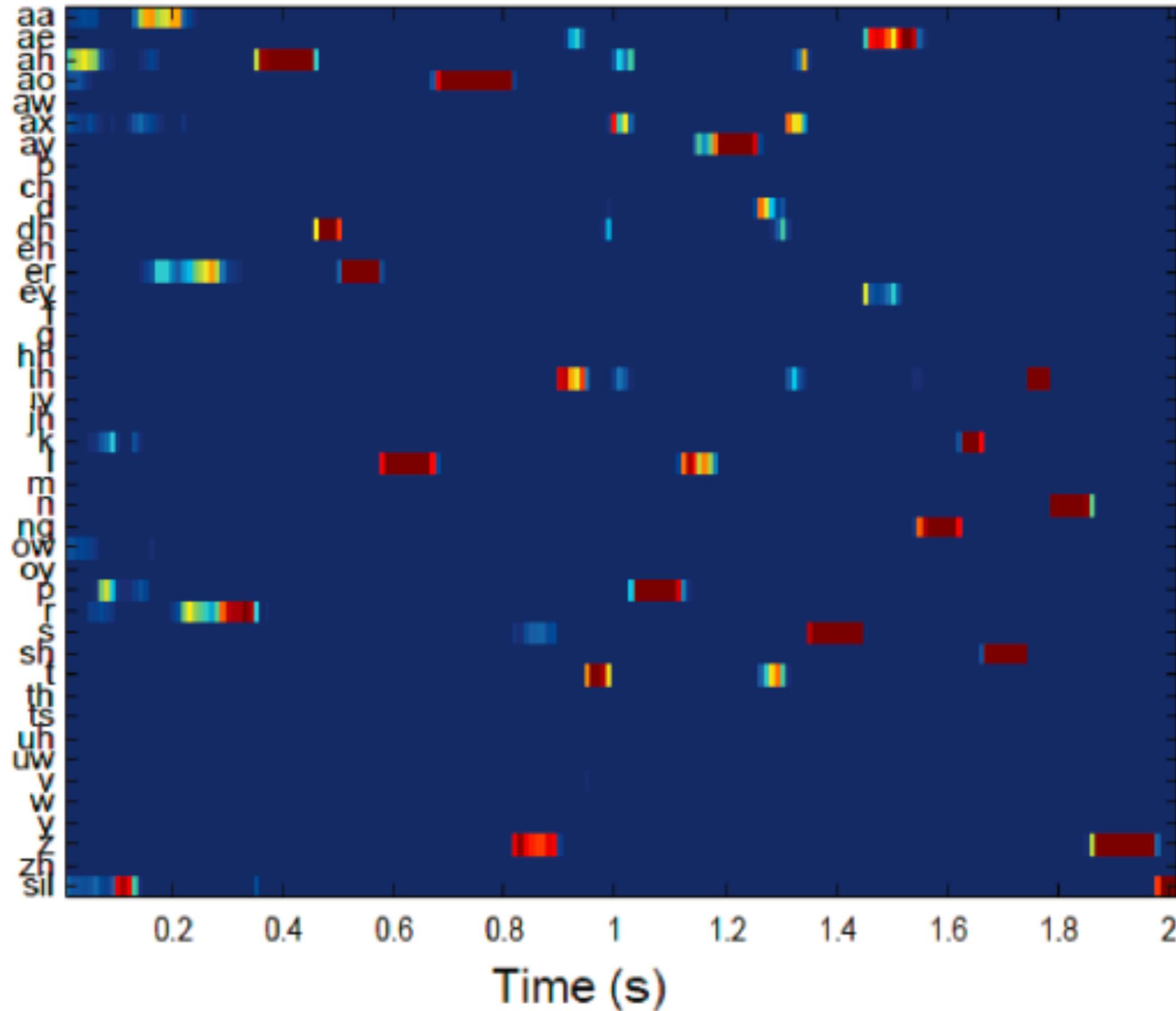
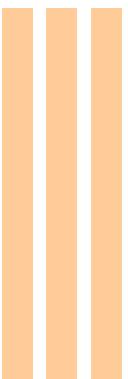
- Map the features to phone class. Using phone labelled data.



- Classical machine learning - train a classifier on speech training data that maps to the target phoneme class.

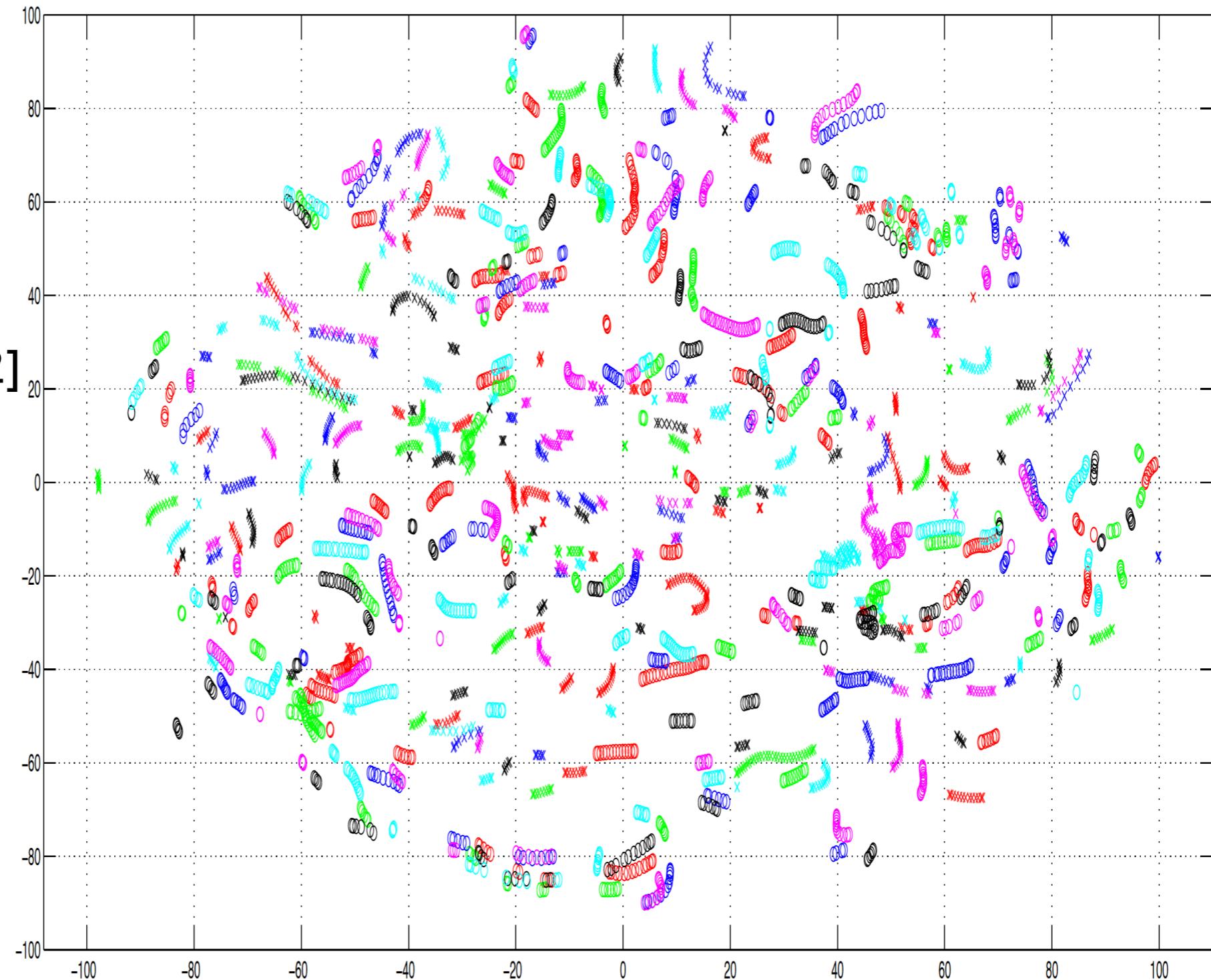
Back to Speech Recognition

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2-D projection of 1st layer DNN

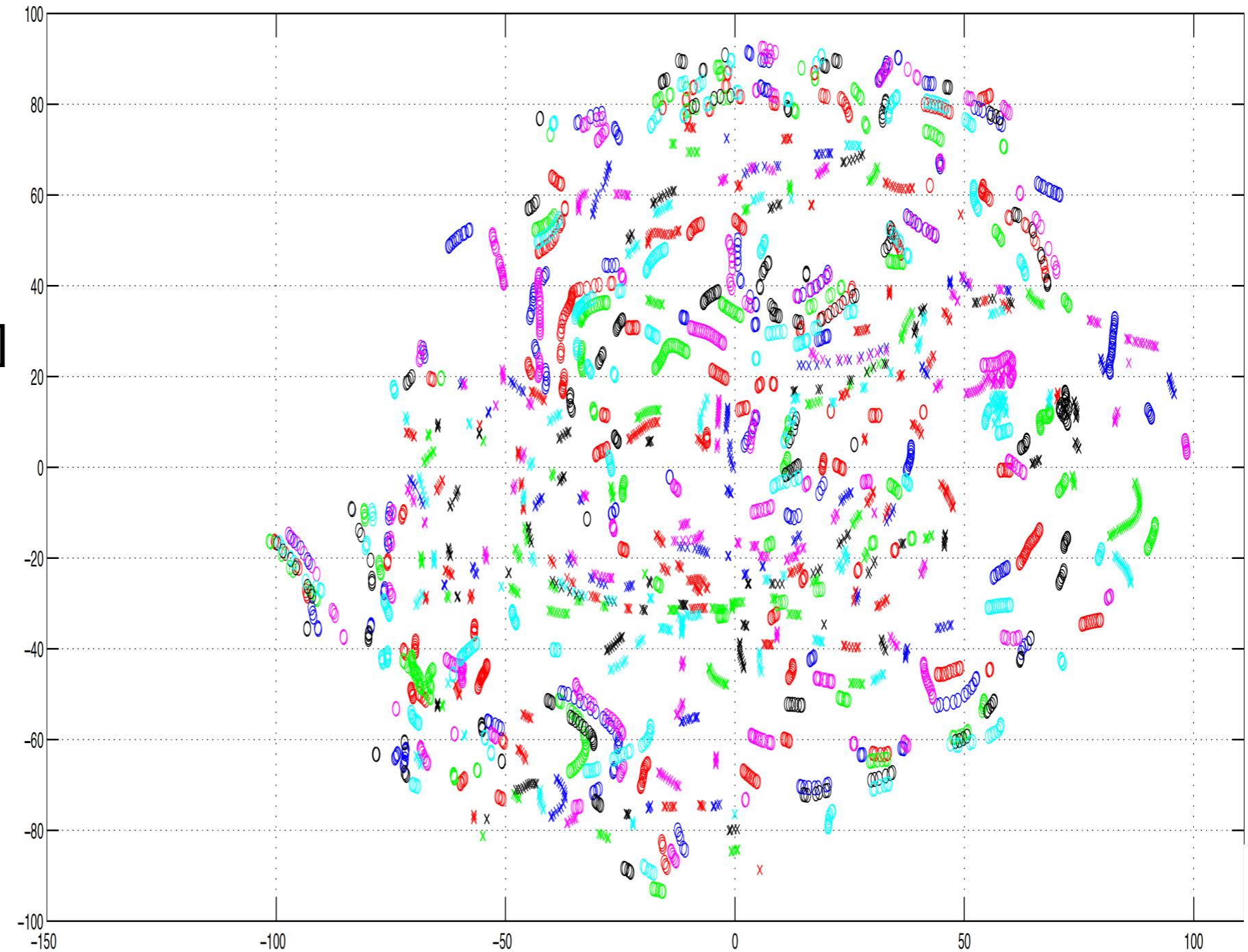


[Abdel Rahman, 2012]

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2-D projection of 2nd layer DNN

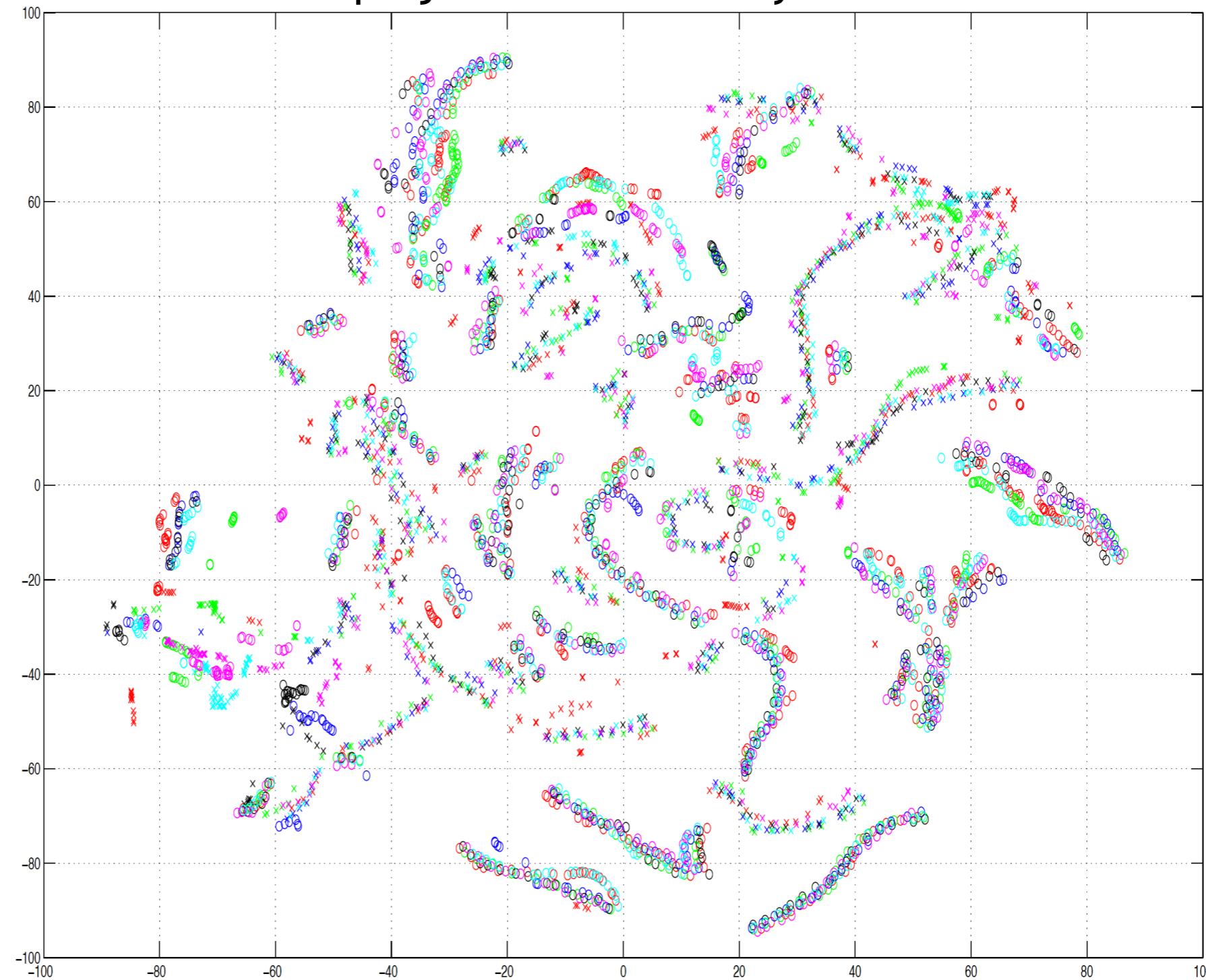
[Abdel Rahman, 2012]



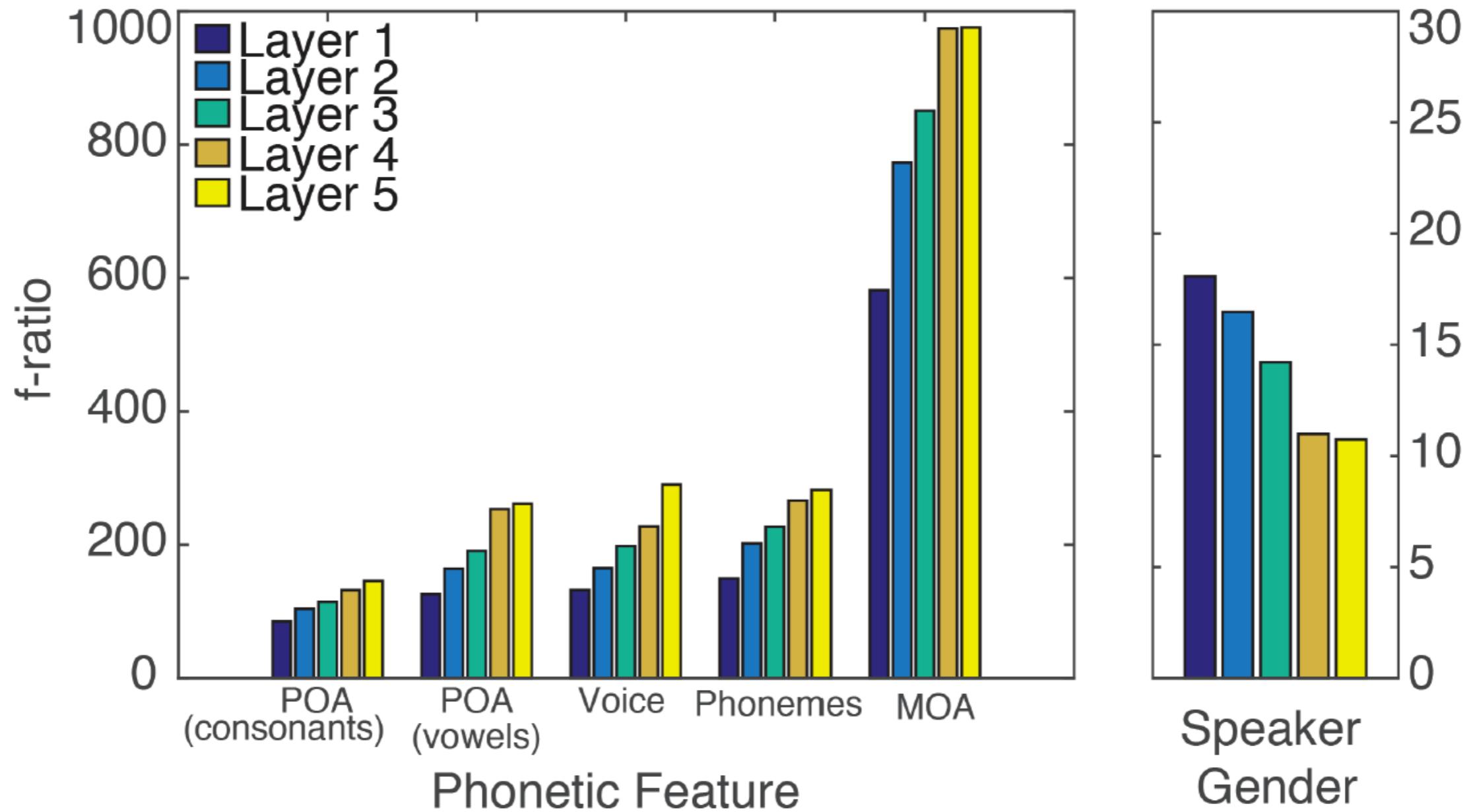
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2-D projection of final layer DNN

[Abdel Rahman, 2012]



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[Nagamine, 2015]