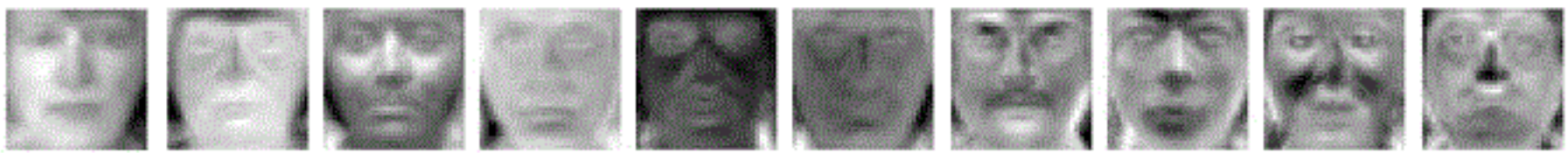
Lecture 9b: Data Mining I
Feature Processing II

http://cs.nju.edu.cn/yuy/course_dm14ms.ashx

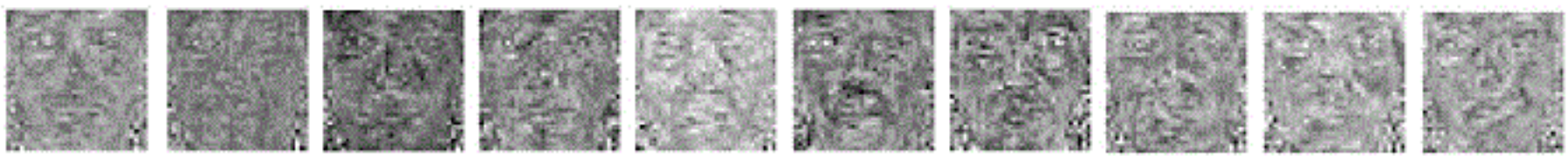
Example: Face recognition

PCA and LDA are commonly used to extract features for face recognition.

Basis of eigenface (PCA):



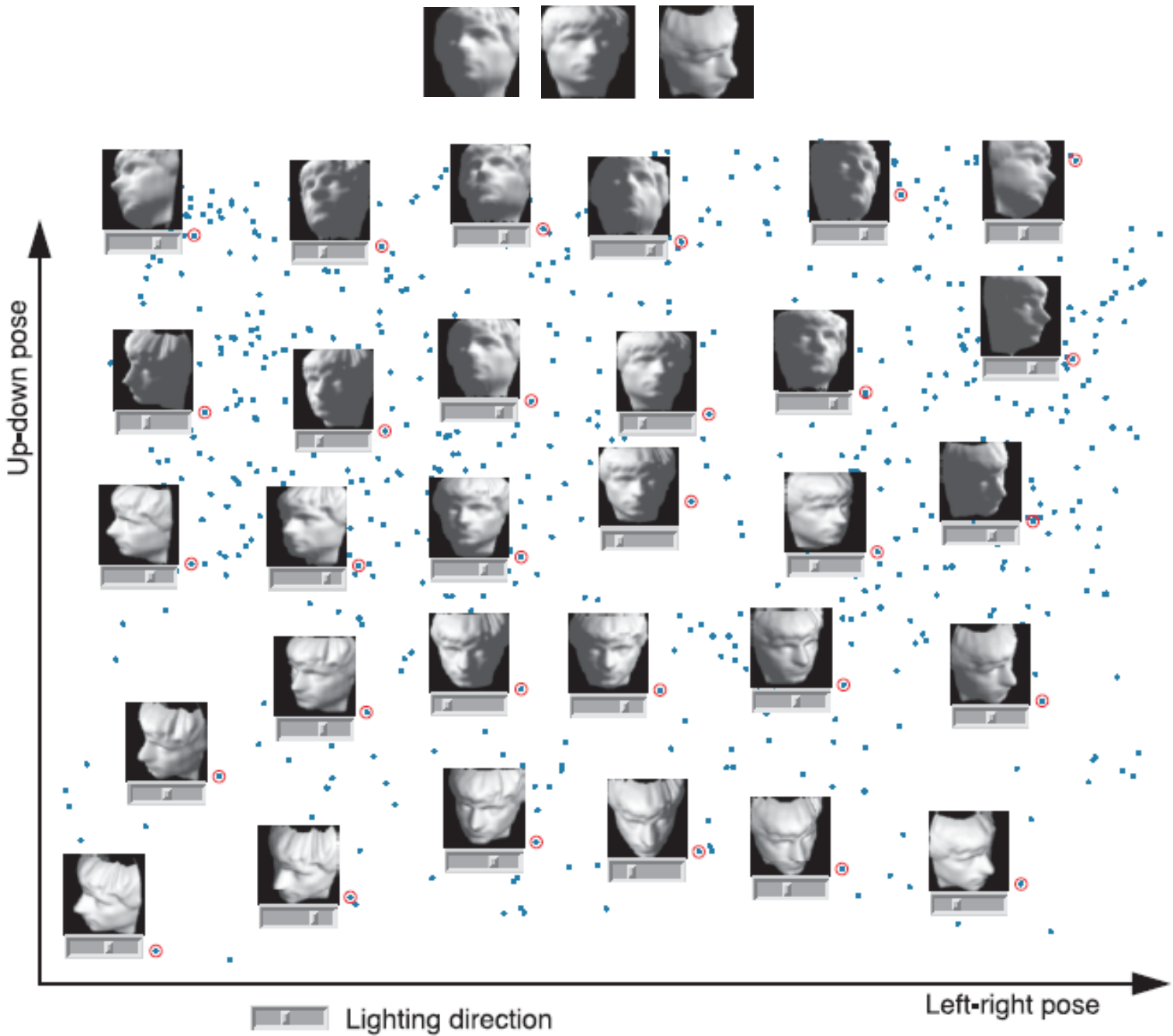
Basis of Fisherface (LDA):



[image from http://commons.wikimedia.org/wiki/File:Fisherface_eigenface_laplacianface.GIF]

Manifold learning

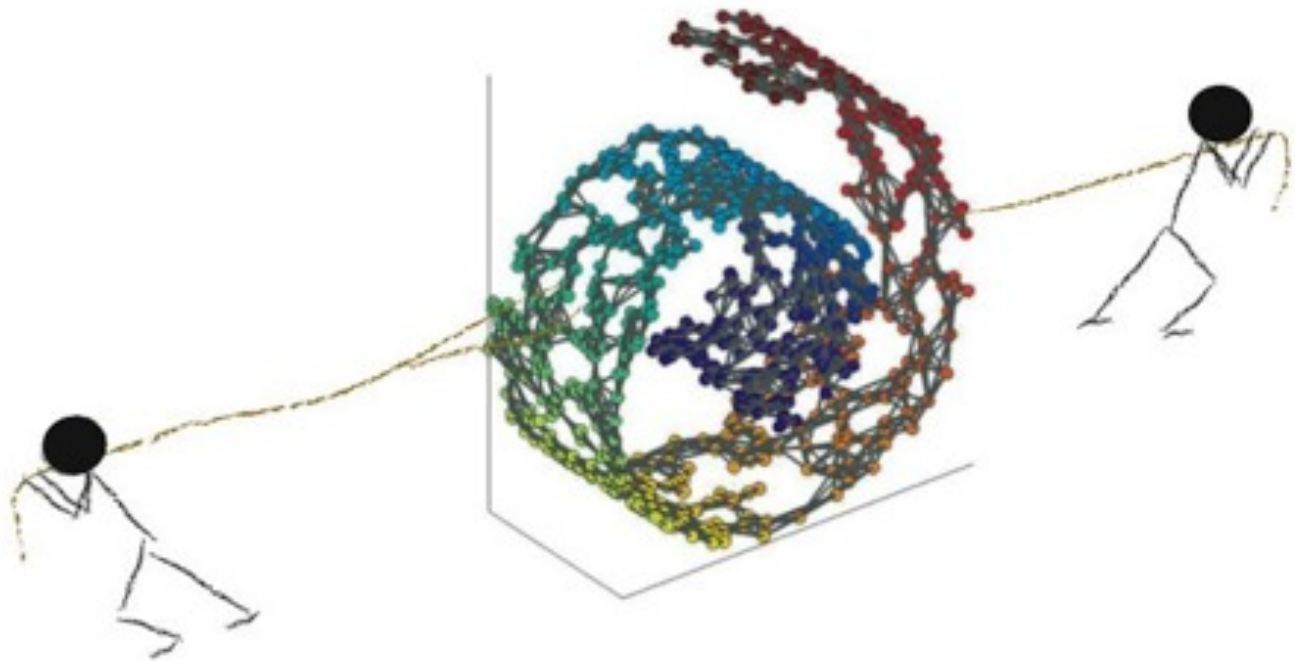
Manifold learning



Manifold learning

A low intrinsic dimensional data embedded in a high dimensional space

cause a bad distance measure



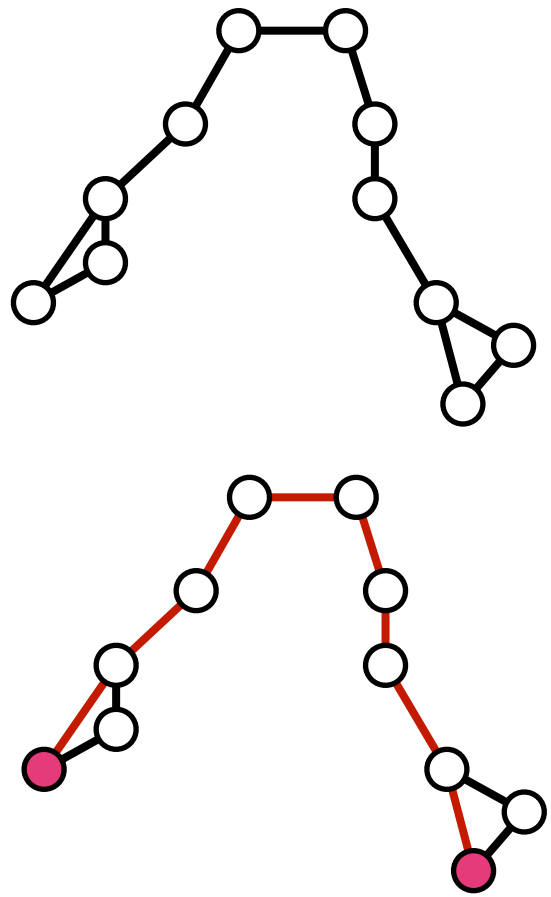
Manifold learning

ISOMAP

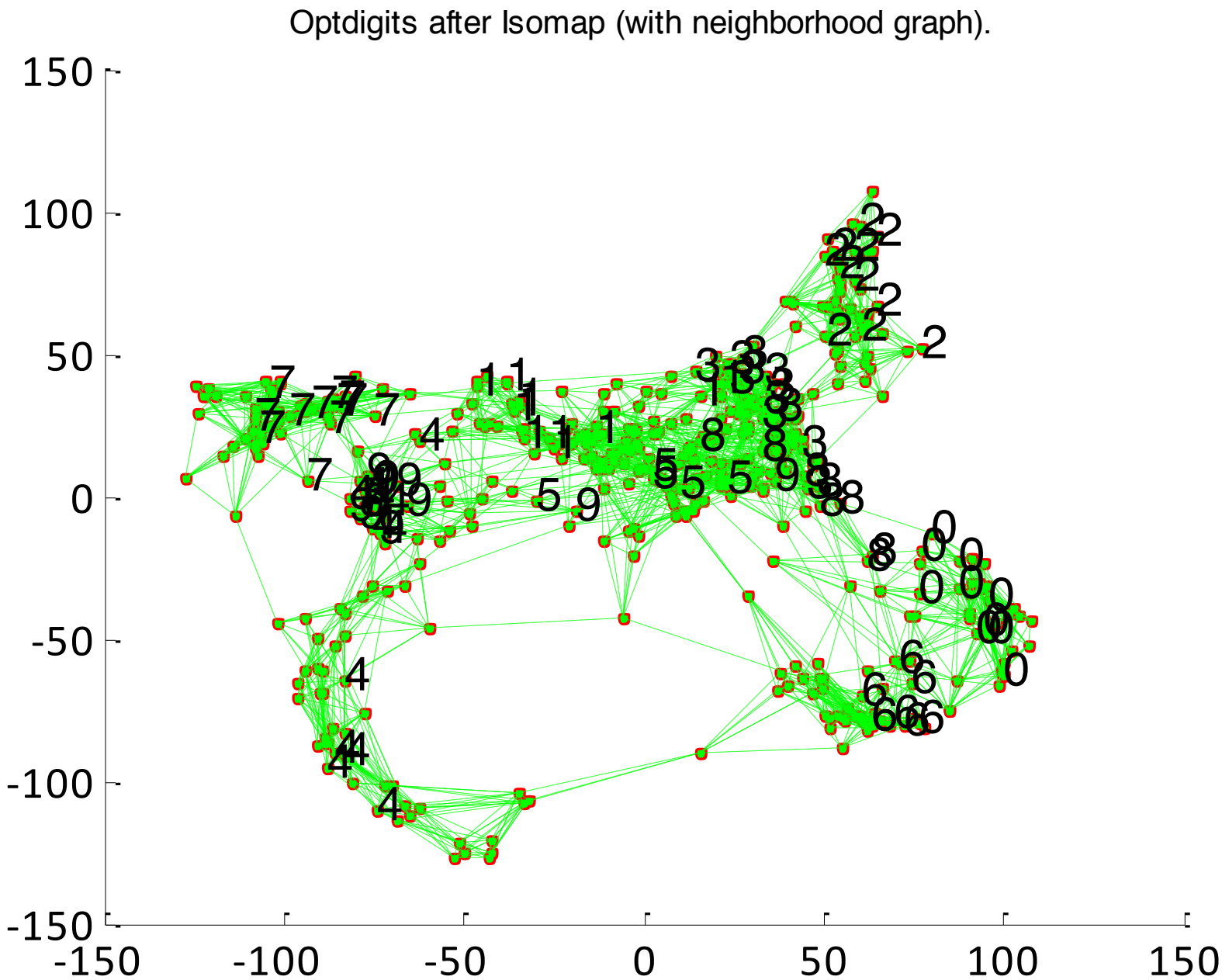
1. construct a neighborhood graph (kNN and ε-NN)

2. calculate distance matrix as the shortest path on the graph

3. apply MDS on the distance matrix



Manifold learning



from [Intro. ML]

Manifold learning

Local Linear Embedding (LLE):

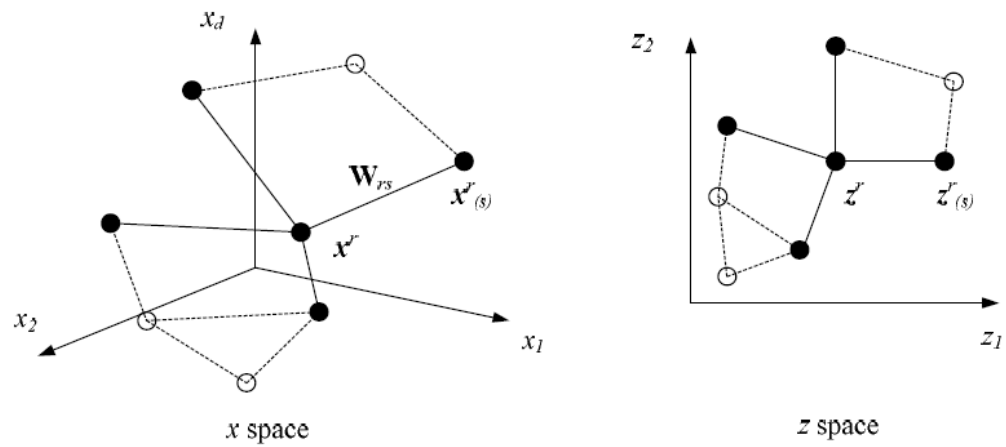
1. find neighbors for each instance

2. calculate a linear reconstruction for an instance

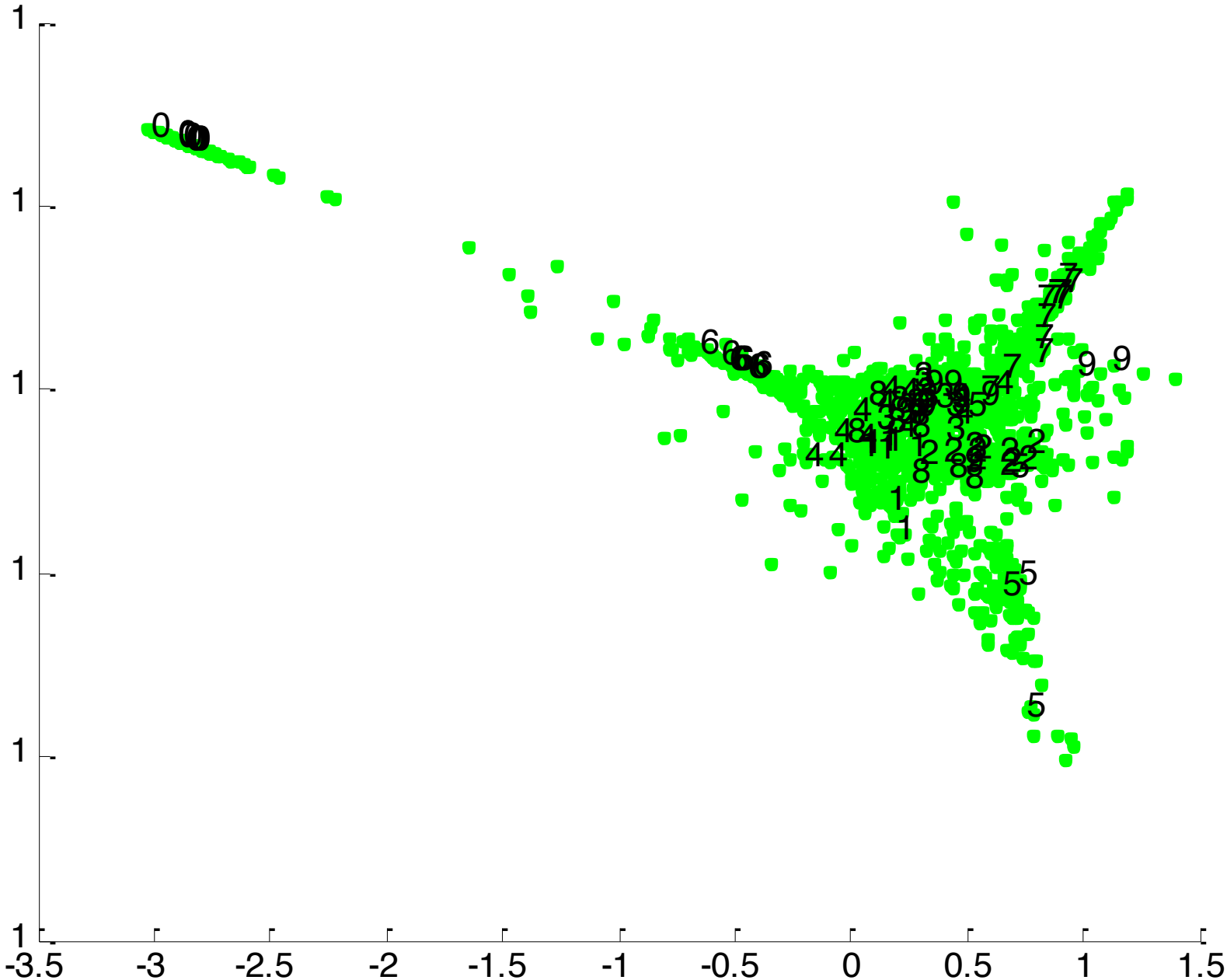
$$\sum_r \| \boldsymbol{x}^r - \sum_s \mathbf{W}_{rs} \boldsymbol{x}^s_{(r)} \|^2$$

3. find low dimensional instances preserving the reconstruction

$$\sum_r \| \boldsymbol{z}^r - \sum_s \mathbf{W}_{rs} \boldsymbol{z}^s \|^2$$



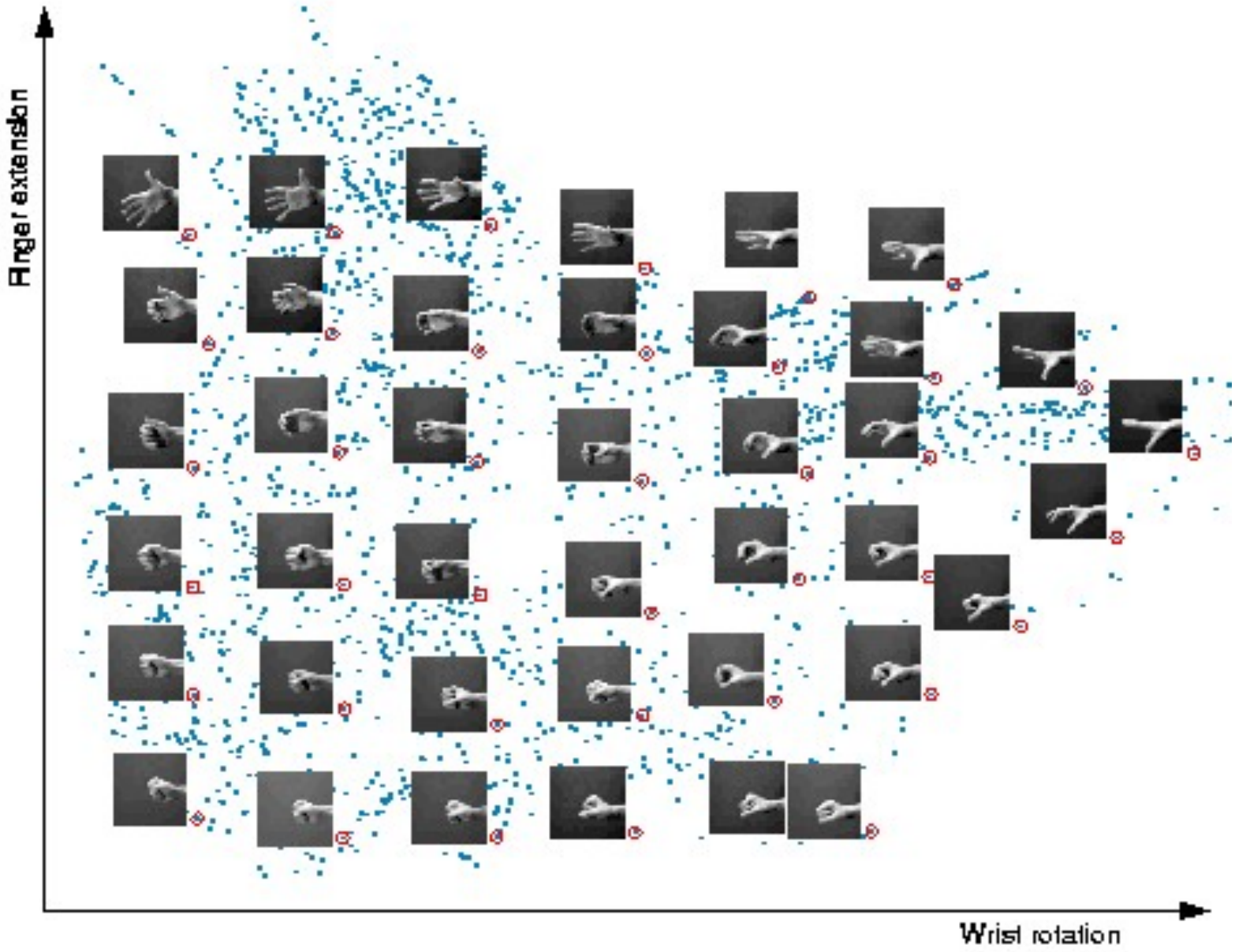
Manifold learning



from [Intro. ML]

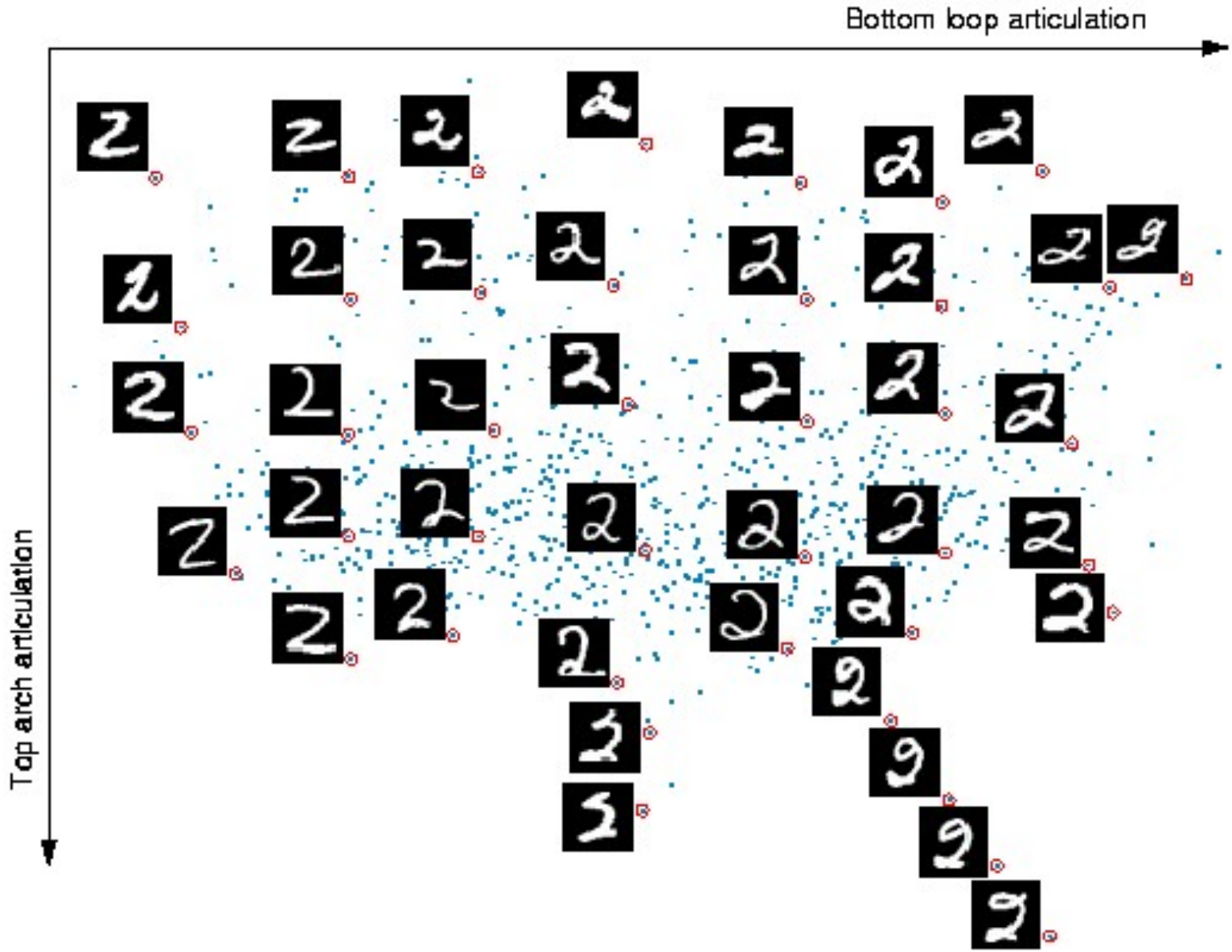
Manifold learning

more manifold learning examples



Manifold learning

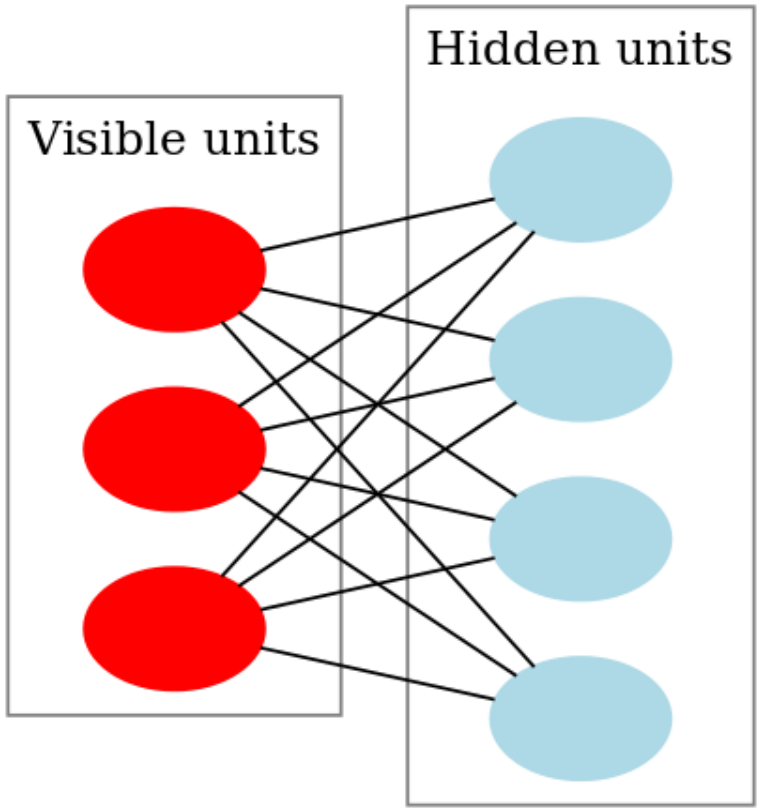
more manifold learning examples



Other feature extraction methods

autoencoder

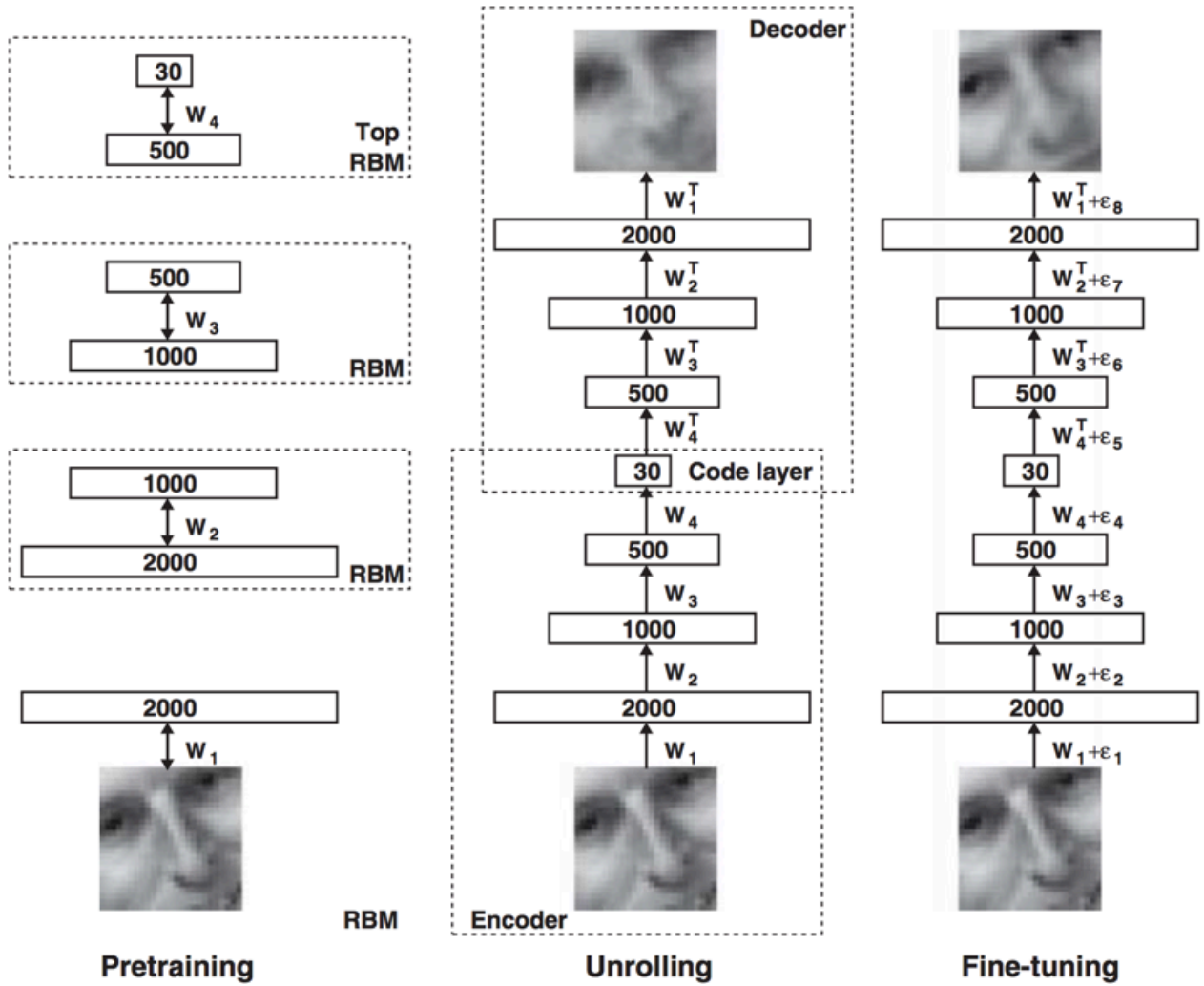
restricted Boltzmann machine
a type of associative memory network



[image from http://en.wikipedia.org/wiki/Restricted_Boltzmann_machine

Other feature extraction methods

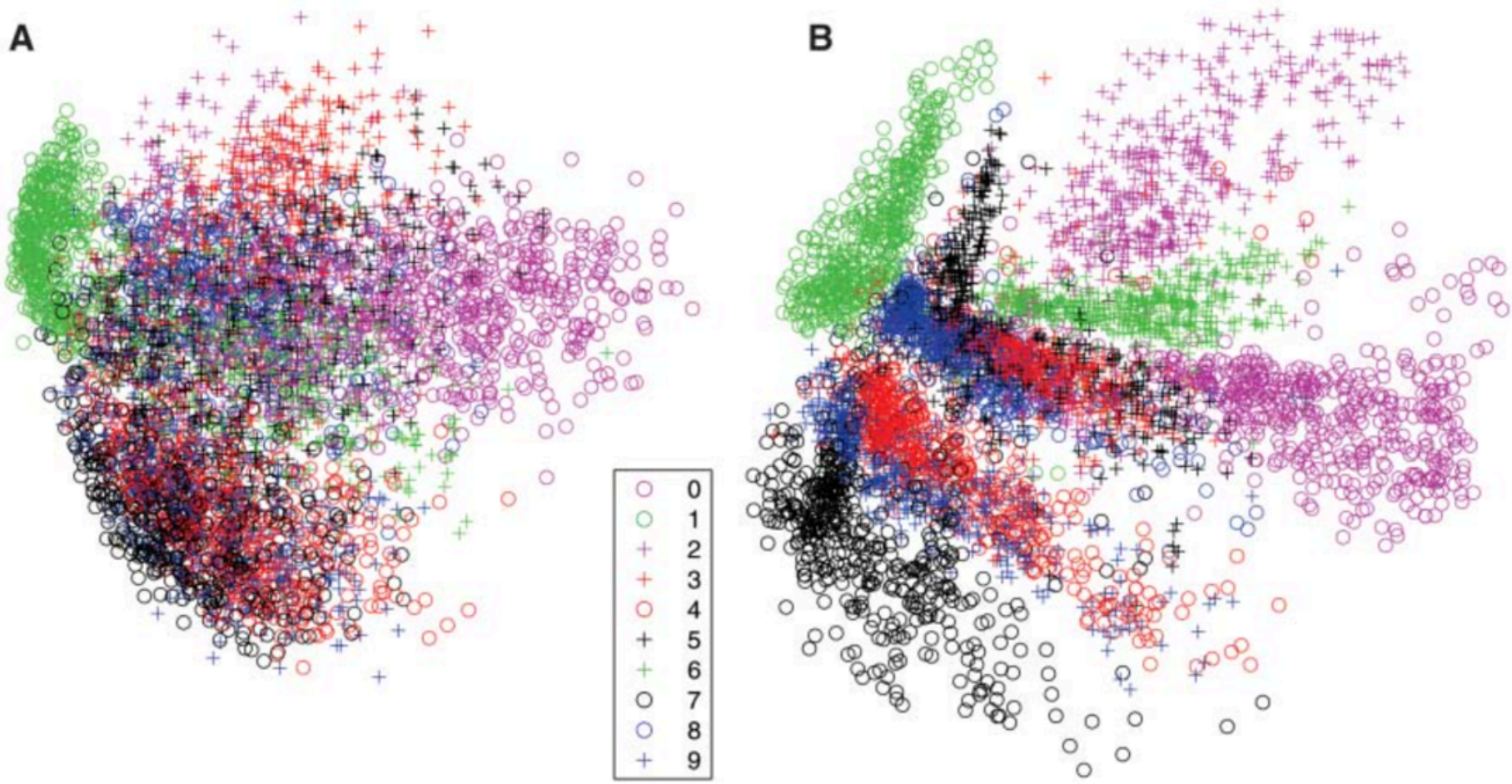
autoencoder



[image from [G. E. Hinton and R. R. Salakhutdinov, Science 2006]]

Other feature extraction methods

autoencoder



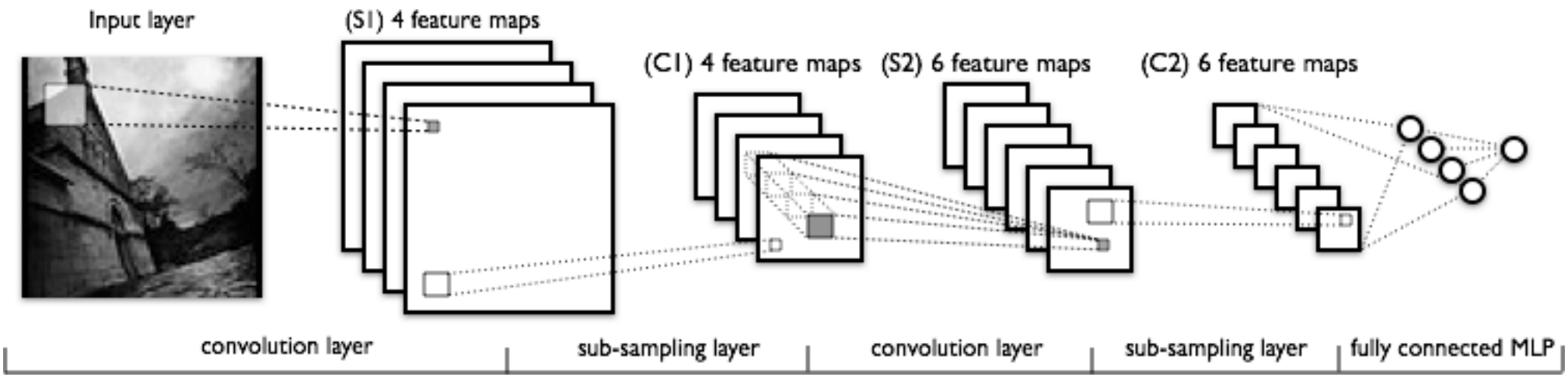
PCA

autoencoder

[image from [G. E. Hinton and R. R. Salakhutdinov, Science 2006]]

Other feature extraction methods

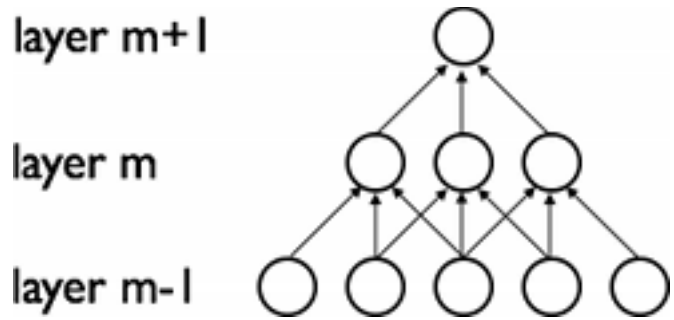
Convolutional Neural Networks (CNN/LeNet)
for general image feature extraction

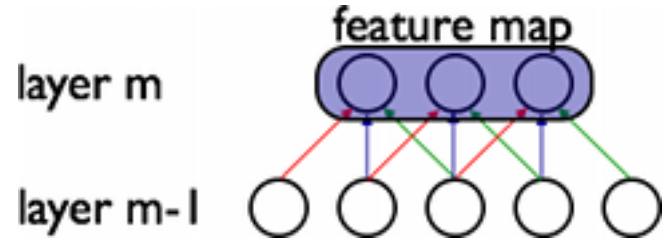


[image from http://deeplearning.net/tutorial/lenet.html]

Other feature extraction methods

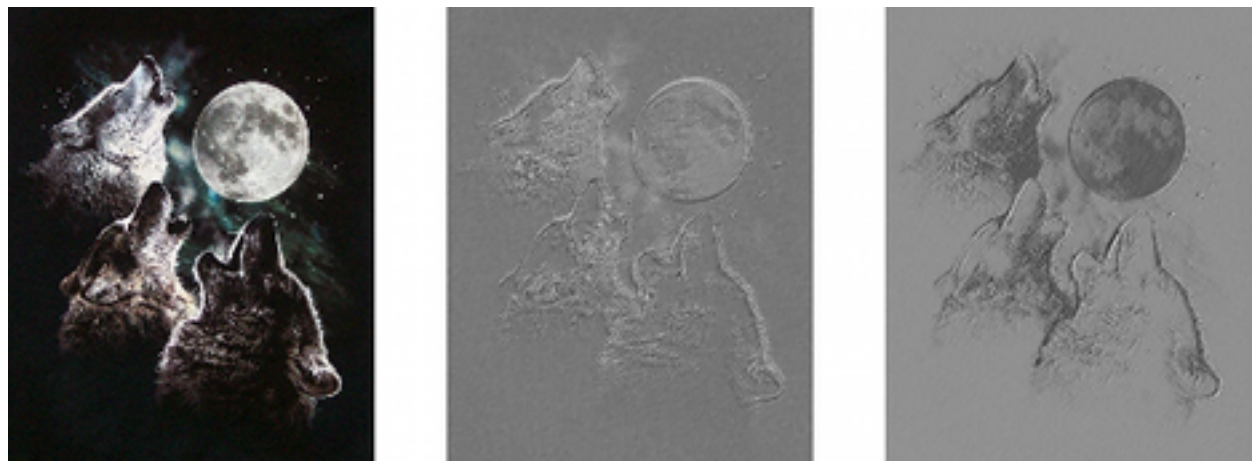
Convolution layer





sparse connectivity

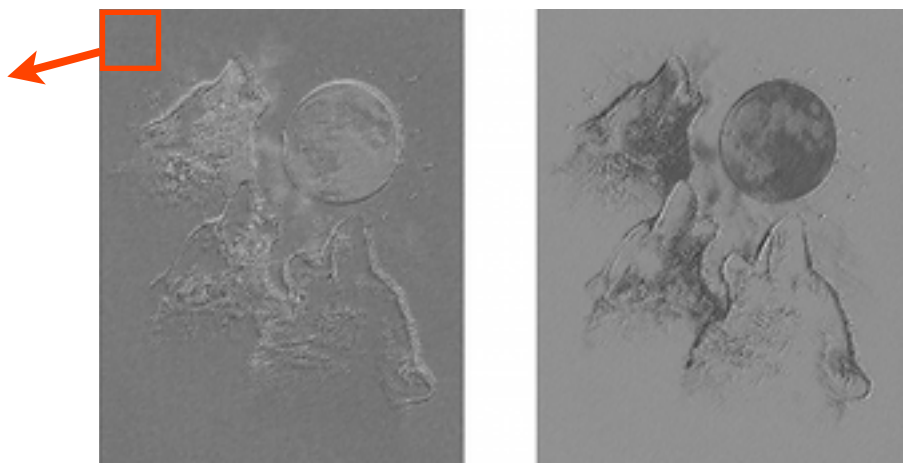
shared weights



[image from http://deeplearning.net/tutorial/lenet.html]

Other feature extraction methods

Subsampling layer



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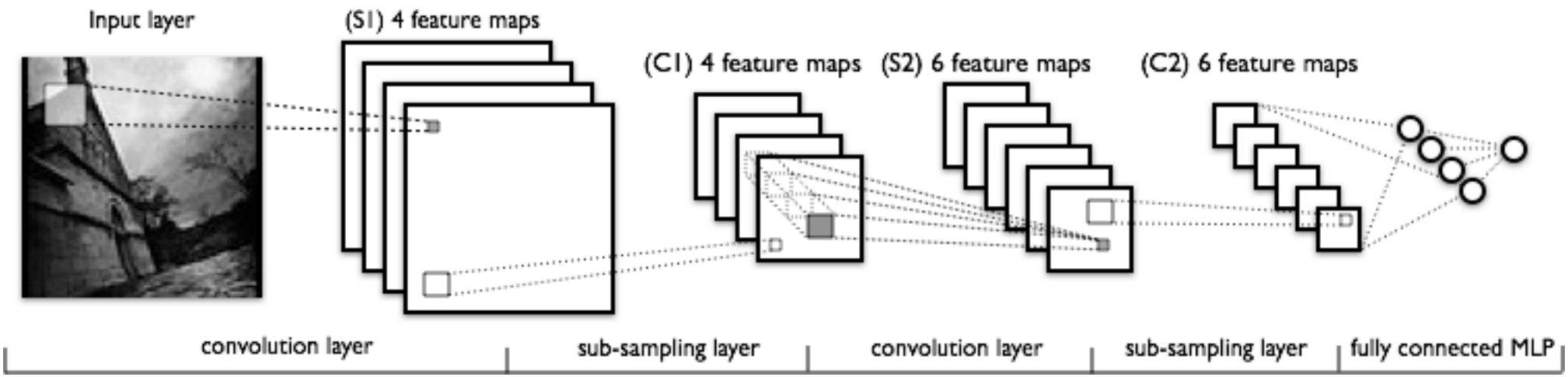
Other feature extraction methods

Convolutional Neural Networks (CNN/LeNet)
for general image feature extraction



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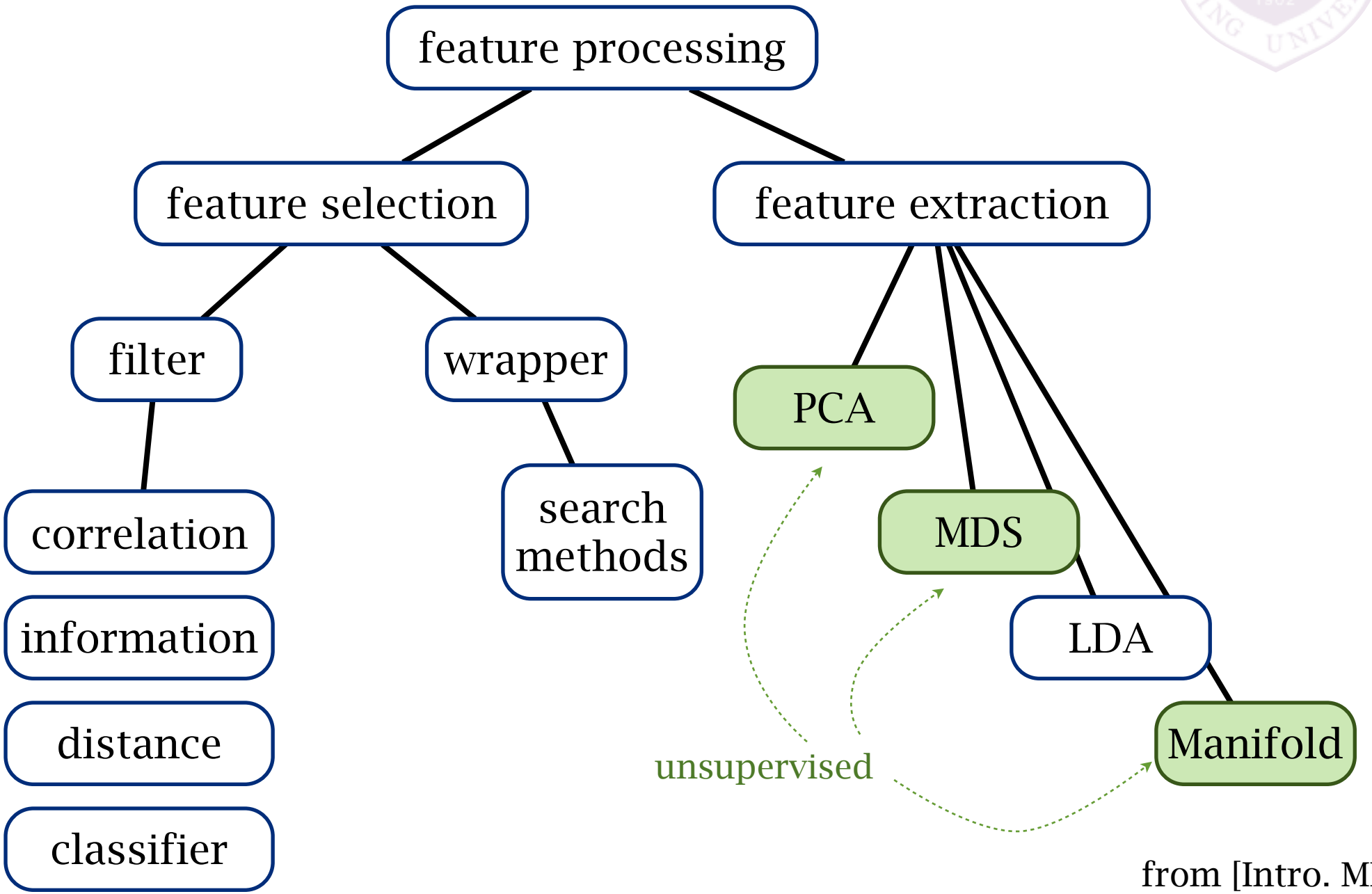
A summary of approaches



from [Intro. ML]