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A comparative analysis and evaluation of various machine learning algorithms for facial recognition

Analiza porównawcza wybranych algorytmów uczenia maszynowego do rozpoznawania twarzy

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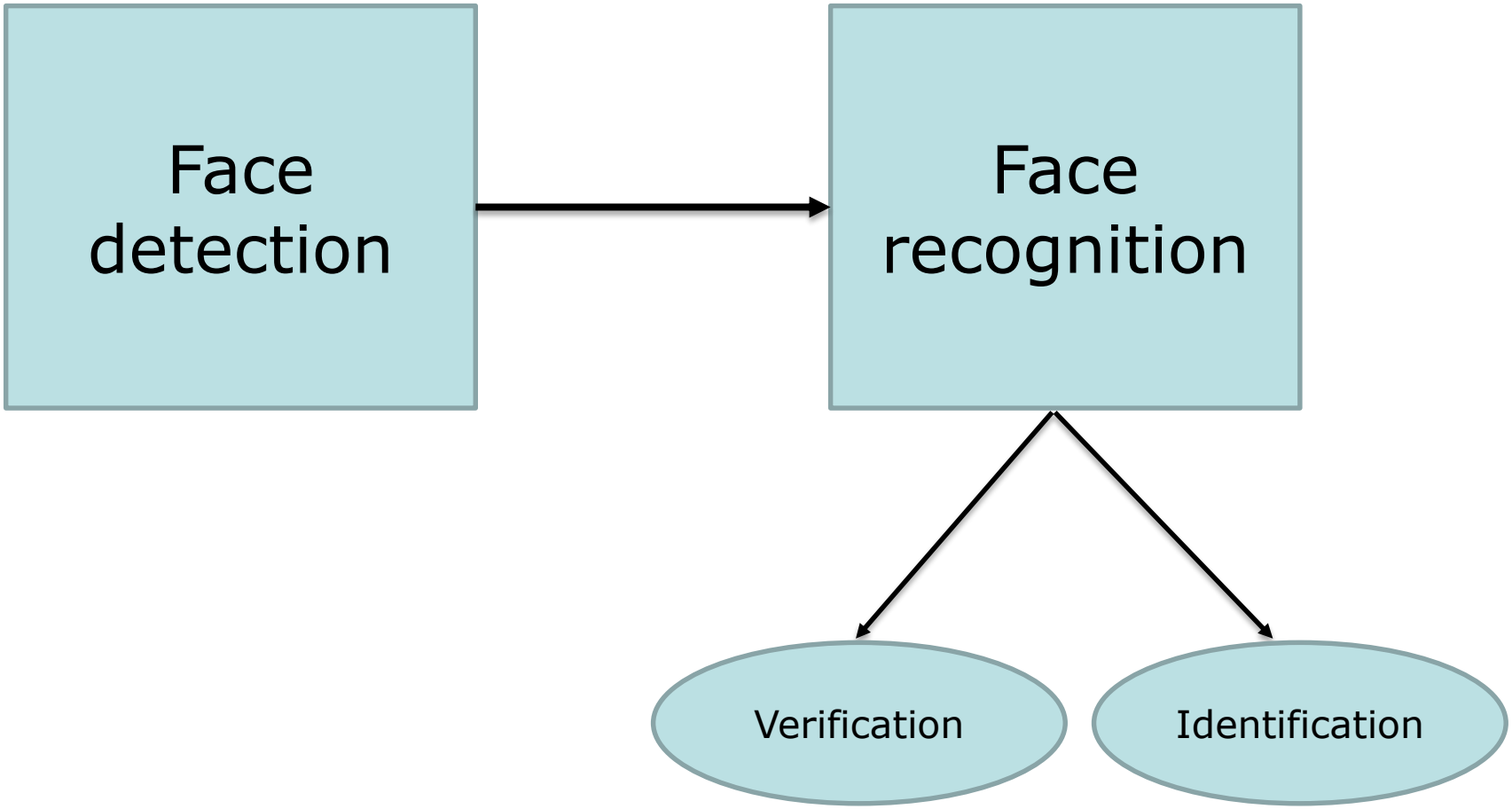
Face recognition process



Face recognition challenges






Evaluated algorithms

- Unsupervised algorithms
  - Principal Component Analysis
- Supervised algorithms
  - Support Vector Machines
  - Artificial Neural Networks
    - Multilayer Perception
    - Convolutional Neural Network

Test scenarios

Labeled Faces in Wild



Chicago Face Database



Principal Component Analysis

Eigenfaces – 50 most significant

Principal Component Analysis

The main advantages

- Low sensitivity to noises
- Reduction of the requirements of the memory
- Increase in efficiency due to the operation in the space of smaller dimensions

Test results – recognition rate

CFD 20	CFD 40	LFW 20
75%	65%	8,5%

Multilayer Perception

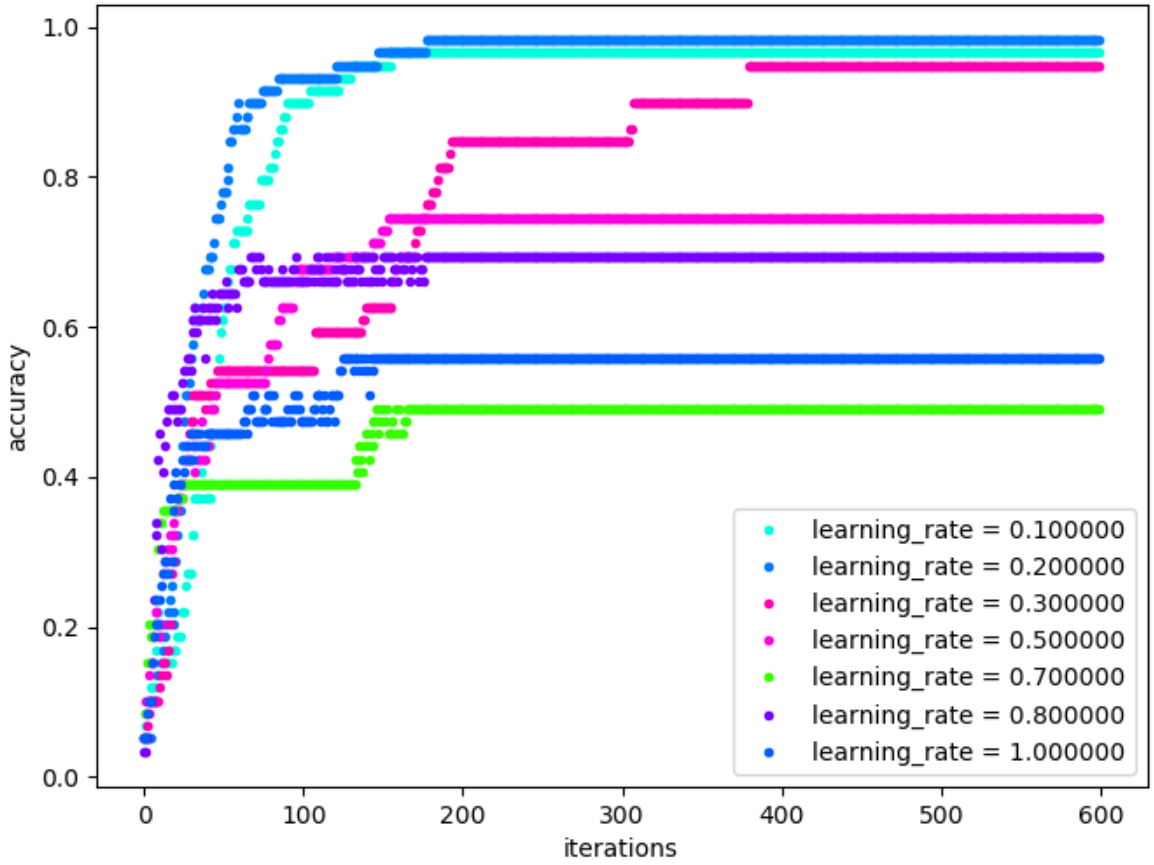
The Multilayer Perception performance varies depending on the change of various parameters such as:

- Input data dimension
- Learning rate
- Number of neurons in each layer
- Number of layers
- Initial weights
- Activation function

Multilayer Perception

Learining Rate

20 individuals from CFD database



Multilayer Perception

Number of hidden neurons

40 individuals from CFD database

Number of hidden neurons	10	33	56
Recognition rate	70%	43,5%	2,5%
Training accuracy	76,5%	50%	2,5%

Multilayer Perception

Test results

CFD 40
Number of hidden layers = 1
Number of hidden neurons = 10
learning rate = 0.2
dimension of input data = 27

76.5%

CFD 20
Number of hidden layers = 1
Number of hidden neurons = 10
learning rate = 0.2
dimension of input data = 27

90%

Multilayer Perception

Test results

LFW 20
Number of hidden layers = 1
Number of hidden neurons = 20
learning rate = 0.2
dimension of input data = 13

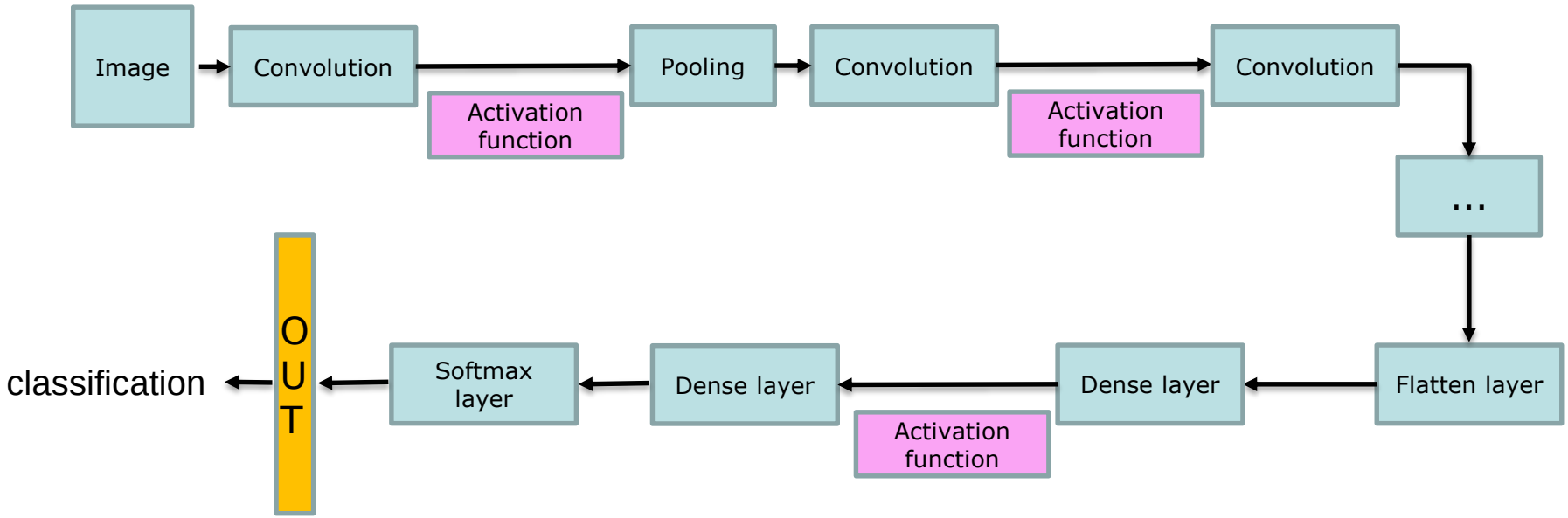
66.6%

LFW 20
Number of hidden layers = 2
Number of hidden neurons in first HL = 10
Number of hidden neurons in second HL = 15
learning rate = 0.05
dimension of input data = 15

73.3%

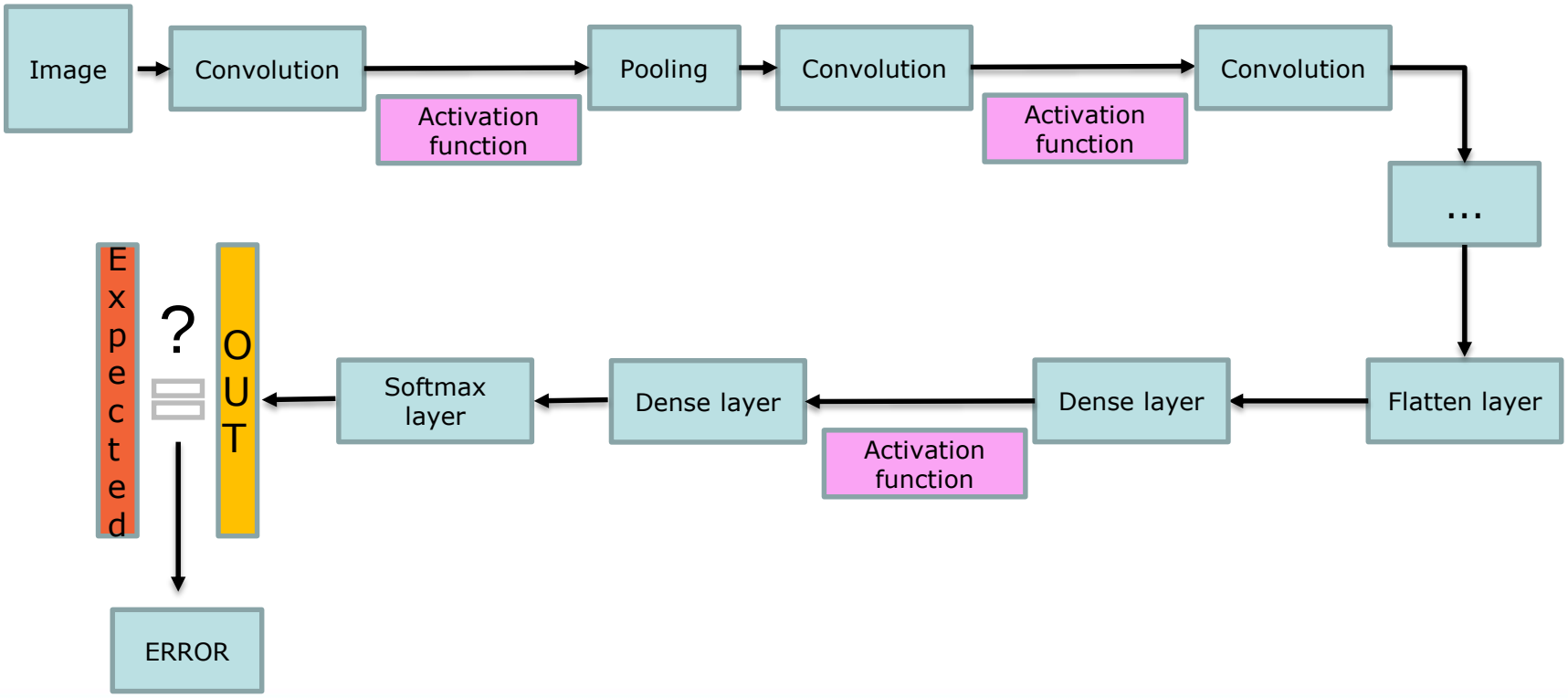
Convolutional Neural Network

Forward pass



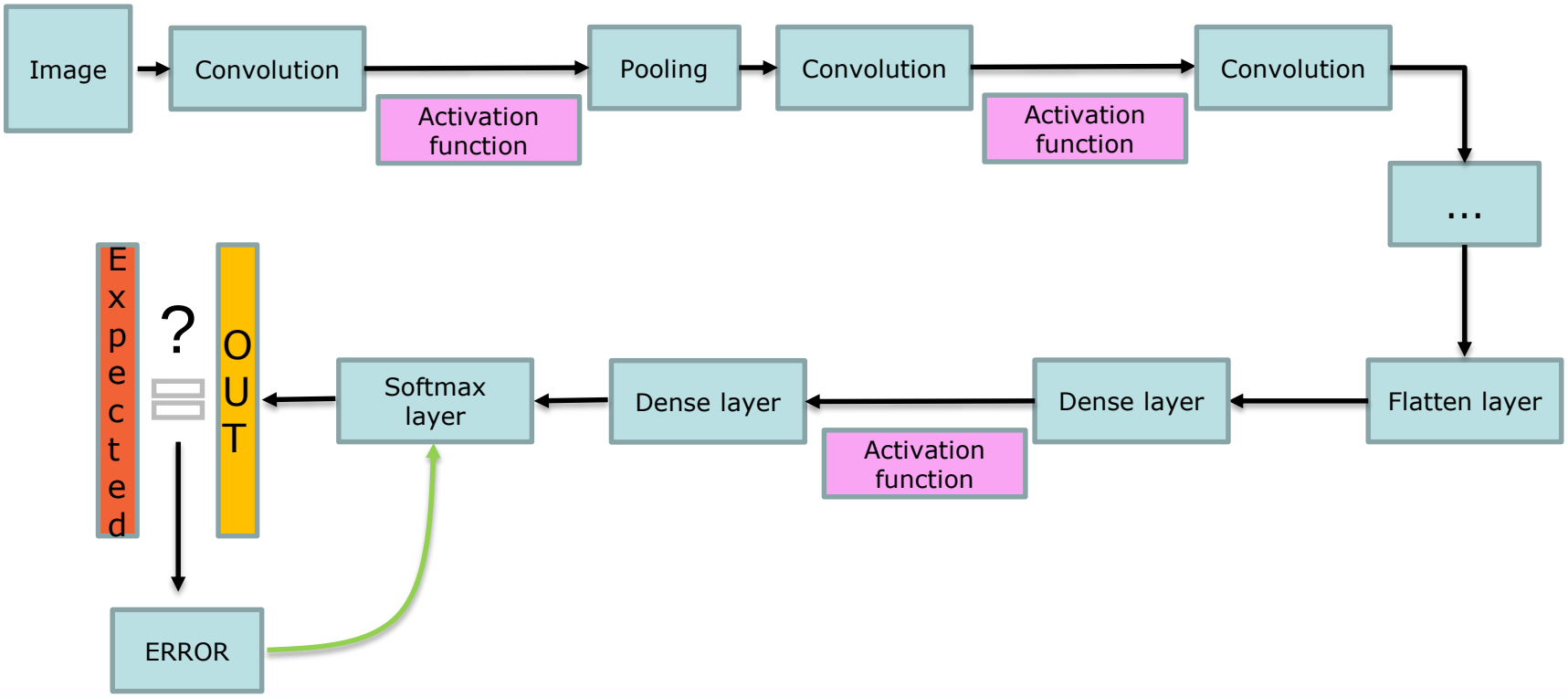
Convolutional Neural Network

Backward pass



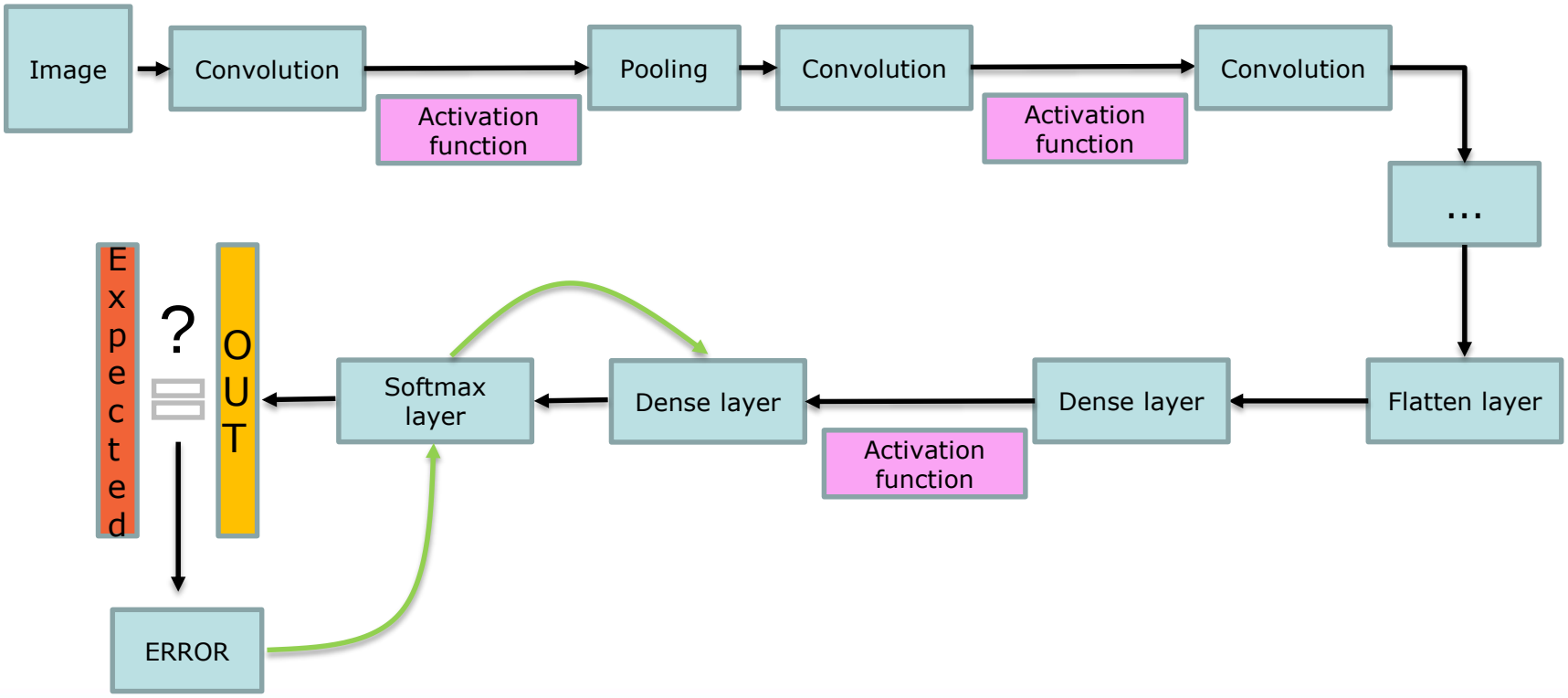
Convolutional Neural Network

Backward pass



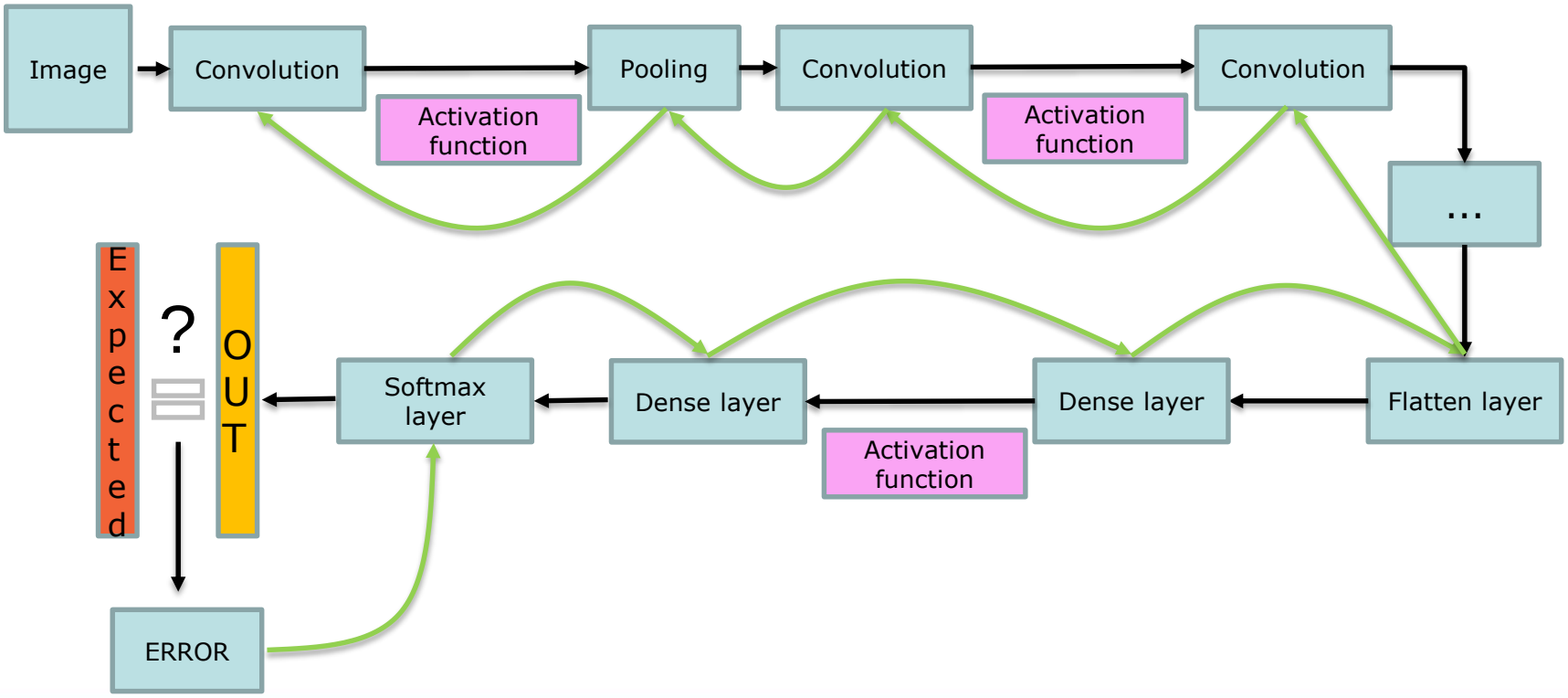
Convolutional Neural Network

Backward pass



Convolutional Neural Network

Backward pass



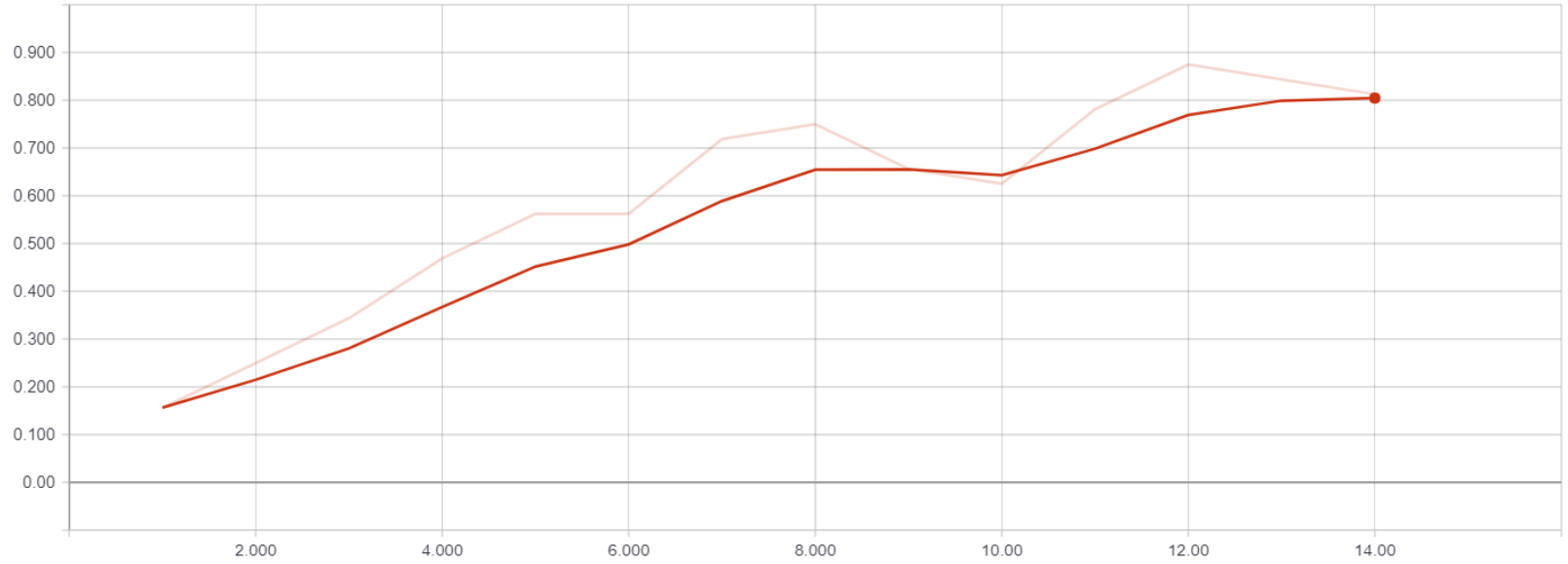
Convolutional Neural Network

Backward pass

Convolutional Neural Network

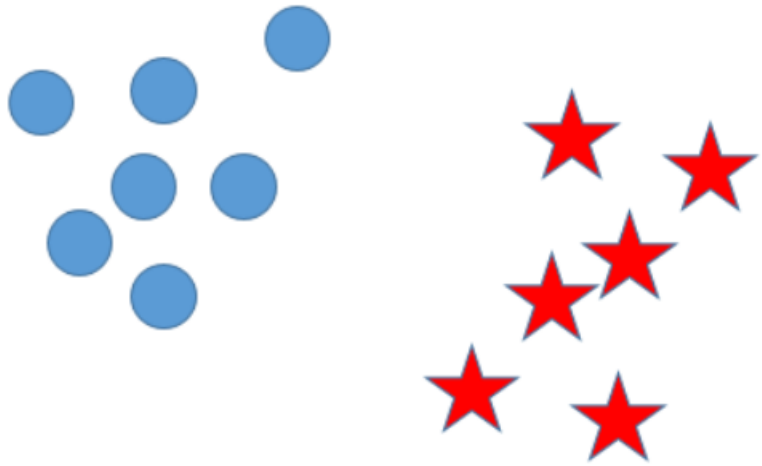
Test results

Training accuracy

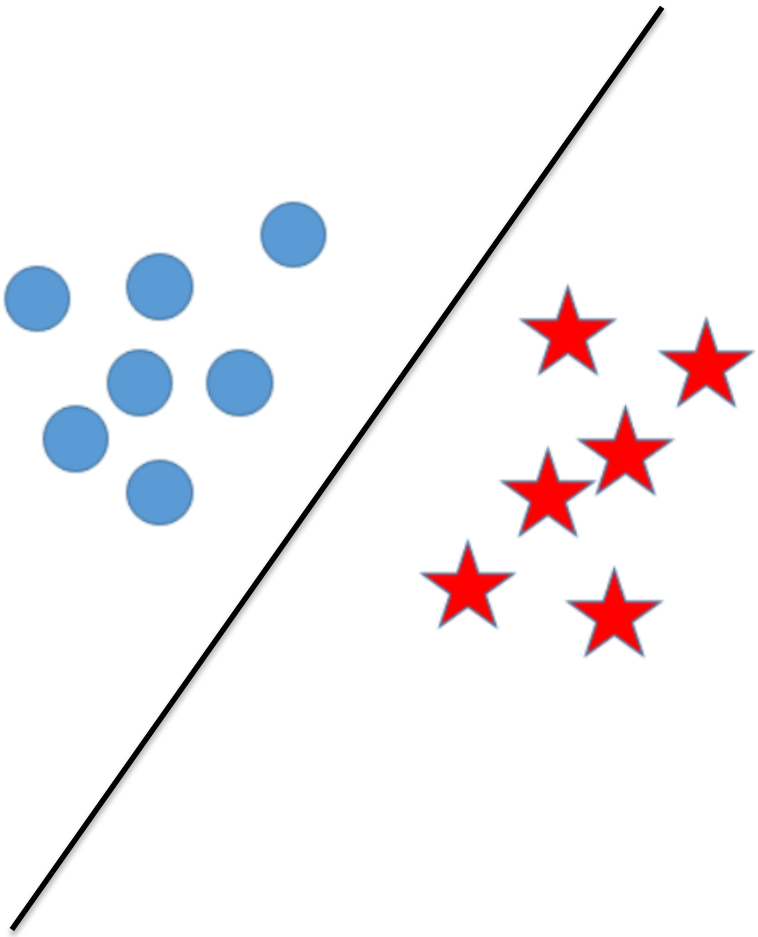


Recognition rate: 75.4%

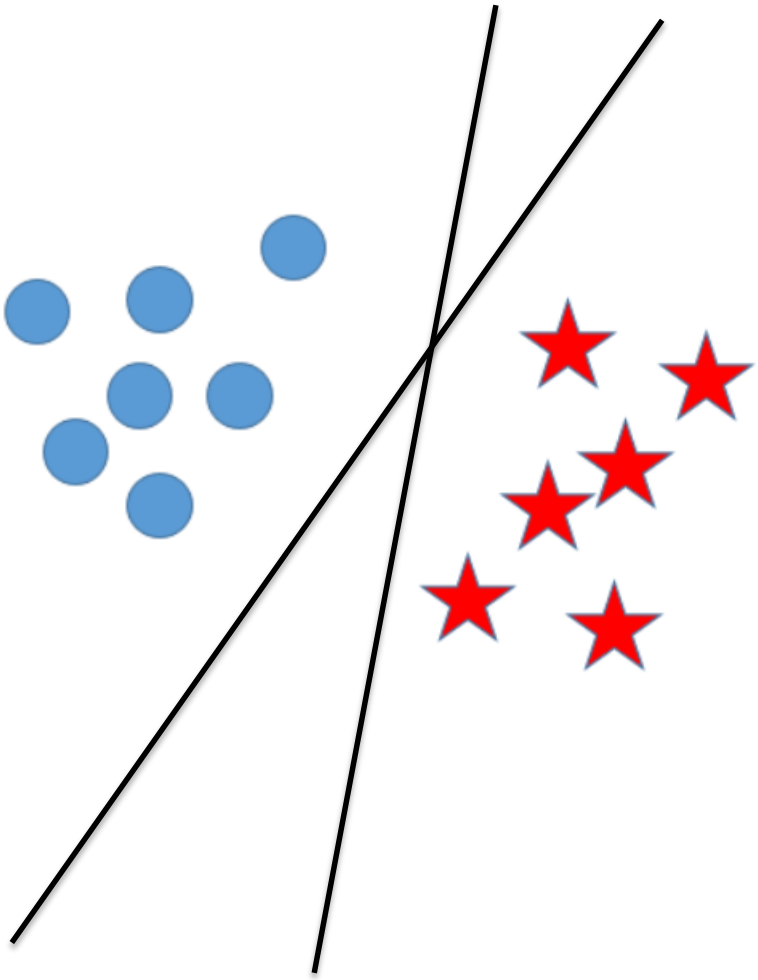
Support Vector Machine



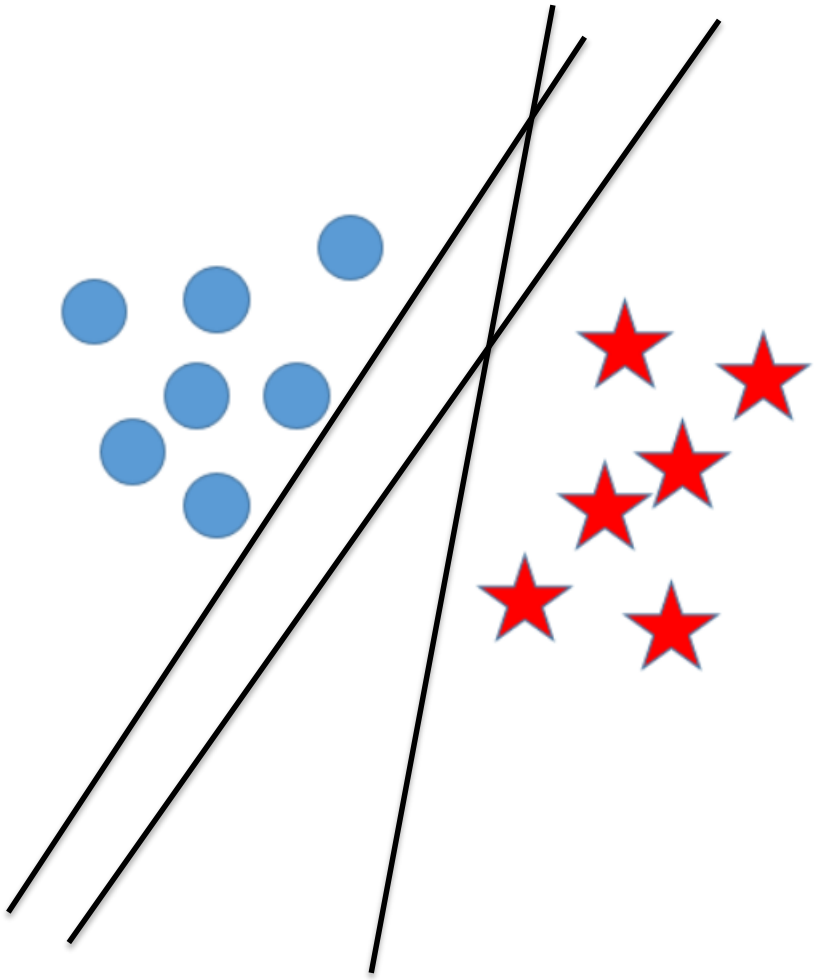
Support Vector Machine



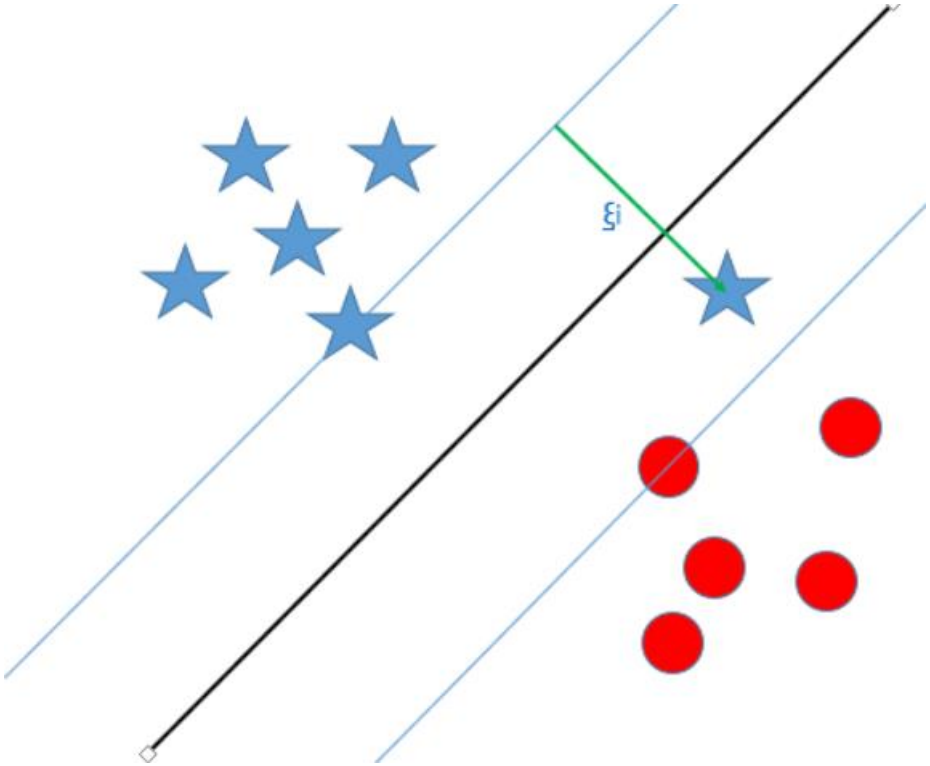
Support Vector Machine



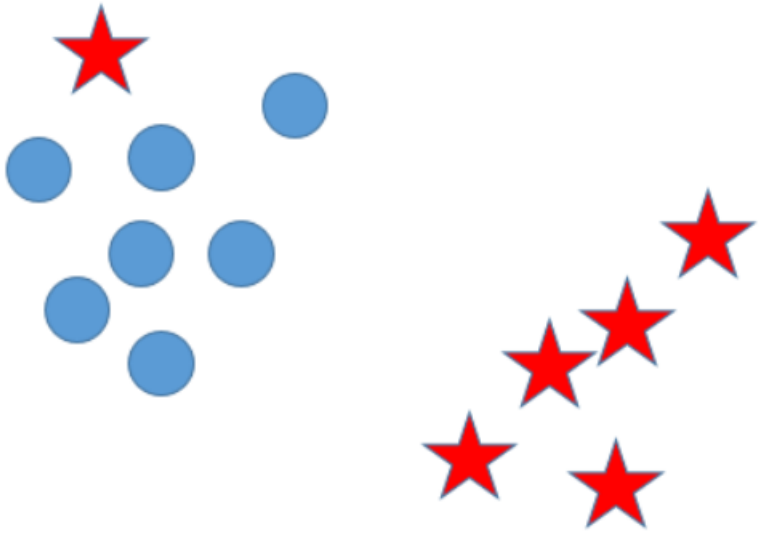
Support Vector Machine



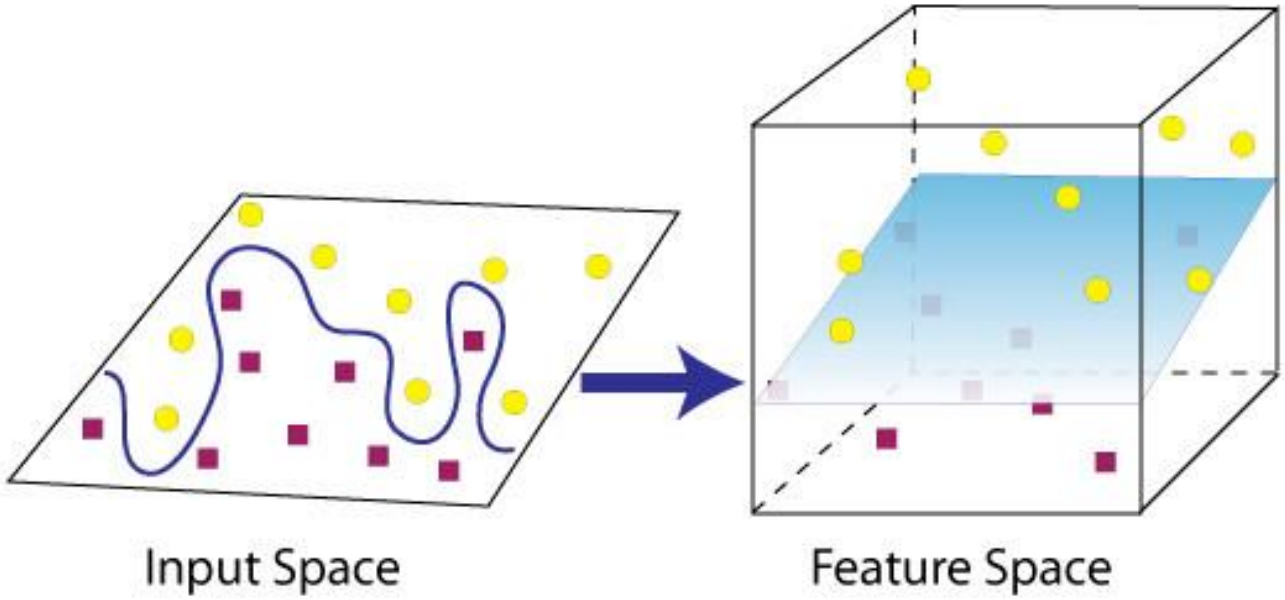
Support Vector Machine



Support Vector Machine



Support Vector Machine



Each point *xi* in the input data is mapped to a point $z = \phi(x)$ of higher dimensional space, called the feature space.

Support Vector Machine

Test results – recognition rates

Database	Gaussian kernel	Polynomial kernel
CFD 20	80%	70%
CFD 40	60%	52%
LFW 20	26.6%	20%

Summary

Algorithm	CFD 20	CFD 40	LFW 20
PCA	75%	65%	8.5%
MLP	90%	70%	73.3%
CNN	-	-	75.4%
SVM	80%	60%	26.6%