# Support vector machines

# Support vector machine (SVM)

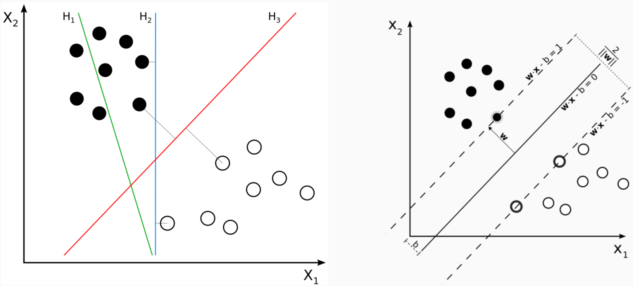


**Figure 6:** Maximum margin idea of SVMs `http://en.wikipedia.org` .

## Principal idea

- The (two class) starting idea is that two point clouds are linearly separable
- The problem is to find the separating hyperplane that maximises the error margin
- A solution to the problem can be formulated as an inequality constrained quadratic optimisation problem

# Linearly non-separable case

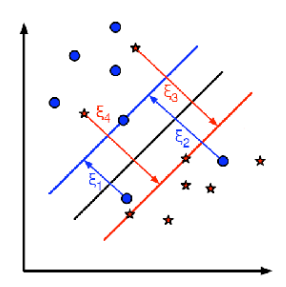


**Figure 7:** Linearly non-separable case
`http://http://docs.opencv.org` .

- We must allow errors $\xi_i$ with respect to the margin inequalities
- We must penalise errors $(C)$ in the optimisation procedure

# Non-linear SVM

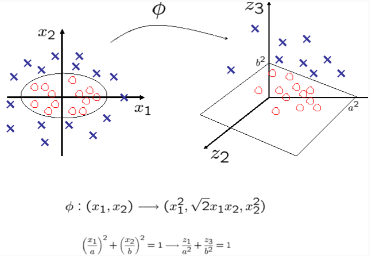


**Figure 8:** "Kernel trick" `http://omega.albany.edu` .

- Apply a transformation kernel to inputs to map them to a higher dimensional space
- The dual formulation of the quadratic optimisation problem allows efficient computation

## State-of-the-art performance with many benchmarks

- Parameter 1: the error penalty $C$
- Parameter 2: the choice of the kernel $\phi(\vec{x})$ and optionally the kernel parameters (e.g., the degree of a polynomial)
- At the core are very efficient methods of quadratic optimisation and especially the dual formulation of the optimisation problem

# Summary

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- Idea of multi-layer perception (MLP) networks and their training
- MLP parameters (from underfitting to overfitting)
- Idea of support vector machines (SVMs)
- SVM parameters