Machine Learning applied to Planetary Sciences

PTYS 595B/495B

Leon Palafox

https://leonpalafox.github.io/MLClass/

News of the day

How Data And Machine Learning Are Changing The Solar Industry

by Katie Fehrenbacher @katiefehren SEPTEMBER 14, 2016, 10:00 AM EDT

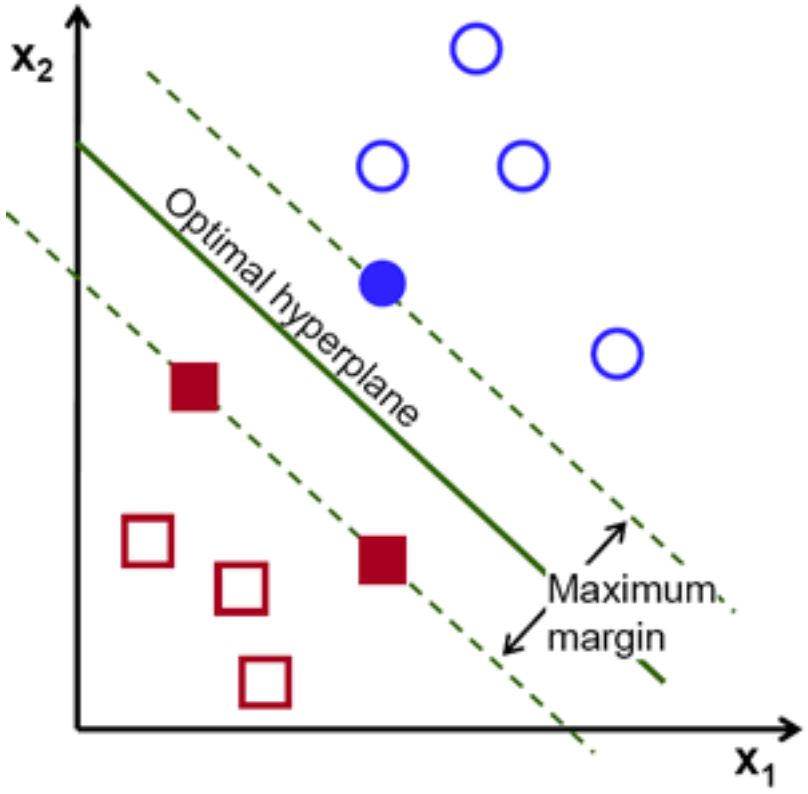
http://fortune.com/2016/09/14/data-machine-learning-solar/

The mighty hammer – Support Vector Machines

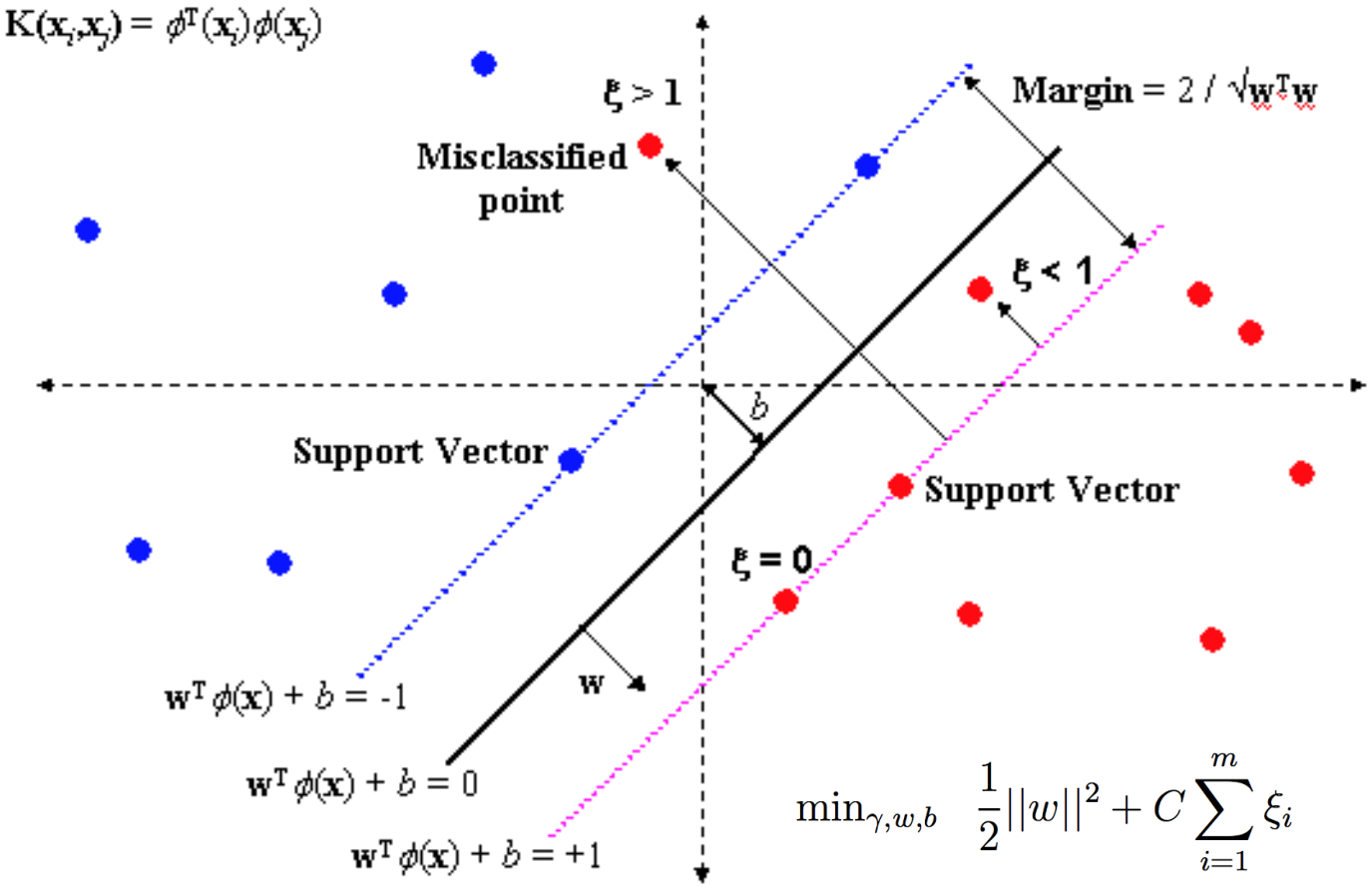
- Support Vector Machines are the best off-the-shelf ML technique.
  - Is relatively straight forward to use.
  - Has few parameters to optimize
  - Works amazingly well, regardless the size of the data.
  - Is fast, compared with other ML techniques.

Try to keep the walls apart!

SVM Introduction



Parameter C



$$\min_{\gamma,w,b} \quad \frac{1}{2}||w||^2 + C\sum_{i=1}^{m}\xi_i$$

$$\text{s.t.} \quad y^{(i)}(w^T x^{(i)} + b) \geq 1 - \xi_i, \quad i = 1,\ldots,m$$

$$\xi_i \geq 0, \quad i = 1,\ldots,m.$$

Kernels

- Like in linear regression, using only lines is impractical to solve classification problems.

- We use the concept of Kernel (distance).
  - Different definitions of Kernels allow for different spaces
  - Most common ones:
    - Linear (logistic regression)
    - Polynomial (expanded powers) (power of polynomial)
    - RBF (Gaussian Kernel) (“variance”)

“Kernel trick”

The kernel trick avoids the explicit mapping that is needed to get linear learning algorithms to learn a nonlinear function or decision boundary. For all $\mathbf{x}$ and $\mathbf{x}'$ in the input space $\mathcal{X}$, certain functions $k(\mathbf{x}, \mathbf{x}')$ can be expressed as an inner product in another space $\mathcal{V}$. The function $k: \mathcal{X} \times \mathcal{X} \to \mathbb{R}$ is often referred to as a *kernel* or a *kernel function*. The word "kernel" is used in mathematics to denote a weighting function for a weighted sum or integral.

https://en.wikipedia.org/wiki/Kernel_method#Mathematics:_the_kernel_trick

Kernels

- RBF (Radial Basis Function)

$$K(\mathbf{x}, \mathbf{x}') = \exp\left(-\frac{||\mathbf{x} - \mathbf{x}'||^2}{2\sigma^2}\right)$$

$$K(\mathbf{x}, \mathbf{x}') = \exp(-\gamma||\mathbf{x} - \mathbf{x}'||^2)$$

- People like calling the ‘sigma’ as ‘gamma’