EE 1390 AIML

SVM Presentation

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Simple Linear Regression

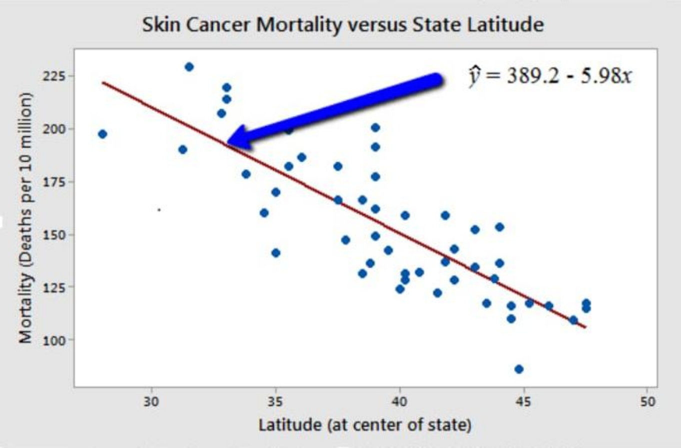


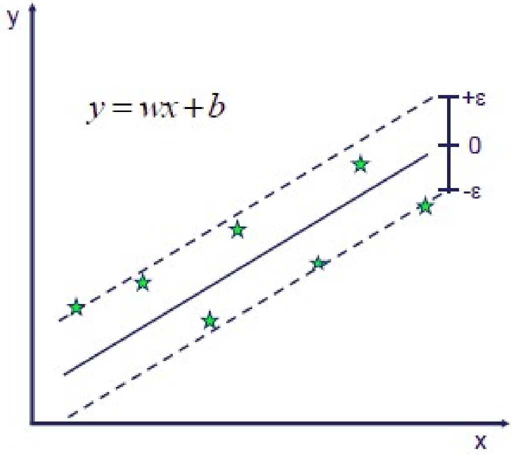
Figure: An example of simple linear regression

Taken from Online Stat of Penn State

Support Vector Machine - Regression (SVR)

Support vector machine can also be used as a regression method, maintaining all the main features that characterize the algorithm (maximal margin).
The main idea is to minimise error, individualizing the hypwrplane which maximizes the margin, keeping in mind that part of the error is tolerated.

Example

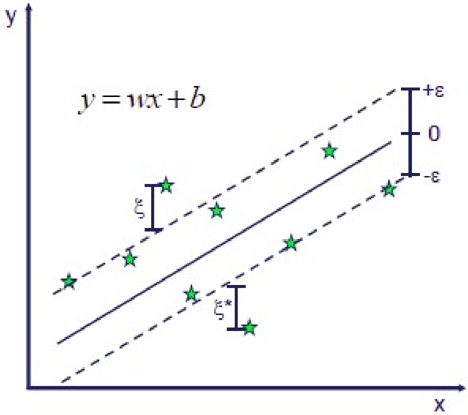


- Solution:

$$\min \frac{1}{2}\|w\|^2$$

- Constraints:

$$y_i - wx_i - b \le \varepsilon$$
$$wx_i + b - y_i \le \varepsilon$$



- Minimize:

$$\frac{1}{2}\|w\|^2 + C\sum_{i=1}^{N}\left(\xi_i + \xi_i^*\right)$$

- Constraints:

$$y_i - wx_i - b \le \varepsilon + \xi_i$$

$$wx_i + b - y_i \le \varepsilon + \xi_i^*$$

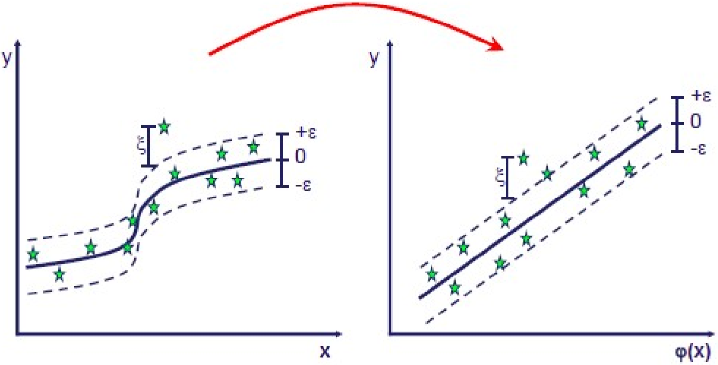
$$\xi_i, \xi_i^* \ge 0$$

- Linear SVR

$y = \sum_{i=1}^{N}(\alpha_i - \alpha_i^*). < x_i, x > +b$

- Non-Linear SVR

The kernel functions transform the data into a higher dimensional feature space to make it possible to perform the linear separation
$y = \sum_{i=1}^{N}(\alpha_i - \alpha_i^*). < \phi(x_i), \phi(x) > +b$
$y = \sum_{i=1}^{N}(\alpha_i - \alpha_i^*).K(x_i, x) + b$



Example taken from saedsayad

Comparing SVR and Linear Regression

- A SVR leads to a non-linear regression, i.e. fitting a curve rather than a line
- optimization problem is transformed into dual convex quadratic programmes

In SVM Regression, input is first mapped onto a m-dimensional feature space using some fixed (nonlinear) mapping, and then a linear model is constructed in this feature space.
The linear model(in the feature space) is given by:
$f(x, \omega) = \omega_j g_j(x) + b$
where $g_j(x), j = 1, ..., m$ denotes a set of nonlinear transformations, and b is the "bias" term. Often the data are assumed to be zero mean(this can be achieved by preprocessing), so the bias term is dropped.