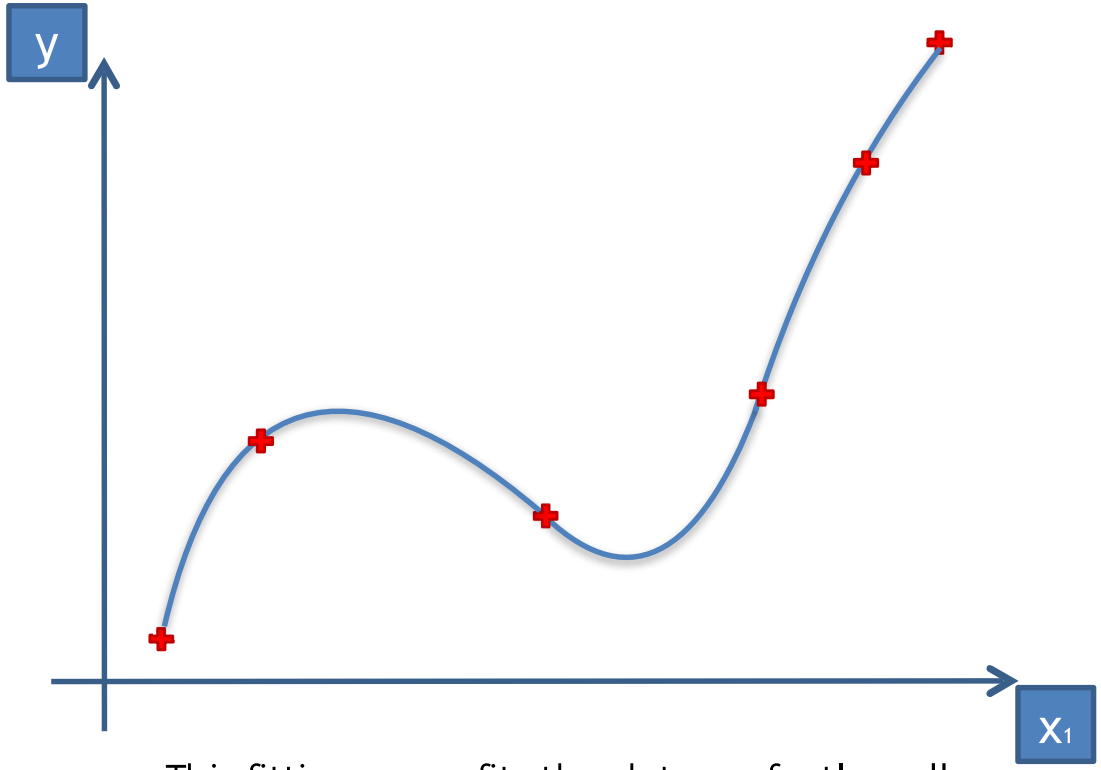
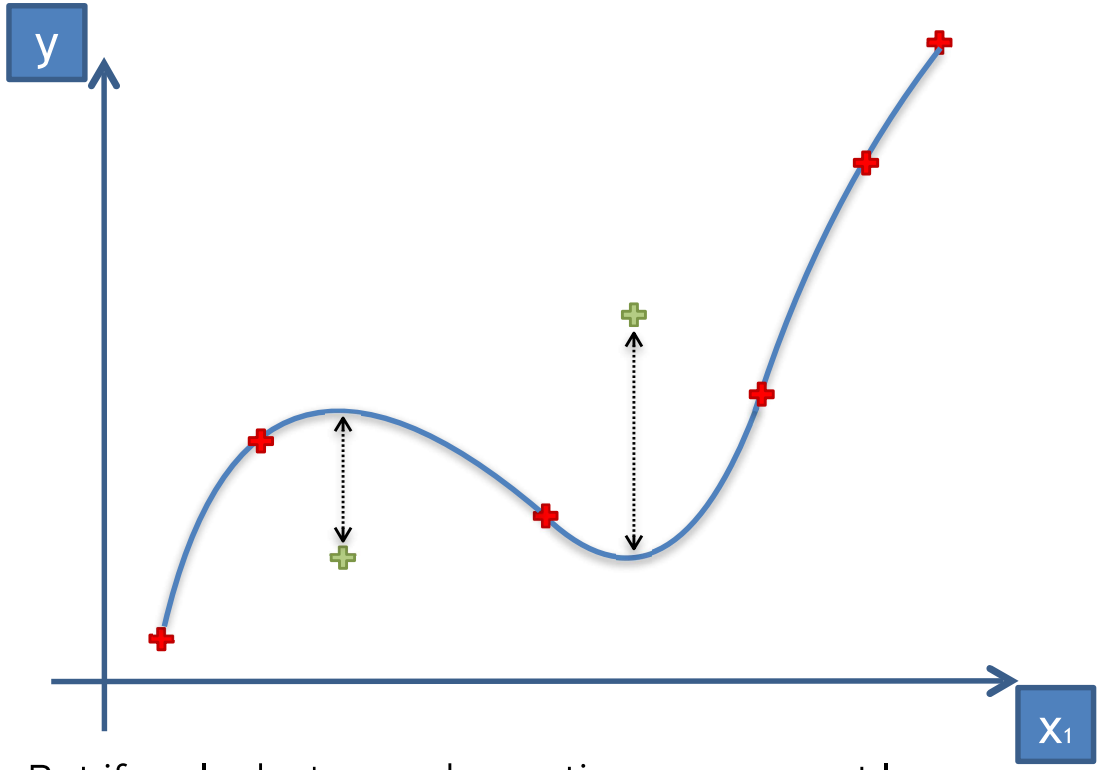
Regularization Intuition

The problem of Overfitting



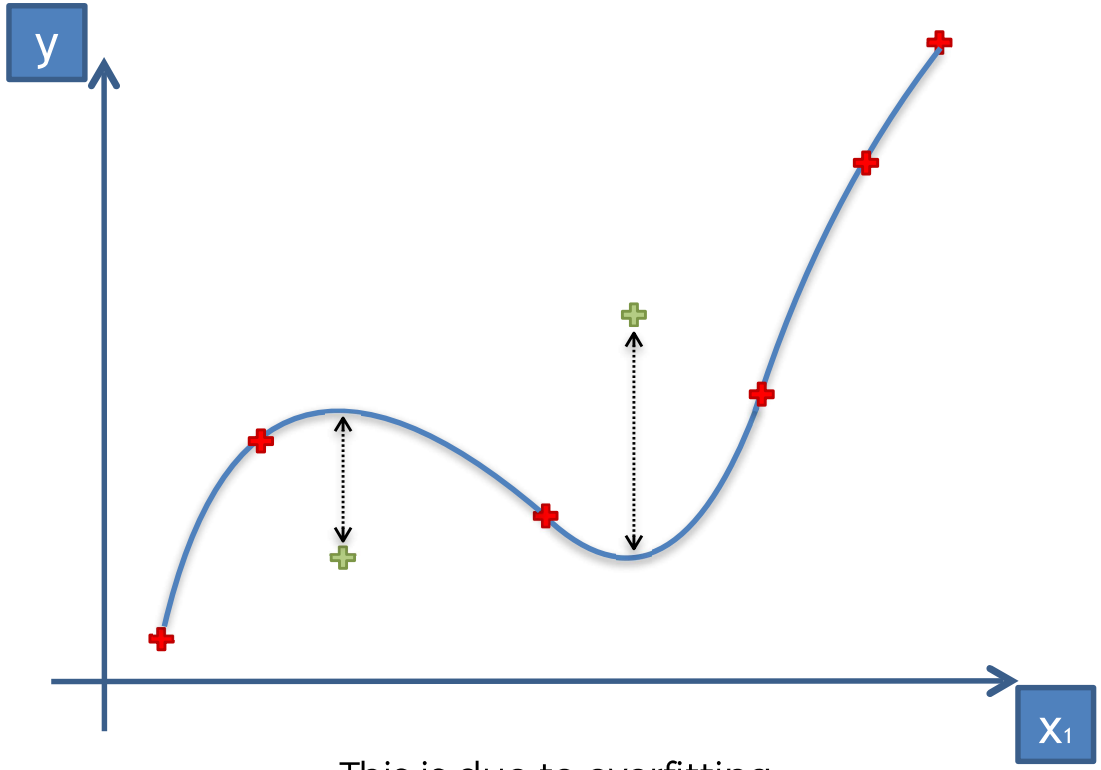
This fitting curve fits the data perfectly well

The problem of Overfitting



But if we look at new observations, we can get large errors

The problem of Overfitting

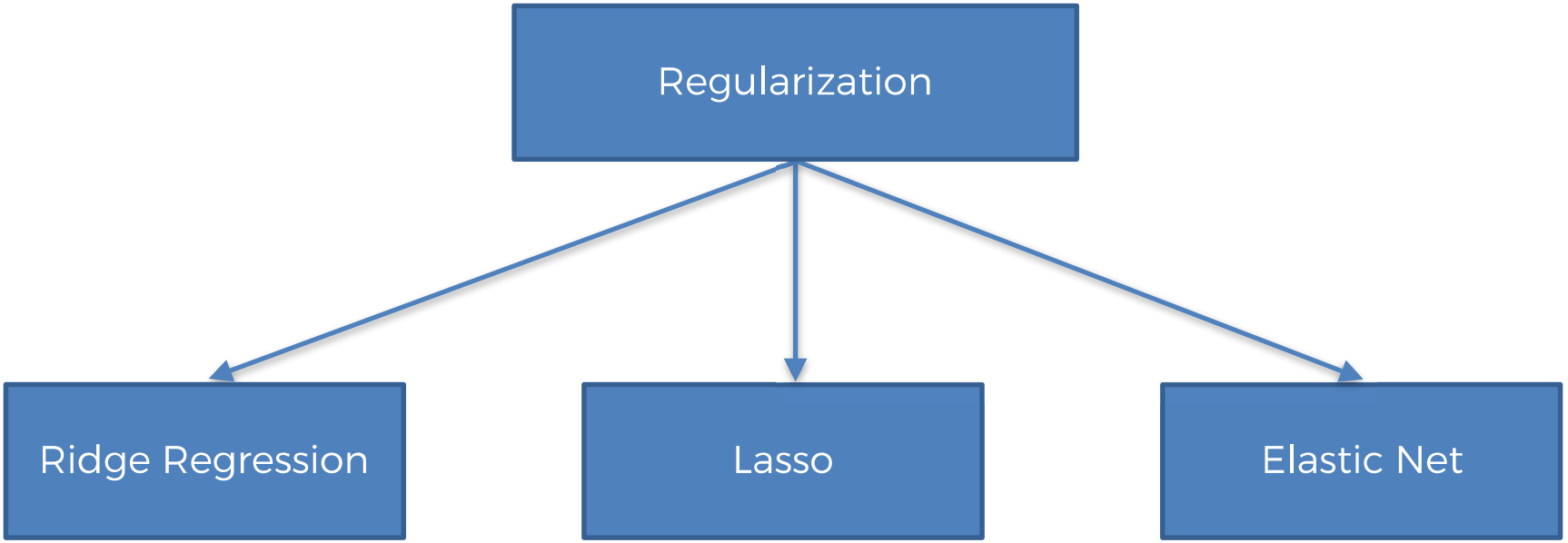


This is due to overfitting

Solution

Regularization

Examples of Regularization



No Regularization

$$\text{Minimize} \sum_{i=1}^{n} \left(y^i - (b_0 + b_1 x_1^i + \ldots + b_m x_m^i)\right)^2$$

Ridge Regression

$$\text{Minimize} \sum_{i=1}^{n} \left(y^i - (b_0 + b_1 x_1^i + \ldots + b_m x_m^i)\right)^2 + \lambda(b_1^2 + \ldots + b_m^2)$$

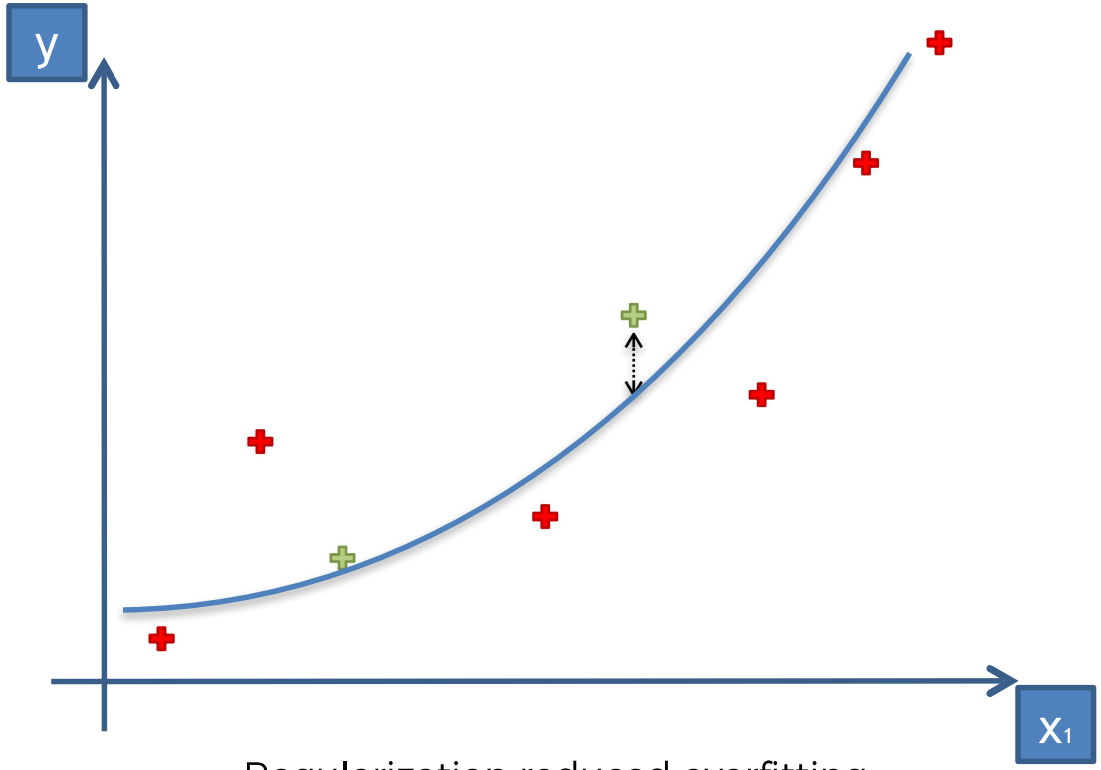
Lasso

$$\text{Minimize} \sum_{i=1}^{n} \left(y^i - \left(b_0 + b_1 x_1^i + \ldots + b_m x_m^i\right)\right)^2 + \lambda\left(|b_1| + \ldots + |b_m|\right)$$

Elastic Net

$$\text{Minimize} \sum_{i=1}^{n} \left(y^i - (b_0 + b_1 x_1^i + \ldots + b_m x_m^i)\right)^2 + \lambda_1(|b_1| + \ldots + |b_m|) + \lambda_2(b_1^2 + \ldots + b_m^2)$$

Regularization



Regularization reduced overfitting