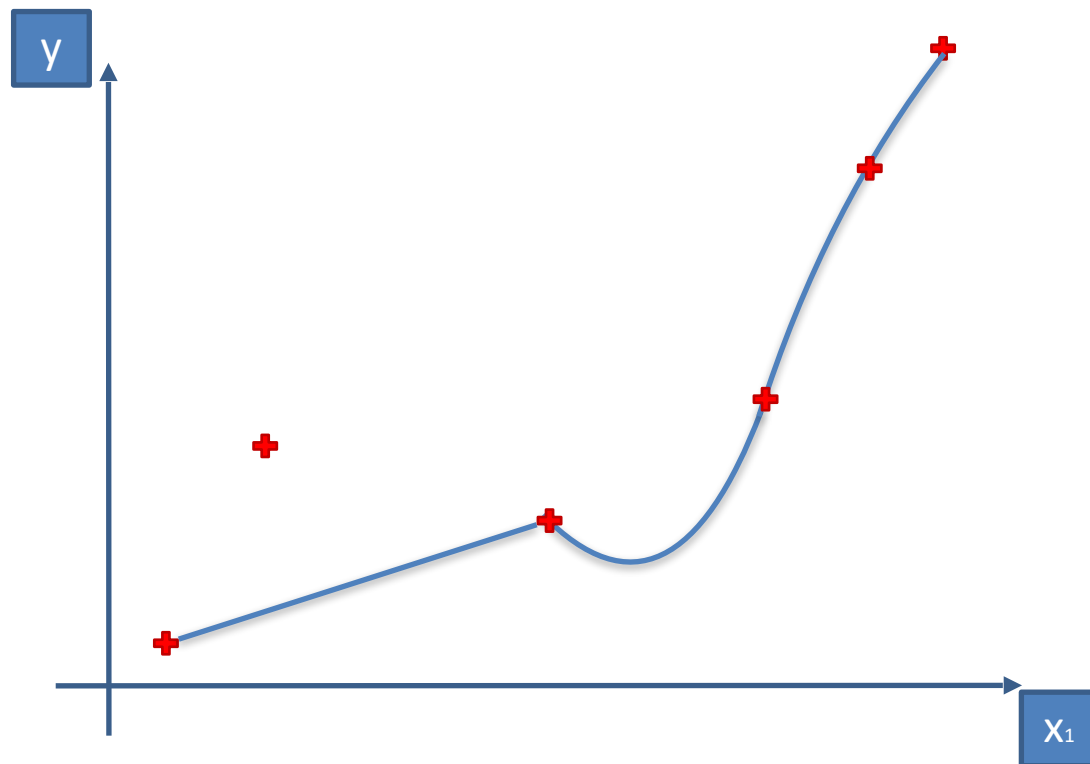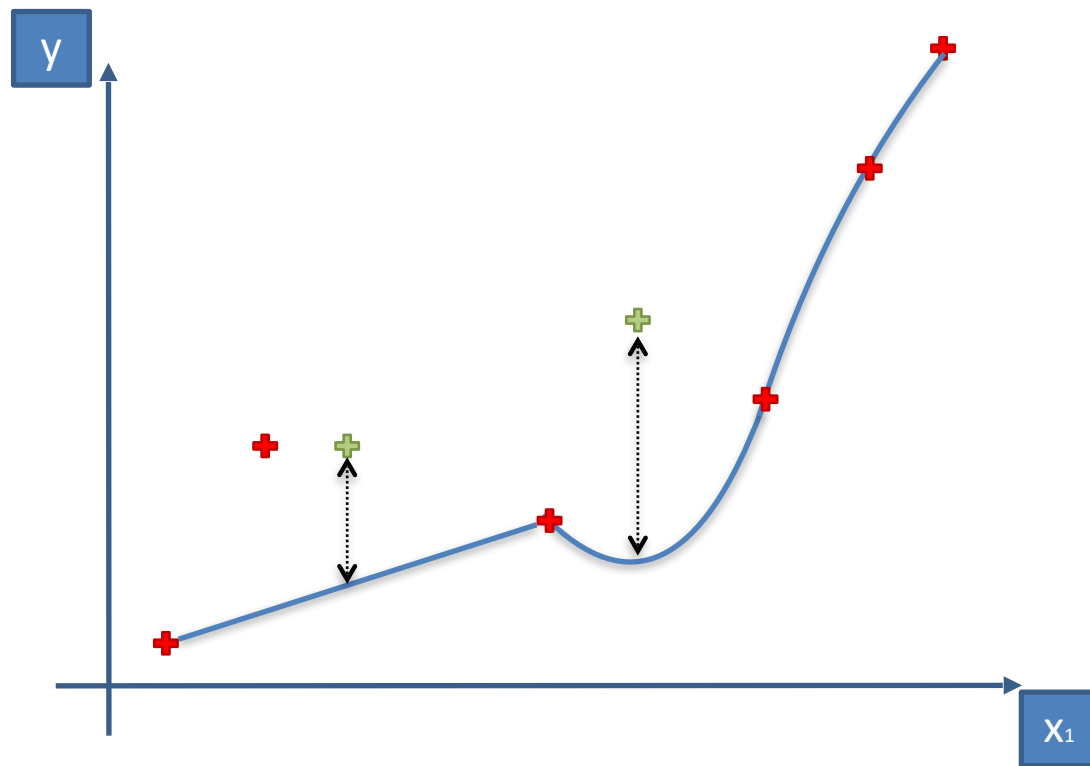# Regularization Intuition

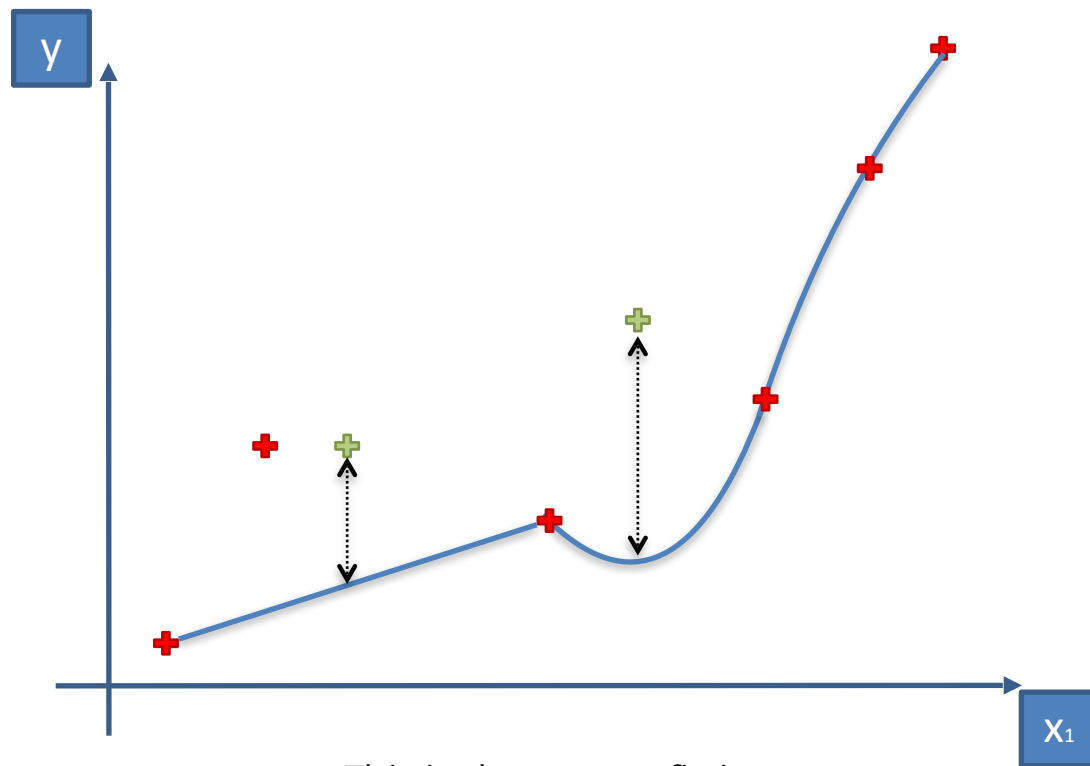# The problem of Overfitting

This fitting curve fits the data perfectly well

The problem of Overfitting

But if we look at new observations, we can get large errors
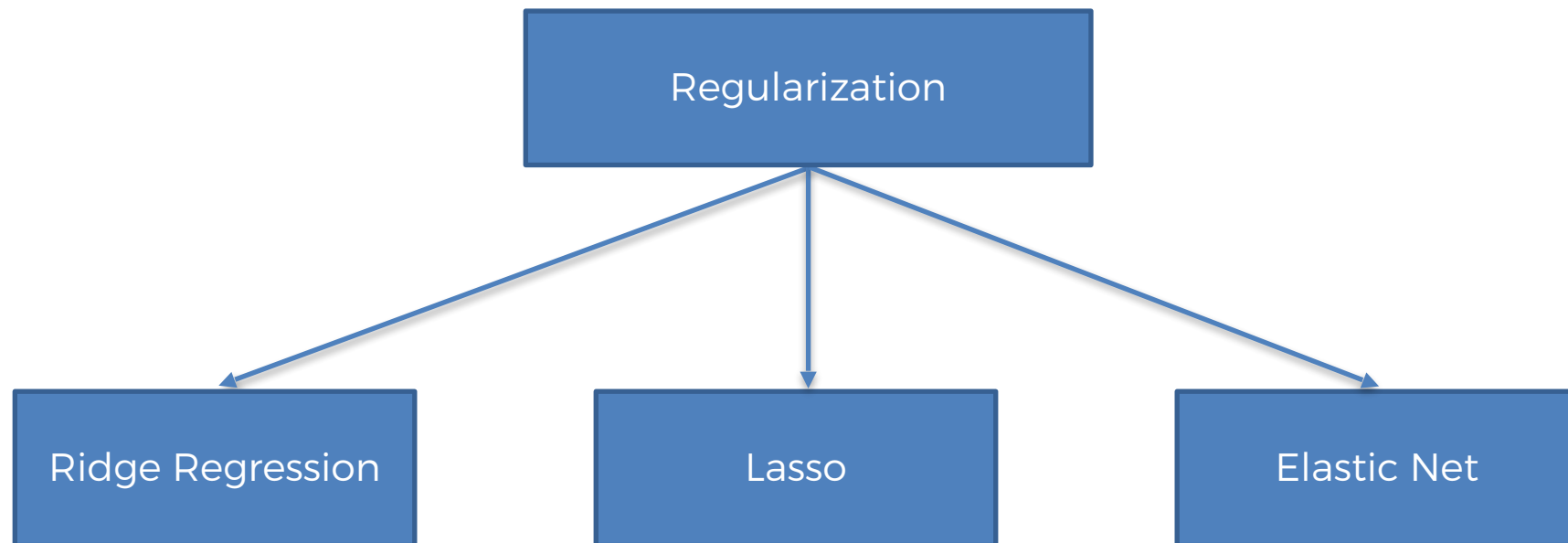
The problem of Overfitting

This is due to overfitting

Solution

Regularization

Examples of Regularization

No Regularization

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

Ridge Regression

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

Lasso

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

Elastic Net

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

Regularization

Regularization reduced overfitting