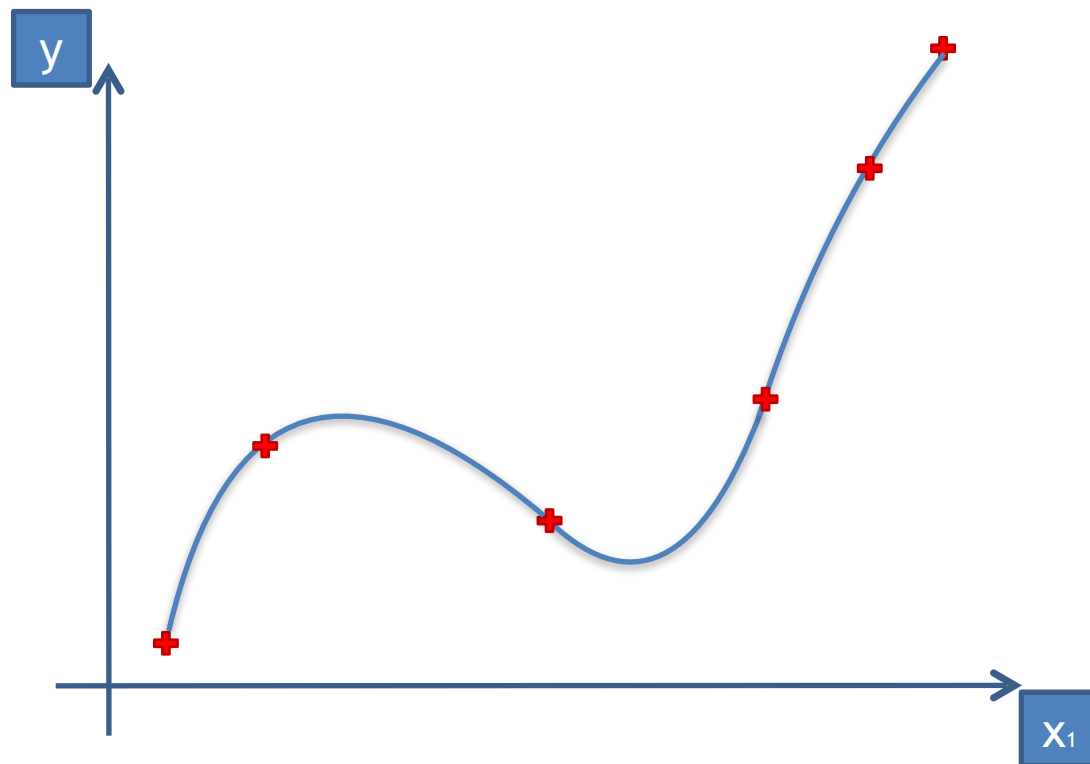


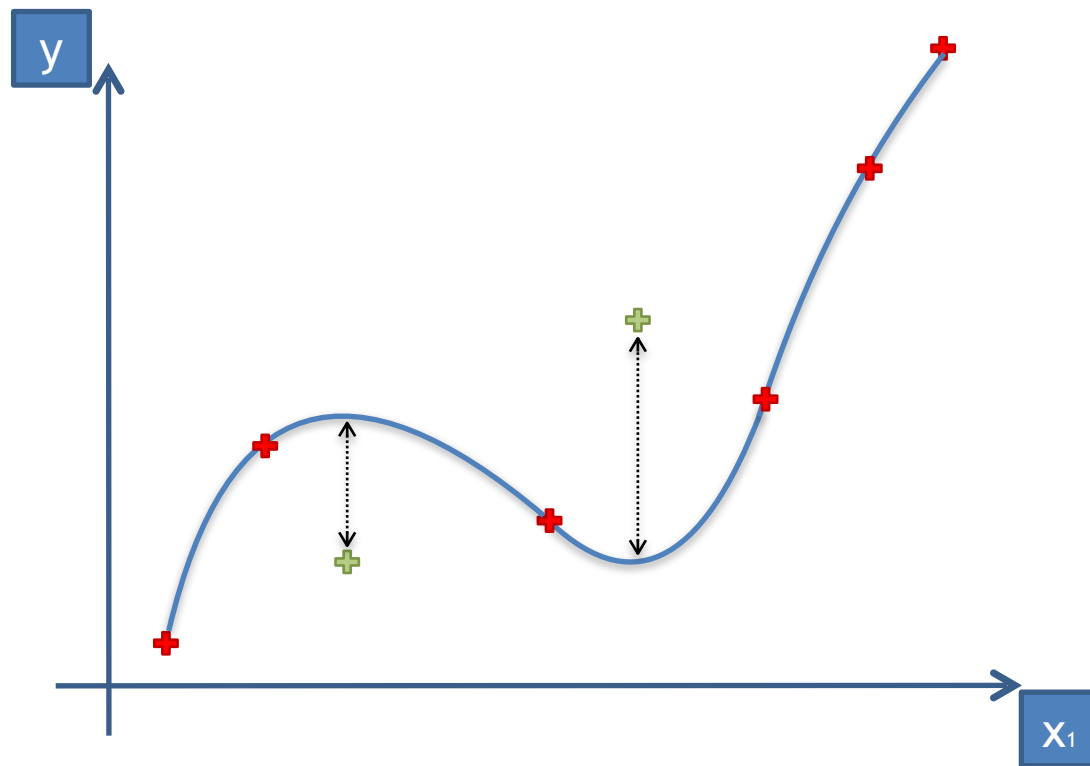
# Regularization Intuition

# The problem of Overfitting



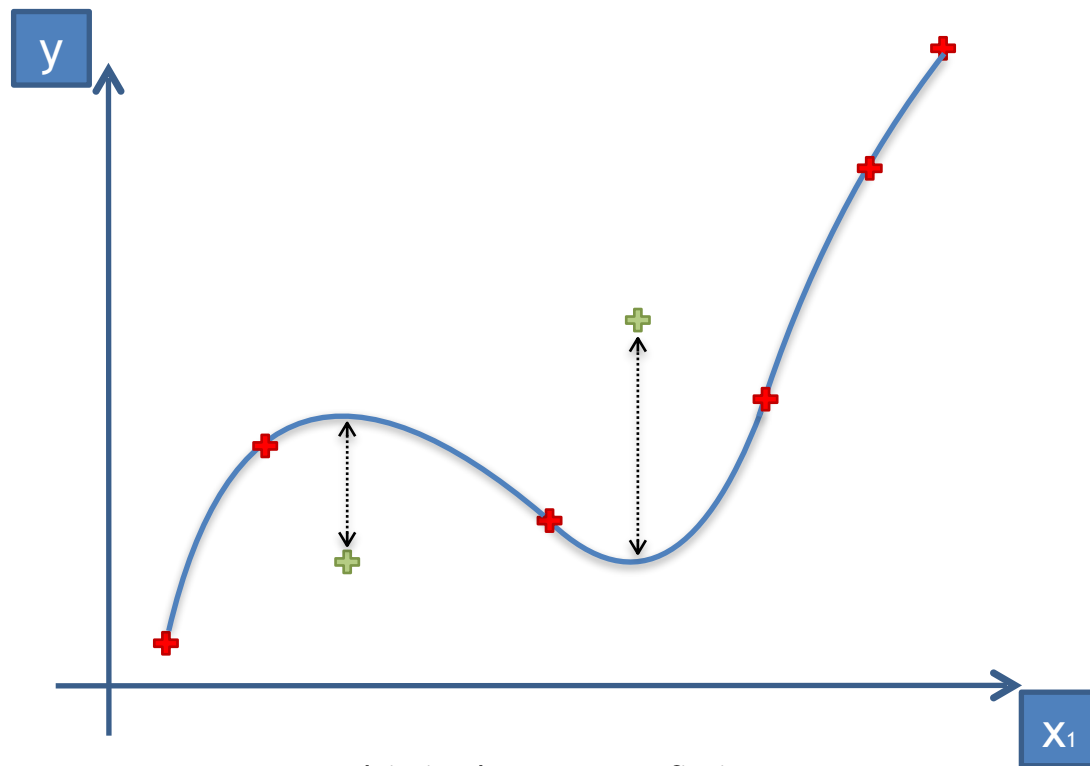
This fitting curve fits the data perfectly well

# 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

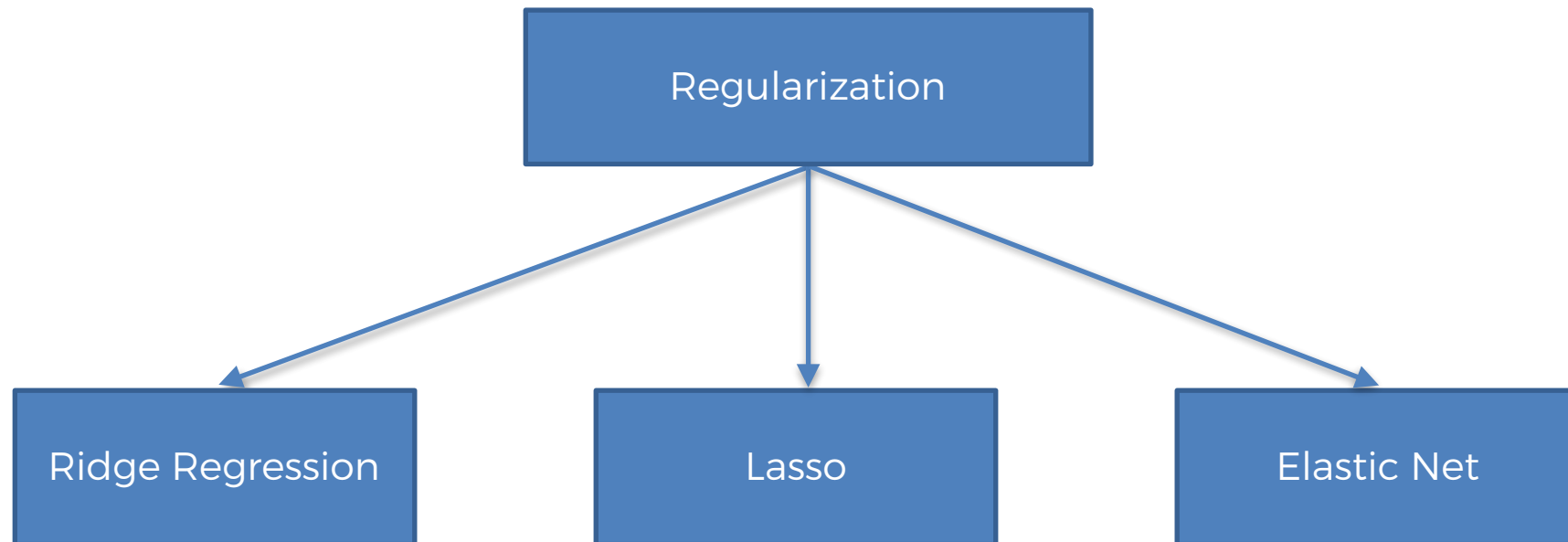
# Solution

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Regularization

# Examples of Regularization

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# No Regularization

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

# Ridge Regression

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



# Lasso

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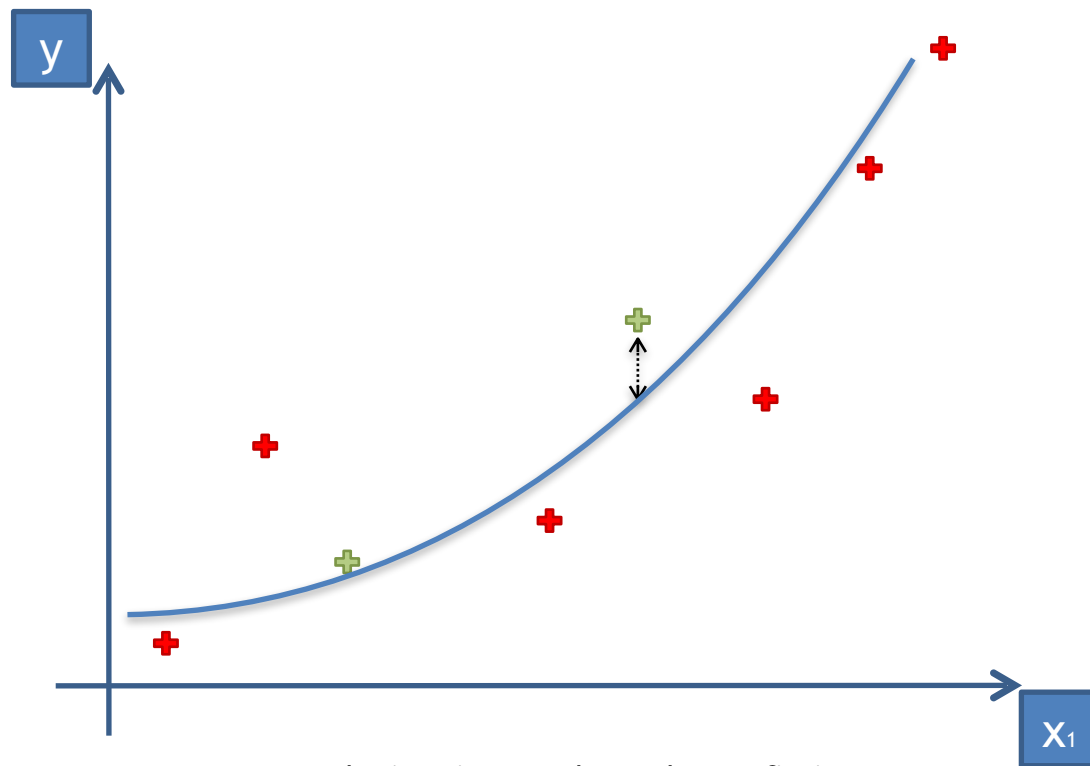
$$\text{Minimize } \sum_{i=1}^n (y^i - (b_0 + b_1 x_1^i + \dots + b_m x_m^i))^2 + \lambda(|b_1| + \dots + |b_m|)$$

# Elastic Net

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

# Regularization



Regularization reduced overfitting