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

- Ridge Regression
- Lasso
- Elastic Net
No Regularization

\[
\text{Minimize } \sum_{i=1}^{n} (y^i - (b_0 + b_1x_1^i + \ldots + b_mx_m^i))^2
\]
Ridge Regression

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

Minimize \[ \sum_{i=1}^{n} (y^i - (b_0 + b_1 x_1^i + \ldots + b_m x_m^i))^2 + \lambda(|b_1| + \ldots + |b_m|) \]
Elastic Net

Minimize $\sum_{i=1}^{n} (y^i - (b_0 + b_1x_1^i + \ldots + b_mx_m^i))^2 + \lambda_1(|b_1| + \ldots + |b_m|) + \lambda_2(b_1^2 + \ldots + b_m^2)$
Regularization reduced overfitting