



## Classification and Representation

- ✓ **Video:** Classification  
8 min
- ✓ **Reading:** Classification  
2 min
- ✓ **Video:** Hypothesis Representation  
7 min
- ✓ **Reading:** Hypothesis Representation  
3 min
- ✓ **Video:** Decision Boundary  
14 min
- ✓ **Reading:** Decision Boundary  
3 min

## Logistic Regression Model

- ✓ **Video:** Cost Function  
10 min
- ✓ **Reading:** Cost Function  
3 min
- ✓ **Video:** Simplified Cost Function and Gradient Descent  
10 min
- ✓ **Reading:** Simplified Cost Function and Gradient Descent  
3 min
- ✓ **Video:** Advanced Optimization  
14 min
- ✓ **Reading:** Advanced Optimization  
3 min



# Regularized Linear Regression

**Note:** [8:43 - It is said that  $X$  is non-invertible if  $m \leq n$ . The statement should be that  $X$  is non-invertible if  $m < n$ , and invertible if  $m = n$ .

We can apply regularization to both linear regression and logistic regression. We will approach linear regression first.

## Gradient Descent

We will modify our gradient descent function to separate the regularization from the rest of the parameters because we do not want to penalize the regularization.

Repeat {

$$\theta_0 := \theta_0 - \alpha \frac{1}{m} \sum_{i=1}^m (h_{\theta}(x^{(i)}) - y^{(i)}) x_0^{(i)}$$

$$\theta_j := \theta_j - \alpha \frac{1}{m} \sum_{i=1}^m (h_{\theta}(x^{(i)}) - y^{(i)}) x_j^{(i)} + \frac{\lambda}{m} \theta_j$$

}

The term  $\frac{\lambda}{m} \theta_j$  performs our regularization. With some rearranging, the update rule can also be represented as:

$$\theta_j := \theta_j (1 - \alpha \frac{\lambda}{m}) - \alpha \frac{1}{m} \sum_{i=1}^m (h_{\theta}(x^{(i)}) - y^{(i)}) x_j^{(i)}$$

The first term in the above equation,  $1 - \alpha \frac{\lambda}{m}$  will always be less than 1. Intuitively you can see it as reducing the value of  $\theta_j$  by some factor every update. Notice that the second term is now exactly the same as before.

## Normal Equation

Now let's approach regularization using the alternate method of the normal equation.