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Anuja Nagpal

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L1 and L2 Regularization Methods

Machine Learning

In my last [post](#), I covered the introduction to Regularization in supervised learning models. In this post, let's go over some of the regularization techniques widely used and the key difference between those.

In order to create less complex (parsimonious) model when you have a large number of features in your dataset, some of the Regularization techniques used to address over-fitting and feature selection are:

1. L1 Regularization

2. L2 Regularization

A regression model that uses L1 regularization technique is called **Lasso Regression** and model which uses L2 is called **Ridge Regression**.

The key difference between these two is the penalty term.

Ridge regression adds "squared magnitude" of coefficient as penalty term to the loss function. Here the *highlighted* part represents L2 regularization element.

$$\sum_{i=1}^n (y_i - \sum_{j=1}^p x_{ij} \beta_j)^2 + \lambda \sum_{j=1}^p \beta_j^2$$

Cost function

Here, if *lambda* is zero then you can imagine we get back OLS. However, if *lambda* is very large then it will add too much weight and it will lead to under-fitting. Having said that it's important how *lambda* is chosen. This technique works very well to avoid over-fitting issue.

Lasso Regression (Least Absolute Shrinkage and Selection Operator) adds "absolute value of magnitude" of coefficient as penalty term to the loss function.

$$\sum_{i=1}^n (Y_i - \sum_{j=1}^p X_{ij} \beta_j)^2 + \lambda \sum_{j=1}^p |\beta_j|$$

Cost function

Again, if *lambda* is zero then we will get back OLS whereas very large value will make coefficients zero hence it will under-fit.

The **key difference** between these techniques is that Lasso shrinks the less important feature's coefficient to zero thus, removing some feature altogether. So, this works well for **feature selection** in case we have a huge number of features.

Traditional methods like cross-validation, stepwise regression to handle overfitting and perform feature selection work well with a small set of features but these techniques are a great alternative when we are dealing with a large set of features.

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