

GENERALIZATION

Arguably, Machine Learning models have one sole purpose - to generalize well. Generalization is the model's ability to give sensible outputs to sets of input that it has never seen before.

Overfitting

Overfitting happens when a model learns the detail and noise in the training data to the extent that it negatively impacts the performance of the model on new data. This means that the noise or random fluctuations in the training data is picked up and learned as concepts by the model. The problem is that these concepts do not apply to new data and negatively impact the models ability to generalize.

Overfitting refers to capturing patterns which do not generalize well to unseen data. The model performs extremely well to the training set but poorly on the test set. Intuitively, overfitting occurs when the model or the algorithm fits the data too well. Overfitting a model result in good accuracy for training data set but poor results on new data sets. Such a model is not of any use in the real world as it is not able to predict outcomes for new cases.

Overfitting is more likely with nonparametric and nonlinear models that have more flexibility when learning a target function. As such, many nonparametric machine learning algorithms also include parameters or techniques to limit and constrain how much detail the model learns. For example, decision trees are a nonparametric machine learning algorithm that is very flexible and is subject to overfitting training data. This problem can be addressed by pruning a tree after it has learned in order to remove some of the detail it has picked up.

Methods to Avoid Overfitting

Early stopping - stop training when the network starts to over fit the data.

Regularization - adding a term to the error function equation intended to decrease the weights and biases and make the network less likely to over fit.

Reduce number of input columns

Dropout - Add a drop out layer

Underfitting

Underfitting refers to a model that can neither model the training data nor generalize to new data. An under fit machine learning model is not a suitable model and will be obvious as it will

have poor performance on the training data. An underfitted model fails to learn patterns hidden in the training data and predicts poorly as well.

Methods to Avoid Under fitting

Adding neuron layers or inputs

Removing or decreasing drop out

Removing or decreasing regularization parameter