Parameter Tuning: Exposing the Gap between Data Curation and Effective Data Analytics

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The Challenge and Promise of “Big Data”

Finding patterns in large datasets can deliver better decision making support to all aspects of our lives. However, the complexity of the data and the underlying analytics makes reproducibility and curation of the analysis difficult. This can lead to confusing results and redundant experimentation. This is the gap between the real and potential value of data analytics.

The case study presented here illustrates the vastness of a typical parameter space and the impact this has on models generated from data. It also illustrates the importance of parameter details to better understand the relationships between data, computational models, and subsequent model accuracy.

Materials and Methods

Our goal is to automatically identify results in scientific articles. The problem was framed as a classification task, where the classifier was trained to distinguish a result from a non-result sentence. Seventeen full-text articles from PubMed were annotated, giving 2556 total sentences with 965 reporting a result. A random sample of 10% of these sentences were used for model evaluation. The other 90% were used to train the classifiers.

The chi-squared (CHI) feature selection method was used to find high-information terms in the vocabulary. The vocabulary consists of all terms from the corpus reduced to their base forms with stopwords removed.

We tested four classifiers as implemented in the Oracle Data Miner 11g (ODM, release 1): support vector machines (SVM), decision trees (DT), general linear model (GLM), and naïve Bayes (NB).

Hundreds of modeling experiments were conducted to explore the parameter space.

Conclusions

The optimal settings for a given modeling problem are data dependent so optimal parameter settings cannot be known a priori.

An exhaustive search of the parameter space is difficult. The parameter space is so large that no single researcher can explore all possible settings. Hence, better curation of the dataset and its resulting models is needed.

Acknowledgments

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Parameter Interactions Further Increase Complexity

This plot illustrates the interaction between parameters, class weights, and the number of features on the SVM classifier. The red line indicates the ODM default settings. Notice that accuracy varies widely for the default model while other models are less sensitive to the number of features.

This table lists the many tuning parameters of the classifiers in the Oracle Data Miner 11g (ODM release 1). Some of these parameters are continuous, which leads to an enormous search space. Reproducibility is compromised unless all modeling parameters are reported, but this is rarely the case in the literature. Likewise, software versions must also be reported precisely. Data mining techniques are evolving so the parameters and default settings often change between versions.

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