

Quality of a Machine Learning Model

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Abstract: In today's world Machine Learning algorithms are used in almost every field in the industry. These algorithms help us to solve complex real-world problems easily and efficiently. To make the solutions efficient and up to the industry standard the algorithms must be efficient. The efficiency of the algorithms depends on the quality of the trained algorithm. Through this paper we aim to discuss various parameters on which this quality depends.

INTRODUCTION

Machine Learning is generally performed in the applications which involve working with data. The algorithms are trained over the data, that means that the algorithms are used to learn the data and then perform necessary computations required by the user and give out the result based on the training data provided to it initially. These algorithms are basically based on various mathematical formulas and theorems. These algorithms have different parameters that are specified in order to train the algorithm on the provided data properly. Hence, we can see that the performance of the algorithm basically depends on the quality of data and the algorithm itself. Though there are various other factors responsible too. We will discuss about various factors in this paper.

FACTORS

Data

Good data can be considered as the key to success of the machine learning model's performance. Good quality of data plays an important role in making the algorithm perform well. If the data is not good then the model won't be able to learn properly and hence the result will be a poor performance and a poor accuracy on the training set. In the real world the results are of a great importance as it can be a matter of difficult decisions involving money or even a life in case of medical applications. So, to get good results we need proper data. This data should be application specific as useless and extra data only degrades the performance

of the model. Hence, the data should be collected very carefully and selectively. The amount of data is also of a great importance. To build a good machine learning model we need an optimum amount of data. This data should neither be too large nor too small as this may lead to problems like under-fitting and over-fitting, this means that either the data was too less to train the model efficiently or the data was too much that the model got hard trained or over trained. Both of these situations decrease the performance of the model and provide bad results. So, the amount of data taken should be optimum and selected carefully. This collected data is often raw in form. That means that the data isn't processed. A very important step in the training of any machine learning model is the data preprocessing step. In this step the data is processed so that it becomes more useful and more suitable to be used. This step involves completion of incomplete data, treating the missing values, treating outliers, correcting the format of the data according to requirement and making the data consistent. After the data preprocessing steps are completed it can be used for training of the machine learning model. This greatly helps in improving the accuracy of the model. One thing to keep in mind is selecting the suitable attributes from the available data according to the requirement of the problem.

Hyperparameters of the Model

Machine learning models are used for prediction and classification of data. These models are parameterized so can tune their behavior with given problem. A model hyperparameter is a configuration this is external to the model and whose value cannot be expected from facts. Hyperparameters are to estimate model parameters. Hyperparameters are specified by the practitioner and can be set using heuristic. You can't realize the exceptional value for a model hyperparameter on given problem. You may additionally use guidelines of thumb, replica values used on different problems, or search for the first-class cost with the aid of trial and error. When

a machine getting to know a set of rules is tuned for a selected hassle then basically you're tuning the hyperparameter of the model to discover the parameters of the model that result in the most skilful predictions.

Hyper-parameters are the most crucial matters inside the version. For instance, a number of hidden layers and the range of devices in a hidden layer and regularization parameters. These parameters will determine the model is over fitting or under fitting on a selected information set. As hyperparameters directly controls the behavior of training algorithm and it also have an impacts on performance of model being trained. So if we improve the quality of hyperparameters, it is useful in improving the quality of training model and it can help us to get better results. The hyperparameters optimization techniques such as Grid search, Random search and Bayesian optimization are used for the optimization process.

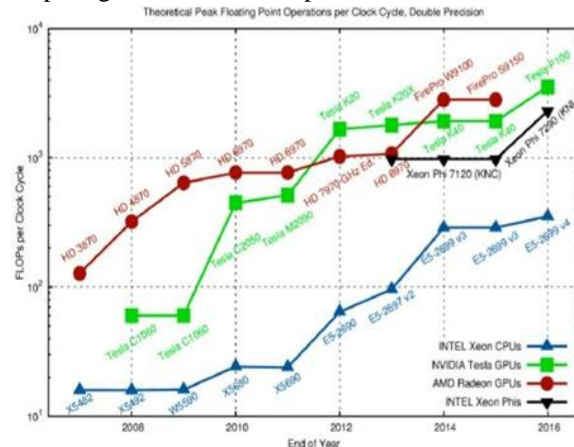
Most optimal hyperparameters can be found with the help of an optimization technique.

Hardware

Hardware can be called as the backbone of Machine Learning algorithms. Good hardware results in better efficiency and a better training quality. Most of the Machine Learning algorithms are used with a huge amount of data. This data can be textual, numerical, images, etc. If the algorithms are executed on a computer configuration that in not powerful, then the algorithms may take a lot of time to run. It can be in hours or even days. So, first of all, this reduces the work efficiency of the programmer executing the code as it caused him to stop till the program is executed and then continue with the work. In this case, if there is some error or the results are unexpected, it is even more frustrating and inefficient as the code needs to be run again which would take a lot of time again.

Machine Learning algorithms also require good memory as there is a need to store the weights of the algorithm in the dynamic memory for faster retrieval and faster execution. If we have a good memory the efficiency can be improved exponentially. After the introduction of deep learning and neural networks there is even more need to focus on the proper hardware for training of these algorithms. Neural networks require a lot of dynamic memory as there is a need to store the network weights and use them again and again until the network is properly trained.

Matrix- matrix multiplication can be considered as a major building block of a machine learning or deep learning system. Matrix-matrix multiplication is a complex process, it takes about $O(n^2)$ memory and $O(n^3)$ compute complexities. Now imagine if we are working with a huge amount of data how much time it would take to complete these kinds of operations, not only once but until the model is trained properly. Hence, we require a lot of processing power and memory so as to perform these operations. SO, for modern day computing GPU computing has been introduced. GPU computing means that the operations like



A comparison between CPU's and GPU's

matrix-matrix multiplications which were earlier being performed on a CPU are now being performed by the GPU of the system. CPU's are basically the general processing units which can take care about all the basic operations more than efficiently, but for more complex numerical operations GPU's are a much better choice as their architecture is based on the matrix itself. GPU's have a better memory bandwidth than the CPU's. For example, NVIDIA Tesla V100 has claimed to have a 900 GB/s memory bandwidth, whereas Intel Xeon E7 has about 100 GB/s of memory bandwidth. Hence, we can see from the comparison that GPU's can perform much better than the CPU's and hence provide better efficiency and better training quality for the intelligent algorithms. Along with matrix-matrix multiplication there are other building blocks like convolution, data preprocessing etc. All these require a good processing power. So, it really matters what kind of hardware is being used for the computations. If we want to have a good efficiency and speedy results we require a high lever architecture. Now, everyone cannot afford to buy and

assemble this kind of architecture, therefore technology giants like Google, Amazon etc have introduced cloud architectures with high processing power configurations.

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CONCLUSION

So, we have seen that there are various factors that affect the quality of a machine learning model. While making a model there is a lot of need to focus on all the parameter to maximize the efficiency of the system. As we talked about it earlier that the modern-day applications of ML are of a lot of importance in the real world, if the quality is not up to the mark there could be a loss to the community. Hence, we can conclude that all the factors must be addressed before deploying the machine learning model in the real-world environment to get the best of the results out of the marvelous technology.

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