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Network Health Intelligence Using Monitoring Tools and Machine Learning Algorithms

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ABSTRACT: Computer networks form the basic building block of any organization's IT infrastructure. As businesses depending mostly on Internet based applications, it is very crucial that the end users remain functioning in spite of network related issues. Monitoring and improved network performance is high priority to keep businesses running with high availability. This assures service level agreements (SLA) maintained and provide reliable solutions to complex business problems. Network is error prone and affects overall business performance. Therefore to maintain reliability and availability of business critical applications proactive monitoring and actions based on the monitoring have uttermost importance. Proactive monitoring identifies the issues and trigger the corrective actions before it actually experience by the users. Network Monitoring is the one part of our proposed solution where already many Open source tools like Nagios and Zabbix can be part of solution. Second part of proposed solution is relying on data collection by network monitoring tools build the analytical based solution, which can be predict the health of network component in advance. Our proposed Network health intelligence system not only efficiently collects the monitoring data but also using machine learning algorithms predict the health of network components in advance.

KEYWORDS: Supervised machine learning models, unsupervised machine learning models, Messaging systems, and Performance metrics

I. INTRODUCTION

As Computer networks form the basic building block of any organization's IT infrastructure. As businesses depending mostly on Internet based applications, it is very crucial that the end users remain functioning in spite of network related issues. Monitoring and improved network performance is high priority to keep businesses running with high availability. This assures service level agreements (SLA) maintained and provide reliable solutions to complex business problems. Network is error prone and affects overall business performance. Therefore to maintain reliability and availability of business critical applications proactive monitoring and actions based on the monitoring have uttermost importance. Proactive monitoring identifies the issues and trigger the corrective actions before it actually experience by the users. Proactive monitoring is the one step but predictive analysis based on previous performance history of the network

II. LITERATURE SURVEY

1. Raouf Boutaba, Mohammad Ali Salahuddin, Noura Limam, Sara Ayoubi, Nashid Shahriar, Felipe Estrada Solano, Oscar Mauricio Caicedo Rendon: A comprehensive survey on machine learning for networking evolution, applications and research opportunities. In this paper authors provides the survey on application of ML techniques in variety of network areas and network technologies. It provides comprehensive analysis of Machine learning application to basic issues in the networking like traffic prediction, traffic routing, and fault management and network security.[1]

2. Rafiullah Khan, Sarmad Ullah Khan, Rifaqat Zaheer, and Muhammad Inayatullah Babar: An Efficient Network Monitoring and Management System This paper discussed the continuous and automated way to monitor the network components i.e. Network switches. It provides the scope for triggering mechanisms like



SMS, EMAIL to the network administrator. It also proposes automated way of ticket creation and assignment. [2]

3. Kwang-Bon Jung, Mi-Jung Choi, Myung-Sup Kim, Young-J. Won, James W. Hong: Traffic Classification Using Machine Learning Algorithms in Practical Network Monitoring Environments. As per this paper the network traffic classification went through evolution from payload/port based to machine learning based. This paper analyzes the classification results from cross validation with split validation. This paper also discussed the classification results depends on flow to those depends on bytes. Authors provides the comparative report of different machine learning algorithms like J48, REPTree, RBFNetwork, Multilayer perceptron, BayesNet, and NaiveBayes. In this paper, Author identifies the best feature sets and the best ML algorithm for network traffic classification using the split validation. [3]

4. Mowei Wang, Yong Cui, Xin Wang, Shihan Xiao, and Junchen Jiang: Machine Learning for Networking: Workflow, Advances and Opportunities. This paper discussed the basic overflow of the application of machine learning algorithms in the networking with machine learning. [4]

5. Deepak Chahal, Latika Kharb, Deepanshu Choudhary: Performance Analytics of Network Monitoring Tools. Network is the backbone of organization's infrastructure and maintaining its availability and reliability is always the challenge. In this paper authors discussed some popular network monitoring tools like Nagios, Zabbix and ganglia and provides the comparison report of different network monitoring tools based on the parameters like license, access control and distributed monitoring. [5]

6. Saac Sikubwabo, Mariam Usanase, Dr. Papias Niyigena: Comparative Study on Network Monitoring Tools of Nagios Versus Hyperic. Author provides the comparison between two well known network monitoring tools Nagios and Hyperic [6]

III. PROPOSED METHODOLOGY

Network components performance metrics collection using network monitoring tool and identification, Implementation of supervised and unsupervised machine learning modal is the overall scope of project. Although scope is not limited to application of existing machine learning algorithms but improvement in existing machine learning techniques/algorithms with developing new interfaces to available network monitoring tools also the part of scope.

A. Architecture

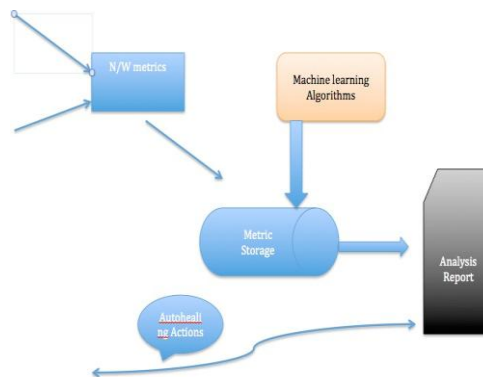


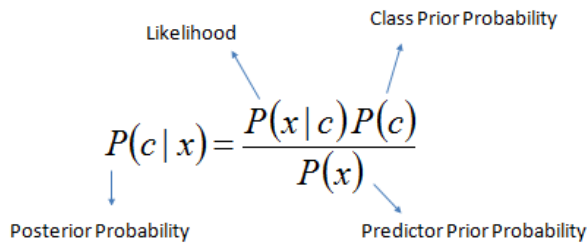
Fig. 1. Proposed System Architecture



Algorithm

1. Naïve Bayes algorithm :

The Naive Bayesian classifier is based on Bayes’ theorem with the independence assumptions between predictors. A Naive Bayesian model is easy to build, with no complicated iterative parameter estimation which makes it particularly useful for very large datasets. Despite its simplicity, the Naive Bayesian classifier often does surprisingly well and is widely used because it often outperforms more sophisticated classification methods. Bayes theorem provides a way of calculating the posterior probability, $P(c|x)$, from $P(c)$, $P(x)$, and $P(x|c)$. Naive Bayes classifier assume that the effect of the value of a predictor (x) on a given class (c) is independent of the values of other predictors. This assumption is called class conditional independence.



$$P(c | X) = P(x_1 | c) \times P(x_2 | c) \times \dots \times P(x_n | c) \times P(c)$$

- $P(c|x)$ is the posterior probability of class (target) given predictor (attribute).
- $P(c)$ is the prior probability of class.
- $P(x|c)$ is the likelihood which is the probability of predictor given class.
- $P(x)$ is the prior probability of predictor.

Naive Bayes classifier calculates the probability of an event in the following steps: Step1: Calculate the prior probability for given class labels Step 2: Find Likelihood probability with each attribute for each class Step 3: Put these value in Bayes Formula and calculate posterior probability. Step 4: See which class has a higher probability, given the input belongs to the higher probability class.

2. Support Vector Machine (SVM) Algorithm:

- SVM can be used for linearly separable as well as non-linearly separable data. Linearly separable data is the hard margin whereas non-linearly separable data poses a soft margin.
- SVMs provide compliance to the semi-supervised learning models. It can be used in areas where the data is labeled as well as unlabeled. It only requires a condition to the minimization problem which is known as the Transductive SVM.
- Feature Mapping used to be quite a load on the computational complexity of the overall training performance of the model. However, with the help of Kernel Trick, SVM can carry out the feature mapping using simple dot product.
- The important modules used while designing of model are:
 1. The CSV Loader: It loads the data stored in a „.csv“ formatted input file.
 2. The Class Assigner: It assigns the nominal value based on which classification is done. By default, the last column of dataset is taken for nominal value.
 3. Train Test Split-maker: Divides the dataset file to separate training set and test set. The training set is used for training while the test set is used to evaluate the performance of the classifier in question.
 4. Classifier Performance Evaluator: As the name suggests, it evaluates the performance of the classifier used.
 5. Text Viewer: Conveys the output of the Classifier Performance Evaluator in a text form.

6. Model Performance Chart: Conveys the output of the Classifier performance evaluator as a graphical representation.

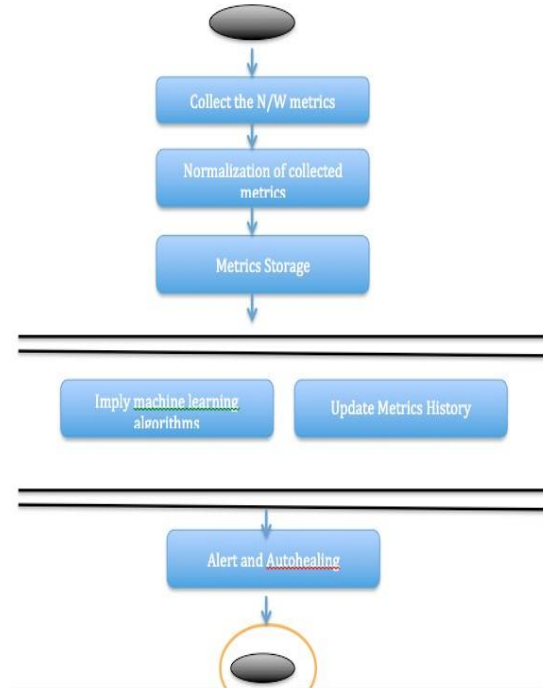


Fig. 2. System Flow

IV. CONCLUSION

Network comprises of different complex components and become more error prone with addition of each new component. Overall it is required of early detection of network errors and necessary actions to remove the errors before it become visible to the users. Proactive monitoring is the one step but predictive analysis based on previous performance history of the network components provides edge. Network components performance metrics collection using network monitoring tool and identification, Implementation of supervised and unsupervised machine learning modals is the overall scope of project. Although scope is not limited to application of existing machine learning algorithms but enhancement of machine learning algorithms with developing new interfaces to available network monitoring tools also the part of scope. Storage strategy to store performance metrics collected by network monitoring tool is essential part of overall scope e.g. Cluster formation/Big data setup.

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