Integrating of Promising Computer Network Technology with Intelligent Supervised Machine Learning for Better Performance

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Received September 20, 2021; Accepted December 17, 2021
ISSN: 1735-188X
DOI: 10.14704/WEB/V19I1/WEB19249

Abstract

The Software defined network (SDN) controller has such networks universal sight and allows for centralized management and control for the networks. The algorithms of Machine learning used alone or combined with the SDN controller's northbound applications in order to make intelligent SDN. SDN is such potential networking design that blends network's programmability with central administration. The control and the data planes are separated in SDN, and the network with central management point is called SDN controller, which may be programmed and utilized as a brain of the network. Lately, the community of researchers have shown a greater willingness to take advantage of current advances in artificial intelligence to give the SDN best decision making and learning skills. Our research found that combining SDN with Intelligent Supervised Machine Learning (ISML) is very important for performance improvement. ISML is the development of algorithms that can generate broad patterns and assumptions from external source instances in order to portend the predestination of future instances. The ISML algorithms of classification goal is to categorize data based on past information. In data science problems, classification is used rather frequently. To solve such problems, a number of successful approaches were already presented, including rule-based techniques, instance-based techniques, logic-based techniques, and stochastic techniques. This study examined the ISML algorithms' efficiency by checking the precision, accuracy, and with or without SDN recall.

Keywords

SDN, SVM, LR, NB, C4.5, ID3, RF.

Introduction

An intelligent machine learns from its actual experiences (such that, from the available environment data) and applies what it has learned to enhance its performance (Brian Williams, 2002 & Michael Negnevitsky, 2005). The methods of learning are included in ISML in this context. pre-defined knowledge on the assumption that for ISML methods. Input-output pairs of training dataset, for example, once the system uses a function to transform an input data into a useful output. This method necessitates are the availability of a dataset that reflects the system in concern with the use of estimation of the chosen method performance (Thuy T.T. Nguyen and Grenville Armitage, 2008).

SDN is a new technology that has emerged as a result of recent advancements in computer networking. Quick responses to granular traffic filtering, the deployment of dynamic security policies, and security risks, are enabled by the controller. An investigation have been doing by the researchers at utilizing SDN to secure computer networks, like ISML and SDN integration that done by few researchers, and building a firewall with switch and an SDN controller.

Neural networks are used in this context (Xiao-Fan Chenab Shun and Zheng Yu, 2016 & Mu He, et al., 2017) (Cui-Chen xiao and Xu-Ya bin, 2016 & Sabbeh, et al., 2016) & (Mihai, et al., 2014), support vector machine (Mestres, et al., 2017& Hu, et al. 2017), decision trees (Latah, et al., 2018 & Van, et al., 2016], ensemble methods (Wijesinghe, et al., 2015 & Su, et al., 2018) and supervised deep learning (Tang, 2018, & Tang, et al., 2016) approaches have been the most commonly utilized SDN supervised learning techniques.

The layered SDN architecture shown in Figure 1 which contain 4 planes: application, control, management, and data planes. The data plane displays a table for forwarding packets which routes the input packets to an appropriate network node. For overall network management, the plane of management includes orchestration and complicated provisioning systems. The control plane, which uses protocols and SBIs to regulate several types of data planes, is often known as the brain of the network. The plane of application describes the layer on various upstream apps that already existent and can assist SDN performing and solving potential 5G challenges, since this plane provides network suppliers with flexibility, openness, and innovation (Huang, et al., 2018). Dynamism, management capabilities, and network flexibility are all provided by SDN architecture. SDN appears to be the most promising and reliable method for data forwarding and separating strategic network computation, according to research.

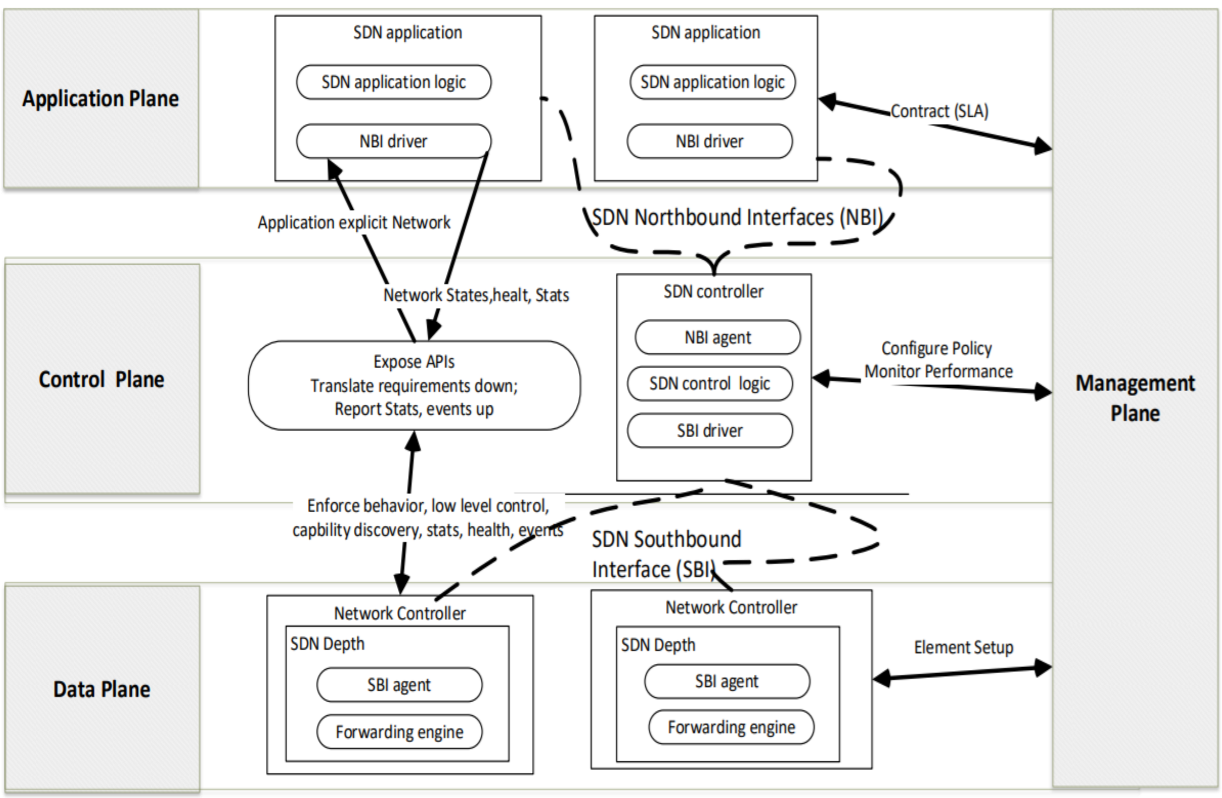

Figure 1 SDN Architecture (Ghaffar, et al., 2021)

Materials and Methods

Software Defined Network

Software Defined Network is an approach of network architecture that uses programmable switches across control planes and the data to manage and alter data routing. For various reasons, SDN is a viable alternate to common networks. To begin with, traditional networks are hardware-based, which means physical devices such as switches and routers required in their infrastructure, limiting their speed and maneuverability. SDN, on the other hand, is software-based that can digitally controlled by the plane of control. SDN's software, rather than having predefined functionality, can be swiftly and readily updated as needed. Second, for determining the packets route, a high-level algorithms are required for standard network routers. When it reaches the SDN, the controller of SDN interacts with the elements of the network to manage the packets' flow centrally based on its own configuration (Nikos and Fernando 2016 & Abdullah Al Hayajne, 2020).

Intelligent Supervised Machine Learning

ISML denotes that a function is generated by the various algorithms which translates inputs to expected output. The problem of classifying is a common supervised challenge in machine learning where the learner should learn (in order to approach the performance for) the function which translates the vector into specific result of multiple classes by searching for multiple input and output samples of the algorithm's function.

In a simple machine learning model, two steps included in learning process which are: testing and training processes. In the phase of training, samples from data are used as input, and the learning algorithm or learner learns the features and builds the model of learning. The execution engine is used by the learning model to produce predictions for test or production data during the testing phase. The final prediction or categorized data is tagged data, which is the output of the learning model. Because the goal is frequently to encourage the machine to learn a classification system that we've constructed, supervised learning (Figure 2) is the most popular technique in problems classification.

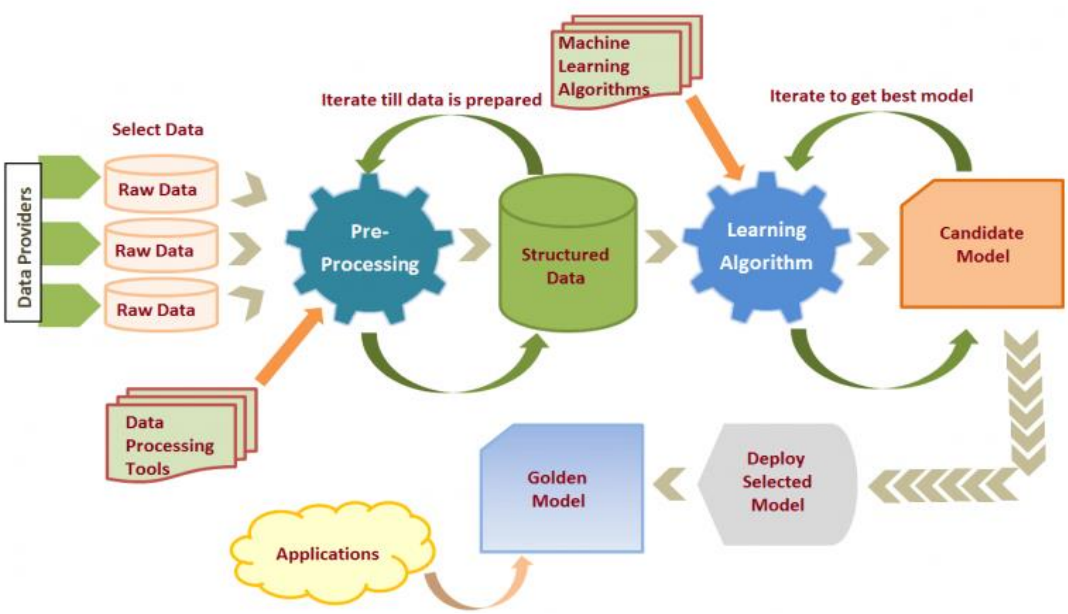

Figure 2 Security layer of E-Medical System (Ezedin Barka, et al., 2021)

Performance Evaluation

In order to specify the right algorithm type, its very important to check the confusion matrix calculation results which serves as a reference in judging whether the accuracy reached is excellent or not. The confusion matrix is shown in Figure 3.

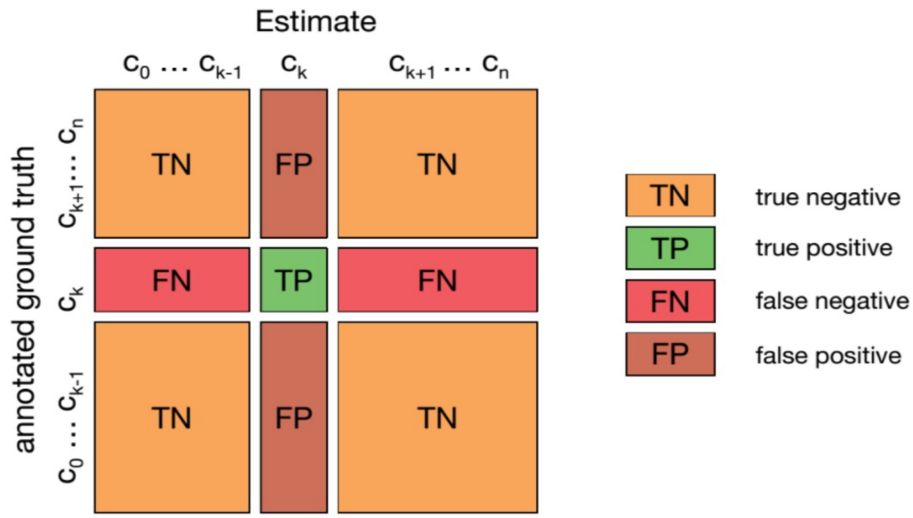

Figure 3 Procedure for making confusion matrix

Accuracy is defined as the degree of similarity between actual and predicted values, or, in other words, the number of successfully classified classifications from the entire tested samples.

Precision is the frequency or amount of accuracy between the required information by the user and the system's provided response. To put it another way, precision refers to data quality generated during the process of classification. The success rate of the system in recovering information is referred to as a recall. To put it another way, recall is a useful byproduct of the process of classification. Table 1 shows the results of the ISML comparison algorithm for datasets containing SDN. The 10 Folds Cross-validation Technique is the type of testing method utilized in WEKA for testing ISML accompanied by SDN. The percentage that classified correctly or the proximity accuracy between the estimated and the real values of the classification algorithm Nave Bayes which is the superior than other algorithms, as shown in table 1, with an accuracy of 89.1 percent. Table 2 shows the performance without SDN results.

Table 1 Results of Performance Measures with SDN

Algorithm with SDN	ACC	Precision	Recall
Random Forest	78.2%	80.9%	80%
Naïve Bayes	89.1%	92%	90.4%
Support Vector Machine	77%	79.2%	75.6%
C4.5	67.9%	70.4%	67%
Logistic Regression	64.2%	66%	62.3%
ID3	62.2%	64%	60.8%

Table 2 Results of Performance Measures without SDN

Algorithm without SDN	ACC	Precision	Recall
Random Forest	70%	72.9%	72.4%
Naïve Bayes	81.9%	84%	81%
Support Vector Machine	72.7%	79.2%	75.6%
C4.5	63%	64.2%	62.1%
Logistic Regression	64.2%	65.4%	62.3%
ID3	60%	62.2%	60%

Conclusions

A comparison of the performance of the Naive Bayes for an SDN, Random Forest, Logistic Regression, ISML classifiers Support Vector Machine, C4.5, and ID3 has been attempted. The Weka tool is used to test those algorithms. By evaluating performance depending on accuracy, precision, and recall, an effective classifier can be discovered. Based on the findings, it can be concluded that the Naive Baise with SDN classifier outperformed various classifiers given the parameters and data sets under consideration. Which has an accuracy rate of 89.1%.

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