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MACHINE LEARNING ALGORITHMS SELECTION PROBLEMS RESOLVED WITH ARTIFICIAL INTELLIGENT RULE-BASED EXPERT SYSTEM USING VISIRULE

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Abstract

Everybody is confronted daily with cluster of decisions that must be appropriately taken in the process of making decision; individuals are faced with and most often fall prey to series of common biases, fallacies, and many other decision-making odds. In determining which algorithm to apply for analysis (with machine learning using supervised and unsupervised approaches) open to critical steps to be taken and also highly depend on many factors ranging from the type of problem at hand to the expected outcomes. The study looks at how artificial intelligent approach with expert system would be helpful in making timely decision on which type of algorithms is capable to be applied and implemented to have desired results. The study also uses VisiRule software to model series of successful channels to arrive at a good decision-making means. The use of VisiRule (Artificial Intelligent Based Expert System) was employed to give directional path ways to the selection of appropriate algorithms from supervised and unsupervised machine learning to different classification methods, regression methods, clustering approaches, dimensionality reduction methods, and association rules. The outcome of this study demonstrates the easy way through paths to select relevant and most appropriate model or algorithm that best fit the analysis at hand with detailed explanation of each alternative option. The use of VisiRule software has proven the easy way to achieve decision making problems without any codes requirement for such actions. Decision making challenges could be resolved by just implementing artificial intelligent rule-based expert system which require less time, coding free, and highly achievable accurate outcomes.

Keywords: Decision Making, VisiRule, Artificial Intelligent, Rule-based System, Expert System

Introduction

Decision making has been a carefully and procedural actions taken by every individual in the society. Researchers are increasingly investigating the conditions attached to application of models or algorithms and how to identify the most suitable existing algorithms/models for solving a problem. The decision-making regarding selection of Algorithm/models is concerned with the kind of procedures or conditions available to apply an algorithm and selecting the best algorithm to solve a given problem (Kotthoff, 2012). Researchers of machine learning algorithms need methods that can help them to identify algorithm or their

groupings (combinations) that achieve the potentially best performance. Selecting the best algorithm to solve a given problem has to do with having well conversant knowledge of conditions to select or use an algorithm/model and which one (Out of available algorithms) could give the required and optimal solution to the problem at hand and finally at what mode of operation to follow – Single or combined method (Abdulrahman, Adamu, Ibrahim, & Muhammad, 2017).

A proliferation of algorithms/models exist, rooted in the fields of machine learning, statistics, pattern recognition, artificial intelligence, and database systems, which are used to perform different data analysis jobs on large volumes of data. The decision to take in order to recommend the most suitable algorithms has thus become rather challenging. Moreover, the problem is exacerbated by the fact that it is necessary to consider different combinations of parameter settings, or the constituents of composite methods such as ensembles (Abdulrahman, Adamu, Ibrahim, & Muhammad, 2017).

It was observed that before a machine learning algorithm/model is trained, the researcher of a machine learning software tool or algorithm typically must manually select a machine learning algorithm and set one or more model parameters termed hyper-parameters. The algorithm and hyper - parameter values used can greatly impact the resulting model's performance, but their selection requires special expertise as well as many labor-intensive manual iterations. To make machine learning accessible to everyone interested to use them, with limited computing expertise, computer science researchers have proposed various automatic selection methods for algorithms and/or hyperparameter values for a given supervised machine learning problem (Luo, Gang, 2017).

The correct use of model evaluation, model selection, and algorithm selection techniques is vital in academic machine learning research as well as in many industrial settings (Dhabarde, 2019). Selecting the right algorithm is an important problem in computer science, because the algorithm often has to exploit the structure of the input to be efficient. So, solutions to the algorithm selection problem can inspire models of human strategy selection. Therefore, the algorithm selection problem as a special case of meta-reasoning and need to be tackled in a systematically approach manner (Lieder, Plunkett, Hamrick, Russell, Hay, & Griffiths, 2014).

Related Literatures

The approach to select appropriate algorithm/model was viewed in two ways: the first aspect is looking at conditions to use an algorithm/model or combinations of algorithms/models and how possible for researcher to select the best algorithm/model to solve a kind of problem. Studies in the past contributed to this trend. The use of application software is a great opportunity to resolve the problem with artificial intelligent rule-based expert system via Visirule. This knowledge can help us to select the best algorithm for these instances. According to Kotthoff, (2012) Algorithm Selection techniques have achieved significant performance improvements. They unified and organized the vast literature according to criteria that determine Algorithm Selection systems in practice. The comprehensive classification of approaches identified and analyzed the different directions from which Algorithm Selection has been approached. Their paper contrasted and compared different methods for solving the problem as well as ways of using these solutions. Their study was closed by identifying directions of current and future research.

This survey presented by Abdulrahman, Salisu Mamman; Adamu, Alhassan; Ibrahim, Yazid Ado & Muhammad, Akilu Rilwan (2017) looked into an overview of the contributions made

in the area of algorithm selection problems. They presented different methods for solving the algorithm selection problem identifying some of the future research challenges in this domain. They further added that researchers have long ago recognized that it is difficult to identify a single best algorithm that will give the best performance across all problems. This is why later on many researchers have developed different approaches to addressing the algorithm selection problems. There are many approaches to addressing the algorithm selection problem; in connection to this, Kotthoff, Gent & Miguel, (2012) claimed that machine learning is an established method of selecting algorithms to solve hard search problems.

The algorithm selection problem, as explained by Rice, (1976) has attracted a great deal of attention, as it endeavours to select and apply the best algorithm(s) for a given task (Brazdil, Carrier, Soares & Vilalta, 2008; Smith-Miles, 2009). The algorithm selection problem can be cast as a *learning* problem: the aim is to learn a model that captures the relationship between the properties of the datasets, or meta-data, and the algorithms, in particular their performance. This model can then be used to predict the most suitable algorithm for a given new dataset as viewed by Abdulrahman, Salisu Mamman; Adamu, Alhassan; Ibrahim, Yazid Ado & Muhammad, Akilu Rilwan (2017).

Kotthoff, Lars; Gent, Ian P & Miguel, Ian (2012) conducted a study where they compared the performance of a large number of different machine learning techniques from different machine learning methodologies on five data sets of hard algorithm selection problems from the literature. They demonstrated that there is significant scope for improvement both compared with existing systems and in general. At the end, they gave clear recommendations as to which machine learning techniques were likely to achieve good performance in the context of algorithm selection problems. In particular, they showed that linear regression and alternating decision trees have a very high probability of achieving better performance than always selecting the single best algorithm. Luo, (2017) researched on machine learning studies automatic algorithms that improve themselves through experience. Their paper reviewed methods, identified several of their limitations in the big biomedical data environment, and provided preliminary thoughts on how to address these limitations. The findings established a foundation for future research on automatically selecting algorithms and hyper-parameter values for analyzing big biomedical data.
Guo & Hsu, (2007) In their paper, they presented a machine learning-based approach to address models induced from algorithmic performance data can represent the knowledge of how algorithmic performance depends on some easy-to-compute problem instance characteristics. Using these models, they could estimate approximately whether an input instance was exactly solvable or not. Furthermore, when it was classified as exactly unsolvable, they could select the best approximate algorithm for it among a list of candidates. The results showed that the machine learning-based algorithm selection system could integrate both exact and inexact algorithms and provide the best overall performance comparing to any single candidate algorithm
Dhabarde, (2019) regarded machine learning as subfield of AI concerned with intelligent systems that learn. According to him, to understand machine learning, it is helpful to have a clear notion of intelligent systems. Therefore, their paper reviewed different techniques that could be used for each of the three subtasks and discussed the main advantages and disadvantages of each technique with references to theoretical and empirical studies. Common cross-validation techniques such as leave-one- out cross-validation and k-fold cross-validation were reviewed, the bias-variance trade-off for choosing k was discussed, and practical tips for the optimal choice of k were given based on empirical evidence

Lieder et al., (2014) applied theory to model how people choose between cognitive strategies and test its prediction in a behavioral experiment. They found out that people quickly learn to adaptively choose between cognitive strategies. People's choices in our experiment were consistent with the model used but inconsistent with previous theories of human strategy selection. Rational meta-reasoning appears to be a promising framework for reverse-engineering how people select between cognitive strategies and translating the results into better solutions to the algorithm selection problem. Masood, Khan, Hussain & Shaukat, (2020) carried out studies on the systematic literature review (SLR) that has been performed to get 20 studies (2012-2019) in the area of EDM. From these studies, 11 highly advanced machine learning models has been obtained and they have implemented them on 2 public student databases in order to predict their future outcomes. Feature extraction techniques were applied and then models have been trained based on the databases to get the required results. Results of different machine learning models were compared in order to find out the best model among them based on accuracy and F-measure. With these experiments, weak students can be easily identified and proper precautions can be taken in order to help them.

Materials and Methods

The study employed the use of artificial intelligent rule-based expert system using Visirule software. Visirule software is designed for researchers as a decision supporting tool that the rules are basically and precisely presented without writing any simple code. The approach was based on the use of Logic Programming Model. The rule-based Expert system is of great use to researchers in making appropriate and relevant selection of machine learning algorithm suitable for statistical data analysis in researches (Muraina, Rahman, Adeleke, & Aiyegbusi, 2013). It allows researchers to concentrate on explaining and establishing the structure of the logic correctly using their chosen tools - those embedded materials that can assist researcher to accomplish his mission (Spenser, 2007; Bilgi, kulkarni, & Spenser, 2010).

Analysis and Results

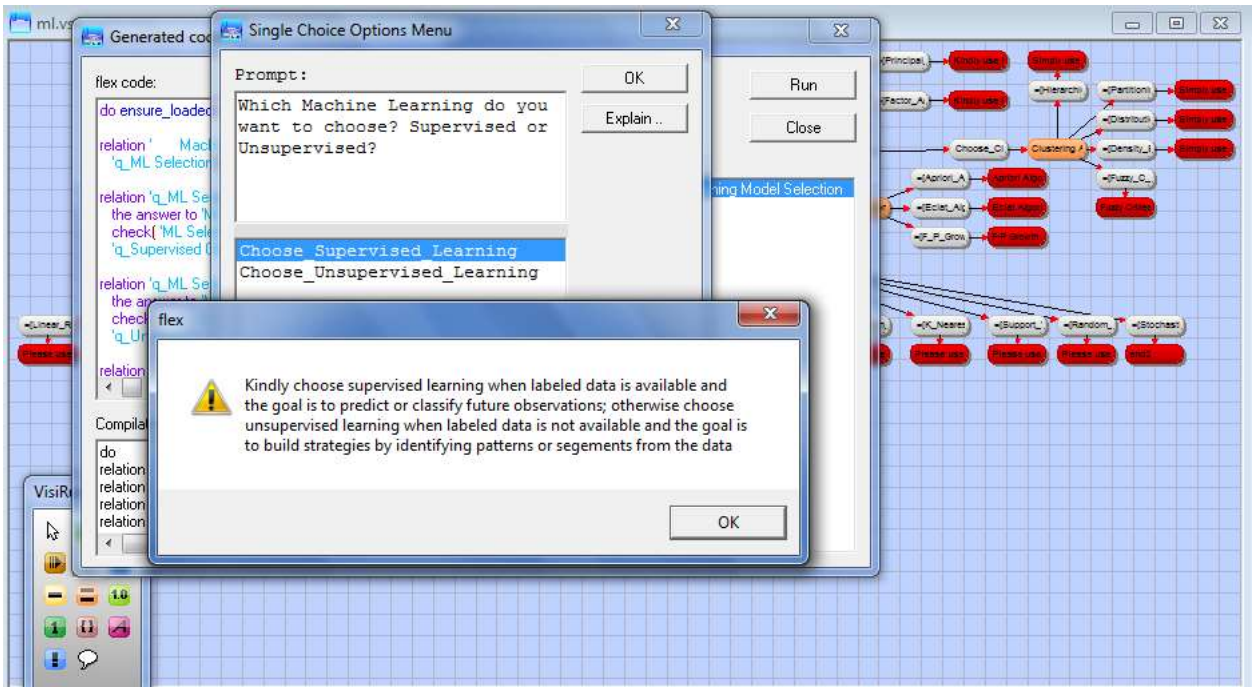

Figure 1: Visirule showing easy selection of either supervised or unsupervised machine learning

The figure 1 displays the condition to choose either supervised or unsupervised machine learning algorithm likewise it goes further to ask another question until the right decision is made on the suggestions provided by the software

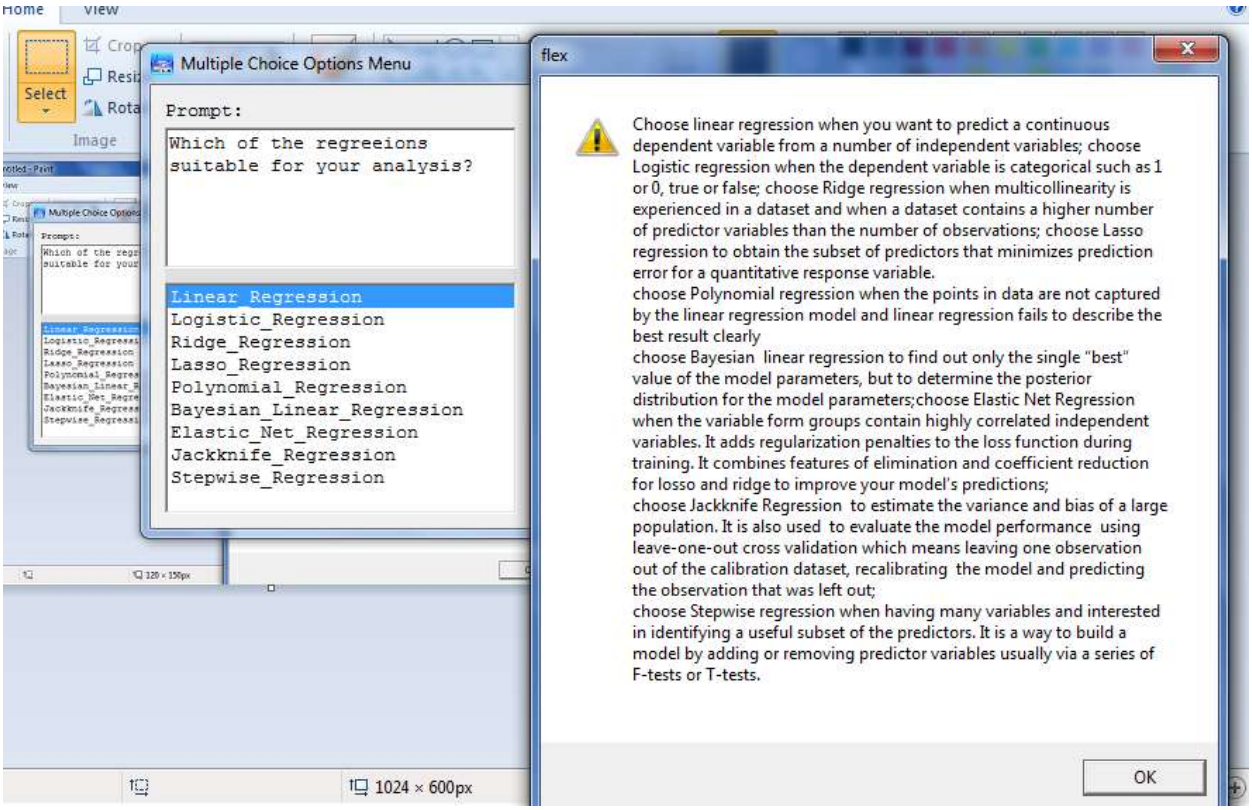

Figure 2: Visirule showing the list of regression types

The second figure (Figure 2) depicts the collection of regression analyses, from which the researcher would choose one. From the figure 2, the details of each of the types are shown at right hand side with applicable conditions for their selection

Discussion

The use of the artificial intelligent rule-based expert system showed the easy way to determine which of the algorithm to use – based on the condition of its use. The figure 1 and 2 showed the systematic procedure to best select the algorithms/model for further analysis and decision making. This approach is said to be useful and cost effective in decision making rather than manual selection method. The software as well will generate codes that can be export to the web and other format. The application of the Visirule covered both supervised and unsupervised machine learning algorithms/models

Conclusion

For years, selecting the best algorithm/model to solve a given problem has been the subject of many studies. In this paper, we have covered briefly the use of artificial intelligent rule-based expert system to select appropriate algorithm by first considering the conditions attached to the use and to select the best algorithm or group of algorithms that can perform better among others. Also, in this research paper, we have performed systematic literature review of machine learning models.

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