Efficient Railway Reservation System through Decision Making

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Abstract— Railway transportation is one of the most convenient modes of transport for the common man. It is an inexpensive mode of transport that is capable of hauling large and heavy loads with ease. But the problem in Indian railway services is that due to a large populous, the wait for the seats is very high. Also, when a traveller misses their train to various reasons, there isn't a system to allocate the seat to the next waiting person. The responsibility rests on the shoulders of the Ticket Collector who has to manually check and identify if indeed the passenger in the reserved seat missed the train. This is a tedious process which has great potential for misuse and increases the wait time for the passengers who are waiting. Most of the times, a person with a waiting ticket won't board the train if their name is not in the chart. This hampers the experience and would result in the loss of a valuable seat that would've been useful for the rest of the passengers. Therefore, a novel technique for effective railway ticket reservation is outlined in this research based on Protocol Estimation and Decision tree. The presented technique has been evaluated for its performance metrics and attained satisfactory results.

Keywords: Railway Reservation, Decision tree, Seat Cancellation

I. INTRODUCTION

Travelling is one of the inevitable requirements of human life, regardless of the zest of the traveller. A lot of people travel and for various different reasons, some for work, some to meet family and others that just love exploring new places and visiting new destinations. Travelling has been a part of a human being's life ever since the early days of hunter and gatherers. The Early Stone Age humans travelled for large distances in search of food, water and shelter. They were nomads, always travelling from one place to another. This travelling allowed them to explore new places as well as fulfil their basic needs.

The nomads usually travelled far and wide, in the early days this was done on foot. All the members of the tribe travelled together, children, old people and young ones alike. This was done in hopes of finding a better location which is rich in nutrients and can also provide them with water. This is particularly true for the travelling nomads of the desert. As the desert environment does not allow people to stay at a particular oasis for longer periods of time. Those people kept moving from one oasis to another, from one water hole to another. This ensured that they found resources and nutrients to stay alive for much longer.

There are tribes in Africa and Kenya that still travel for miles on foot. This is to acquire water and other resources for the tribe. This is highly needed in such an environment to stay alive. It is essential for their survival that they search and find water and other food items. The treacherous terrain is unforgiving and can claim a lot of lives due to the scarcity of the resources around them. For them travelling is an essential requirement that aids survival. If they do not travel, they risk dehydration and malnutrition, and it can be fatal for those people. Travelling in some parts of the world, therefore, becomes a very large necessity.

This has been evident since the start. As the first settlers had travelled for years, sometimes generations to reach a suitable place that could be used to settle down. Such a place was hard to find as certain resources are essential for human survival and they needed to be present at that location. Most of the time all the resources sans one would be present at the location. This would then ensure that the people would travel for that particular resource that is not available at that location. That could be anything, food, water etc. that is essential for the survival of human beings.

Most of the early civilizations settled on the banks of large rivers. This was due to the fact that rivers provide the most important resource for human survival, Water. This allowed the settlers to be close to this very valuable resource. This was practical as the settlers would also use the fertile soil deposited by the river as a source of rich nutrients for the cultivation of their crops which provided food for the entire community. But this would also allow them to fulfil their basic needs for survival. This was how most of the early civilizations were formed after passing through the nomad phase.

The setting did not make travelling obsolete, due to the fact that only certain criteria were fulfilled while settling, not every resource was available for use at that location. As society progressed, it led to an increase in population and a sense of security for the residents. This also led to an increase in the knowledge of the residents which started using better tools and practices for a stable agrarian society to take place. The tools and other items required resources such as metal and other minerals which had to be found and were not close by to where the people had settled.

Therefore, this needed the settlers to travel large distances again to find such minerals such as iron ore and other useful and strong materials for use. People travelled to various sites rich in such minerals and materials and mined them and transported to another location to be processed and smelted into various different tools for use, as the stone tools were not as strong and durable as the metals. This transportation and travel were essential components that facilitated this transition from the Stone Age to the Iron Age. The transportation during this time was done through the use of horse or oxen-drawn carriages, which supplied the various goods to the city and other places.

Transportation through faster means was needed at this juncture to hasten the process to serve a larger section of the populous. By this time the civilizations reached a significantly large size, which meant the volume and speed of transportation had to be increased to support the city. This led to the inventions of various different forms of transportation. The criteria were to increase the load-carrying capacity to

promote larger cargo to be transported to various different places, along with the workers and other people managing the working sites. As most of the carrying capacity was determined by the animal that was pulling the load, which could not be increased more than the threshold without maiming the animal in the process.

Steam engines were the invention that was needed to bolster the process of transportation. The steam engines used hot steam generated by a large boiler to turn the turbines in the engine. These turbines were used to propel a locomotive on parallel tracks that were laid in advance. This type of machine was referred to as the steam engine locomotive which was the older cousin of the modern rail engine. The rail was designed to facilitate a safer and faster means of transportation which could also take large amounts of cargo.

Introduction of the steam engine changed the game; the speed of the train perceptually decreased the size of the world as more and more places became increasingly affordable. The motive to travel was now not fuelled by a desire to survive and maintain the stability of the city, but instead, it ignited a fire in the hearts of the explorers that wanted to reach new destinations and discover various different locations on this planet. This also fuelled the discovery of various different continents and led to an industrial revolution that ultimately laid the foundations of the modern world which we see now.

Transportation is a very important aspect which helps us visit different places in a short time and allows us to work and meet our relatives and loved ones when needed. This is all done without wasting a lot of valuable time of the user, which is highly important in this fast-paced life. The Indian Railway is one of the most extensive networks of railroads and locomotives in the entire world. But when serving one of the largest populations in the world, it gradually becomes a herculean task. This is what the users experience when they try to book tickets for the railway as there is a lot of waiting time.

This leads to a lot of people not actually preferring the hassle of railway travel which would lead to the railway losing very important revenue in the long run. Also, due to an inefficient reservation mechanism it leads to inaccuracies and other blunders which further impact the service of the railway system. Some travellers miss their train and their seat goes vacant, which is an undesirable scenario as a lot of people are waiting to travel and this seat is vacant. Therefore, there needs to be a system that can intelligently allot and manage the reservations and bookings done on the railway. Machine Learning paradigm can be a very helpful addition that can meliorate these effects with relative ease.

This paper dedicates section 2 for analysis of past work as literature survey. Section 3 narrates the proposed model and section 4 elborates the Result and Discussions. Finally, Section 5 concludes the paper with feasible statemement of the literature study.

II. LITERATURE SURVEY

This section of the literature survey eventually reveals some facts based on thoughtful analysis of many authors work as follows.

S. Khokale [1] explains in recent year's world depends on digitalization. And Indians ranked second in the mobile uses. The use of an android application makes public and their data more systematic and secured. Data of the passenger's details are stored in the cloud database, which is easy verify through android the application. As we visit the railway station, we face different problems such platform tickets and also crowd management problems at railway ticket counter. In the proposed system, there is signup phase for registration of new users who will request the ticket for first time through our most system for user identification Aadhaar-card (UADAI) number is mandatory. After payment tickets will be assigned to user in user's mobile phone with QR code generated and the information in QR code will be saved in database.

P. Chatterjee [2] explains as the world is migrating towards Digitalization. All around the world railway services are available in most of the countries. With the increasing number of traveler and freight loads, more efficient mechanisms are needed to handle this increasing demand. A newer approach of technology that can be used in the Railway system is Smart Computing. The global railway market is segmented on the basis of the following Solutions, Devices, components, and Services. In proposed paper authors have surveyed different issues of developing smart computing in railway systems concern to reservation models.

S. Hamane [3] discusses digitalization is the need of this world, in this world of computers, almost all manual system has switched to a computerized and automated system. Remove the drawbacks of the present system is need to develop a fast and correct system for Railway Ticket Checking model. The first E-ticketing was introduced for ticket reservations. After that m-ticket is was invented m-ticketing was used for spot booking and it is generally used in India. In proposed methodology passenger and Ticket checker are most important aspects of the proposed system.

B. Mallikarjuna [4] narrates that smart transportation is implemented by North America (NA), Asia Pacific including Japan (APAC), Europe (EU), Latin America (LA), and the Middle East and Africa. The smart railway provides GSM-R technology for operational voice and data communications, innovation in wireless communications technologies offered reliable transmission of video and data services for long distances. People face many problems will reserving the ticket and railway reservation system to issues the ticket. The result of this paper proves that passengers receive ticket with fraction of mile seconds, the reservation chart contains the passenger's name with photos, effective passenger reservations will be maintained.

R. Takagi [5] explains that "Reservation-Compulsory Commuting Railways" should be introduced. Trying to solve the congestion on busy commuting railway routes has been done through the increase in the number of trains. Such improvements will result in an increase in the number of passengers. Some idea is feasible such as to release train operations with very high train frequency that has never been achieved on the real-world railways. The proposed systems define the difficult issues of designing the ticketing systems for the reservation-compulsory commuting railways.

The solution to this issue is finding better methods to incorporate tickets based on conventional technologies.

R. Sachs [6] describes an automated prototype interactive voice system that has been developed to make better the efficiency of agent pools by executing routine airline employee flight listings and flight load inquiries. Automated Transaction Processing Services (ATPs) are developed by AT&T to get customers significant costs associated with human agents in their day-to-day business transactions such as airline reservations. The proposed system tried to achieve a prototype system for an important domestic airline to appraise currently available speech processing algorithms in the automation of routine flight listings. There are a number of limitations in the methodology which the authors have planned to discuss in the future publications.

Y. Alfredo [7] explain if a company is an online travel company that provides services for booking hotel and flight, they need to keep data of each and every customer who is traveled by their agency. They need this data to help them resolve the action they need to do based on the data they have to compete with a rival in online travel companies. The data is stored in data warehouse company can make the best decision through observation on the insight from information presented from OLAP analysis. The system also can be magnified in the future to do prediction analysis based on customers' behavior.

X. Jun [8] narrates dialogue manager plays a very important role in a task-oriented spoken dialogue system and this system also gets more attention. By using natural language understanding (NLU) module and imperfectness of the speech recognizer he manager tries to keep the dialogue going easily and to exchange mandatory and useful information with the user in a friendly and efficient way. The finite-state and the plan-based dialogue management methods are used which come from different dialogue model theories each dialogue control competent as his own different tasks.

B. Freisleben [9] proposes a neural network that is intended to helps airline marketing specialists in controlling seat allocations on flight departures. Seat inventory management is a very crucial economical job for airline companies because it is focused on balancing the number of seats sold for each reservation class to maximize total passenger revenues. The aim is to control optimal limits on the number of bookings that may be accepted in a particular reservation class. The methodology has been tested extensively to analyze the performance and compare it with the other techniques. There are several issues for further research which authors plan to investigate in the future.

P. Wu [10] elaborates traffic congestion is one of the major challenges all over the world. Traffic is caused by high-speed growth of travel demand, whereas the capacity of transport networks is limited. A new variant of lane reservation problem called a bus lane reservation problem (BLRP) is developed for only bus lane this makes public transport very fast. Randomly generated instances show that the proposed approach is easier than the optimization software. The maturing of public transport is an important plan of action for the better development of city.

S. Mhamane [11] explains one of the major provocations are ticket reserving in a queue. Digitalization and usage of a smartphone are increasing this day by day. Users' ticket data is stored in a database for security. Dynamic seat allotment also gives 100% utilization of seats as well proper allocation for waiting list passengers during Journey. Smartphone Application for Ticket Reservation and Validation Using Mobile Network is one of the fine deductions if some passengers expanded the journey. QR code is generated and QR code access to design unique code for each ticket should be compatible with common QR code readers.

X. Lui [12] elaborates on the growth of information technology in China railway data have been collected in China railway ticketing and reservation system. It is very important to extract important data from the huge data available to get valuable decision at a very lower cost. Thus, there is an urgent request for decision department of railway. At the crucial time is very important to analyze the favorite class data is one of important tasks for railway decision-makers to help them regarding their train transportation system. The proposed system present promising approach FEBIR is a simple, valid and feasible tool for train ticket data analysis.

L. Xia [13] discusses the rapid development of mobile computing and information technology it has made great progress in the capability and quality of location data acquisition. Human mobility and behavior pattern observation have become trending in the coming time. The prediction rate is easy to be affected by the quality of the real-world dataset. The proposed system contextual location prediction for best location recommendation in LBS by predicting next personally semantic place from mobile devices logs. The clustering algorithm is developed POI dictionary have proven to be in semantic places identification

C. Manapragada [14] explains novel incremental decision tree learning algorithm, Hoeffding Anytime Tree, that is statistically better organized than the current state-of-the-art, Hoeffding Tree. Developing of Hoeffding Anytime Tree is Extremely Fast Decision Tree. The tree makes a simple change to the current standard for incremental tree learning and it’s easy to take the feasible decision. In learned HATT’s strategy deployed to make decisions before fully learned always useful to identified to date has profound benefit. Therefore, it can be concluded that the incremental tree learning is highly useful application for this process.

B. Yang [15] estimates decision trees have to allure much attention during the past previous years. Decision trees include axis-parallel and oblique decision trees; both of them try to find the better splits via exhaustive search or heuristic algorithms in each monotony work presents new Weighted Oblique Decision Tree (WODT). Develop to construct ensemble methods, such as random forests and improving, based on our WODT method. Proposed experiments show the effectiveness of the proposed algorithm through rigorous testing that is performed to evaluate and compare the performance with the widely used techniques for the purpose of searching decision trees.

III. PROPOSED METHODOLOGY

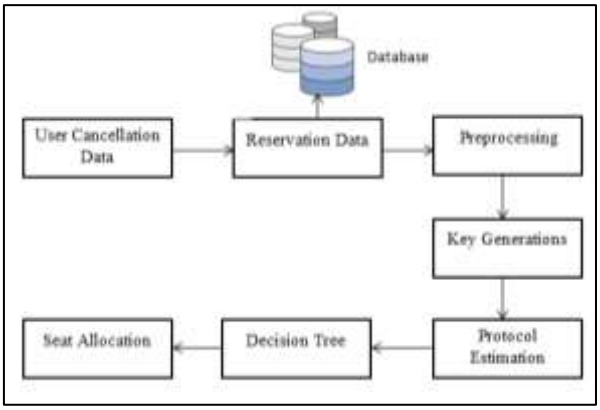

Figure 1: System Overview Diagram

The presented technique for a railway reservation system is depicted in the system overview diagram given below.

The methodology for enabling an effective railway reservation system has been achieved through the following steps in the procedure. The steps are discussed in detail in the section given below.

A. Step 1: User Registration and Ticket Booking –

The user or the traveler must be registered on the system to gain access and book the railway tickets. The user registration is done through an interactive Graphical User Interface or GUI. Through this interface, the user registers on the system by providing various attributes such as name, Email address, Mobile number, username, and a password of their choice. Once the entries are verified, the registration is successful and the user can log in to the system using the credentials.

Once the user is logged in, he/she can then utilize the interface to book a train ticket. The user has to provide the various attributes for booking purposes, such as source station, destination station, train number, train name, journey date, and time of departure, type of berth, passenger name, age, and sex. After the attributes have been provided, the system displays the number of available seats or the waiting status according to the details entered. The user can then book the desired ticket that will be reserved.

B. Step 2: Cancellation of Ticket –

In the event that the traveler after the booking the ticket intends to cancel the ticket due to unforeseen circumstances, the user can utilize the web application for this purpose. The user can visit the webpage for the cancellation purpose and enter the requisite PRN number of his/her ticket.

The system accepts the PRN number from the web application and checks the schedule of the train. If the train has reached the source station in the ticket at the time of cancellation, then the cancellation is not permitted. If the train is yet to reach the source station, the user is asked for their confirmation for cancellation, if the user replies in the affirmative, the ticket is canceled from that station.

C. Step 3: Key Generation –

The signature key is computed at the time of registration. This signature key is unique for all the individuals registered on the system. The registered users can use the unique username and password to gain validated access into the proposed system to execute their roles. The signature key is generated through the utilization of random characters. These random characters are extracted from the hash key which is created from the concatenated user attributes. This along with the use of current date and time is combined to achieve the signature Key. The signature Key is generated through the effective utilization of the MD5 hashing algorithm. This process of signature key creation is illustrated in algorithm 1 shown below.

ALGORITHM 1: Signature Key Generation

//Input : Attribute List A_{TL}
//Output: Signature Key KEY
Function: *keyGeneration*(A_{TL})
1: Start
2: con = " ", KEY= ""
3: *for* i=0 to size of A_{TL}
4: con = con + $A_{TL[i]}$
5: *end for*
6: $MD5_{HK}$=MD5(con)
7: REM= $MD5_{HK}$ SIZE MOD 7
8: *for* j=0 to KEY Length < 7
9: j=j+(REM+1)
10: *if* (j< $MD5_{HK}$ length)
11: KEY=KEY+ $MD5_{HK\ [j]}$
12: $MD5_{HK}$ = $MD5_{HK}$ >> 1
13: *else*
14: j=0
15: *end for*
16: return KEY
17: Stop

D. Step 4: Protocol Estimation and Decision Tree –

The process of railway ticket cancellation and reallocation is a complex procedure that is governed by a set of rules. The Protocol Estimation procedure is tasked with the realization of these perquisites to ensure the effective and efficient execution of this complex task. The Protocols consist of a set of rules that are tested when the user opts for a cancellation of the ticket.

The protocols such as the date and time of the journey on the ticket are validated, as a ticket cannot be canceled after the journey has already started. The protocols also determine the current time and crosscheck with the journey time to ensure that the train hasn't reached the source station at the time of cancellation. One all the protocols are estimated and validated, the decision tree is implemented to make a decision for the cancellation or not.

The decision tree approach is implemented in the presented system to facilitate efficient decision-making capability. The decision tree is tasked with the realization of the decision to cancel the ticket of the user or not. This is achieved through the utilization of the IF-Then Rules of the Decision Tree technique to provide a decision for accomplishing the accurate cancellation of the ticket. This module is highly essential for the realization of a constructive railway ticket reservation system.

IV. RESULTS AND DISCUSSIONS

The presented technique for realization of a railway reservation system is realized using the Java programming language on the NetBeans development environment. The

presented technique has been deployed on a development machine executing on an Intel Core i5 processor along with the 500GB of hard drive utilized as storage and 4GB as RAM. For realization of the database responsibilities, the MySQL database server is implemented.

Detailed Experimentation has been performed to determine the performance of the presented methodology. For the assessment of the accuracy of the proposed technique, the RMSE and MSE approach were utilized which can precisely extract the performance of the presented methodology. The performance of the system has been analyzed in detail to conclude that the reservation system based on Protocol Estimation and Decision Tree described in this paper has been implemented properly.

A. Performance Evaluation based on Root Mean Square Error

For the assessment of the accuracy of Railway ticket reservation system, the Root Mean Square Error (RMSE) is utilized. The RMSE technique is used for the measurement of the error rate between the two continuous and correlated values. In the presented system, the two continuous and correlated values are, no. of expected reservations performed and the no. of achieved reservations performed. This can be calculated using equation 1 below.

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(x_{1,i} - x_{2,i})^2}{n}} \quad \_ (1)$$

Where,

$\sum$ - Summation

$(x_1 - x_2)^2$ - Differences Squared for the summation in between the number of expected reservations and the number of achieved reservations

n - Number of samples or Trails

An evaluation is performed through the utilization of the RMSE technique, and the outcomes are tabulated in table 1 below.

Experiment No	No. of Transactions	No. of Expected Reservations	No. of achieved Reservations	MSE
1	10	10	8	4
2	20	20	19	1
3	30	30	28	4
4	40	40	37	9
5	50	50	47	9

Table 1: Mean Square Error measurement

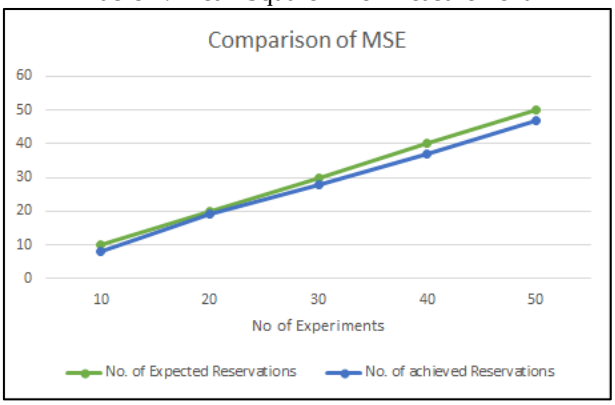

Fig. 2: Comparison of MSE in between No of Expected Reservations V/s No of Achieved Reservations

The graph displayed in figure 2 illustrates the mean square error rate between the No of obtained fraudulent transactions and No of accurate reservations performed for a set of 5 experiments. The first experiment consisted of 10 transactions with subsequent experiments incrementing by 10 iteratively. The experimental outcomes attain an average RMSE of 2.32. The obtained RMSE values are measured for the purpose of accurate railway ticket reservation. The attained RMSE value depicts that the performance extracted for the first time implementation of such a system has been a very successful achievement.

V. CONCLUSION AND FUTURE SCOPE

The methodology proposed in this paper deals with the allotment of seats that are reserved in the railway reservation system process. Along with the proper handling of the seats on the cancellation of the reserved seats. This paper learns the fact that due to the improper allocation of the cancelled seats to the deserved person based the fact of increasing the revenue of the railway is being practiced not fairly in much reservation software. This eventually may end up in creating the losses or poor management of the railway reservation system. So, in this paper outlines an innovative approach for effective railway seat reservation through the implementation of Protocol Estimation and Decision tree. The approach has also been quantified for its performance through the evaluation of the error through the RMSE approach. The obtained outcomes illustrate that the methodology has been implemented successfully.

For the purpose of future research this methodology can be implemented in a real time environment. The methodology can also be implemented in the form of a web application for ease in access to the users.

REFERENCES

[1] Swati R. Khokale, Vaibhav U. Bunde, Shweta B. Karande, Shyam Ingale, and Mayuri Ghaywat, "Authentication System for Smart Railway Station – A Review", International Journal for Modern Trends in Science and Technology (IJMTST), 2018.

[2] Parag Chatterjee and Asoke Nath, "Smart Computing Applications in Railway Systems - A case study in Indian Railways Passenger Reservation System", International Journal of Advanced Trends in Computer Science and Engineering, 2014.

[3] Mr. Sunil Mhamane, Mr. Pranav Shriram, "Digirail - The Digital Railway System and Dynamic Seat Allocation" Proceedings of the Second International Conference on I-SMAC IoT in Social, Mobile, Analytics, and Cloud, I-SMAC, 2018.

[4] Basetty Mallikarjuna, Arun Kumar Reddy Doddi, "Enhanced Railway Reservation System using the Internet of Things" IADS International Conference on Computing, Communications & Data Engineering (CCODE) 7-8 February 2018.

[5] Ryo Takagi, "Required Characteristics of the Ticketing Systems for Reservation-Compulsory Commuting Railways", International Conference on Intelligent Rail Transportation (ICIRT), 2018.

[6] Richard M. Sachs, Deborah W. Brown and Joel DeLong, "A First Step on The Path To Automated Flight Reservations", Proceedings of IVTTA '96. Workshop on Interactive Voice Technology for Telecommunications Applications, 1996.
[7] Yoel Frans Alfredo, Abba Suganda Girsang, Sani Muhamad Isa, an Ahmad Nurul Fajar "Data Warehouse Development for Flight Reservation System" IEEE INAPR International Conference, 7 Sept 2018.
[8] Xiao-Jun Wu, Fang Zheng, and Wen-W Wu, "A Hybrid Dialogue Management Approach for A Flight Spoken Dialogue System", Proceedings of the First International Conference on Machine Learning and Cybernetics, Beijing, 4-5 November 2002.
[9] Bernd Freisleben, Gernot Gleichmann, "Controlling Airline Seat Allocations with Neural Networks", Proceedings of the Twenty-sixth Hawaii International Conference on System Sciences, 1993.
[10] Peng Wu, and Feng Chu, "A bus lane reservation problem in urban bus transit network", 2014 IEEE 17th International Conference on Intelligent Transportation Systems (ITSC) October 8-11, 2014.
[11] Mr. Sunil Mhamane, and Mr. Pranav Shriram, "Digirail-The Digital Railway System and Dynamic Seat Allocation", Proceedings of the Second International Conference on I-SMAC IoT in Social, Mobile, Analytics, and Cloud, I-SMAC, 2018.
[12] Xiaoyan Lui, Chunhuang Liu, and Weiwei Wang, "Study on Feature Extraction in China Railway Ticketing and Reservation System" Fourth International Conference on Fuzzy Systems and Knowledge Discovery, FSKD, 2007.
[13] Linyuan Xia, Qiumei Huang, and Dongjin Wu, "Decision Tree-Based Contextual Location Prediction from Mobile Device Logs" Hindawi Mobile Information Systems, 2018.
[14] Chaitanya Manapragada, Geoffrey I. Webb, and Mahsa Salehi, "Extremely Fast Decision Tree", Proceedings of the 24th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining, August 2018.
[1] Bin-Bin Yang, Song-Qing Shen, Wei Gao, "Weighted Oblique Decision Trees", The Thirty-Third AAAI Conference on Artificial Intelligence (AAAI-19), 2019.

