A Machine Learning based Solution to the Employee Assignment Management

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Abstract: The key management issue to be addressed by the business administrators is to efficientlyassign the work flow to the three employees. Many times administrators are required to identify the availability of the employees who are free for any work to be assigned. This paper is aimed to demonstrate the use of the staff assignment problem using the machine learning technique. The binary classification problem is addressed as a simple example using the support vector machine (SVM) as the tool. The random employee data base is considered for the institutional employees.Theclassifiers accuracyarepredicted based on their occupancy or availability.

Keywords: Employee Assignment, Machine Learning, SVM, Binary tree, classification, work assignment.

1. Introduction

These papers havefocused to solve the most common issue of the businessadministrators or departmental incharges as employee assignment problem. The purpose of the employee assignment problem is to distribute staff members to jobs in such manner that overall expenses are minimized or overall productivity is maximized. It is a problem of combinatorial optimization. The problem is typically encountered in scheduling as well as assigning resources difficulties. The ultimate goal of this paper is to use the machinelearning (ML) methods to solve such a problem as a case of binary classification and assignment. There are many ML based approaches already used to solve the staff assignmentissues[1, 2, 3, and 4]. In the recent times the deep learning based solutions are also employed [5], for the largescale assignment problems. The broad classification of the employee assignmentproblem is given as balanced and un-balanced as shown in the Figure 1.

There are an equal amount of personnel and duties in the balanced solution. While in the un-balanced case there are varying numbers of workers and tasks in the unbalanced solution. There are certain approaches gives exact solution to assignments problem but are computationally too complex. But there are certain probabilisticapproaches which may giveapproximate fast solution to problem. The major challenge is to use the fast approach but with the improved accuracy of prediction and assignments. The aim of this paper is to demonstrate the use of ML based classification [6, 7] as solution to availability assessment of employees.
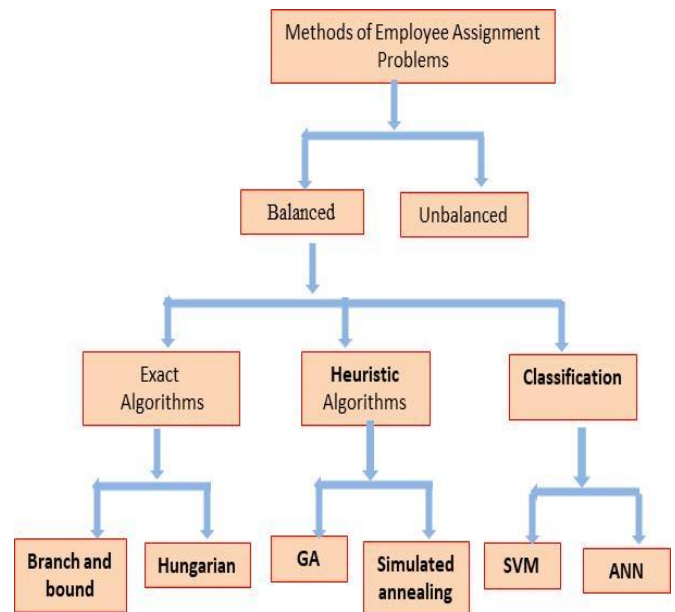

Figure 1 Classification of Employees Assignment Problems (EAP) approaches

The various technological methodologies were used for the staff assignment problem. Viz., Genetic algorithm (GA), heuristic approaches [8], and simulated annealing (SA). In this paper it is proposed to demonstrate the classification problem to solve the staff assignment using the SVM based approach. Employees are assigned Loaded or Available for job assignment. Although for the sake of reference it is considered as the binary assignment problem. The optimization problem is mathematically defined as the

$$Cls(x,y) = \begin{cases} 1 & for\ availability\ of\ employee \\ 0 & for\ known\ availability \end{cases} \quad (1)$$

Where the x, and y are the name and load vectors of the employees.

2. Benefits of Employee Assignment

The use of the ML based solution in the employee assignmentproblem make sure that the

➢ To make sure the productivity of the employees by assigning task to them.

➢ To overcome the issue of the over work load or burnout.

➤ Maintain the job assignment fairness and authenticity by equally assigning the work to the employees.

➤ The unbalanced based assignment may offer the employee assignment based on top level skilled employees. As per their expertise.   .

The factors to be considered for the employee assignment problem for work assignment are shown in the Figure 2. These factors may include the skillset, experience, and field of interest, workload, and the availability. This paper has addressed the major one out of this as availability of the employee. As if they are availablecan be assigned many tasks,to compensate the over load of the other employees.
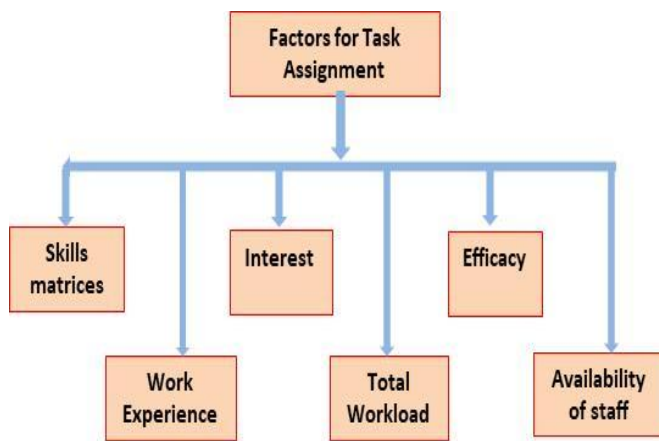

Figure 2 Factors frequently to be considered for task assignments.

Many ties the skill set of the employee is essentialespecially to the technical expertise. But for most of the task the skillsets is optional in the industry. Thus availability of employee is essentials. If employee is available for job that means he was siting idle and is responsible for the less productivity. Thus it is essential to identify the availability of the employees and the task assignmentsas an administrator. Employee availability may be monitored via availability schedules. After then, work may be scheduled using this information so that none of the employees' accessibility is impacted.

3. Literature Review

There were lots of researches carried out for employee assignment. Fallucchi et al [1] businesses can utilize technology to aid decisions being made in a number of areas. For example, among most advanced technologies currently in use is machine learning (ML), which helps with personnel administration, administrative issues, and corporate strategy. Human resources (HR) have received more attention in recent years since a skilled labour is an actual competitive advantage for businesses and a growth element. theArtificial intelligence (AI) has been implemented in the marketing and sales teams and is now beginning to inform HR managerial choices pertaining to employees. Bujold et al. [2]suggested AI is becoming more and more integrated into the field of human resources administration (HRM), as it does with many other company procedures and operations. While automated human resources management isn't without hazards and constraints, AI has a great deal of opportunity to enhance HRM tasks in organizations. Recognizing these issues is essential to encouraging the ethical application of artificial intelligence within HRM.

Ali Shah et al [3]in there article presented methods that use Deep Learning and artificial neural networks for predicting workers' professional timeliness behavior. Standard artificial intelligence approaches are used to examine the effectiveness of the suggested method. The results show that the deep neural network performs at a 90.6% level, while the A single-layer Neural Network performs at 73.3% and decisions tree, SVM, & Random Forest algorithms perform at 82%. Canavesi et al, [4]studied and conclusion indicate that servant leadership has a beneficial effect on employee engagement via a variety of mediators, including those that are job centered like challenging tasks organizationcentered like team cohesion leader-centered like empowerment or employee-centered like a proactive demeanor. Msuya et al [5] have purposedstudy to evaluate how supervisor's job-life support affects bank workers' productivity by examining the connection between autonomy at work and staff workload. Bank workers in Tanzania's Middle Zone areas participated in a survey. A total of 417 questionnaires for surveys were completed by bank employees. This was followed by an equation-based model analysis of the data.

Brusco et al [6]for achieving the dual goals of low operating expenses and excellent client service requires careful consideration of workforce employment as well as planning strategies. Researched on policy are especially important when there is a severe staffing deficit in the labour force. Labour cross-utilization between divisions or work centers is a well-known staffing strategy for handling constraints. Tran et al [7] have offered an overview of the society and communities at Google Corporation, a well-known international corporation with a sizable technical workforce and numerous accomplished executives. Although there may have been administrative difficulties, it has had good social effects throughout its period of existence.

.   You, Peng-Sheng et al [8] addressed the assignment of medical workers to each clinical division based on individual career choices and hiring abilities is the primary concern with regard to the duty schedule. Nevertheless, there hasn't been much research done on how to implement vocational management and leverage the multiskilling qualities of employees. Betts et al [9] have preseted simple approach although their method does not ensure the best answer, it may be of interest to you. In this brief study, we will demonstrate

that the genuine optimum answer, with a cost of 1520, can be obtained by solving the identical case derived from Yadaiah and Haragopal article using the traditional Hungarian approach of Kuhn after balancing the issue using a straightforward textbooks approach.Yadaiah et al [10] addressed a novel method for resolving an imbalanced allocation issue in this research. To efficiently assign all of the duties to devices, a Lexi-search method is employed. When the new technique's outcomes are juxtaposed to those of the previous ones, it scores better. Zsolt et al. [11]in this research a method utilizing the Support Vector Machine, or SVM, modeling method to construct a broader system model is presented. It examines the maximum number of relationships among the relevant system variables and determines the input as well as output arrangement of the entire system modeling that realizes the most exact estimation.

Madzarov et al. [12] study had presented a novel design for supported vector machine learners that solve multiple classes' issues using bipolar decision chains (SVM-BDT). Using an organizational approach, a structure of discrete judgment sections with SVM is created. This clustering method uses distance measurements taken at the level of the kernel instead of the input space to ensure consistency with the SVM. The excellent rate of classification of SVMs and the effective computing of the choice tree design are both benefited by suggested SVM-based Binary Choice Tree architecture. The goal of SVMBDT structure was to achieve better multi-class detection outcomes.

4. ML Methodology

There are many ML approaches were used for the EAP solution. The paper is focused on the SVmnased classification approach for binary allocation. The various kindof SVM are available for molding. The three of the are linear SVM, cubic SVM and Gaussian SVM. The linear SVM can be modeled as the solution to linear equation for as

$$Y = mx + c \qquad (2)$$

The nonlinear kernel based SVM are recently become more popular.Kernel function SVMs have been developed for data that is nonlinearly segregated. In essence, the kernel's functions are sigmoid, Gaussian, or polynomial. By projecting an input vector onto Hilbert space, the Gaussian kernel feature separates data that has not been linearly separated.

Gaussian Kernel tool is used to convert data when any prior knowledge about the data is unknown.

$$G(x, y) = e^{\frac{\lfloor(x-y)\rfloor^2}{2\sigma^2}} \qquad (3)$$

The Gaussian SBM offers better classification for nonlinear set of data.

5. Proposed EAP

Encouragement In order to segregate the training data, vector machines first translate the input to a higher dimensional space and then identify the greatest marginal hyper-plane. SVM is not recommended for big data sets, though, because the training time required to compute the maximal marginal hyper-plane for a data set size of N is at least $O(N^2)$.

This research suggests a novel method for improving SVM training when working with big data sets. Its foundation is the fusion of clustering analysis with SVM. The concept is as follows: Since SVM calculates the maximum margin separating data points, only patterns that are closest to the margin can have an impact on the margin's computations; other points can be eliminated without changing the outcome.

In this paper first the data of employee assignment is randomly preseted for the faculty assignment for institutes. Then the ML tool in MATLAB is used for the training and testing of the binary data classification the results are shown for the random classification for Wednesday of the week and the accuracy are calculated.

6. Results and Discussion

In this paper the random employee data base as shown in the Table 1 is created for the teaching staff of institutional department, and the Monday to Saturday load availability is assigned as binary classification case. Where 1, means available and 0 means loaded.The graphical representation of the actual input staff data assignment for the employee availability is shown in the Figure 3. The employee no is assigned to each employee and is used for the prediction case.

The proposed employee availability is considered as the classification problem and the SVM based classifiers are applied in training and testing phase of the input data. The random classification results for the Wednesday assignment is shown in the Table 2 for the three cases of classifiers

Emp.No.	Name	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	Dr.sanjeev	0	1	1	0	1	0
2	Mr.Neelesh Kr. Gupta	0	1	1	0	0	0
3	Ms.Neetu Sharma	0	0	0	0	1	0
4	Mr.Abhishek Agwekar	0	1	1	0	0	0
5	Mr. Sunil Raghuwanshi	0	1	1	0	1	0
6	Mr.Vikram Singh Thakur	1	0	1	0	1	0
7	Ms.ChandrikaSaxena	0	1	1	0	0	0
8	Ms.Ankita Jain	0	1	1	0	1	0
9	Ms. Zia Ali	0	1	1	0	1	0
10	Mr.ShraddhaSinghal	0	1	1	0	0	0
11	Mr.Vinod Kumar Singh	0	1	1	0	0	0
12	Ms. Sana Qureshi	0	0	0	0	1	0

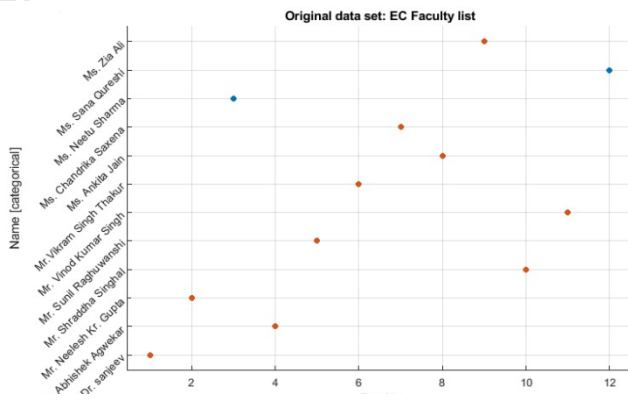**Table 1 The input employee assignment in binary form**

Figure 3 Actual input data assignment for the employee availability.

.Table 2 Comparison of the training and testing accuracy for SVM based methods

Method	Training Accuracy	Testing Accuracy
Linear SVM	77	03.3
Cubic SVM	77	83.3
Gaussian SVM	83.3	100

It can be observed from the Table 2 that for the given set of data the Gaussian kernel SVM offers the maximum accuracy at training and testing phases.

The true positive rate (TPR) and false negative rate (FNR) at the training phase of the Gaussian SVM for the employee assignment are shown in the Figure 4.
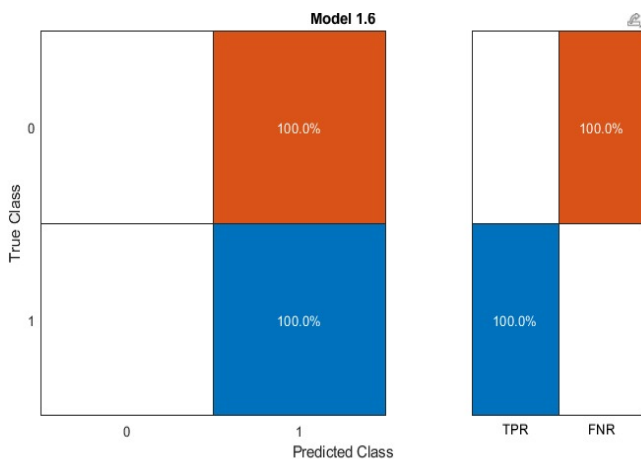

Figure 4 The positive and TPR rate and FNR for the Gaussian SVM based employee assignment

The Figure is corresponding to 100 % accuracy as clearly observed no values in 0 common

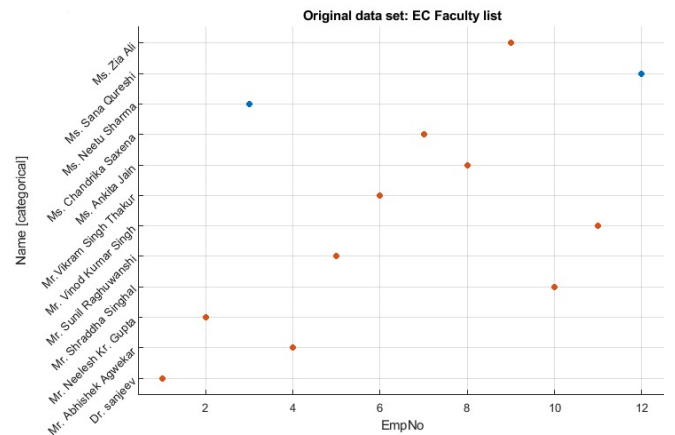Output data assignments based on SVM with 83.3 % accuracy are shown in the Figure 5 for the example.

Figure 5 Output data assignment based on SVM with 83.3 % accuracy.

7. Conclusions and Future Scopes

Administrators are frequently required to determine the availability of employees who are available for any job that may be assigned. The purpose of this study is to explain how to apply an employee assignment issue with ML.

As an illustration, the problem of binary classification is solved employing the support vector machine (SVM) as an the tool. For institutional personnel, the randomly selected employee data based is evaluated. The accuracy of the classifiers is anticipated depending on their fullness or availability. The accuracy of the training and testing phase are calculated for the three different SVM approaches. The maximum accuracy is achieved for the Gaussian SVM as 83.3 % in training phase and 100 % for testing phase.

As a scope in future multi class classification problem can be consider with better KNN or CNN based classifiers.

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