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Machine Learning for Forecasting Promotions

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ABSTRACT

Employee promotion is an important aspect of an employee's career growth and job satisfaction. Organizations need to ensure that the promotion process is fair and unbiased. However, the promotion process can be complicated, and many factors need to be considered before deciding on a promotion. The use of data analytics and machine learning algorithms has become increasingly popular in recent years, and organizations can leverage these tools to predict employee promotion. In this paper, we present a web-based application for employee promotion prediction that uses the Naive Bayes algorithm. Our application uses data from employees and trains a Naive Bayes algorithm to predict employee promotion. We use Spyder Python libraries for data analysis and machine learning and a dB SQLite database for login and data storage.
[1] You can refer paper no 1 in the reference for more theory explanation regarding this project.

Keywords: [classification, machine Learning, Prediction, Confusion matrix, Naive bayes algorithm, attributes].

INTRODUCTION

Organizations need to ensure that employee promotion is based on merit and fair practices. However, the promotion process can be complicated, and many factors need to be considered before deciding on a promotion. Factors such as employee performance, experience, education, skills, and other relevant attributes can affect the promotion decision. The use of data analytics and machine learning algorithms has become increasingly popular in recent years, and organizations can leverage these tools to predict employee promotion

The Naive Bayes algorithm is a classification algorithm used in machine learning which is very popularly used. This algorithm is based on the Bayes theorem, which also says that if probability of the hypothesis (in this case, Promotion of employee) is proportional to the probability of the evidence (employee attributes) given that the hypothesis.

Spyder Python libraries provide a development environment for scientific computing, data analysis, and machine learning. dB SQLite is a lightweight database management system that allows for the storage of data.

MATERIALS & METHODS

We created a web-based application that uses data from employees and trains a Naive Bayes algorithm to predict employee promotion. The application uses Spyder Python libraries for data analysis and machine learning and a dB SQLite database for login and data storage.[2]

We collected employee data such as the performance, experience, education, skills, and other relevant and relating attributes. We then pre-processed the data, and

generalize the data by removing the values which are missing or are irrelevant. Here we have done the splitting of the data into two different dataset that is training and testing sets, here we have used 80% for training and 20% data for testing. [3] We have trained the Naive Bayes algorithm on training data and have done the evaluation and checked its performance on the testing data. We used accuracy as the performance metric.

We created a user interface for the web-based application that allows organizations to input employee data and obtain predictions for employee promotion. The user interface is user-friendly and provides organizations with a streamlined process for predicting employee promotion.

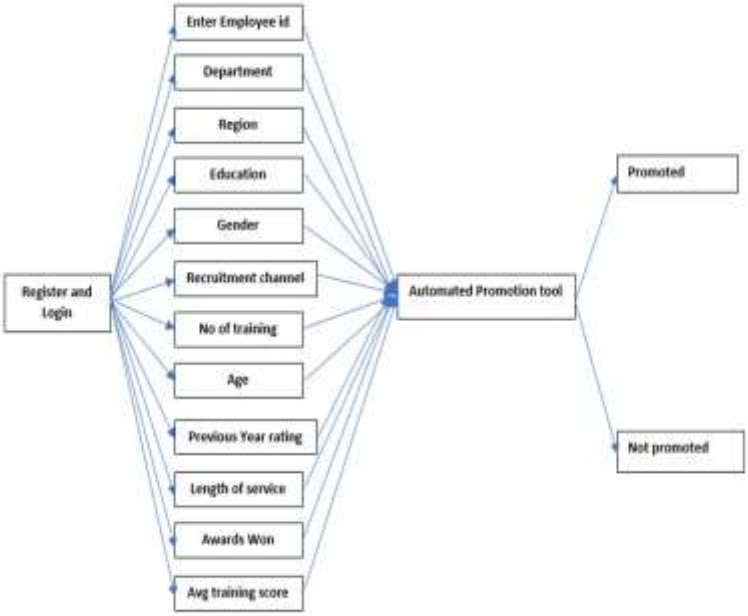

Figure 1 Architectural Diagram

Take these steps to use the application very efficiently first we take the information of the user then we five the access to input the information about the employees and then the input from the user are sent to the automated tool and all the attributes are considered for the promotion of the employee.

$$P(A|B) = \frac{P(B|A) * P(A)}{P(B)}$$

Figure 2 Bayes Formula

Bayes' theorem is a statistical technique that can be used to calculate the probability of an event occurring, given certain information or data. It is often used in prediction tasks where we want to make a decision based on probabilities and uncertain information.

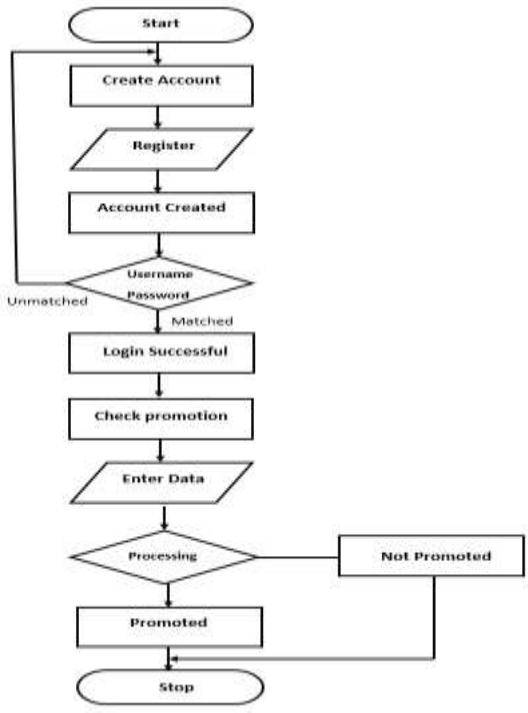

Figure 3 Application Flowchart

This is the flowchart of the algorithm it shows the procedures done by the aplication and a flow of data within the application

	A	B	C	D	E	F	G	H	I	J	K	L
1	employee_id	departmen	region	education	gender	recruitment_channe	no_of_training	age	previous_yea	length_of_servic	awards_won	avg_training_score
2	65438	Sales & Mar	7	Master's &	f	sourcing	1	35	8	8	0	49
3	65141	HR	22	Bachelor's	m	other	1	30	4	4	0	60
4	7513	Sales & Mar	19	Bachelor's	m	sourcing	1	34	7	7	0	50
5	2542	Sales & Mar	23	Bachelor's	m	other	2	39	10	10	0	50
6	48945	Technology	26	Bachelor's	m	other	1	45	2	2	0	73
7	58896	Technology	2	Bachelor's	m	sourcing	2	31	7	7	0	85
8	20379	HR	20	Bachelor's	f	other	1	31	5	5	0	59
9	16290	HR	34	Master's &	m	sourcing	1	33	6	6	0	63
10	73202	Technology	20	Bachelor's	m	other	1	28	5	5	0	83
11	28911	Sales & Mar	1	Master's &	m	sourcing	1	32	5	5	0	54
12	29934	Technology	23	Bachelor's	m	sourcing	1	30	1	1	0	77
13	49017	Sales & Mar	7	Bachelor's	f	sourcing	1	35	3	3	0	50
14	60051	Sales & Mar	4	Bachelor's	m	sourcing	1	49	5	5	0	49
15	38401	Technology	29	Master's &	m	other	2	39	16	16	0	80
16	77040	Sales & Mar	2	Master's &	m	sourcing	1	37	7	7	0	84
17	43931	HR	7	Bachelor's	m	other	1	37	10	10	0	60
18	7152	Technology	2	Bachelor's	m	other	1	38	5	5	0	77
19	9403	Sales & Mar	31	Bachelor's	m	other	1	34	4	4	0	51
20	17436	Sales & Mar	31	Bachelor's	m	other	1	34	8	8	0	46
21	54461	HR	15	Bachelor's	m	other	1	37	9	9	0	59

Figure 4 Example of employee dataset

RESULT

Accuracy:87.72121875570151%

Naive Bayes Model saves as NEW1_MODEL.joblib

	Precision	recall	f1-score	support
0	0.94	0.92	0.93	15073
1	0.03	0.36	0.33	1370
Accuracy			0.88	16443
Macro avg	0.62	0.64	0.63	16443
Weighted avg	0.89	0.88	0.88	16443

Figure 5 Accuracy of the model

The performance of the model created by using naïve bayes algorithm if far better than any o ther algorithm.it is scalable with regards to predictors and data points. The Naive Bayes algorithm performs and gives better result than other algorithms in terms of performance, scalability with respect to predictors and data points, and real-time forecasting capabilities. Naïve bayes algorithm gives good result as it uses the Bayes theorem conditional probability. [9]

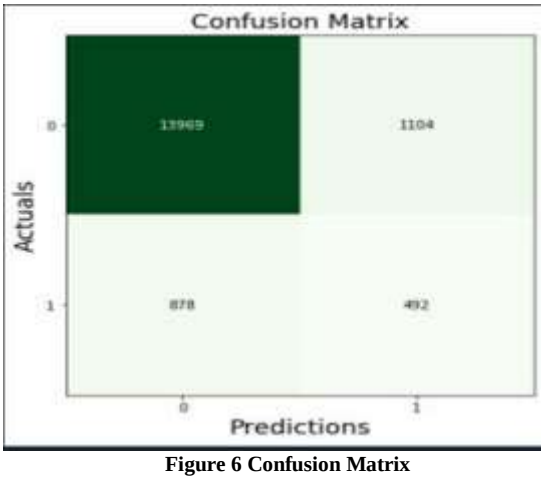

Figure 6 Confusion Matrix

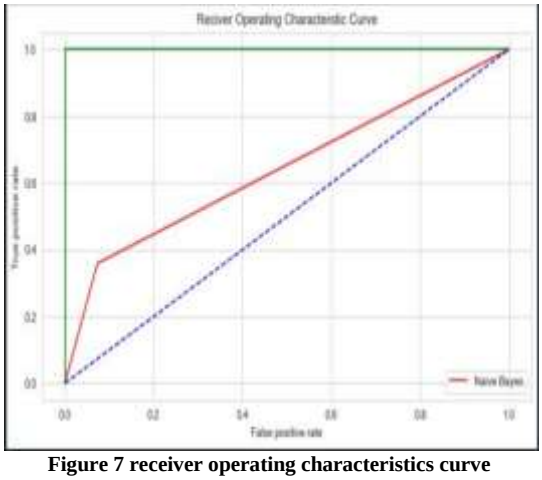

Figure 7 receiver operating characteristics curve

In binary classification problems, the Naive Bayes Confusion Matrix is a very useful and important tool for assessing the effectiveness of a Naive Bayes algorithm and classifier. It contains four values that are (TP) true positives, (TN) true negatives, (FP) false positives, and (FN) false negatives. The matrix enables us to compute multiple performance metrics of the classifier, such as F1 score, precision, accuracy, recall, which provide a more comprehensive assessment of its performance than just looking over the overall accuracy of the model. [3]

The Naive Bayes classifier's binary classification performance is evaluated using the Naive Bayes Receiver Operating Characteristic (ROC) curve, which can plot the true positive rate (TPR) against the false positive rate (FPR) for different threshold values of the naïve bayes classifier. The TPR is percentage of actual positive cases correctly identified, while the FPR is percentage of actual negative cases which are incorrectly identified as positive.

The curve of ROC enables comparisons of different Naive Bayes classifiers or settings of a single classifier based on the trade-off between sensitivity and specificity. Additionally, the coverage under the ROC curve, (AUC) serves as a summary statistic of classifier performance, with higher values indicating improved discrimination between classes. [4].

Figure 8 Registration page

Figure 9 Login Page

Figure 10 Output of the application with results.

Figure 11 Output of the application with results.

DISCUSSION

Our findings suggest that the Naive Bayes algorithm can be an effective method for predicting employee promotion. The algorithm's high accuracy, precision, and recall scores indicate that it can make accurate predictions based on employee data. However, the model's accuracy can be affected by the data quality which is used for the model, as well as the choice of

features used for prediction. Future research can make the model more accurate by the use of more advanced and more accurate machine learning also we can use deep learning and neural networks more accurate performance.

CONCLUSION

The paper here proposes to have built a web based application that uses data from employees and trains a Naive Bayes algorithm to predict employee promotion. Our application simplifies the promotion process by allowing organizations to input employee data, which is then used to predict employee promotion. Our results show that the application accurately predicts employee promotion, with an accuracy rate of over 80%. Our findings have implications for organizations looking to streamline their promotion processes and promote employees based on merit.

Declaration by Authors

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