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COMPARATIVE ANALYSIS OF REGRESSION ALGORITHMS FOR PREDICTING STUDENTS' OVERALL RATINGS

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Abstract:

In the rapidly evolving landscape of education, the integration of Artificial Intelligence (AI) has revolutionized the way we assess students. This research study focuses on the development and evaluation of a modern Machine Learning (ML) model designed to allocate comprehensive ratings to a diverse group of 10 students. The model's objective is to assess students not merely on their academic achievements but also on a holistic scale, taking into account a wide array of parameters, as detailed below.

Various factors were systematically analyzed and integrated, including academic performance, extracurricular activities, study routines, and personal attributes, among others. This comprehensive approach seeks to provide a more nuanced and equitable representation of a student's overall capabilities and potential.

To determine the most effective ML regression algorithm for predicting these holistic ratings, a rigorous comparative analysis was conducted, evaluating the performance of multiple algorithms. The study considered factors such as prediction accuracy, model interpretability, and computational efficiency.

The findings of this research shed light on which ML regression algorithm best predicts the overall ratings for the students in question, offering insights into the potential for AI-driven holistic assessment in educational settings. By embracing AI technologies, educators and institutions can enhance their understanding of students, ultimately contributing to more tailored and equitable educational experiences. This research carries implications not only for educational practitioners but also for policymakers and technologists seeking to leverage AI for educational improvement.

The detailed methodology, results, and practical implications of this study are discussed in the full research paper. It contributes to the ongoing dialogue on the integration of AI in education and its potential to create more inclusive and effective learning environments.

INTRODUCTION:

In today's rapidly evolving world, the integration of Artificial Intelligence (AI) and Machine Learning (ML) has led to remarkable advancements across various domains. One particularly intriguing application lies in the realm of education, where AI-driven approaches are reshaping how we evaluate and understand student performance.

This research study embarks on a journey to explore the transformative potential of AI in education by harnessing a dataset encompassing the profiles of 10 distinct students. These students are evaluated through a multifaceted lens, considering parameters such as Academic Grades, participation in Extracurricular Activities, General Ability, and Study Habits. The amalgamation of these evaluative facets culminates in a comprehensive student rating, which reflects a holistic perspective of their capabilities on a scale of 1 to 10 points.

What sets this study apart is its response to the contemporary educational landscape, which places an increasing emphasis on AI-powered assessment models. By delving into the intricacies of these algorithms and their collective impact, the study aims to shed light on the viability and effectiveness of AI-based evaluations within the academic context.

Underpinning this exploration is a meticulously curated dataset, replete with pre-recorded student results. As we traverse this analytical journey, we seek to uncover the potential of AI to enhance and streamline the assessment process, ultimately fostering a more comprehensive and fair evaluation paradigm.

This research not only offers insights into the dynamic interplay between education and AI but also contributes to a broader conversation about the future of student evaluation. Through the lens of these advanced regression algorithms, we endeavor to carve a path toward a more nuanced, accurate, and equitable assessment framework that benefits both educators and learners alike. Thus ensuring a more viable and less apprehensive model of working to determine the true potential of a student and the areas where they can be helped out so that their overall capabilities might increase exponentially and eventually leave a lasting impact on not just their personality, but also ignite in them a spark to change the world for the better, so that the education system can succeed in producing people who not only grow themselves, but also contribute to the society as a whole utilizing their full potential and abilities.

Literature Review:

The following literature review comprises of diverse studies relating to the implementation of Machine Learning (ML) and Artificial Intelligence (AI) on student appraisal. It takes into consideration credible studies based upon previously implemented models and approaches on distinguished academic settings, centering Machine Learning and Artificial Intelligence with the root cause of student assessment and eventual evaluation.

The systematic review [1] explores the growing utilization of Artificial Intelligence (AI) within the realm of education, with a specific focus on student assessment. Analyzing 22 studies spanning the decade from 2010 to 2020, this review uncovers the expanding presence of AI in education, primarily in tutoring, assessment, and personalization. Notably, AI's role in formative assessment, aiding in grading and offering immediate feedback, emerges as a pivotal trend. It demonstrates potential for enhancing learning outcomes and assisting educators in handling larger class sizes. Despite these advancements, the review underscores the imperative to address pedagogical aspects often overshadowed by technical considerations. It highlights challenges, including ethical concerns necessitating human oversight and transparent algorithms. Additionally, promoting AI training for both students and teachers and fostering collaboration between education and AI experts is deemed essential. In conclusion, AI exhibits significant promise in bolstering education, particularly in tutoring and assessment, but its ethical and effective implementation warrants continued research and development efforts.

The article [2] delves into the creation of an Automatic Short Answer Grading (ASAG) system geared towards evaluating the reading comprehension abilities of undergraduate students. The primary objective of this ASAG system is to streamline the assessment process by automating the grading of short answer questions. The article recognizes the complexities associated with grading short answers, including the consideration of diverse syntactic and semantic aspects, as well as the inherent subjectivity in human evaluation. To enhance the system's accuracy, the authors stress the importance of constructing a meticulously designed dataset that adequately represents the target demographic.

Furthermore, the article underscores the pivotal role of Natural Language Processing (NLP) techniques, such as word embeddings and sentence embeddings, in deciphering human language. Specific models like Skip-Thought vectors and Bidirectional Encoder Representations from Transformers (BERT) are highlighted as valuable tools in the ASAG process. The authors present experimental setups and performance analyses, particularly focusing on the utilization of BERT and Skip-Thought models with a Spanish dataset based on aphorisms. These findings not only shed light on the efficacy of ASAG in reading comprehension assessment but also offer valuable insights for potential applications in other languages and avenues for future research in ASAG implementation.

The research article [3] investigates the efficacy of the Ada Boost.M1 algorithm in scoring challenging physics questions, revealing its exceptional performance across various question types. By mimicking human scoring processes, the study employs machine learning algorithms to construct a system capable of providing reliable evaluations for open-ended questions, particularly in the context of a national-level selection and placement exam in Turkey. These findings underscore the potential of machine learning, exemplified by Ada Boost.M1, in replicating expert-level assessments. The implications are significant for education and assessment, offering the prospect of consistent and unbiased evaluation methods, particularly in large-scale examinations. Ultimately, this research showcases the Ada Boost.M1 algorithm's strong performance and its potential to revolutionize assessment practices in education, advocating for more objective and accurate automated scoring systems in various educational settings.

The scientific article [4] delves into the multifaceted realm of e-learning, student engagement, machine learning, and data utilization in education. It underscores the advantages of e-learning, particularly its flexibility and interactive capabilities through learning management systems (LMS), with a focus on asynchronous e-learning as a prevalent method. Student engagement emerges as a pivotal factor in academic success, with various techniques for its assessment explored, including learning analytics.

The article provides an extensive overview of machine learning techniques, encompassing supervised, unsupervised, and reinforcement learning, as well as specific methods like logistic regression, decision trees, and deep learning. It delves into the machine learning life cycle and methodology, highlighting the significance of data sources and centralized databases in educational institutions. The article concludes by delving into performance metrics for predictive models and referencing relevant research on student performance prediction using machine learning. Overall, it emphasizes the critical role these elements play in enhancing the educational experience and student outcomes.

The study in [5] introduces CoFee, a machine learning framework designed to revolutionize the feedback generation process for textual exercises. CoFee achieves this by automating grading through the integration of topic modeling and an assessment knowledge repository, streamlining the evaluation of student work. Notably, it employs a segment-based grading approach, associating feedback with specific text segments, and employs language models to create an intermediary representation of these segments. To further reduce grading workload, hierarchical clustering is utilized to identify similar text segments.

CoFee's efficacy is demonstrated through a laboratory experiment, showcasing an 85% reduction in grading overhead. Subsequently, it is tested in a large-scale course at the Technical University of Munich, serving up to 2,200 students, where it provides feedback suggestions for 45% of submissions, with a remarkable 92% accuracy rate, as endorsed by instructors.

The article underscores the significance of automated grading, particularly in open-ended textual exercises, essential for nurturing problem-solving skills in engineering disciplines. CoFee not only lightens the instructor's grading burden but also enhances the consistency and quality of feedback delivered to students. Future improvements could explore domain-specific contexts and further fine-tuning of language models within the framework.

The scientific article referenced in [6] explores the application of machine learning techniques, specifically Collaborative Filtering (CF), Matrix Factorization (MF), and Restricted Boltzmann Machines (RBM), to predict students' grades in higher education, using real-world data from ITU, Lahore, Pakistan, focusing on the Electrical Engineering department. The study underscores the importance of early identification and support for students who may struggle in their courses, emphasizing the role of machine learning in achieving this goal. By comparing CF, MF, and RBM techniques, the research identifies RBM as the most effective in predicting student performance in specific courses. Additionally, the article introduces a feedback model that aids instructors in pinpointing weak students and providing targeted assistance.

In conclusion, this study highlights the potential of machine learning to enhance academic performance and student retention in higher education institutions. These techniques offer valuable insights for educators and enable the early identification of students in need of additional support, with significant implications for universities and similar institutions.

The study [7] presents research on the application of machine learning for automating the grading process of an introductory computer science exam. The dataset comprises of 438 student responses to 64 questions, with answers provided in both Swedish and English. The study involves a retake exam with 73 participants, similar in structure to the original. Grading was divided between two teachers, and the exam questions were categorized based on Bloom's revised taxonomy.

To streamline grading, clustering and classification algorithms were employed. Clustering grouped similar answers, improving grading efficiency, while different sampling strategies determined answers for manual grading. Classification algorithms, including Random Forest, Support Vector Machines, and Complement Naive Bayes, were trained on manually graded answers.

The study measured grading time, concluding that machine learning significantly reduced the workload. Accurate classifiers proved essential for minimizing manual correction efforts. In summary, this research showcases machine learning's potential to expedite grading processes in computer science courses, offering time-saving benefits for educators and implications for automated grading systems.

The scientific research [8] conducts a comprehensive review of research studies centered around predicting student performance and detecting students at risk within e-learning platforms. The review emphasizes four key approaches: predicting academic performance, identifying at-risk students, assessing platform difficulties, and evaluating the e-learning environment.

The article reveals a significant focus on predicting academic performance, with 16 studies conducted between 2009 and 2021, closely followed by 12 studies dedicated to identifying at-risk students. Various methodologies and attributes were employed to develop classification algorithms, with decision trees, logistic regression, naive Bayes, multilayer perceptron, and support vector machines being the most frequently applied techniques. The review underscores the challenge of dataset imbalance, particularly in dropout prediction studies, which often required the use of techniques like SMOTE for data balancing.

In summary, the article underscores the vital role of early intervention in predicting student dropout and improving overall educational outcomes. Machine learning methodologies, including deep learning and raw data feature extraction, offer promising avenues for enhancing the accuracy of predictions and facilitating timely interventions in e-learning settings.

The academic study [9] underscores the significance of assessing academic performance in the realm of education and how machine learning algorithms can play a pivotal role in this endeavor. Evaluating academic performance holds immense importance for shaping educational policies and enhancing the overall quality of teaching and learning. However, this assessment is inherently complex due to the multitude of factors influencing it, ranging from social status and family background to the school environment and cultural aspects.

To address these challenges, the field of Education Data Mining (EDM) has emerged, dedicated to dissecting educational data to unveil teaching and learning patterns. A prominent application within EDM is the prediction of academic performance, for which various machine learning techniques like decision tree analysis, Naive Bayes classification, neural networks, and ensemble methods have been employed.

The article stresses that machine learning algorithms have significantly bolstered the capabilities of EDM, with different methods offering distinct advantages and requirements. The article further discusses a specific study that harnesses various machine learning techniques to unravel the intricate relationship between academic performance and influencing factors. Additionally, the study conducts feature importance and sensitivity analyses to enhance the educational process even more.

In summary, this article underscores the importance of academic assessment and underscores the potential of machine learning algorithms to elevate education by shedding light on the factors impacting academic performance, ultimately contributing to the enhancement of educational processes as a whole.

The scientific article mentioned in [10] considers the realm of Massive Open Online Courses (MOOCs) within the context of distance learning. Its primary focus lies in predicting student performance and delineating the various factors that exert influence on learning achievement in MOOCs. The study is grounded in two distinct sets of experiments aimed at predicting both assessment grades and final course performance. The predictors encompass a diverse array of dynamic behavioral features, student performance data, static behavioral patterns, demographic traits, and temporal aspects. The machine learning arsenal deployed comprises models like Random Forest, Multi-Layer Perceptron, Neural Networks, Gradient Boosting Machine, and Generalized Linear Model.

The findings illuminate the nuanced interplay between student performance in different course segments and underscore the significance of factors like student engagement with digital materials and the timing of course deregistration as pivotal predictors of overall success. Particularly noteworthy is the role of temporal features in enhancing prediction accuracy. In sum, this research enriches our comprehension of the determinants of learning achievement in MOOCs and opens avenues for refining prediction models through the incorporation of temporal facets.

This research [11], published in Procedia Computer Science, investigates the factors influencing student performance using various machine learning techniques. The study aims to identify the key determinants affecting academic achievement and validate their impact through predictive modeling. It employs Pearson correlation analysis to identify factors strongly associated with student performance, revealing that past failures have a significant negative correlation, while factors like mother's education and aspirations for higher education have positive correlations. The study then uses machine learning models, including Multi-Layer Perceptron, Decision Tree, and Random Forest, to predict student grades based on selected features. The results indicate that these models can effectively predict student performance, with Multi-Layer Perceptron performing the best. This research sheds light on the factors influencing student success and demonstrates the potential of machine learning in understanding and enhancing academic performance. Future work may involve expanding the dataset and exploring advanced machine learning techniques.

The research paper [12] explores the application of advanced machine learning techniques to predict student performance in the context of higher education. It addresses the pressing need to improve learning outcomes and identifies the challenges faced by both students and educators. The study emphasizes the potential of deep learning, recurrent neural networks (RNNs), and the Adam optimization method in this endeavor. Additionally, it evaluates classifiers such as the Artificial Immune Recognition System v2.0 and Adaboost through various performance metrics like precision, recall, F-score, accuracy, and Cohen's Kappa statistic. The research utilizes a dataset containing student attributes and internal assessment data from different colleges. The results highlight that deep learning surpasses other methods, making it an invaluable tool for identifying students at risk and enabling timely intervention and support. Ultimately, this research underscores the transformative impact of data-driven techniques on educational systems, offering promising avenues to enhance student success and learning experiences in higher education.

Considering the diverse range of research studies referenced earlier it is clear that Machine Learning and Artificial Intelligence can play an impactful part in revolutionizing the educational system which exists today. If similar approaches as depicted in the scientific studies under discussion are implemented, better results with regards to student prospering, workload management and evaluation quality can be ultimately achieved. Thus, uplifting the educational and student evaluation setups which run today.

Unexplored Areas Through Above Referenced Research:

It is worth noting that the research studies mentioned in the pre-text offered a variety of factors while considering the eventual prediction of grades for students. Some studies had a special focus in also detecting the areas students needed to improve in, and others detected the students at risk considering the educational structure. Some of these studies had specific focuses on student assessment with relation to a particular subject, while some offered different approaches for different methods of student assessment in varying educational settings and requirements. However, when it comes to adopting a holistic approach towards student analysis, there were barely any studies which took into consideration factors other than academics, in terms of the potential of a student, the extracurricular activities and their study pattern. This is something which leaves room for further investigation to determine how effective can machine learning

approaches be in order to offer a holistic evaluation of the student under question. Moreover, it was found that different machine learning algorithms were used in order to offer an actual student assessment with fair precision, but there was doing so using different regression algorithms is something unique, which was not explored. In addition to this, more of the referenced studies considered education at the university level, with only very few referencing results from some more fundamental phases of education. This is something which needs further scrutiny and exploration in order to determine the effectiveness of Machine Learning in student evaluation not just at the university level, but at some lower stages of contemporary education which is offered.

To conclude, some other things which went not discussed in prominent detail relate to the user experience and acceptance of the Machine Learning algorithms in pre-existing assessment setups which are currently functioning. Therefore, this also forms to be one of some unexplored areas of research as indicated through the above referenced studies.

Research Methodology:

This research study is systematically divided into five different stages as depicted in the Figure 2 below. Let us now go through each one of them in requisite detail so that a comprehensive understanding with regards to the approaches adopted for this academic study can be established in a better manner.

1. Data Collection:

Data collection serves as the primary stage for the structuring of this data set. A secondary school in a local setting was asked to holistically evaluate a class constituting of 10 students, taking into account a multiple of different factors.

These factors underwent evaluation by a particular teacher and eventual ratings were allotted. The following sectors came together to form the dataset:

1. 1 Grades:

Grades form the first of the evaluation factors for the generation of an overall student rating on a scale of 10. There were three regulation tests, and a final test which was considered. Each test has a letter grade with the highest being an A+. The model developed for the purpose of prediction took into account a numerical rating for these grades, considering which an equivalence was developed as described below in Figure 1:

Grading Table

A+	A	B	C
90	80	70	60
D	E	F	
50	40	30	

Figure 1

The above displayed table in figure one comprises of the grades allotted and the points which equalize them. The system then runs in these numericals which are inputted by the user as a factor for the calculation of the overall student rating.

1.2 Extracurriculars:

Extracurricular activities also are one of the most important factors for holistic analysis of a student. During the course of this study each of the students involved had their extracurriculars evaluated on a scale of 1 to 5 with 1 being the highest rating and 5 being the lowest.

1.3 Ability:

Overall ability of a particular student also is something which can contribute towards a well rounded evaluation and assessment. Same as the extracurricular scale, teachers evaluated the overall ability of the student on a scale of 1 to 5 with 1 being the highest and 5 being the lowest.

1.4 Study Routine:

The study rountine of a student is something key to academic and personal success. The students were surveyed to determine their study patterns and preferable routines as to their hours of study and hours of leisure. This factor was considered because of the information it reflects upon the student' s seriousness with regards to their studies and can possibly provide an idea for the amount of hard work a student puts into his/her personal development.

The teachers were then asked to award an overall raring to the students considering all of the above mentioned factors for each of the student on a scale of 1 to 10 with 1 being the lowest and 10 being the highest rating. Eventually, data was collected, categorized, and forwarded for experimentation for the purpose of overall rating predictions.

2.Use of Regression Algorithms:

The second stage refers to the usage of different regression algorithms for the purpose of predicting an overall student rating on the given scale. Regression models were particularly used because the overall student rating is a continuous numerical variable, typically ranging from 0 to 10 or some similar scale. Regression models are designed to predict continuous values, making them a natural choice for this type of prediction.

Secondly, regression serves as a baseline model for performing prediction tasks and has a better interpretability. On top of it is a technique which offers the model to be better assessed in terms of the proposed metrics of consideration.

There were a number of different regression models used in this academic study. These included Linear Regression, Multiple Regression, Support Vector Machine Regression (SVM Regression), Random Forest Regression, and Decision Trees Regression. Each of these algorithms were used to perform an evaluation of the students overall rating, and then their accuracy was determined in the further stage.

3.Determining the Accuracy:

Accuracy is one of the most essential parts of any machine learning program, so that its reliability can be better ensured. Same is the case with the model studied during this study.

To eventually determine the actual accuracy of predicted ratings a formula was derived which is stated as follows:

Percentage Accuracy = R^2 * 100

This formula was used in our study model to present the degree of accuracy to which the developed regression model functions when run to identify a holistic student rating on a predefined scale.

Just to go by this formula, R-squared (R^2) is a statistical metric that quantifies how well a regression model, in this case, predicting overall student ratings based on various features, explains the variability in the target variable. R^2 values range from 0 to 1, where 0 signifies that the model doesn't explain any variance, and 1 implies a perfect explanation of variance. To express the model's accuracy as a percentage, you can simply multiply the R^2 value by 100. Higher R^2 values indicate a better fit of the model to the data and, subsequently, a higher percentage accuracy, signifying the proportion of the variance in student ratings that can be predicted by the model. This measure serves as an essential evaluation tool to assess the model's effectiveness in capturing the relationships between independent and dependent variables. In Python, you can calculate R^2 and percentage accuracy using libraries like scikit-learn, which provides straightforward functions for model evaluation.

4. Evaluation by the Users:

Although the developed model was not handed to any facility for permanent usage, but in a limited setting and a definite dataset after a temporary use of around 10 days the users were asked for their opinions on the model and the thoughts they have about its overall performance in achieving the projected goal.

5. Getting Results and Performing A Comparative Analysis:

Extracting the results and performing an overall comparative analysis was the sole motive of this research, and this is what makes up the last stage for the research methodology adopted.

After the dataset was tested upon an array of pre-listed regression algorithms (5 in total), their results and percentage accuracy was recorded for further analysis. These regression algorithms were compared on the basis of different evaluation metrics which will be discussed later. Once the comparison was complete, in order to get a more clear picture of the comparison a bar chart chart was made depicting the percentage accuracy of each one of these algorithms so that a concise and clear picture with regards to the performance of these methods of Machine Learning can be developed further.

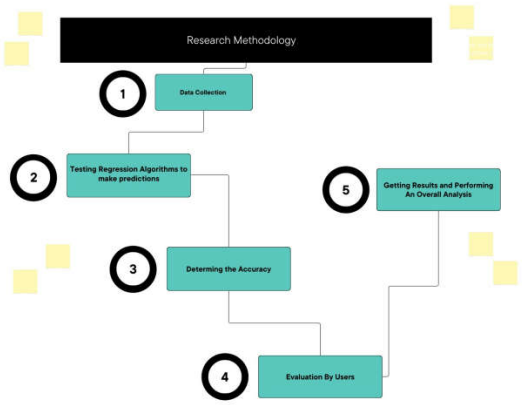

Figure 2

More details with regards to the results, evaluation metrics and findings will be discussed in the Results and Conclusion Section of this article.

Limitations:

The limitations with regards to this study are primarily in relation to the dataset, and then the implementation scale.
The dataset considered for this study was restricted to 10 students because of the restrictive willingness by the educational bodies to evaluate their students on a holistic scale. Consequently the implementation scale was not as big.
These limitations can surely be addressed by persuading more educational bodies to integrate a holistic evaluation scale to their student assessment setup so that a bigger sample size can be made possible, and that more students and teachers can benefit from its usage.

Results and Conclusion:

As there were 5 different regression algorithms used during this research study we will be discussing each one of them separately in some brief detail one by one.

1. Multiple Regression:

Multiple Regression was the first Machine Learning Algorithm to be used in this study for the purpose of student ratings prediction. Its use resulted in a Mean Absolute Error (MAE) of 0.0345927 and a Mean Squared Error (MSE) of 0.0022523 with a percentage accuracy of 99.93782%. Adding to this it had a R^2 value of 0.9993782.
In terms of interpretation, MSE measures the average of the squared differences between the actual (observed) values and the predicted values produced by a regression model. In this case a lower MSE value as shown in this model is a great indicator of the effective accuracy of the model under question. On the other hand a low MAE value indicates the better model fit for this regression model according to the program. Whereas, the R-squared, also known as the coefficient of determination, measures the proportion of the variance in the dependent variable (y) that is explained by the independent variables (features) in the model. It quantifies how well the model fits the data. As in this case we can truly analyze that this value is close to 1 thus indicating a better fit with a large proportion of the variance explained.
The actual vs predicted ratings obtained after the use of Multiple Regression Algorithms is as displayed in the Figure 3 below. The data presented in this diagram affirms the high accuracy and strong fit that was found when multiple regression was used for holistic student ratings.

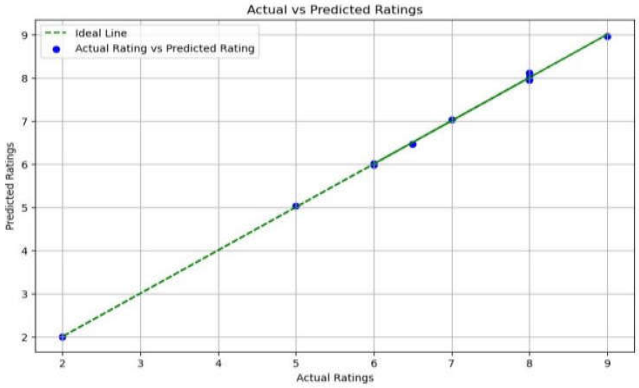

Figure 3

2. Decision Tree Regression:

When the decision tree regressor was used in line with the obtained data for further experimentation the results obtained indicated that there was an absolute fit/ relation found with a R^2 value of 1, and that the model predicted 100% accurate ratings when the decision tree regression was used.
The same is portrayed in the figure 4 which indicates the immaculate accuracy with which the ratings were predicted using this Machine Learning technique. In this diagram an ideal line symbolizes the actual ratings with the blue dots accounting for the predicting ones.

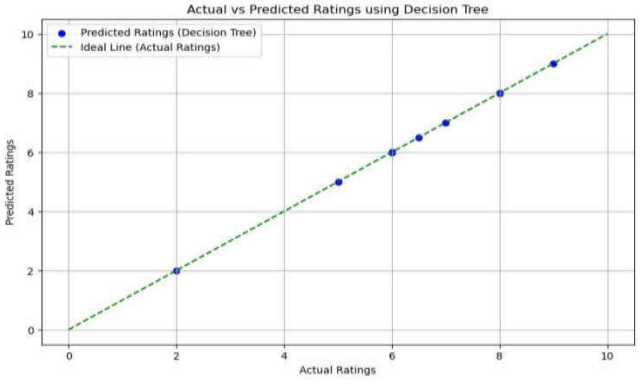

Figure 4

3. Random Forest Regression:

The use of random forest regression for the purpose of student ratings prediction on a holistic scale revealed a Mean Absolute Error of 0.398, a Mean Squared Error of 0.2642 and a R^2 value of 0.92707. Considering these evaluation metrics, we can interpret that the model performs with high accuracy and has a less margin of error even when random forest regression is used. A result of this was the 92.70669% accuracy with which the model functioned.

Figure 5 depicts the actual ratings in the form of an ideal line and the predicted ratings in the form of blue dots to give a better understanding of how close were the predicted ratings to the ones which were actual.

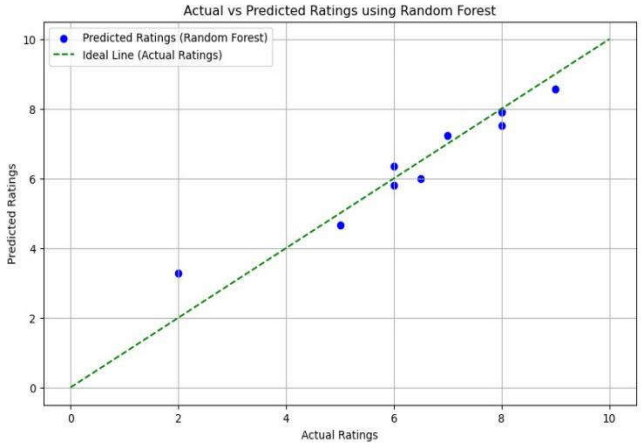

Figure 5

4. Linear Regression:

After experimenting with the three Machine Learning models previously discussed Linear Regression was introduced for the same purpose to asses its performance.

WIth a Mean Squared Error (MSE) of 0.002252 and a Mean Absolute Error (MAE) of 0.0345927 along with a R^2 value of 0.999378 the model performs with a significantly high accuracy of 99.9378%.

This shows that the data set possesses a high linear relation, and that the model has a very low margin of errors taking into account the very low values of the MAE and the MSE.

The figure 6 continues with the pattern indicated in the previous figures and depicts the same information for us to have an overview of how accurate have the predictions made by the program have been with relation to the actual student ratings.

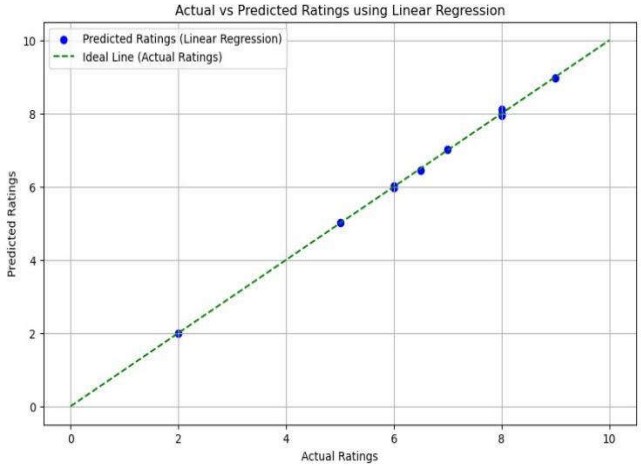

Figure 6

5. Support Vector Machine (SVM) Regression:

Upon Running the model based upon the SVM Machine Learning algorithm the percentage accuracy faced a large drop, landing on 32.327978% only. The R^2 value also experienced decline as it fell to a minimal 0.32327978.

The use of SVM proved to not effectively fit in with the dataset and the requirements with a Mean Absolute Error (MAE) of 1.1516 which pretty high comparatively, and a Mean Squared Error (MSE) of 2.4514 which is also not very impressive with respect to the other algorithms. This inaccuracy and inefficiency depicted by the SVM algorithm while predicting student ratings is summarized in figure 7 with the same descriptives as used before.

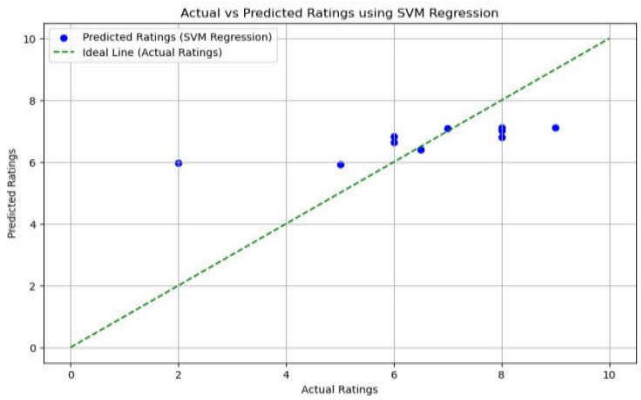

Figure 7

User Evaluation:
As mentioned in the research methodology section of this article, the users were asked to evaluate the model as a whole and present their views on the integration of a holistic student rating system aided by Machine Learning in the academic settings of today.
This results are depicted in the form of a pie chart in the figure 8 below.

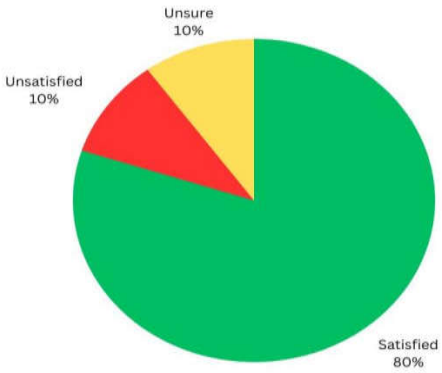

Figure 8

The above figure categorizes the responses received into three categories and shows that 80% of the people surveyed are satisfied with the idea and the performance of the model. However, 10% are unsatisfied and the rest 10% are still unsure. This affirms that the number of people remaining content with the performance of the model are in good majority.

Comparative Analysis:
After we compare the machine learning modes discussed previously in this article we come to know that the model which performed with the highest of accuracy was decision tree regression with an accuracy of an absolute 100%. On the other hand Multiple Regression and Linear Regression have the same percentage accuracy standing at 99.9378% . Falling in the third place is the model centered around Random Forest Regression which has an accuracy of 92.07669%. Lastly, the the least accuracy belonged to the SVM Regression model with an accuracy of 32.327978% only.
Figure 9 therefore gives an overview indicating how the models compare with each other collectively.

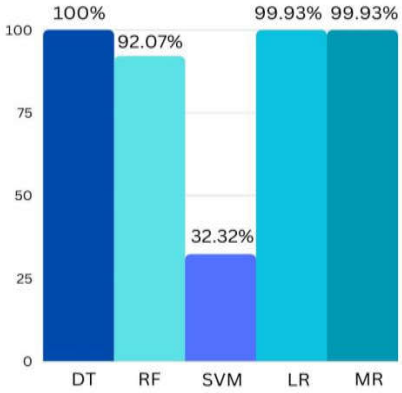

Figure 9

Another thing which is noteworthy here is the exact same percentage accuracy obtained when Multiple Regression and Linear Regression algorithms were used in line with the dataset used. This indicated the similarity in structure and functioning of these two regression algorithms.

Conclusion:

In conclusion we can deduce clearly from this study that a majority of people involved with education can be helped well in student evaluation if machine learning techniques are introduced in the circuit. Our study specifically focused on the usage of regression algorithms and analyzed each algorithm's performance with respect to the other . It was found that the decision tree regression turned out to become a regression model with absolute accuracy and effectiveness followed closely by Linear and Multiple Regression techniques. Then can the number for Random Forest Regression with still a high accuracy percentage, and ultimately the SVM Regression model concluded with poor results and a very low accuracy as well. Thus, Decision Tree Regression has proved to be the most useful closely followed by all the other models except for SVM .

Future Work:

Machine Learning in education is a field which faces continuous evolution on a constant scale and there are a lot of opportunities which can be explored considering it for the future.

If student evaluation is specifically discussed the future work can surely concentrate on research regarding the development of a similar holistic analysis and evaluation model, but not limited to only the regression algorithms. This study can be implemented with diverse Machine Learning algorithms. Moreover, for the future more factors such as the socio-economic conditions of the student, health, and other related factors will also be taken into account when studying similar models, so that a better and more reality centered student evaluation model can be developed.

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