Data mining for student performance analysis by Clustering K-Means Algorithm

Nagaswetha. R Asst.Prof, Dept. of ECE,Anurag University,Hyderabad
Narendar Singh.D, Asst.Prof, Dept. of ECE,Anurag University,Hyderabad
Pavitra.B Asst.Prof, Dept. of ECE,Anurag University,Hyderabad
Ashwini.G , Asst.Prof, Dept. of ECE,Anurag University,Hyderabad
Anil Kumar G, Asst.Prof, Dept. of ECE,Anurag University,Hyderabad

Article Info
Page Number: 1271-1287
Publication Issue:
Vol. 71 No. 3 (2022)

Article History
Article Received: 12 January 2022
Revised: 25 Febuary 2022
Accepted: 20 April 2022
Publication: 09 June 2022

Abstract
Data mining may analyse data and give fresh insights into student behaviour. Data mining methods may be used in formative assessment to assist instructors make important pedagogical decisions. It is data mining in education. Educational Data Mining involves discovering information from educational databases in novel ways.We classified the student's academic and personality achievements. This study suggests a method of categorising pupils to identify their ideal stream. Interests and capabilities may help predict student academic development.

INTRODUCTION

Students are a university's greatest asset. Universities and students play an essential role in developing high-quality graduates. Exams, evaluations, and other measures may be used to evaluate a student's academic performance. However, academic performance accomplishment differs from student to student. Academic performance of students is frequently kept in student management systems as files, documents, records, photographs, and other forms. These public student data might be used to generate helpful data. The rising volume of student data makes standard statistical approaches and database management technologies ineffective. Universities need a tool to extract meaningful data. This data might be utilised to predict student outcomes. In the extremely competitive area of education, students and graduates must be all-rounders. Educational institutions surely play a vital role in preparing students for such a competitive environment. Choosing an institution in this day with various options is tough for parents and students. With so many institutions nowadays, it is important to stand out in terms of academic achievement and student pass rate. This initiative intends to assist institutions improve student performance by assessing the primary features of their grades in periodic tests.

Because pupils' learning abilities vary, some have excellent grabbing capacity while others need more instruction. Thus, assessing each student's ability helps the class and the institution as a whole. In this study, we categorised pupils depending on their test results. Each student group has kids that struggle in one or more topics. This method of forming student batches is efficient since each batch may be instructed in the area where they are lacking, therefore improving total student performance.

The report's motivation, issue description, and goal chapters provide a basic introduction to the project's premise, followed by a literature review of previous comparable initiatives. The

project is then analysed in depth using software specs and an overall description. The model and process flow are represented using UML diagrams. The module description section offers an overview of each module's implementation. Test cases and images of the output show the basic input and output. The study finishes with suggestions for improvement.

1.1 MOTIVATION

Humans find it difficult and tedious to analyse each student's weaknesses and then provide additional lessons in those areas. Manual computations may sometimes lead to mistakes that can be eliminated with automation. This is one of the major issues in educational data mining. As we all know, pupils' grasping skills vary. Few of them can focus well enough to take in everything at once. Others need just one explanation. This might be due to poor focus, distraction, or IQ. These children need more attention and help from their teachers. Some students can study and complete work alone, while others need mentorship. For such pupils, extra courses are required. For an institution to be known and renowned, it must attain and sustain 100% pass. To be successful, an institution needs a reliable student performance analyzer.

1.2 PROBLEM IDENTIFICATION

First and foremost we collect the target database which have to be grouped, this data set is saved in the excel sheet in the form of a .csv file. Any class of students will have students who perform well and students who are average performers and few of the students might fail. Our system focuses on the students who are average and below average performers in an examination. Thus from the existing combined class as such, we try to group students based on their academic aggregates. These students, once grouped, then the necessary action for each of these groups can be planned and enforced by the school management. Basically, identifying weak students in every subject of the prescribed curriculum is identifying the problem. Once the raw data set is linked to the python program, we write a code to plot an elbow graph. This graph gives us the appropriate number of clusters for grouping the data. Finally the clusters will show us the students who are weak and need training in the particular subjects.

1.3 OBJECTIVE OF THE PROJECT

Nowadays, there is a lot of competition in the field of education be it in schools, colleges, under graduation or post-graduation. This high competition among students has a huge impact on the functioning of institutions. This has created pressure on every academic organization to yield better results. Another cause of concern is that, there is a drastic increase in the number of educational institutions that have been opened up. In comparison to the older days when there were very few schools, which further lead to the demand for schools. Whereas today, the options have broadened and parents choose those schools which have high pass percentage, good teaching, wide co-curricular activities, etc.

The proposed system will help the school management rule out any drawbacks it possesses in the academic field. The main objective of the project is to help every student perform above average in their examinations and to slowly narrow down the failure percentage to zero. This

in turn helps the institution as a whole to perform better and thereby increase their name and demand in the society.

2. LITERATURE SURVEY

Many articles have been published on Educational Data Mining (EDM). Much study has gone into predicting student academic achievement.

Kurniadi and Waras [1] intend to use the k-Nearest Neighbor (K-NN) algorithm model to analyse, forecast, and categorise individuals who may be eligible for university scholarships. The dataset for the exam includes 1018 students, of whom 24 are scholarship recipients. A semester, parents' income, number of family dependents, and CGPA are employed in the forecast procedure.

Veena and Srinivas [2] examined the performance of Fuzzy Inference and Neuro Fuzzy systems with average score. These classifiers may be used to assess student achievement based on classification accuracy and classification time. The student's performance is reviewed and rated into five categories: extremely bad, average, good, very good, and exceptional. Future vector machine-neighbor, ensemble, and discriminant analysis.

Rahman and Islam[3] used standard classification algorithms, ensemble classification techniques, and ensemble filtering methods to assess students' academic achievement. They used the normalisation approach to normalise numbers in the range of 0 to 1. Then they built the classification model utilising four classification methods. The article employed NB, KNN, and DT algorithms. Academia performance evaluated using ensemble approaches including boosting, bagging, and random forest .Unified clustering technique and its relevance to EDM have been reviewed for over 30 years [4]. Based on the examined literature, this report suggests various future directions for research on educational data clustering. In summary, the authors found that clustering may reveal important factors that separate clusters. Roy and Garg [5] compared the output of Naive Bayes classifier, J48 Decision Tree, and MLP. They compared qualities to final grades to find which attributes were the greatest predictors. Any algorithm's performance is measured by accuracy and recall. It uses a J48, Nave Bayes and MLP classification matrix. Each classifier's TP, FP, Precision, and Recall were also computed and compared based on run time and properly categorised examples. The pupils' test results were compared to their health, alcohol usage, and parental education.It employs four different sorts of attributes: family spending, family income, student personal information, and family assets. It alters the approach of selecting attribute subsets to identify key traits for student academic performance prediction. According to Amjad Abusaa [7], student performance is influenced by personal, social, and extracurricular activities. He employed three decision tree techniques coupled with Naive Bayes to classify data.M. and H. [8] evaluated existing research on predicting student performance using different analytical methodologies. It deduces that most researches employed CGPA and internal assessment as data sets. In educational data mining, the classification approach is commonly used for prediction.Ahmed and Elaraby [9] used several variables obtained from educational establishments to classify and predict academic achievement of a group of persons over a 6-year period. They might predict students' grades

in a specific subject..Baradwaj and Pal [10] suggested a 4-year study of 50 students. The categorization task is applied on student database to forecast student division. Attendance, class exam, seminar, and assignment scores were used to forecast student achievement at the conclusion of the semester. They used the ID3 Decision tree to classify student data and then built a decision tree to predict student performance.

OneR Rule Learner, Decision Tree, Neural Network, and K-Nearest Neighbor are four data mining methods employed by Dorina Kabakchieva [11]. The neural network model works better with the “Strong” class than the other three. Each model's results are compared against others for the same features and data set.

3. ANALYSIS

This section specifies a brief analysis of the current project. It describes the systems that already exist. It also specifies the drawbacks of the existing system. The analysis has a detailed description about the proposed system and its advantages over the existing systems. It specifies the software requirements, scope and purpose of the project.

3.1 EXISTING SYSTEM

A review of comparable current methods used to analyse student performance is conducted. It is selected because it is comparable to three existing systems.

Système d'aide (FSS) To monitor student performance in a course given by Coimbatore Institute of Technology of Anna University, Shana and Venkatacalam designed a framework termed Faculty Support System (FSS). FSS may examine and update student data dynamically to build or add new rules. The rule is established using data mining techniques such as categorization and may be updated by domain experts. The classifier predicts student performance. Also, FSS focuses on identifying characteristics that influence student success in a given course.

B. Performance Analyzer (SPA) SPA is a secure online web-based programme that allows instructors to monitor student progress and school statistics. The SPA analyses, displays, stores, and provides comments on student assessment data. It is a sophisticated analyzer tool used by schools worldwide to examine raw student data. The analysis tracks the student or class to assess overall performance. It helps detect student performance that is below, at, or above expectations. This would let instructors or staff quickly determine current student performance. It also allows for the generation of student progress and accomplishment reports.

Smart Mining and Decision Support System (InMinds) InMinds assists Universiti Malaysia Sarawak (UNIMAS) in monitoring departmental performance [2]. The system gives UNIMAS top and mid-management a clear view of areas that need attention based on data, revenues, and hazards. The system's capabilities, simplicity of use, and flexibility make performance analysis in UNIMAS an appropriate choice. The system provides charts to aid with student performance interpretation. The current systems' evaluations might be used to

improve the proposed system's performance. The open source programme WEKA was selected for data mining.

3.1.1 DISADVANTAGES

All present methods have the following flaws.

i. Only higher authorities have access to the student performance system.

ii. The lecturers are not permitted to access this information.

iii. Most present tools need internet access.

PROPOSED SYSTEM

We suggest a mechanism to let school administrators know where their kids stand academically. The cluster visualisation raises awareness and aids school administration in providing additional lessons for affected kids. Every pupil is focused.

The suggested approach would enable school administration and instructors identify poor pupils in certain disciplines. The technology will analyse student data and group like pupils together. Using this data, the school administration may plan extra lessons for certain groups. Teachers like this technique because they receive more time to work with struggling kids. This also delights the learner since he feels heard. Overall, the approach helps the school enhance its teaching methods and identify its target audience. Making the institution unusual and unique increases demand.

3.2.1 ADVANTAGES

The suggested system provides the following benefits over current solutions.

i. Internet access is not needed for system operation.

We pay close attention to each learner.

iii. Improved results accuracy.

3.3 SOFTWARE REQUIREMENTS

The suggested approach requires the following software:

i. Python

ii. Python Idle 3.7.4

3.3.1 PURPOSE

Python - Python has steadily gained popularity in recent years and is currently one of the world's most popular programming languages. Python is increasingly becoming the preferred language for developers working on AI, machine learning, and deep learning projects.

Python's Benefits

The Python language's wide range of applications is a consequence of its unique mix of features. Among the advantages of Python programming are:

There are various third-party modules in the Python Package Index (PyPI) that allow Python to communicate with other languages and systems. The Python standard library covers topics including internet protocols, string operations, web services tools, and operating system interfaces. Many common programming activities are already coded into the standard library, reducing code writing time.

Open Source and Community Development: Python is developed under an OSI-approved open source licence that allows commercial usage and distribution. The community also contributes to its code by organising conferences and mailing groups and providing several modules.

Python's high readability and easy syntax make it ideal for novices. PEP 8 code style standards give a set of criteria to help format code. The large user and developer base has resulted in a vast online resource bank to stimulate further development and acceptance of the language.

Python contains built-in list and dictionary data structures that may be used to build quick runtime data structures. Python also allows for dynamic high-level data types, which decreases the amount of support code required.

Python's clean object-oriented architecture, increased process management, powerful integration and text processing capabilities, and own unit testing framework all contribute to its speed and efficiency. For sophisticated multi-protocol network applications, Python is a suitable choice

Python IDLE is a free integrated development environment. IDLE (Integrated Development and Learning Environment) is an integrated development environment for Python that is included with various Linux distributions' Python packages. It uses Python's Tkinter GUI toolkit (wrapper functions).

IDLE is designed to be simple and easy to learn, particularly in schools. So it's cross-platform and lacks features.

Other features include a multi-window text editor with syntax highlighting and auto-completion. Syntax highlighting in Python The call stack is visible and the debugger has stepping.

3.3.2 SCOPE

Develop a non-intrusive technique to assess pupils' performance. This approach unites students with comparable results in each of the curriculum's subjects. We utilise K Means clustering for grouping. Management may take action after the pupils are categorised. The system comprises two phases:

- Analysing and cluster visualisation phase
- The data is pre-processed in the first step. To create the target dataset, the noisy and redundant data are removed.
- The second step analyses the data and visualises the clusters.

3.3.3 DESCRIPTION

This system creates pre-processed data from raw data input. This data is now utilised to analyse different pupils' results. The elbow graph is used to determine the number of clusters. The x-axis is wcss (within cluster squared mean) and the y-axis is number of clusters. The pupils are then categorised depending on their math and science scores. Then comes the clustering. They are also graphed. With this information, the school administration may plan extracurricular or co-curricular activities for the groups.

4. DESIGN

This section presents the students' performance analyzer architecture and UML diagrams. The UML diagrams below show the system's primary players, roles, actions, and classes. They aid in system comprehension. This chapter contains the use-case, activity, class, and sequence diagrams.

4.1 UML

UML is mostly used as a general-purpose modelling language in software engineering. However, it is currently being used to record numerous business operations. Flowcharts may be replaced with activity diagrams, a form of UML diagram. In addition to standardising process modelling, they give extra features to increase readability and effectiveness.

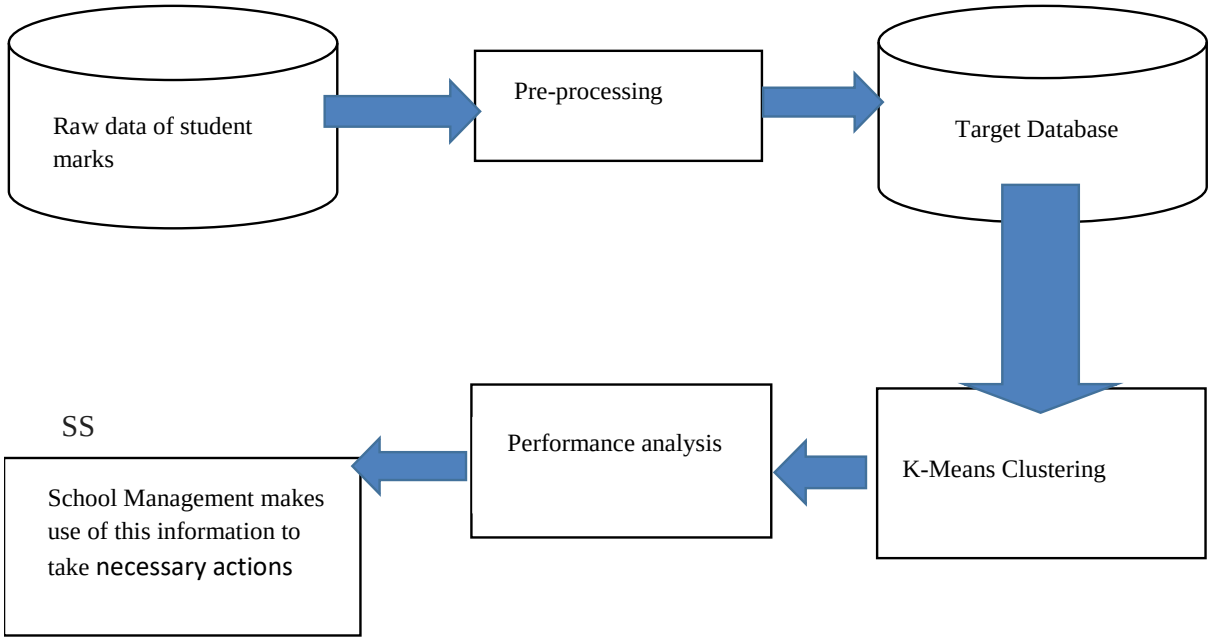
Initially, the sources provide the raw data. We used Kaggle datasets for our project. This data is preprocessed to eliminate outliers. Further processes utilise the obtained data. K-means clustering is used to categorise pupils in math, science, and social studies. The findings and cluster allocations are examined. The school administration uses this data to plan additional lessons for certain pupils.

There are various sorts of UML diagrams, each with its own function, whether developed before or after implementation (as part of documentation).

The two broadest categories are Behavioral UML diagram and Structural UML diagram.

ARCHITECTURE

Fig. 4.1 shows the suggested system's design. Initially, the school administration collects raw student mark data. The data is then pre-processed to remove noise and outliers. The admin does this. The admin then uses k-means clustering to group pupils who scored similarly. The clusters are shown next. The school administration uses this data to help pupils do better in exams.



Students' Performance Analysis

4.1.2 USECASE DIAGRAM

In the usecase diagram shown in Fig 4.2, every operation is performed to achieve the project's objective is mentioned along with the actor, who is involved in performing the operations. There are two major actors involved in the operations. They are Admin and School Management. The operations performed are collect dataset- The admin collects the respective datasets. Preprocessing- This operation is performed by the admin in order to extract the required data. Apply Clustering- The student has no part in performing this operation, the admin groups students' data using the clustering algorithm. View Clusters- The school management can view the cluster assignments. Visualization- The school management can also view the students belonging to different groups.

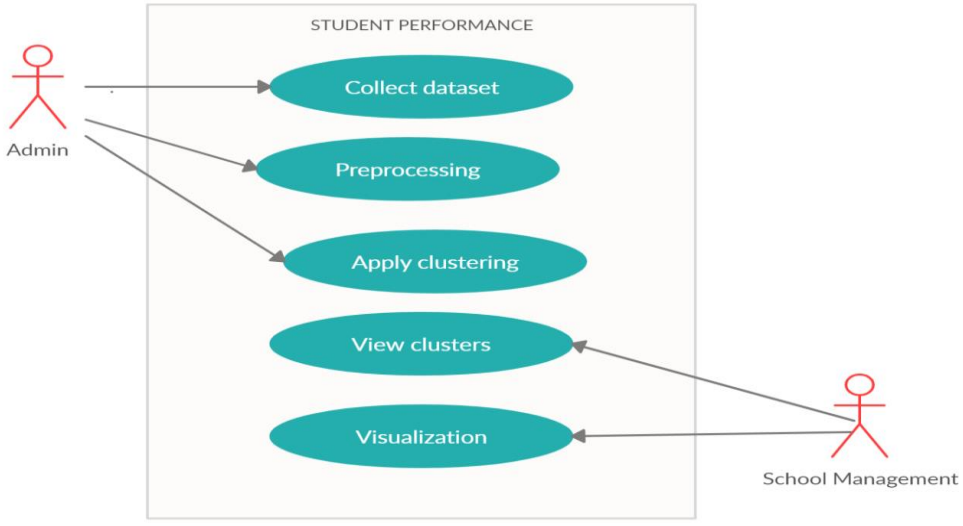
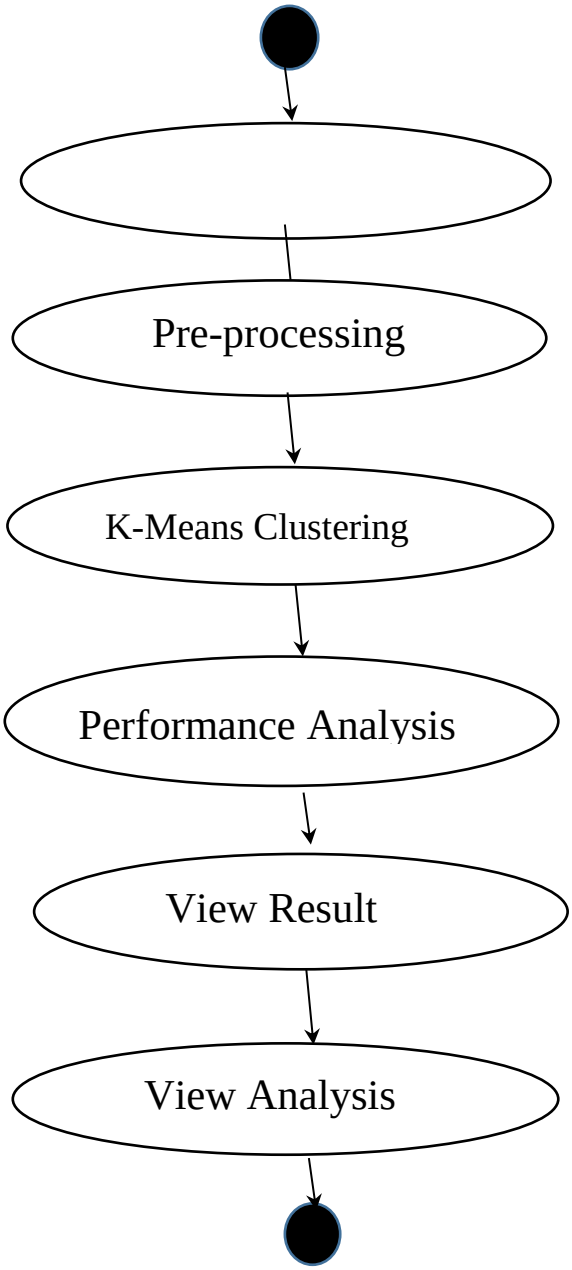


Fig 4.2 Use-Case Diagram for Students' Performance Analysis

4.1.3 ACTIVITY DIAGRAM

In the activity diagram shown in Fig 4.3 represents the flow of the operations performed sequentially and the actor of each operation.tarts. Get Marks- This operation is performed by the admin in order to get the input detail This enables us to understand the workflow in detail and thereby understanding the exact working, the various possibilities of outcomes and the involvement of each actor in this project. This diagram consists of multiple operations like start- This is the step where the process ss from the user. Preprocessing- The admin preprocesses the data to remove outliers and noise.



4.1.4 CLASS DIAGRAM

This Class Diagram represents the detailed design of the project using which this project has been implemented. Fig 4.4 represents a class diagram for the students' performance analyzer. It consists of two classes User and Admin Here the users' data like marks are given as input

to the admin. The admin first pre-processes the data obtained and then identifies the appropriate k-value using the elbow method. Using this value, he executes the clustering algorithm in order to obtain the respective student groups. Therefore the operations performed by the admin completely depends on the input provided by the user. Thus a dependency relationship exists between the user and admin.

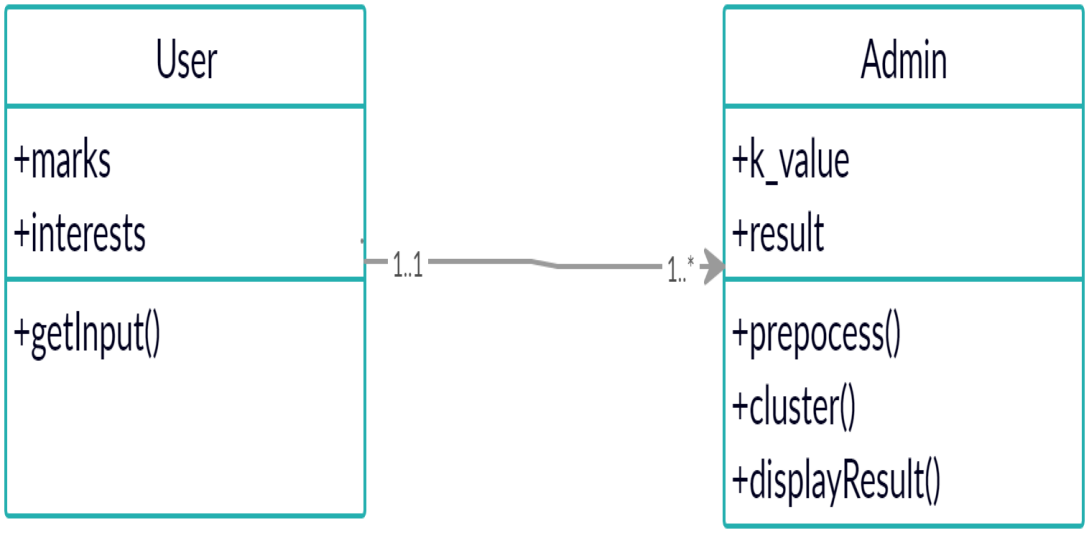


Fig 4.4 Class Diagram for Students' Performance Analysis

4.1.5 SEQUENCE FLOW DIAGRAM

The sequence diagram shown in Fig 4.5 exhibits each and every process in the completion of the project sequentially. Its functionality is similar to that of the Activity diagram but it also represents the interactions between the objects in detail. In this diagram, we have three objects- admin, performance analyzer and databases. There are various steps in this diagram each of which contains lifelines and the arrow mark shows the direction of interactions taking place. The operations include get data- The admin requests for data from the database, through the performance analyzer. Send data- The admin receives the datasets. Preprocessed data- The admin preprocesses the data and sends it to be stored on the database (permanent storage). Predicted result- The performance analyzer predicts the result using k-means clustering. This result is sent to the admin, which can further be displayed to the school management (user). Stop- Once the result is obtained, the admin stops the functioning of the performance analyzer. Close- On receiving the stop command from the admin, the performance analyzer informs the database to close connection.

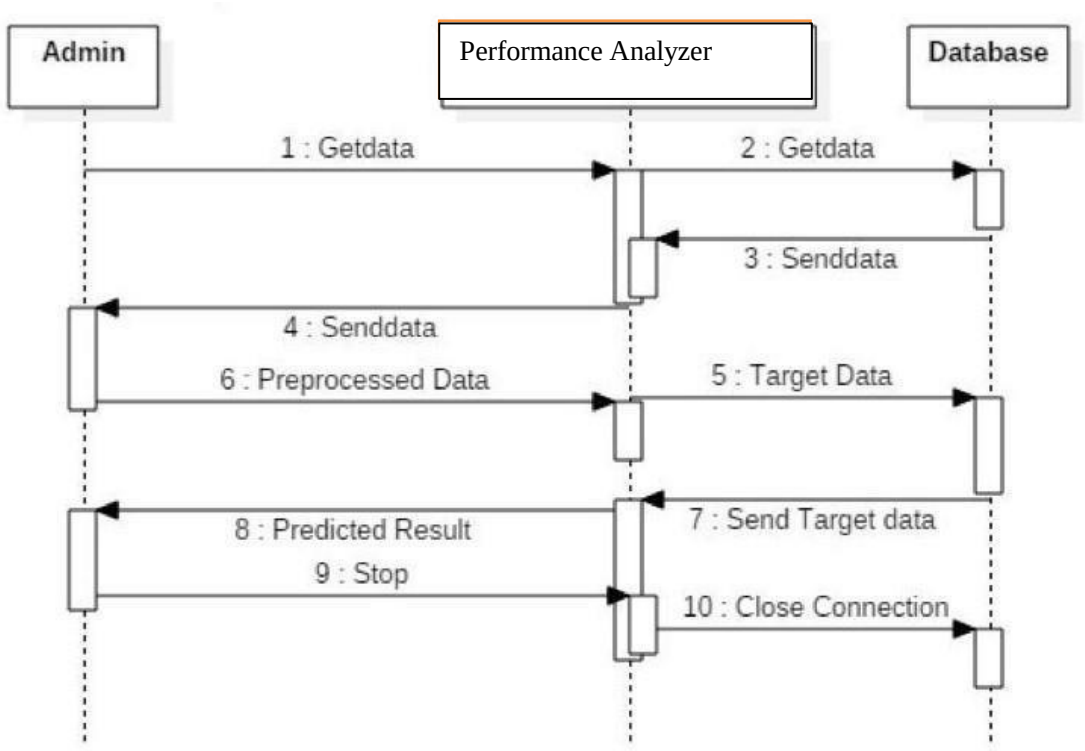


Fig 4.5 Sequence Flow Diagram for Students' Performance Analysis

5 IMPLEMENTATION

The implementation of the project has been carried out in a step-by-step manner. The first stage comprises of data collection. The data is then transformed and mined in the subsequent stages. A detailed description of each module is given below and it is followed by an introduction to the technologies used in implementing the project.

5.1 Modules

The different modules required to implement Student Performance Analyzer are Data Collection, Data Selection and Transformation, Clustering using K-Means and Result and Discussion.

5.2 Modules Description

The detailed description about each of the modules is given in this section.

5.2.1 Data Collection

In this module, data will be collected for the mining to be performed in the form of marks secured in the test written by all the students who are to be segregated into batches. This collected data is in the form of an excel sheet where all the marks are stored subject wise with every student's name, hall ticket number and branch.

The main code used in this module is

```
test_url =r"C:\Users\Desktop\pranay\performance.csv"
```

dataset = pd.read_csv(test_url)

5.2.2 Data Selection and Transformation

In this module, the data in the excel sheet is analyzed and then, the data selection is done by selecting all the fields of data required for the data mining to be performed. When this phase is completed, the required fields are known and the data is then transformed using various tools and functions like substitution functions to remove or modify the unnecessary data and obtain the transformed data which consists of only the required fields of data for the mining process.

5.2.3 Clustering using K-Means

This module is the most important one as it consists of the processing and clustering part. In this module, the K-Means Algorithm is used and applied on the transformed data to cluster the data into a certain number of clusters by specifying the clustering criteria. The number of clusters is determined by using the elbow method which is quite efficient. These clusters results in the filtered groups of students which are the batches they have been divided into based on the specified criteria.

The main code used in this module is

```
kmeans=KMeans(n_clusters=i,init='k-means++',random_state=0)
  kmeans.fit(X)
```

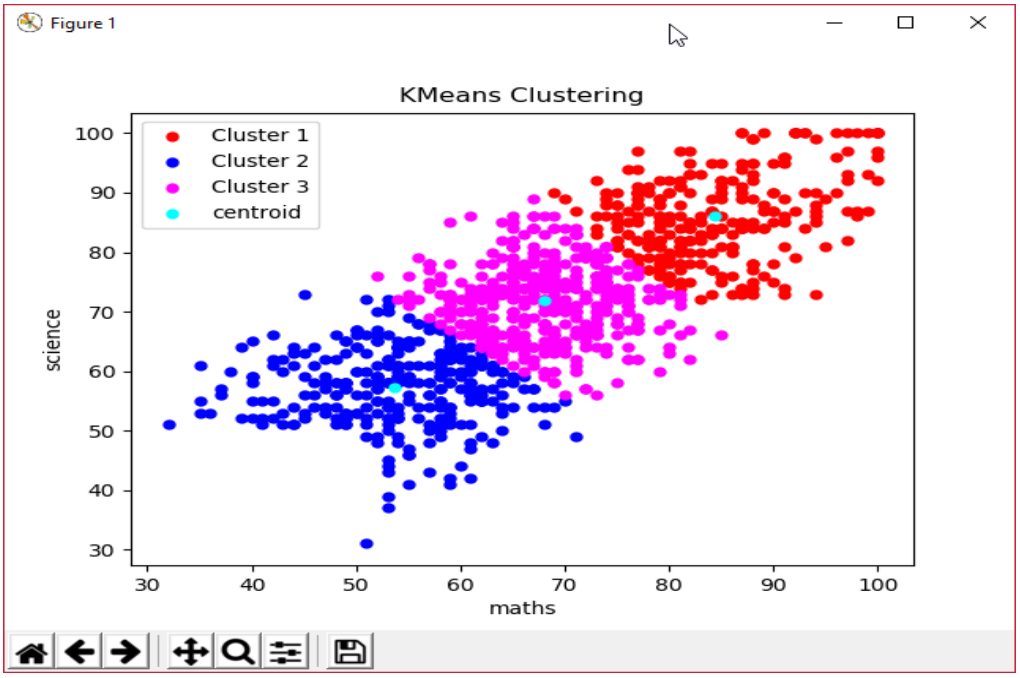
5.2.4 Result and Discussion

This is the final module in which the result is obtained after K-Means clustering is performed. The final result will be in the form of different lists of students which contain students lacking in individual subjects and also in combination of subjects. This result can also be viewed graphically. This helps in the all-round development of every student. The final output obtained is in the form of textual output and graphical output as shown in Fig 5.1 (a) and (b) respectively.

Fig 5.1(a) Theoretical output of Student Performance Analyser and **(b)** Graphical output of Student Performance Analyser

Squeezed Output Viewer

	StudentID	cluster
0	1	2
1	2	0
2	3	0
3	4	1
4	5	2
5	6	2
6	7	0
8	9	2
9	10	1
10	11	1
11	12	1
12	13	2
13	14	2
14	15	1
15	16	2
16	17	0
19	20	1
20	21	2
21	22	2
22	23	1
23	24	2
24	25	2
25	26	2
26	27	1
27	28	2
28	29	2
29	30	2
30	31	2



6. TESTCASES

Table 6.1 shows the test cases that have been satisfied by the performance analyzer. Students with marks below 50 in science and mathematics are not considered as a separate analysis is made for below average students. Thus clusters are not displayed for students having scores below 50 in science and maths.

Students who obtained marks above 50 but less than 65, belong to cluster1, these students require intensive training and guidance to perform well.

Students who obtained marks above 65 but less than 85, are average performers and require little additional training to do well.

Students who obtained marks above 85 are good performers and these students don't require any additional training classes.

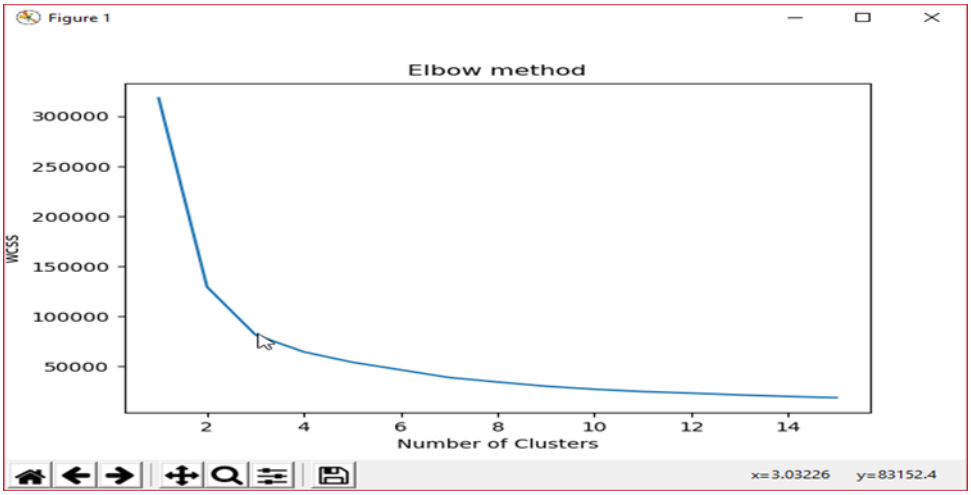
Students who scored above 50 in one subject but less than 50 in the other, are not considered as a separate analysis can be done for these students.

Table 6.1 Test cases satisfied by the students' performance analyzer

INPUT	EXPECTED OUTPUT	ACTUAL OUTPUT
Maths>50 and Maths<65 Science>50 and Science<65	Cluster 1	Cluster 1
Maths<50 Science<50	Failure	Failure
Maths>85 Science>85	Cluster 3	Cluster 3
Maths>85 Science<50	Failure	Failure
Maths>65 Science>65	Cluster 2	Cluster 2

7. OUTPUT SCREENSHOTS

The Fig 7.1 shows the output of the elbow method graph. The elbow method is used to identify the appropriate number of clusters for a given dataset. Since the size of different datasets is different, the elbow method can be used to dynamically find out the suitable clusters for any current instance. The peak in the graph gives us the correct value. The graph has its peak at 3. Thus we use the total number of clusters as 3. In the Fig 7.2, the cluster



Assignments have been displayed. The cluster points which are red in colour indicate the first cluster. All the students belonging to this cluster are good at academics and have high scores in mathematics and sciences. The cluster points which are blue in colour belong to the second cluster. All these students are weak in both mathematics and sciences and thus require intensive training support, in order to do well in the examinations. The cluster points which are pink in colour belong to the third cluster. All these students are average performers in both mathematics and sciences. Thus the conclusion drawn is that they require little guidance and support from the management.

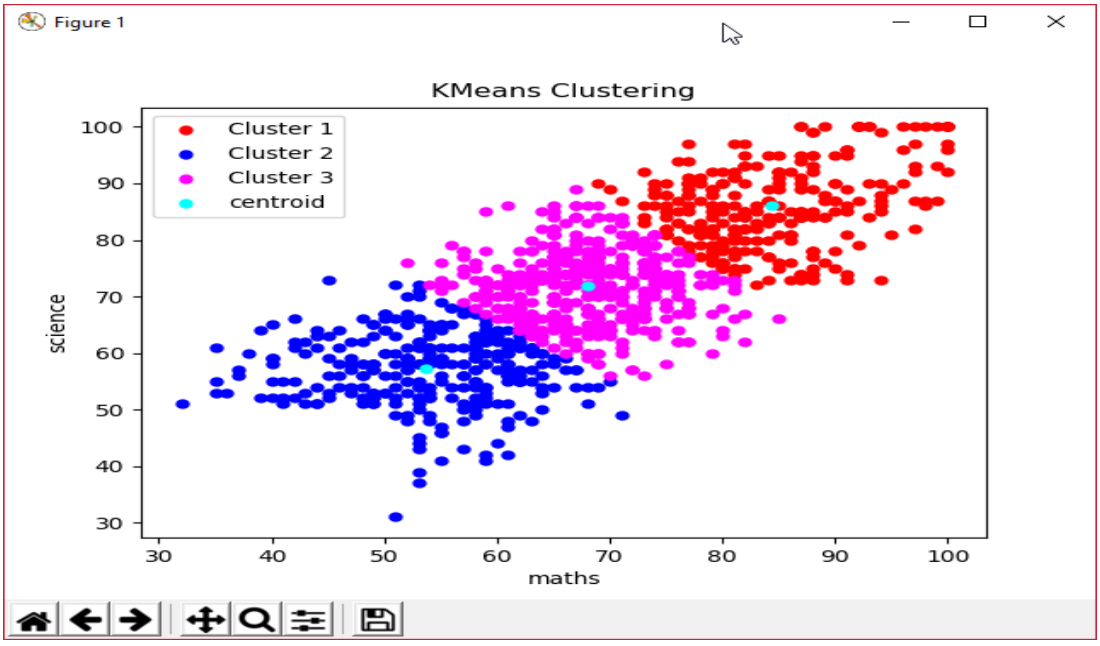
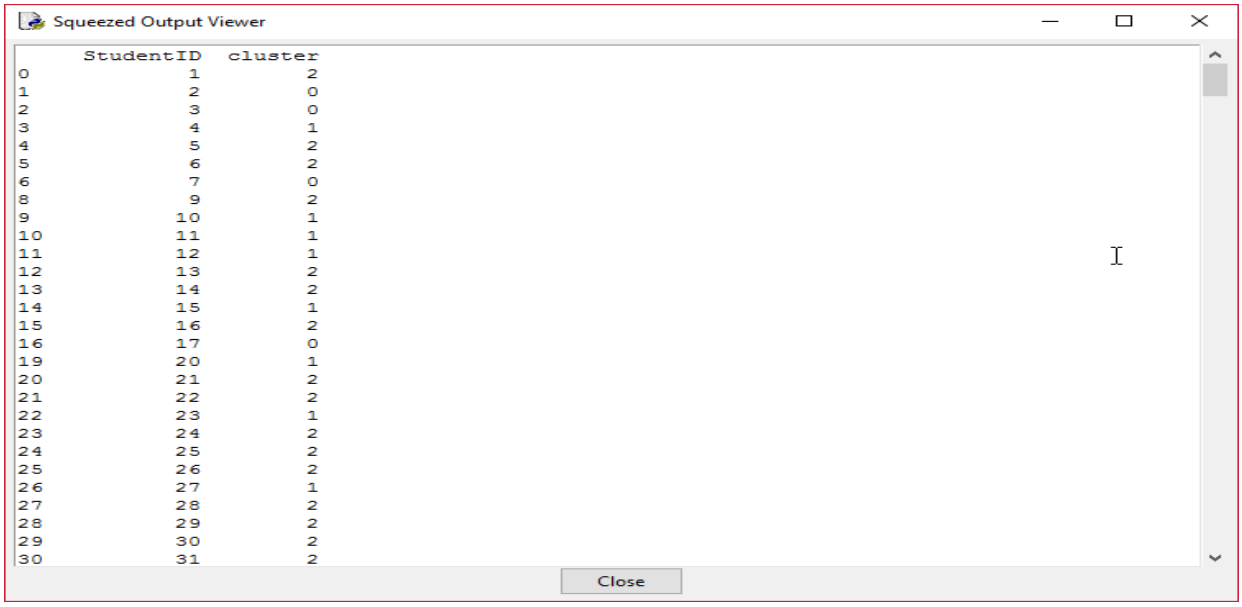


Fig 7.2 Cluster Assignments generated after applying clustering



	StudentID	cluster
0	1	2
1	2	0
2	3	0
3	4	1
4	5	2
5	6	2
6	7	0
8	9	2
9	10	1
10	11	1
11	12	1
12	13	2
13	14	2
14	15	1
15	16	2
16	17	0
19	20	1
20	21	2
21	22	2
22	23	1
23	24	2
24	25	2
25	26	2
26	27	1
27	28	2
28	29	2
29	30	2
30	31	2

Fig 7.3 Cluster Groups generated by the performance analyzer

Fig 7.3 represents the students according to the group to which they belong. This can be viewed by the school management in order to perform the necessary actions. Students are provided with additional training depending on the group they belong to.

8. CONCLUSION

We have proposed a relatively simple and accurate system for analysing the students' performance in various examinations like final exams, half-yearly exams or quarterly exams. This system is capable of analysing and depicting all the students who belong to the same group. This grouping is done based on their aggregate scores obtained in individual subjects. This system works well even in the case of minute differences in the marks obtained by students.

This system is effective because, it functions even without internet connectivity.

It is also available to anybody i.e. it can be used by the school management as well as by the teachers to gauge their students' performance. The results yielded by this system are 100% accurate.

9. FUTURE ENHANCEMENT

The future work may focus on aspects like creating a user friendly interface, where the user has to just provide the required data and the system should display the cluster assignments. For this, the user interface should have a back-end which would run the python code and display the visualization result to the user. Future works may also include expanding the number of subjects. In future, this system can also be used for gauging the performance of students' in co-curricular activities like sports, art and crafts, singing, dancing, etc. This may help the school management in selecting the candidates for inter-school competitions easily

BIBLIOGRAPHY

1. D Kurniadi, E Abdurachman, HLHS Warnars and W Suparta, "The prediction of scholarship recipients in higher education using k-Nearest neighbor algorithm", IOP Conference Series: Materials Science and Engineering, Volume 434, Number 1, 2018
2. Veena Deshmukh, Srinivas Mangalwede, Dandina Hulikunta Rao, "Student Performance Evaluation Using Data Mining Techniques for Engineering Education", Advances in Science, Technology and Engineering Systems Journal, Volume 3, Issue 6, Page No 259-264, 2018.
3. Rahman, M. H., & Islam, M. R., "Predict Student's Academic Performance and Evaluate the Impact of Different Attributes on the Performance Using Data Mining Techniques" 2nd International Conference on Electrical & Electronic Engineering, 2017.
4. Dutt, A., Ismail, M. A., & Herawan, T., "A Systematic Review on Educational Data Mining", IEEE Access, Vol 5, 2017.
5. Roy, S., & Garg, A, "Predicting academic performance of student using classification techniques", 4th IEEE Uttar Pradesh Section International Conference on Electrical, 2017.
6. Ali Daud, Farhat Abbas, "Predicting Student Performance using Advanced Learning Analytics", International World Wide Web Conference Committee (IW3C2), published under Creative Commons, Pages 415-421, 2017.
7. Amjad Abusaa, "Educational Data Mining & Student's Performance Prediction" International Journal of Advanced Computer Science and Applications, Vol. 7, No. 5, 2016.
8. Amirah Mohamed Shahiri, Wahidah Husain, Nuraini Abdul Rashid, "Predicting Student's Performance using Data Mining Techniques", The Third Information Systems International Conference, Volume 72, 2015.
9. Ahmed, A.B.E.D. and Elaraby, I.S., "Data Mining: A prediction for Student's Performance Using Classification Method", World Journal of Computer Application and Technology, 2(2), pp.43-47, 2014.
10. D.Narendar singh, Anusha Reddy and Dr.Sharma Sudhir Kumar, "IoT based wireless attendance management system using finger print recognition", International Journal of Latest Trends in Engineering and Technology Vol.(7)Issue(3), pp. 410-418.
11. D. Narendar Singh**,** Somu Mahendra Vignesh, Two Factor Authentication Based Access Control, International Journal Of Current Engineering And Scientific Research, Rese 4 (11), 73-76,2017