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Student Performance Analysis System (SPAS)

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***Abstract*— Almost every university have their own management system to manage the students' records. Currently, even though there is a student management system that manages the students' records in Universiti Malaysia Sarawak (UNIMAS), no permission is provided for lecturers to access the system. This is because the access permission is only to top management such as Deans and Deputy Deans of Undergraduate and Student Development due to its privacy setting. Thus, this project proposes a system named Student Performance Analysis System (SPAS) to keep track of students' result in the Faculty of Computer Science and Information Technology (FCSIT). The proposed system offer a predictive system that is able to predict the students' performance in course "TMC1013 System Analysis and Design", which in turns assists the lecturers from Information System department to identify students that are predicted to have bad performance in course "TMC1013 System Analysis and Design". The proposed system offers student performance prediction through the rules generated via data mining technique. The data mining technique used in this project is classification, which classifies the students based on students' grade.**

Keywords- Student performance; student analysis; data mining; student performance analysis; classification; prediction; system

I. INTRODUCTION

Students are the main asset for various universities. Universities and students play an important role in producing graduates of high qualities with its academic performance achievement. Academic performance achievement is the level of achievement of the students' educational goal that can be measured and tested through examination, assessments and other form of measurements. However, the academic performance achievement varies as different kind of students may have different level of performance achievement.

The student academic performance is usually stored in student management system, in different formats such as files, document, records, images and other formats. These available students' data could be extracted to produce useful information. However, the increasing amount of students' data becomes hard to be analysed by using traditional statistic techniques and database management tools [4]. Thus, a tool is necessary for universities to extract the useful information. This useful information could be used to predict the students' performance.

Currently, in Universiti Malaysia Sarawak (UNIMAS), even though there is Intelligent Mining and Decision Support System (InMinds) that is able to view student performance, it is limited only to top management such as Deans and Deputy Deans of Undergraduate and Student Development due to its privacies setting. The lecturers, who are not part of top management, do not have the permission to view the students' performance. Presently, lecturers seek for students' data manually, from students' files and records, without aid from automated system. Thus, it is a hurdle for each lecturer to retrieve information of their students' data throughout the semesters. The proposed performance analysis system allows lecturers to retrieve the students' previous performance in courses offered by FCSIT and increase the understanding of factors that contribute to students' performances in present courses taken by students. Other than that, the IS lecturers are able to predict students' performance in course "TMC1013 System Analysis and Design". Thus, this helps the faculty to aim for higher success rate in the future.

In this project, a system is developed to predict student academic performance in course "TMC1013 System Analysis and Design" offered by FCSIT through analysing the students' performance using data mining classification techniques. Moreover, Student Performance Analysis System (SPAS) is developed to assist lecturers in consulting with students by giving lecturers the permission to view the students' past performance in a particular course and semester.

There are a few objectives that are identified during the development of this system:

i. To develop a system for students' performance analysis.
ii. To assist the IS lecturers in analysing and predicting student performance in course "TMC1013 System Analysis and Design" by using data mining technique in the proposed system.
iii. To identify the factors that affect the students' performance in course "TMC1013 System Analysis and Design"
iv. To assist lecturers in keeping track of the students' progress throughout the semester.

II. LITERATURE REVIEW

A background study is done to review similar existing systems used to perform student performance analysis. Three existing system are chosen because these systems are similar to the proposed system.

A. Faculty Support System (FSS)

Shana and Venkatacalam has proposed a framework named Faculty Support System (FSS) which is low in cost as it uses cost effective open source analysis software, WEKA to analyse the students' performance in a course

offered by Coimbatore Institute of Technology of Anna University [1]. FSS is able to analyse the students' data dynamically as it is able to update of students' data dynamically with the flow of time to create or add a new rule. The update of new rule is possible with the help from domain expert and the rule is determined by data mining technique such as classification technique. Classification technique is used to predict the students' performance. Besides, FSS focus on the identification of factors that contribute to performance of students in a particular course.

B. Student Performance Analyser (SPA)

SPA is existing secure online web-based software that enables educators to view the students' performance and keep track of the school's data. The SPA is a tool designed for analysing, displaying, storing, and getting feedback of student assessment data [3]. It is a powerful analyser tool used by schools worldwide to perform analysis and displays the analysis data once raw student data is uploaded to the system. The analysis is done by tracking the student or class to get the overall performance of student or class. It helps to identify the students' performance which is below the expected level, at expected level or above the expected level. This would allow the educators or staffs to identify the current students' performance easily. Other than that, it enables various kinds of students' performance report such as progress report and achievement report to be generated.

C. Intelligent Mining and Decision Support System(InMinds)

InMinds helps Universiti Malaysia Sarawak (UNIMAS) to monitor the performance of various areas in every UNIMAS's departments [2]. The system enables top and mid-management in UNIMAS to have a clear look on the areas that needed attention by looking at the figures, revenues and risks. The features, ease of use and flexibility provided by the system makes the performance analysis in UNIMAS to be performed in an ideal solution. Charts are provided by the system for ease of student performance's interpretation.

From the reviews on these existing systems, useful techniques and features could be applied into the proposed system for a better system's performance. The WEKA is chosen as a tool for data mining because it is open source software.

III. PROPOSED SYSTEM

There are a few features from the existing systems that are employed during the design and implementation phase of the proposed system. These features and functionalities include the user interface, students' performance prediction, illustration displays and report generation. A good user interface provides an user-friendly interface as it is easy to be navigate and not complicated. Meanwhile, the students' performance prediction is included into the proposed system to make sure the objectives are achieved. Furthermore, the generation of reports in Portable Document Format (PDF) and illustration display such as charts in PDF makes student performance analysis easier.

From these features found in proposed system, all the user requirements would be fulfilled. The user requirements collected from lecturers of FCSIT during the system analysis phase are as follows:

i. Able to help lecturers to automatically predict students' performance in course "TMC1013 System Analysis and Design"
ii. Able to keep track and retrieve students' performance in a particular course and semester
iii. Able to view the factors that affect the students' prediction result
iv. Able to generate students' reports

The proposed system architecture is designed as shown in below:

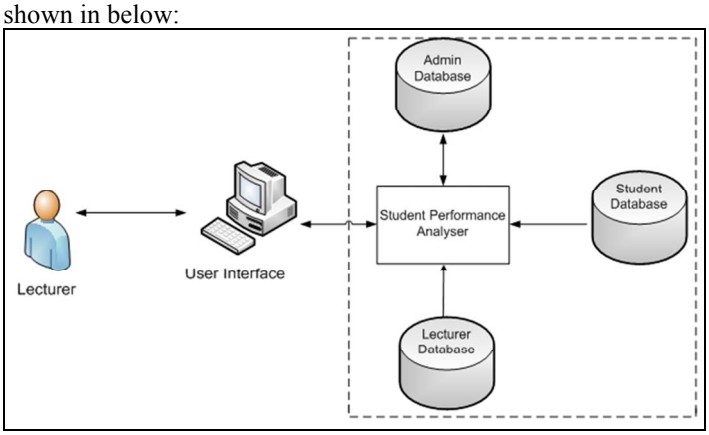


Figure 1. Proposed System's Architecture

IV. METHODOLOGY

There are several phases of methodology used throughout the project development, which is as follows:

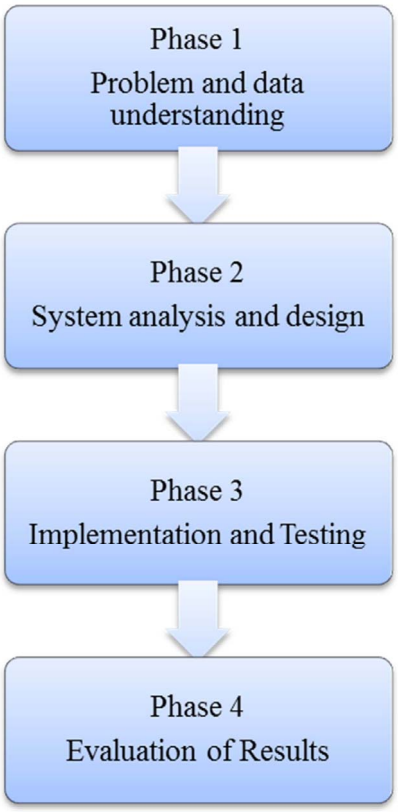


Figure 2. Methodology

A. *Problem and data understanding*

The problem and data understanding is critical in determining the success of the Student Performance Analysis system. Before the system development, problems and data understanding is identified to define the project goal and objectives. The problems of the existing systems are identified and analyzed for its effectiveness and efficiency in term of functionality. After the problems are identified, the solutions to solve each problem is identified and collected through more reading and studying on the related research papers.

Moreover, an interview with the UNIMAS's system administrator is conducted in a meeting room of Centre of Information & Communication Technology Services (CICTS), UNIMAS to have a clearer look on the UNIMAS's InMinds system in UNIMAS. Besides, other similar systems are studied and analysed for its features, strengths and weaknesses. This helps to identify the needs and opportunities for the proposed system.

Other than that, student data is collected in this phase. The students' data such as student's results from the past two semesters in course "TMC1013 System Analysis and Design" is collected. Table 1 shows the attributes of dataset collected for data mining classification.

TABLE I. ATTRIBUTES OF DATASET

Attributes	Values
Quizzes	Discrete
Assignment 1	Discrete
Assignment 2	Discrete
Project	Discrete
Midterm Examination	Discrete
Final Examination's Grade	Categorical (A, A-, B+, B, B-, C+, C, C-, D, F)
Gender	Categorical (Female, Male)
Program	Categorical (Information System, Computer Science, Software Engineering, Network Computing, Multimedia Computing)
Entrance Qualification	Categorical (Pusat Asasi UNIMAS, STPM Science Stream, STPM Art Stream, Matrikulasi/Asasi Sains, Technical Matriculation, Accounting Matriculation, International Student, Diploma)

B. *System analysis and design*

In this phase, the overall flow of the system is planned, analysed and designed. The system and user requirements are analysed and listed in table format. Data flow diagram is used to chart the input, processes and output of the system. Data flow diagram from the context diagram up to the first level is analysed and drawn.

Besides, logical design of the proposed system is drawn to ensure the developed system is functioning as expected. The logical design is designed by drawing entity-relationship diagram (ERD). The ERD illustrates the data objects, attributes and relation between tables in the database as it is a graphical representative of the entity-relationship data model. Furthermore, the design of the proposed system includes the design of database and user interface.

The hardware requirement in this phase is a computer for analysis and design. Other than that, Microsoft Office Visio 2007 is needed to draw the ERD and data flow diagrams.

C. *Implementation and testing*

During the implementation phase, a dataset of 637 students' records in course "TMC1013 System Analysis and Design" is collected and analysed by using data mining technique to generate IF-THEN rules for prediction of students' result in course "TMC1013 System Analysis and Design". The generation of IF-THEN rules is performed by using an open software tool, named WEKA. The dataset is divided into training set and test set. 80% of the dataset is used for the training set and the remaining 20% is for the test set. The training set is used to train the classification model while the test set is used to test the classification model build for its prediction's accuracy. A comparison of accuracy between different decision trees classifications' techniques are tested to ensure the highest prediction of accuracy could be achieved. Table 2 shows the accuracy comparison between five different decision trees' classification techniques found in WEKA.

TABLE II. COMPARISON BETWEEN CLASSIFICATION TECHNIQUES

Technique used	Correctly Classified Instances
J48	58.3%
Simple CART	59.1%
BFTree	61.4%
Random Tree	45.7%
J48graft	58.3%

From the table shown above, the BFTree is chosen to be implemented in the proposed system due to its highest accuracy (61.4%) among decision tree classification techniques. The IF-THEN rules are generated from the best-first decision tree build by WEKA. These rules will be implemented into the IF-ELSE condition in PHP language of the proposed system. The rules are used to predict the students' grade in course "TMC1013 System Analysis and Design" before the students take the final examination. The prediction assists the lecturers to identified students that are predicted to fail in course "TMC1013 System Analysis and Design". The grades' values are shown in Table 3.

TABLE III. GRADES' VALUE

Grades' Value
A
B+
B
B-
C+
C
C-
D
F

The programming skills such as PHP and MySQL queries will be applied to build the proposed system once

the system has been designed. To write the programming coding, tools for writing codes and local web server is needed. Thus, NotepadPlusPlus and XAMPP are installed to a computer during the system implementation.

In order to predict a student's result in course "TMC1013 System Analysis and Design", lecturer is required to import five important components listed below alongside with course name, semester, and student ID to the system's database for analysis:

i. Quizzes mark
ii. Assignment 1 mark
iii. Assignment 2 mark
iv. Project Mark
v. Midterm examination mark

After these data are imported to the database, an analysis is carried out inside the system to predict a student's grade in course "TMC1013 System Analysis and Design". Figure 3 illustrates an interface that enables the prediction of students' result in course "TMC1013 System Analysis and Design".

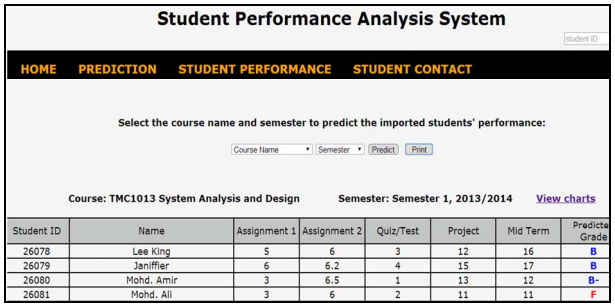


Figure 3. Students' Results Prediction Interface

An analysis of students' prediction results is performed through the IF-ELSE condition in PHP language extracted from the decision tree generated by WEKA. Figure 4 shows part of the IF-ELSE rules implemented into the system.

```
<?php
if($project<11.1){
        if($midterm<13.6){
            echo "F";
        }elseif($midterm>=13.6){
            if($project<8.25){
```

Figure 4. IF-ELSE Rules Implemented

Moreover, lecturers are able to view the other students that have the similar grade's prediction. Besides, lecturers are able to view the factors that affect the prediction's result. These factors are viewed in the IF-THEN form. Figure 5 shows an interface that enables lecturers to view the similar grade's prediction and the rules applied.

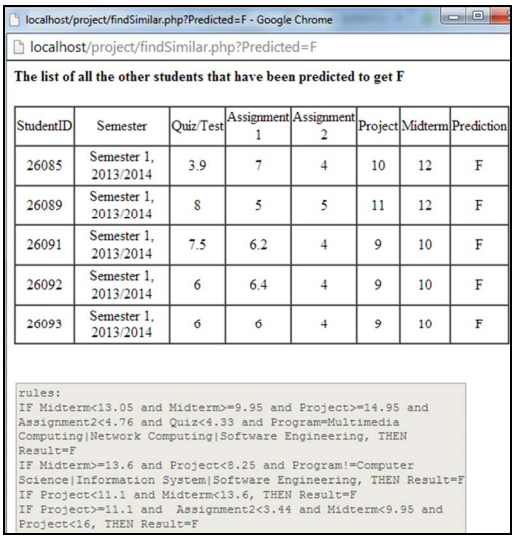


Figure 5. Similar Prediction and Rules

Besides, the predicted students' results could be printed in PDF format. Figure 6 shows the predicted students' results in PDF format.

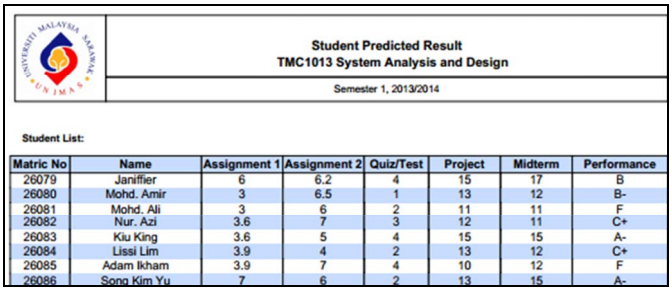


Figure 6. Predicted Results in PDF Format

Furthermore, a bar chart is generated based on the predicted students' results in course "TMC1013 System Analysis and Design". Figure 7 illustrates the bar chart generated.

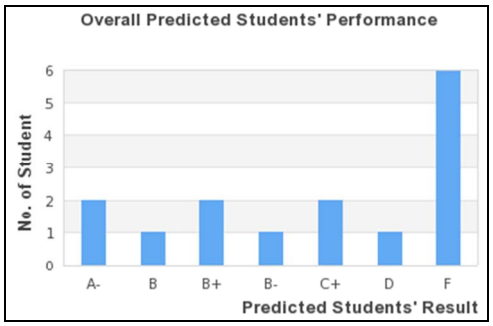
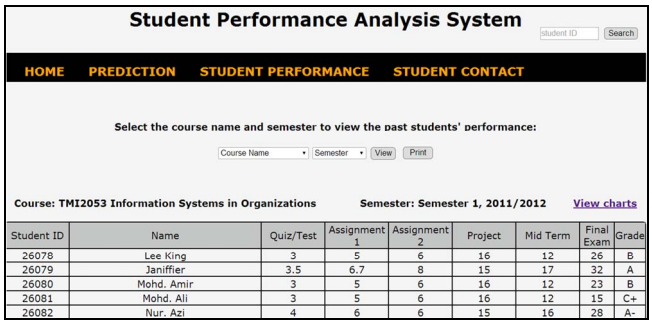


Figure 7. Overall Predicted Students' Performance

Other than that, the proposed system is able to manage and keep track of students' performance results in a particular course and semester. This could be performed by storing all the students' performance results in the proposed system. In this way, the students' records could be stored in database and could be retrieved any time for

lecturers' review. The lecturers are able to edit and delete a student's result in a course. Figure 8 shows the management of students' results interfaces.



Student ID	Name	Quiz/Test	Assignment 1	Assignment 2	Project	Mid Term	Final Exam	Grade
26078	Lee King	3	5	6	16	12	26	B
26079	Janiffier	3.5	6.7	8	15	17	32	A
26080	Mohd. Amir	3	5	6	16	12	23	B
26081	Mohd. Ali	3	5	6	16	12	15	C+
26082	Nur. Azi	4	6	6	15	16	28	A-

Figure 8. Management of Students' Result Interface

In addition, there are two bar charts and one pie chart implemented to illustrate the overall students' performance in a course. Figure 9, Figure 10 and Figure 11 shows the charts displayed in the system to keep track of students' performance.

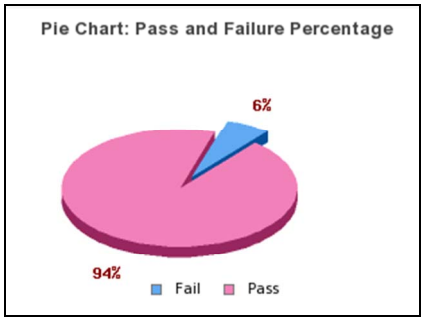


Figure 9. Pie Chart

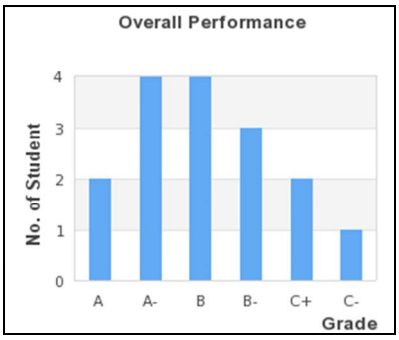


Figure 10. Overall Students' Performance in a Course

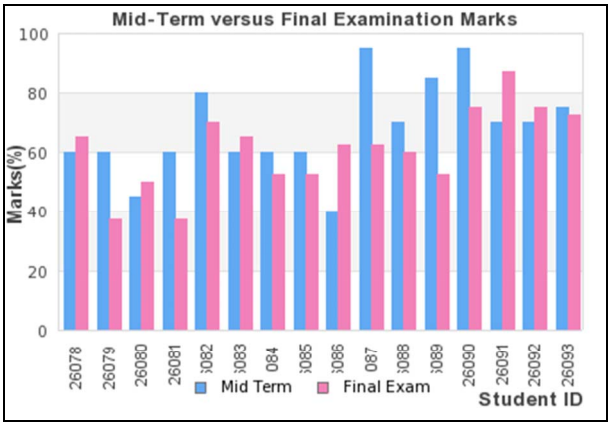


Figure 11. Mid-term versus Final Examination's Performance

After the system is built, the unit testing, system testing and user acceptance testing are needed for errors detection before the system is distributed and used by IS lecturers. This is to ensure the performance of the system is in its optimal state. Besides, the errors and bugs that are detected during testing of the proposed system can be fixed. The unit and system testing will be tested by developer while the user acceptance testing will be tested by a few end-users to ensure the functionalities of system are working as expected.

D. Evaluation of System

For the evaluation of the system, five end-users are requested to evaluate the usability of Student Analysis Performance system. This is to ensure the objectives of the proposed system are achieved as well as to ensure the ease of navigation across the interfaces of the proposed system. Moreover, the evaluation is performed to ensure the high effectiveness of the proposed system is achieved. From the evaluation performed, a list of users' recommendation is stated as shown below:

i. Apply the students' results prediction to other courses offered by FCSIT.
ii. Enable the viewing of all semesters' performance when search for a student's performance.
iii. Provide a flexible rules when perform students' results prediction.

E. System Limitation

A few system limitations have been identified from the users' evaluations, which are listed below:

i. Resources and time constraint
ii. Inflexible rules implemented in the system

V. FUTURE WORK

In this project, the prediction using the decision tree generated from WEKA is not updated dynamically within the system's source codes. Thus, in future, a dynamic prediction model could be implemented by train the prediction model itself whenever a new training set are

fed into the system. Moreover, the prediction can offered to the other courses in future as well.

VI. CONCLUSION

In conclusion, the project concentrates on the development of a system for student performance analysis. A data mining technique, classification algorithm is applied in this project to ensure the prediction of the student performance in course "TMC1013 System Analysis and Design" is possible. The main contribution of the SPAS is that it assists the lecturers in conducting student performance analysis. The system assists lecturers in identifying the students' that are predicted to fail in the course "TMC1013 System Analysis and Design". Other than that, SPAS assist lecturers' to retrieve information of their students' performance throughout the semesters.

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REFERENCES

[1] J. Shana, and T. Venkatacalam, "A framework for dynamic Faculty Support System to analyse student course data", International Journal of Emerging Technology and Advanced Engineering, Vol. 2, No. 7, 2012, pp.478-482.

[2] Quality Assurance Division (2010). InMinds: Intelligent Mining and Decision Support System. *Universiti Malaysia Sarawak, UNIMAS* [Online]. Available: http://www.qad.unimas.my/Function/ICT-Compliance/inminds.html

[3] SPA (2013). What is SPA Standard? *SPA Student Performance Analyser* [Online]. Available: https://www.studentperformanceanalyser.com.au/spa/about.html

[4] V. Kumar, and A. Chadha, "An empirical study of the applications of data mining techniques in higher education", International Journal of Advanced Computer Science and Applications (IJACSA), Vol. 2, No..3, 2011, pp. 80-84.

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