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Mobile Application Development For Measurement Of Learning Outcomes Students Using The Decision Tree Algorithm

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ABSTRACT

During college, students tend to be confused in determining the Program Learning Outcome(PLO) they have completed. In this case, the SKLU application is an application that aims to determine the PLO graduation that has been taken by Android-based students. This application is used to help users as self-reflection or self-measurement so that they can be better in the future. With the C4.5 Method to form a Decision Tree and by determining the level of accuracy through the available datasets, it is concluded that the accuracy rate is approximately 96% in the SKLU application. The data collected is based on the value from FTI Untar directly, so that it gets definite data. The more data collected, the results produced by the application will be more accurate and better, the results produced by the application are still less accurate because of the small number of datasets collected.

Keyword: Program Learning Outcome(PLO), SKLU, Data, Decision Tree.

INTRODUCTION

There are many universities in the world, especially in Indonesia. Each college has their own standard values, and also each college has its own learning outcomes. Learning Achievement aims to determine the objectives that can be achieved from learning or Course Learning Outcomethat will be completed by alumni. Every university certainly provides facilities in measuring learning achievement, without alumni having to find out the purpose of the learning they have completed. There are so many alumni who don't care about learning achievements, because learning achievements are not shown to alumni. Therefore, Alumni need applications that can measure learning outcomes and can automatically display learning outcomes that have been successfully obtained from learning or Course Learning Outcomethat have been completed. With that, it is necessary to have a minimum measure in measuring the achievement of student learning outcomes to determine whether they pass or not correctly and precisely. With various lessons or Course Learning Outcomethat have been followed and completed, alumni also need knowledge to get the results of their learning in higher education, even though by knowing the results of learning achievements, alumni who have graduated can adapt to the challenges of work that will come in the future in accordance with the achievement of results. their learning. Measurement of learning achievement is very important so that alumni can deepen and hone better learning outcomes or take back learning that does not pass in measuring learning achievement results in accordance with hobbies and work that may have been planned in the future, learning outcomes while studying in

college have an important influence in the world of work later, whereas if alumni do not know what learning outcomes they have achieved then they may choose the wrong job and cause discomfort in the work they do later. the achievement of different learning outcomes, so we need a system that is automatic or helps in checking the learning outcomes that have been obtained. So the application of measuring learning achievement can make it easier for alumni to find out what learning outcomes they want or have achieved, after attending all lessons or Course Learning Outcome at the final stage of college alumni can check whether the selected learning outcomes have met the minimum weight or graduation requirements for learning outcomes. This application is also useful for companies in screening prospective workers who will work in their company. At the time of screening workers who apply to work in their company, of course it takes a lot of time, especially during the initial screening where the applicants can be 100 people or more, the function of this application is very suitable for screening job applicants, especially during the initial screening, so that companies are more spend a little energy with this application. This research aims to help alumni who plan to continue their work in the IT field, so that alumni can consider more appropriate jobs based on measuring learning outcomes. And this application company helps to facilitate the screening of prospective workers quickly and efficiently. With this research, alumni can find out suitable jobs using data mining science, Decision Tree calculations with the C4.5 Algorithm method, because the C4.5 algorithm can handles many attributes and with the C4.5 algorithm, can trim the decision tree. pruned trees will be smaller and more accurate. Decision tree or decision tree is one way in data mining to predict the future by building a classification or regression model in the form of a tree structure. [1] The C4.5 algorithm is a solution that can be used to solve problems related to cases in classification techniques. The output of the C4.5 algorithm is a structured decision tree that can be used to convert a data set into a decision tree consisting of decision rules.[2] The designer chose the decision tree with the C4.5 algorithm method because it can make predictions by providing a more ideal level of accuracy measurement to predict the ability of each alumni based on the results. 95.11%, while the processing time of the two algorithm models studied showed results of 0 s.[3]

METHOD AND MATERIALS

Data Used

SKLU is an android based program, all data for this program is originally taken from Fakultas Teknologi Informasi Universitas Tarumanagara. Data will be used for creating and testing the system. The following is the data I got regarding the Program Learning Outcome(PLO), Course Learning Outcome(CLO) and their relation.

TABEL 1 PROGRAM LEARNING OUTCOME(PLO)

PLO-1	Fear of God Almighty and able to show a religious attitude
PLO-2	Upholding human values in carrying out duties based on religion, morals, and ethics
PLO-3	Can act as citizens who are proud and love their homeland, have nationalism, and a sense of responsibility to the country and nation
PLO-4	Can contribute to improving the quality of life in society, nation and state based on Pancasila
PLO-5	Can work together and have social sensitivity and concern for society and the environment
PLO-6	Can appreciate the diversity of cultures, views, religions, and beliefs, as well as the opinions or original
PLO-7	Obey the law and discipline in social and state life
PLO-8	Demonstrate a responsible attitude towards work in their area of expertise independently
PLO-9	Internalizing academic values, norms, and ethics
PLO-10	Internalize the spirit of independence, struggle, and entrepreneurship

PLO-11	Mastering mathematical principles and methods to solve computational problems
PLO-12	Mastering the principles of algorithm development and various programming language concepts for
PLO-13	Mastering the concepts and principles of intelligent systems for the development of intelligent system applications in various fields
PLO-14	Master the basic concepts of software development, have skills related to the software development process, and be able to create programs to increase the effectiveness of using
PLO-15	Mastering the concepts of computer architecture and organization and using them to support computer
PLO-16	Understand the basic principles of computer network systems to develop network-based applications by implementing information management and network security

TABEL 2 COURSE LEARNING OUTCOME(CLO)

Course Learning Outcome (CLO)	
CLO-1	TK13019
CLO-2	TK13020
CLO-3	TK13021
CLO-4	TK13022
CLO-5	TK13023
CLO-6	TK13024
CLO-7	TK13025
CLO-8	TK13026
CLO-9	TK23015
CLO-10	TK33010
CLO-11	TK23016
CLO-12	TK23017
CLO-13	TK23018
CLO-14	TK23019
CLO-15	TK23020
CLO-16	TK33005
CLO-17	TK33012
CLO-18	TK33013

TABEL 3 MAPPING PLO AND CLO

PLO-1	15
PLO-2	15
PLO-3	15,18,19,35
PLO-4	15,18,19
PLO-5	15,18
PLO-6	15,16,17,18,23
PLO-7	15,18,19
PLO-8	1,2,3,5,6,7,9,10,12,13,14,15,19,20,23,24,25,26,27,28,29,30,31,32,33,34,3
PLO-9	16,17,21,23
PLO-10	13,19,20
PLO-11	1,5,6,16
PLO-12	2,6,16,17,26,27,31,32
PLO-13	8,16,24,25,28,29,34

PLO-14	2,3,6,7,12,13,14,16,22,26
PLO-15	11,16
PLO-16	10,16
PLO-17	4,6,9,12,13,14,16,17,18,19,20,21,22,24,25,27,29,32,33,34,35
PLO-18	3,4,7,8,9,11,13,14,16,17,18,19,20,21,22,23,24,25,26,28,29,31,32,33,34,36
PLO-19	1,2,4,5,6,8,9,11,12,13,14,16,17,18,19,20,21,22,23,24,25,27,28,29,32,33,3
PLO-20	15,16,18,19,23,35
PLO-21	23
PLO-22	7,13,16,17,18,19,20,24,26,27,31,34,36
PLO-23	16,17,18,19,20
PLO-24	9,10,13,14,19,22,25,26,27,32,33,34
PLO-25	9,10,14,16,17,18,19,20,25,26,27,32,33,34
PLO-26	4,8,11,13,17,22,23,28,29,36
PLO-27	4,8,9,11,13,14,16,17,18,19,20,21,22,23,24,25,26,27,28,29,32,33,34
PLO-28	19,20,22,23,26,31
PLO-29	1,2,9,12,14,16,17,18,19,22,26,27,28,30,31,32,33,34
PLO-30	8,16,17,18,19,22,,25,27,28,30,33
PLO-31	7,16,17,18,19,24,25,33
PLO-32	16,17,18,19,
PLO-33	19,22

METHOD

Data Mining

Data mining is an analysis of reviewing data sets to find unexpected relationships and summarizing data in different ways in a different way than before, which is understandable and useful for data owners.[4] Then in Data Mining, there is a term pattern recognition or pattern recognition is a technique that utilizes grouping object patterns in a large amount of data using certain algorithms in the hope of providing useful and desired information. Data mining is the process of exploration and analysis, by automatic or semiautomatic means, of large quantities of data in order to discover meaningful patterns and rules. [5] The pattern in question is the depiction and appearance of a data. Data mining can also be interpreted as extracting new information taken from large chunks of data that helps in decision making.

Decision Tree

Decision tree is a very interesting classification method that involves the construction of a decision tree consisting of decision nodes connected by branches from the root node to the leaf node (end). At the decision node the attributes will be tested, and each result will produce a branch.[6] Decision Tree is defined as an algorithm that functions optimally in classifying datasets for use in Jakarta water level reports with 96.56% accuracy. Among these classification algorithms decision tree algorithms is the most commonly used because of it is easy to understand and cheap to implement.[7] Decision Tree is a flowchart structure shaped like a tree, where each inner node indicates a test on an attribute, with the resulting branch showing the test result, and the leaf node representing the class distribution.

C4.5 Algorithm

The C4.5 algorithm is included in the decision tree. The structure of a decision tree is like in a flowchart, where each internal node (non-leaf node) performs an attribute test, each branch is a result set, and each leaf node (or terminal node) becomes a class label.[8] For many of these domains, the trees produced by C4.5 are both small and accurate, resulting in fast, reliable classifiers.[9] In general, the C4.5 algorithm for building a decision tree is as follows:

- Select Attribute as root.
- Create a branch for each value.
- Divide cases in branches.
- Repeat the process for each branch until all cases on the branch have the same class. Before entering into the Steps and node calculations or making a decision tree, there are 2 concepts that need to be known, namely:
  - Entropy(S) concept.
    Entropy (S) is the number of bits that are needed to determine a class from a number of random data in the sample space S.
    Entropy value calculation formula[5]:

$$\text{Entropy}(S)=\sum_{i=1}^{n} p_i * \log_2 p_i \qquad (1)$$

Information:

1. S : Set of cases.
2. A : Features.
3. n : Number of partitions S.
4. p_i : the proportion of S_i to S

- Gain Concept.
  Gain (S , A) is the acquisition of information from attribute A relative to the output data S. To select the attribute as the root, it is based on the highest gain value of the existing attributes.
  Information gain is the acquisition of information or a measure of the effectiveness of an attribute in classifying data. The formula for calculating the value of Gain[8]:
  $Gai(S,A) = Etry(S) - \sum |Sv|\,|S|\ Etry(Sv)$ (2)
  Where :
  - A : attribute
  - |Sv| : number of samples for the value of v
  - |S| : the total number of data samples Entropy is the diversity of a data.

The following is an example of a C4.5 calculation to create a decision tree in PLO-28. The data obtained is the original data in accordance with the values in the Faculty of Information Technology, Tarumanagara University. Here are 70 value data consisting of Course Learning Outcome and grades that can be seen in the table.

RESULT AND DISCUSSION

To implement a learning outcomes approach, a program must first formulate program educational objectives (broad goals) that address institutional and program mission statements and are responsive to the expressed interests of program stakeholders.[10] The results of the calculation test are made by the system and then compared with manual calculations and get an accuracy rate of approximately 96%, below is the calculation, the calculation taken is CPL- 28.

TABLE 1 70 STUDENT'S DATA IN CPL-28

No	TK33005	TK43005	TK55021	TK34009	TK3402
1.	4	4	0	3.9	3.35
2.	2.68	2.32	4	3.4	2.06
3.	3.69	3.88	3.5	3.2	2.87
4.	4	4	3.4	4	4
5.	3.46	2.54	3.5	3.92	3.88
6.	4	4	3.5	3.9	2.87
7.	4	4	4	3	3.6
8.	4	4	4	3.9	3.51
9.	4	4	0	3.4	2.6
10.	3.75	4	0	4	4
11.	4	4	4	3.88	3.5

12.	4	4	3.7	3.88	4
13.	4	4	4	4	4
14.	4	4	0	4	4
15.	3.34	4	4	3.88	2.32
16.	4	2	4	4	3.52
17.	4	2.54	0	3.6	3.52
18.	4	3.84	4	3.88	4
19.	4	3.88	4	4	4
20.	4	4	0	4	3.66
21.	3.33	4	4	4	3.14
22.	4	3.88	4	4	3.51
23.	4	4	4	4	0.94
24.	3.27	3.88	4	4	4
25.	4	4	4	2.41	2.02
26.	4	4	3.8	3.48	3.85
27.	4	4	0	3.55	3.76
28.	4	2.3	4	3.85	4
29.	4	4	4	3.55	0
30.	3.9	4	4	3.85	3.12
31.	4	4	4	3.85	2.73
32.	4	4	4	4	3.62
33.	3.46	4	4	4	1.92
34.	4	4	0	4	4
35.	4	3.44	4	3.9	2.77
36.	4	4	4	3.4	2.79
37.	4	3.35	4	3.2	2.75
38.	4	4	4	4	1.65
39.	4	3.44	0	3.92	3.17
40.	4	4	3.8	3.9	0
41.	4	4	3.9	3	3.2
42.	4	4	0	3.9	3.22
43.	4	4	0	3.4	2.3
44.	4	3.27	0	4	2.6
45.	4	4	0	3.88	0
46.	3.34	4	0	3.88	2.57
47.	4	4	0	4	2.44
48.	4	3.35	0	4	0
49.	4	3.35	0	3.88	0
50.	3.33	4	0	4	0
51.	4	4	0	3.6	0
52.	3.54	4	0	3.88	0
53.	3.62	4	0	4	0
54.	4	2	0	4	0
55.	4	3.5	0	4	0
56.	3.27	3.35	0	4	0

57.	3.98	4	0	4	0
58.	4	4	0	4	0
59.	4	4	0	0	0
60.	4	2.43	0	0	0
61.	2.92	4	0	0	0
62.	3.3	2.49	0	0	0
63.	3.5	4	0	0	0
64.	3.9	4	0	0	0
65.	0	4	0	0	0
66.	3.5	4	0	0	0
67.	3.4	4	0	0	0
68.	3.2	4	0	0	0
69.	4	4	0	0	0
70.	4	0	0	0	0

From the data above, it is converted into several categories, namely: good, sufficient and less. The following is a table of categories and their transforms.

A = Achieved

NA = Not Achieved

TABLE 2 SCORE CATEGORIES

Score	Transform
>3.5	GOOD
>2.5	SUFFICIENT
<2.5	LESS

TABLE 3 DATA TRANSFORMATION TESTING 70 STUDENT SCORES

No	TK33005	TK43005	TK55021	TK34009	TK34020	Results
1.	GOOD	GOOD	GOOD	GOOD	SUFFICIEN	A
2.	GOOD	GOOD	GOOD	SUFFICIENT	GOOD	A
3.	GOOD	GOOD	GOOD	GOOD	GOOD	A
4.	GOOD	GOOD	GOOD	GOOD	GOOD	A
5.	GOOD	GOOD	GOOD	GOOD	GOOD	A
6.	GOOD	GOOD	GOOD	GOOD	GOOD	A
7.	GOOD	GOOD	GOOD	GOOD	GOOD	A
8.	GOOD	GOOD	GOOD	GOOD	GOOD	A
9.	GOOD	GOOD	GOOD	GOOD	GOOD	A
10.	GOOD	GOOD	GOOD	SUFFICIENT	GOOD	A
11.	GOOD	LESS	GOOD	GOOD	GOOD	A
12.	GOOD	GOOD	GOOD	GOOD	SUFFICIEN	A
13.	GOOD	GOOD	GOOD	GOOD	SUFFICIEN	A
14.	GOOD	GOOD	GOOD	GOOD	GOOD	A
15.	GOOD	SUFFICIE	GOOD	GOOD	SUFFICIEN	A
16.	GOOD	GOOD	GOOD	SUFFICIENT	SUFFICIEN	A
17.	GOOD	GOOD	GOOD	SUFFICIENT	SUFFICIEN	NA
18.	GOOD	LESS	GOOD	GOOD	GOOD	NA

19.	GOOD	GOOD	GOOD	GOOD	LESS	NA
20.	GOOD	GOOD	GOOD	LESS	LESS	NA
21.	GOOD	GOOD	GOOD	GOOD	LESS	NA
22.	GOOD	SUFFICIE	GOOD	SUFFICIENT	SUFFICIEN	NA
23.	GOOD	GOOD	GOOD	GOOD	LESS	NA
24.	GOOD	GOOD	GOOD	GOOD	LESS	NA
25.	SUFFICI	GOOD	GOOD	GOOD	SUFFICIEN	A
26.	SUFFICI	GOOD	GOOD	GOOD	GOOD	A
27.	SUFFICI	LESS	GOOD	SUFFICIENT	LESS	NA
28.	SUFFICI	SUFFICIE	GOOD	GOOD	GOOD	NA
29.	SUFFICI	GOOD	GOOD	GOOD	LESS	NA
30.	SUFFICI	GOOD	GOOD	GOOD	LESS	NA
31.	LESS	GOOD	GOOD	SUFFICIENT	SUFFICIENT	NA
32.	GOOD	GOOD	SUFFICIENT	GOOD	GOOD	A
33.	GOOD	GOOD	LESS	GOOD	SUFFICIENT	NA
34.	GOOD	GOOD	LESS	SUFFICIENT	SUFFICIENT	NA
35.	GOOD	GOOD	LESS	GOOD	GOOD	NA
36.	GOOD	GOOD	LESS	GOOD	GOOD	NA
37.	GOOD	SUFFICIE	LESS	GOOD	GOOD	NA
38.	GOOD	GOOD	LESS	GOOD	GOOD	NA
39.	GOOD	GOOD	LESS	GOOD	GOOD	NA
40.	GOOD	GOOD	LESS	GOOD	GOOD	NA
41.	GOOD	SUFFICIE	LESS	GOOD	SUFFICIENT	NA
42.	GOOD	GOOD	LESS	GOOD	SUFFICIENT	NA
43.	GOOD	GOOD	LESS	SUFFICIENT	LESS	NA
44.	GOOD	SUFFICIE	LESS	GOOD	SUFFICIENT	NA
45.	GOOD	GOOD	LESS	GOOD	LESS	NA
46.	GOOD	GOOD	LESS	GOOD	LESS	NA
47.	GOOD	SUFFICIENT	LESS	GOOD	LESS	NA
48.	GOOD	SUFFICIENT	LESS	GOOD	LESS	NA
49.	GOOD	GOOD	LESS	GOOD	LESS	NA
50.	GOOD	GOOD	LESS	GOOD	LESS	NA
51.	GOOD	GOOD	LESS	GOOD	LESS	NA
52.	GOOD	LESS	LESS	GOOD	LESS	NA
53.	GOOD	GOOD	LESS	GOOD	LESS	NA
54.	GOOD	GOOD	LESS	GOOD	LESS	NA
55.	GOOD	GOOD	LESS	GOOD	LESS	NA
56.	GOOD	GOOD	LESS	LESS	LESS	NA
57.	GOOD	LESS	LESS	LESS	LESS	NA
58.	GOOD	GOOD	LESS	LESS	LESS	NA
59.	GOOD	GOOD	LESS	LESS	LESS	NA
60.	GOOD	GOOD	LESS	LESS	LESS	NA
61.	GOOD	GOOD	LESS	LESS	LESS	NA
62.	GOOD	LESS	LESS	LESS	LESS	NA
63.	SUFFICIENT	GOOD	LESS	GOOD	SUFFICIENT	NA

64.	SUFFICIE	GOOD	LESS	GOOD	LESS	NA
65.	SUFFICIE	SUFFICIE	LESS	GOOD	LESS	NA
66.	SUFFICIE	GOOD	LESS	LESS	LESS	NA
67.	SUFFICIE	LESS	LESS	LESS	LESS	NA
68.	SUFFICIE	GOOD	LESS	LESS	LESS	NA
69.	SUFFICIE	GOOD	LESS	LESS	LESS	NA
70.	LESS	GOOD	LESS	LESS	LESS	NA

After the table is created according to the value category, it is time to group the attributes, then calculate the entropy to find the highest gain to determine the start of the decision tree according to the entropy and gain formula.

TABLE 4 NODE 1 PLO-28

Node 1		Total S	NA	A	Entropy	Gain
Total		70	51	19	0.84350708	
TK33005						0.02752
	LESS	2	2	0	0	
	SUFFICIEN	13	11	2	0.61938219	
	GOOD	55	38	17	0.89212128	
TK43005						0.02638
	LESS	7	6	1	0.59167277	
	SUFFICIEN	9	8	1	0.50325833	
	GOOD	54	37	17	0.89865337	
TK55021						0.40899
	LESS	38	38	0	0	
	SUFFICIEN	1	0	1	0	
	GOOD	31	13	18	0.98115223	
TK34009						0.095752
	LESS	13	13	0	0	
	SUFFICIEN	9	6	3	0.91829583	
	GOOD	48	32	16	0.91829583	
TK34020						0.34783
	LESS	34	34	0	0	
	SUFFICIEN	15	9	6	0.97095059	
	GOOD	21	8	1	0.95871188	

from the example of node 1 above, the calculation continues until the end of the PLO-28 node, then the result of the decision tree is as follows

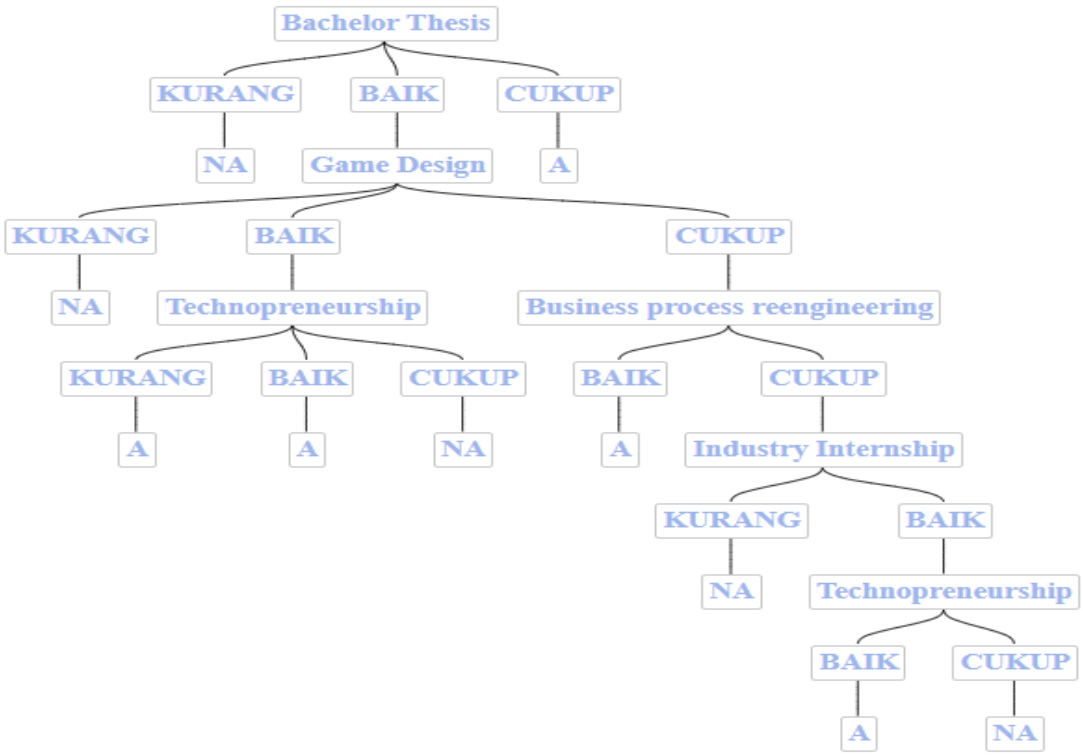

FIGURE 1 DECISION TREE OF PLO-28

From the results of all PLO calculations, the SKLU application is formed, below is a display of the main features taken from the decision tree.

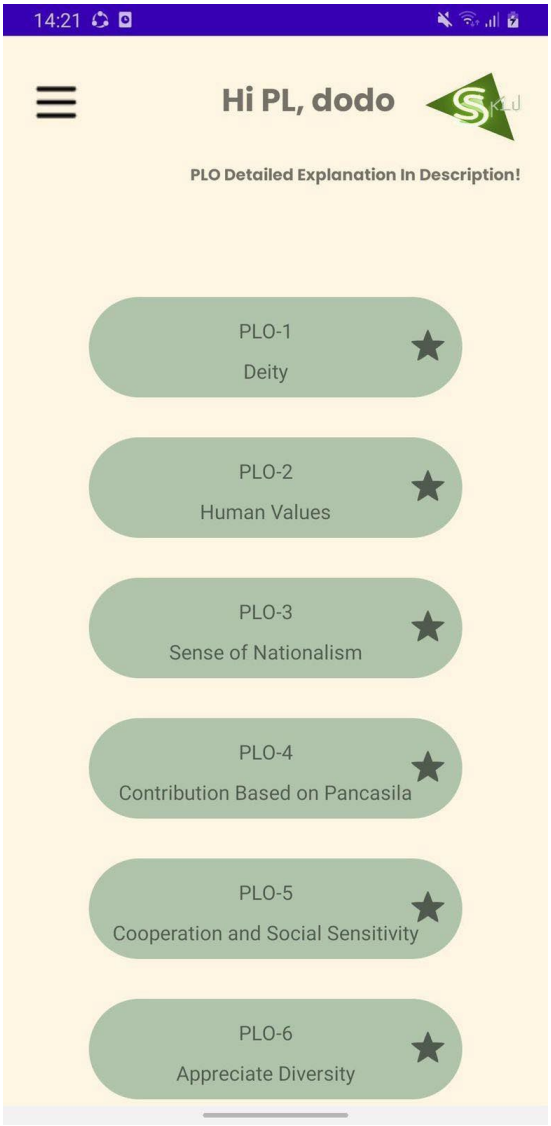

FIGURE 2 PROGRAM LEARNING OUTCOME MEASUREMENT MODULE

The image above shows an application that displays the calculation module of the decision tree of each PLO.

CONCLUSION

The results of the discussion above can be concluded, users who pass or do not pass Program Learning Outcome(PLO) are based on the grades they get during the lecture period, and input values in the SKLU application with a Decision Tree. Based on the Decision Tree that is applied to the SKLU application, this application can be better and more ideal, if more datasets are entered. Which means that Decision trees can be used to measure Program Learning Outcome in lectures.

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