The Comprehensive Mamdani Inference to Support Scholarship Grantee Decision

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Abstract— Fuzzy Mamdani has been mostly used in various disciplines of science. Its ability to map the input-output in the form of a surface becomes an interesting thing. This research took DSS case of a scholarship grantee. Many criteria in taking a decision need to be simplified so that the result obtained remains intuitive. The model completion by conducting two stages consisted of two phases. The first phase consists of four FIS blocks. The second phase consists of one FIS block. The FIS design in the first phase was designed in such a way so that the output obtained has a big score interval. FIS output at the first phase will become FIS input at the second phase. This big value range becomes good input at FIS in the second phase. Each FIS block has different total input. Until the surface formed must be seen from various dimensions to assure trend surface increasing or decreasing softly. This kind of thing is conducted by observing the movement of output dots kept for its soft surface form. The output dots change influenced by the membership function, the regulations used, total fuzzy set, and parameter value of membership function. This research used the Gaussian membership function. The Gaussian membership function is highly suitable for this DSS case. This article also explains the usage of a fuzzy set in each input, the parameter from the membership function, and the input value range. After observing the surface form with an intuitive approach, then this model needs to be evaluated. The evaluation was done to measure the model performance using Confusion Matrix. The result of model performance obtained accuracy in the amount of 85%.

Keywords— Fuzzy; mamdani; DSS; scholarship; reasoning.

I. INTRODUCTION

Mamdani inference is one of the Fuzzy Logic methods. This method has been widely used in DSS. The unique feature of this method is that it can accept linguistic variables, implement human knowledge and have the ability to make complex models that are easy to understand [1]. The cases that resolved in this study were the Scholarship Grantee. The scholarship aims to increase access and opportunities to study in higher education; improve student achievement; ensure the continuity of student studies in a timely manner; and produce graduates who are independent, productive, and have social concerns so that they can play a role in breaking the chain of poverty and empowering the community.

Other efforts that were conducted to support the program include compiling a database of secondary education level students who have good academic potential and are economically incapable of being accessed by various parties who are expected to help or provide tuition assistance [2].

This form indicates the government's effort to provide scholarships for students who cannot have academic achievements. Therefore, the selection of scholarship grantees must be under procedures, hoping that this scholarship grantee is right on target and the selection process runs objectively. Usually, scholarship applicants from year to year increase sharply. Lots of data can be easily resolved by modeling a system that adopts human knowledge.

One of the information technology systems that can help managerial decisions is to use a decision support system (DSS) [3]. Solving problems with this DSS has developed a lot [4], [5]. One of them is the Fuzzy Inference System method, both Mamdani and Tsukamoto [6] and Sugeno [7]. This fuzzy method is reliable enough to be used in various fields, including aerospace, automotive, control [8], prediction [9], [10], and informatics. Although the type-2 fuzzy [11] has been popular since the 2000s, this method in the DSS field still needs more consideration. This is due to the high cost in implementing type-2 fuzzy [12], [13] both in terms of a fairly long processing time and high computational resource
requirements. So that people still use the fuzzy type-1 model in some cases. Therefore, building this DSS requires speed in producing decision recommendations. Thus, this research was designed using the type-1 fuzzy method. This research aimed to design a system that can be used in making decisions for prospective scholarship grantees.

II. MATERIAL AND METHOD

There are several fuzzy inference techniques, namely Mamdani, Stukamoto, and Sugeno. Dealing with the case of SPK, it was a more suitable solution approach using Mamdani inference. According to Jang et al. [14], the Fuzzy Inference System (FIS) is a computer paradigm that involves fuzzy set theory if-then rules and reasoning.

If-then, the rule of If is also known as fuzzy rules, fuzzy implication, or fuzzy conditional statements. This leads to fuzzy logic being meaningful. An example of a simple if-then rule is as follows:

\[ \text{If } x \text{ is } A \text{ then } y \text{ is } B \]

Where A and B are linguistic values expressed in fuzzy sets in ranges, X and Y. Part A is called a condition (antecedent) while part B is called a consequent.

The reasoning technique is also called the reasoning technique. The reasoning technique is a problem-solving technique by representing the problem into a knowledge base using logic. Fuzzy logic (cryptic logic) is one of the logics used in reasoning techniques [15].

![Fig.1 Inference by using the method of Mamdani [14]](image)

The process of designing this fuzzy model is still being carried out by trial and error [1]. Several processes need to be considered when designing the Mamdani fuzzy model.

a) Select input and output variables. Based on the decision criteria.

b) Determine the number of linguistic terms for each input and output. This can be undertaken by clustering techniques using k-means or silhouette [16], [17].

c) Choose the type of membership function.

d) Select parameter values for each membership function.

e) Design the rule base.

f) Adjust parameter value [12].

g) Analyze the formed surface. If there is no ideal surface [18], repeat from point b.

In this system, there were two applications; the first was data validation used the web, and the second was visitation used android. The system design scheme can be seen in fig 2. Operators retrieved files from the Belmawa Ristekdikti website. The file was imported to the information system for data validation. The rules regarding scholarship registration were contained in the 2019 Bidikmisi scholarship registration guide document [2].

![Fig.2 System Schematic](image)

There are 10 input criteria for consideration in choosing the Bidikmisi scholarship. The requirements can be seen in fig 3. The 10 criteria were divided into five system blocks consisting of two phases. Each block used the Type-1 Fuzzy Inference System approach. The first phase consisted of four blocks, including Academic, Economic, Household, and Coverage area. The four blocks issued output. The output became input in the second phase. The second phase carried out a fifth block process, and it was called a decision. The results of the decision block gained the output in the form of a firm value. The firm value will be ranked from the highest score.

![Fig.3 Framework DSS by using Fuzzy.](image)

All blocks used a gaussian membership function. The Gaussian membership function was determined by two parameters \( \{c, \sigma\} \). The parameter of c determines the center of the Gaussian membership function, while \( \sigma \) determines the width of the membership function. Equation of the Gaussian membership function at eq 2 [14]

\[
\text{gaussian}(x; c, \sigma) = e^{-\frac{(x-c)^2}{2\sigma^2}}
\]  

(2)
The following describes the design of each block. Each block describes the input, output, knowledge, and surface. Previous studies discussed tuning on the input and output parameters. The parameter range is adjusted according to the actual data to obtain strong firm values [13]. Meanwhile, to get the form of surface that is under people's perceptions, it is necessary to optimize the rule base and its membership function [19].

A. FIS Academic

There are two (2) inputs, namely Assessment and Achievement. In fig 4 (a, b, c) can be seen the linguistic function on the academic block. Table 1 presents the input-output variables, the fuzzy set and its parameters.

| Variable       | Fuzzy Set | Parameter |
|----------------|-----------|-----------|
| Input: Average assessment | Low       | (6.5 60)  |
| Range (60-100) | Medium    | (5 73)    |
|                | High      | (5 85)    |
|                | Very high | (8 100)   |
| Input: Achievement | Few       | (2 0)     |
| Range (0-5)   | Many      | (2 5)     |
| Output: Academic | Very low  | (12 0)    |
| Range (0-100) | Low       | (12 25)   |
|                | Medium    | (12 50)   |
|                | High      | (12 75)   |
|                | Very high | (12 100)  |

B. FIS Economics

There are two (2) inputs in the FIS Economic, namely Income and Dependent and one output can be seen in fig.5. Table 3 contains the information of fuzzy set and table 4 consists of knowledge.

TABLE III FIS ECONOMIC LINGUISTICS

| Variable       | Fuzzy Set | Parameter |
|----------------|-----------|-----------|
| Input: Income  | Low       | (6e+05 0) |
| Range (0-4x10^6) | Medium  | (6e+05 2e+06) |
|                | High      | (6e+05 4e+06) |
| Input: Dependent | Few       | (3.25 0)  |
| Range (0-13)  | Medium    | (2.5)     |
| Output: Economic | Very low  | (12 0)    |
| Range (0-100) | Low       | (12 25)   |
|                | Medium    | (12 50)   |
|                | High      | (12 80)   |
|                | Very high | (12 100)  |

C. FIS Household

There are four (4) suggestions of FIS Household, namely Homeowner, Sanitation, Marital Status and Source water which can be seen in fig.6. and one output.

TABLE II RULE BASE OF ACADEMIC

| No | Average Assessment | Achievement | Academic |
|----|--------------------|-------------|---------|
| 1  | Very high          | Many        | Very high|
| 2  | Very high          | Few         | High    |
| 3  | High               | Many        | High    |
| 4  | High               | Few         | Medium  |
| 5  | Medium             | Many        | High    |
| 6  | Medium             | Few         | Low     |
| 7  | Low                | Many        | Low     |
| 8  | Low                | Few         | Very low|
The fuzzy set in this block can be seen in table 5 below. And table 6 contains information about knowledge.

**TABLE V**
LINGUISTIC OF FIS HOUSEHOLD

| Variable          | Fuzzy Set | Parameter |
|-------------------|-----------|-----------|
| Input 1: Homeowner| Have      | (35 0)    |
| Range (0-100)     | No have   | (35 100)  |
| Input 2: Sanitation| Good      | (35 0)    |
| Range (0-100)     | Poor      | (35 100)  |
| Input 3: Marital  | Complete  | (25 0)    |
| Range (0-100)     | Not complete | (40 100) |
| Input 4: Source water| Good      | (35 0)    |
| Range (0-100)     | Not good  | (35 100)  |
| Output: Household | Established | (20 0)    |
| Range (0-100)     | Less established | (20 50) |
|                   | Not established | (20 100) |

**TABLE VI**
RULEBASE OF HOUSEHOLD

| No | Home Owner | Sanitation | Marital Status | Source Water | Household       |
|----|------------|------------|----------------|--------------|-----------------|
| 1  | Have       | Good       | Complete       | Good         | Established     |
| 2  | Have       | Good       | Complete       | Poor         | Less established|
| 3  | Have       | Good       | Incomplete     | Good         | Less established|
| 4  | Have       | Good       | Incomplete     | Poor         | Not established |
| 5  | Have       | Poor       | Complete       | Good         | Less established|
| 6  | Have       | Poor       | Complete       | Poor         | Less established|
| 7  | Have       | Poor       | Incomplete     | Good         | Not established |
| 8  | Have       | Poor       | Incomplete     | Poor         | Not established |
| 9  | No Have    | Good       | Complete       | Good         | Less established|

**D. FIS Coverage**

There are two (2) inputs, namely land area and building area and one output shown in fig.8, while table 7 information about fuzzy sets and table 8 information about its knowledge.

**TABLE VII**
LINGUISTIC OF FIS COVERAGE

| Variable          | Fuzzy Set | Parameter |
|-------------------|-----------|-----------|
| Input 1: Land     | Big       | (35 0)    |
| Range (0-100)     | Small     | (35 100)  |
| Input 2: House    | Big       | (35 0)    |
| Range (0-100)     | Small     | (35 100)  |
| Output: Area      | Small     | (27 0)    |
| Range (0-100)     | Medium    | (15 50)   |
|                   | Big       | (27 100)  |

**TABLE VIII**
LINGUISTIC OF FIS COVERAGE

| No | Surface Land | Surface House | Surface Area |
|----|--------------|---------------|--------------|
| 1  | Small        | Small         | Small        |
| 2  | Big          | Big           | Big          |
| 3  | Small        | Big           | Medium       |
| 4  | Big          | Small         | Medium       |

**E. FIS Final DSS**

The previous FIS output is an input for this FIS DSS. There are four (4) inputs, namely academic, economic, household, area. It can be seen in fig.9.
Fig. 9 Variable block final DSS

The fuzzy set in this block is in Table 9 and the knowledge information is in Table 10.

### TABLE IX
**LINGUISTIC OF FIS FINAL DSS**

| Variable       | Fuzzy Set          | Parameter |
|----------------|--------------------|-----------|
| Input 1: Academic | Low (20)           |           |
| Range (0-100)   | Medium (20 50)     |           |
|                 | High (20 100)      |           |
| Input 2: Economic | Low (20)           |           |
| Range (0-100)   | Medium (20 50)     |           |
|                 | High (20 100)      |           |
| Input 3: Household | Established (20)  |           |
| Range (0-100)   | Less established (20 50) |           |
|                 | Not established (20 100) |           |
| Input 4: Area   | Big (25 0)         |           |
| Range (0-100)   | Medium (20 50)     |           |
|                 | Small (25 100)     |           |
| Output: Decision | Very low (8 0)    |           |
| Range (0-100)   | Low (12 20)        |           |
|                 | Medium (12 50)     |           |
|                 | High (12 80)       |           |
|                 | Very high (10 100) |           |

### TABLE X
**RULE BASE FIS FINAL DSS**

| No | Antecedent | Consequent |
|----|------------|------------|
|    | Academic   | Economic   | Household | Area | Decision |
| 1  | High       | Low        | Not established | Big  | Very high |
| 2  | High       | Low        | Not established | Small | Very high |
| 3  | High       | Low        | Less established | Big  | Very high |
| 4  | High       | Low        | Less established | Small | Very high |
| 5  | High       | Low        | Established   | Big   | Very high |
| 6  | High       | Low        | Established   | Small | Very high |
| 7  | High       | Medium     | Not established | Big   | High      |
| 8  | High       | Medium     | Not established | Small | High      |
| 9  | High       | Medium     | Less established | Big   | High      |
| 10 | High       | Medium     | Less established | Small | High      |
| 11 | High       | Medium     | Established   | Big   | Medium    |
| 12 | High       | Medium     | Established   | Small | Medium    |
| 13 | High       | High       | Not established | Big   | Medium    |
| 14 | High       | High       | Not established | Less established | Small | Medium |
| 15 | High       | High       | Less established | Not established | Big   | Low      |
| 16 | High       | High       | Established   | Not established | Small | Low      |
| 17 | High       | High       | Established   | Not established | Big   | Low      |
| 18 | High       | High       | Established   | Not established | Small | Low      |
| 19 | Medium     | Low        | Not established | Less established | Not established | Big   | High      |
| 20 | Medium     | Low        | Not established | Less established | Not established | Small | High      |
| 21 | Medium     | Low        | Not established | Less established | Not established | Big   | High      |
| 22 | Medium     | Low        | Not established | Less established | Not established | Small | High      |
| 23 | Medium     | Medium     | Established   | Not established | Not established | Big   | Medium    |
| 24 | Medium     | Medium     | Established   | Not established | Not established | Small | Medium    |
| 25 | Medium     | Medium     | Not established | Less established | Not established | Big   | High      |
| 26 | Medium     | Medium     | Not established | Less established | Not established | Small | High      |
| 27 | Medium     | Medium     | Less established | Less established | Not established | Big   | High      |
| 28 | Medium     | Medium     | Less established | Less established | Not established | Small | High      |
| 29 | Medium     | Medium     | Less established | Less established | Not established | Big   | Low       |
| 30 | Medium     | Medium     | Less established | Less established | Not established | Small | Low       |
| 31 | Medium     | Medium     | Less established | Less established | Not established | Big   | Low       |
| 32 | Medium     | Medium     | Less established | Less established | Not established | Small | Low       |
| 33 | Medium     | Medium     | Less established | Less established | Not established | Big   | Low       |
| 34 | Medium     | Medium     | Less established | Less established | Not established | Small | Low       |
| 35 | Medium     | Medium     | Less established | Less established | Not established | Big   | Low       |
| 36 | Medium     | Medium     | Less established | Less established | Not established | Small | Low       |
| 37 | Low        | Low        | Very low      | Not established | Big   | High      |
| 38 | Low        | Low        | Very low      | Not established | Small | High      |
| 39 | Low        | Low        | Very low      | Not established | Small | High      |
| 40 | Low        | Low        | Very low      | Not established | Small | High      |
| 41 | Low        | Low        | Very low      | Not established | Small | Low       |
| 42 | Low        | Low        | Very low      | Not established | Small | Low       |
| 43 | Low        | Medium     | Very low      | Not established | Big   | High      |
| 44 | Low        | Medium     | Very low      | Not established | Small | High      |
| 45 | Low        | Medium     | Very low      | Not established | Small | Low       |
| 46 | Low        | Medium     | Very low      | Not established | Small | Low       |
| 47 | Low        | Medium     | Very low      | Not established | Small | Low       |
| 48 | Low        | Medium     | Very low      | Not established | Small | Low       |
| 49 | Low        | High       | Not established | Less established | Not established | Big   | Very low |
| 50 | Low        | High       | Not established | Less established | Not established | Small | Very low |
| 51 | Low        | High       | Not established | Less established | Not established | Big   | Very low |
| 52 | Low        | High       | Not established | Less established | Not established | Small | Very low |
| 53 | Low        | High       | Not established | Less established | Not established | Big   | Very low |
| 54 | Low        | High       | Not established | Less established | Not established | Small | Very low |
A good surface is formed from a smoother movement of output points. As shown in figure 4 (d), fig. 5 (d), fig. 8 (d), there is no significant gap. The Input-Output surface (I/O surface) is easy to be observed because the mapping is still in 3-dimensional space. Another description of the surface in the picture of fig. 7, the mapping of input-output produces 5 dimensions where there are 4 inputs and 1 output. Due to human limitations in modeling space so that the resulting surface remains in 3 dimensions. Mapping of two inputs and one output while the other 2 inputs are made constant. From the I/O surface results that were formed, it was still visible that the gaps were formed. A lot of inputs probably caused this, and each input had a little fuzzy set. The surface was still acceptable because the trend was still visible, whether it is decreasing or increasing.

The results presented were taken from FIS academic and FIS economic. Both of these FIS greatly influenced the final DSS results. This was due to the design of academic and economic outputs where there were many fuzzy sets. This firm output in phase 1 makes the value range large. This will be profitable as an input in phase 2. The FIS economy had the lowest value of 15.49, and the highest value was 71.14, while FIS academic had the highest value of 71.94 and the lowest was 16.38. FIS economic output showed that the income was small or dependent a lot, got a low economic value. This can be seen in table 11. Likewise, with FIS academic, high values, or many achievements, the academic values will be high, as shown in table 12.

| Name            | Assessment | Achievement | Out Academic |
|-----------------|------------|-------------|--------------|
| Student 1       | 92.53571   | 2           | 71.94        |
| Student 8       | 89.53571   | 2           | 69.69        |
| Student 15      | 87         | 2           | 68.23        |
| Student 6       | 90.28571   | 1           | 58.69        |
| Student 2       | 91.10714   | 0           | 52.26        |
| Student 3       | 91.03571   | 0           | 52.11        |
| Student 4       | 90.96429   | 0           | 51.97        |
| Student 5       | 90.46429   | 0           | 50.90        |
| Student 29      | 90         | 0           | 49.80        |
| Student 7       | 89.97569   | 0           | 49.74        |
| Student 21      | 84.60714   | 1           | 49.16        |
| Student 30      | 85         | 1           | 49.16        |
| Student 9       | 89.46429   | 0           | 48.36        |
| Student 10      | 89.28571   | 0           | 47.82        |
| Student 11      | 89.17857   | 0           | 47.49        |
| Student 27      | 88         | 0           | 43.21        |
| Student 12      | 87.57143   | 0           | 41.36        |
| Student 13      | 87.42857   | 0           | 40.76        |
| Student 14      | 87.17857   | 0           | 39.77        |
| Student 16      | 86.78571   | 0           | 38.12        |
| Student 17      | 86.45833   | 0           | 36.67        |
| Student 18      | 85.82143   | 0           | 34.13        |
| Student 19      | 85.71429   | 0           | 33.75        |
| Student 20      | 84.72222   | 0           | 30.88        |
| Student 26      | 84         | 0           | 29.49        |
| Student 22      | 81.92857   | 0           | 28.29        |
| Student 23      | 81         | 0           | 27.95        |
| Student 24      | 80.52256   | 0           | 27.71        |
| Student 28      | 78         | 0           | 23.75        |
| Student 25      | 75         | 0           | 16.38        |

| Name            | Assessment | Achievement | Out Economic |
|-----------------|------------|-------------|--------------|
| Student 21      | 92.53571   | 2           | 71.94        |
| Student 8       | 89.53571   | 2           | 69.69        |
| Student 15      | 87         | 2           | 68.23        |
| Student 6       | 90.28571   | 1           | 58.69        |
| Student 2       | 91.10714   | 0           | 52.26        |
| Student 3       | 91.03571   | 0           | 52.11        |
| Student 4       | 90.96429   | 0           | 51.97        |
| Student 5       | 90.46429   | 0           | 50.90        |
| Student 29      | 90         | 0           | 49.80        |
| Student 7       | 89.97569   | 0           | 49.74        |
| Student 21      | 84.60714   | 1           | 49.16        |
| Student 30      | 85         | 1           | 49.16        |
| Student 9       | 89.46429   | 0           | 48.36        |
| Student 10      | 89.28571   | 0           | 47.82        |
| Student 11      | 89.17857   | 0           | 47.49        |
| Student 27      | 88         | 0           | 43.21        |
| Student 12      | 87.57143   | 0           | 41.36        |
| Student 13      | 87.42857   | 0           | 40.76        |
| Student 14      | 87.17857   | 0           | 39.77        |
| Student 16      | 86.78571   | 0           | 38.12        |
| Student 17      | 86.45833   | 0           | 36.67        |
| Student 18      | 85.82143   | 0           | 34.13        |
| Student 19      | 85.71429   | 0           | 33.75        |
| Student 20      | 84.72222   | 0           | 30.88        |
| Student 26      | 84         | 0           | 29.49        |
| Student 22      | 81.92857   | 0           | 28.29        |
| Student 23      | 81         | 0           | 27.95        |
| Student 24      | 80.52256   | 0           | 27.71        |
| Student 28      | 78         | 0           | 23.75        |
| Student 25      | 75         | 0           | 16.38        |

In table 13, the results data are sorted based on the highest decision value. The highest decision value is obtained by student 21. Student 21 has the lowest economic value and average academy value. Student 15 has low economic value and somewhat high academic values. And student 27 has the two lowest economic grades and average academic values. Note that students 15 and 27 have almost the same assessment values, but it is far different academic values. The academic value of student 15 is 68.23, while the academic value of student 27 is 43.21. This is because student 15 has some achievement while student 27 has no achievement. By looking at this phenomenon, problem-solving uses fuzzy under human perception. This human perception is also related to instinct. In AI, this fuzzy system can be created intuitively.
Measurement of model performance using a confusion matrix. Model accuracy can use the formula [20]:

\[
\text{accuracy} = \frac{TP + TN}{TP + TN + FP + FN} \times 100\%
\]  

Notes: TP: True Positive
TN: True Negative
FP: False Positive
FN: False Negative

Model accuracy is obtained by comparing the results of the fuzzy system with manual results. The results obtained show that the system accuracy reaches 85%.

IV. CONCLUSION

In designing the input-output, it must attempt to minimize the ideal number of inputs is 2 input 1 output. By having 2 inputs, it can facilitate the researcher to observe the surface that is formed. The smoother the surface that is formed, the more human the decisions will be obtained. The evaluation of the model using a confusion matrix obtained an accuracy rate of 85%. The suggestion for future research is the significance of software that can help the researcher to get more optimal fuzzy and rule base sets.

TABLE XIII

| Name  | Out economy | Out Academy | Out Household | Out Area | Out Decision |
|-------|-------------|-------------|---------------|----------|--------------|
| Student 21 | 15.49 | 49.16 | 62.86 | 42.97 | 68.82 |
| Student 15 | 26.06 | 68.23 | 48.54 | 58.90 | 62.49 |
| Student 27 | 19.38 | 43.21 | 75.01 | 28.22 | 62.17 |
| Student 11 | 25.79 | 47.49 | 65.99 | 49.38 | 61.05 |
| Student 1 | 34.25 | 71.94 | 50.62 | 21.74 | 60.90 |
| Student 7 | 28.61 | 49.74 | 50.62 | 31.55 | 59.37 |
| Student 17 | 22.57 | 36.67 | 59.49 | 74.30 | 59.00 |
| Student 6 | 31.85 | 58.69 | 50.62 | 58.90 | 57.91 |
| Student 14 | 27.08 | 39.77 | 75.01 | 21.74 | 57.92 |
| Student 3 | 34.10 | 52.11 | 78.95 | 42.97 | 56.57 |
| Student 8 | 58.92 | 69.69 | 50.62 | 42.97 | 55.74 |
| Student 29 | 35.06 | 49.80 | 50.52 | 21.74 | 55.20 |
| Student 5 | 39.01 | 50.90 | 50.52 | 49.38 | 53.11 |
| Student 22 | 22.10 | 28.29 | 75.01 | 28.22 | 51.84 |
| Student 9 | 45.49 | 48.36 | 75.01 | 42.97 | 50.85 |
| Student 19 | 34.10 | 33.75 | 59.49 | 51.34 | 49.80 |
| Student 10 | 50.03 | 47.82 | 48.54 | 40.15 | 49.63 |
| Student 18 | 35.06 | 34.13 | 62.86 | 28.22 | 49.44 |
| Student 16 | 40.78 | 38.12 | 50.62 | 40.15 | 48.22 |
| Student 2 | 58.92 | 52.26 | 48.54 | 40.15 | 48.22 |
| Student 11 | 25.79 | 47.49 | 65.99 | 49.38 | 49.63 |
| Student 20 | 34.10 | 33.75 | 59.49 | 51.34 | 49.80 |
| Student 27 | 19.38 | 36.67 | 75.01 | 28.22 | 49.44 |
| Student 15 | 26.06 | 52.11 | 78.95 | 42.97 | 47.64 |
| Student 21 | 35.06 | 29.49 | 50.62 | 58.90 | 46.67 |
| Student 12 | 50.03 | 41.36 | 48.54 | 22.95 | 43.12 |
| Student 22 | 21.10 | 28.29 | 75.01 | 28.22 | 43.12 |
| Student 13 | 50.03 | 40.76 | 48.54 | 22.95 | 47.40 |
| Student 23 | 36.56 | 29.49 | 50.61 | 42.97 | 46.67 |
| Student 24 | 39.01 | 27.71 | 50.52 | 49.38 | 43.37 |
| Student 25 | 39.01 | 34.13 | 62.86 | 28.22 | 49.44 |
| Student 26 | 40.78 | 23.75 | 50.61 | 22.95 | 39.34 |
| Student 28 | 40.78 | 23.75 | 50.61 | 22.95 | 39.34 |

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