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INTELLIGENT SYSTEM FOR CLASSIFICATION OF STUDENT PERSONALITY WITH NAIVE BAYES ALGORITHM

Dony Fahrudy[1], Izza Afkarina[2], Muhammad Fadli[3] , Rinny Assasunnaja[4], Wildan Nadiyal Ahsan[5] , Febri Eka Setyawan[6], Maria Ulfah Siregar[7*]

[1,2,3,4,5,6,7] Master of Informatics Study Program, Faculty of Science and Technology, State Islamic University of Sunan Kalijaga
Jl. Laksda Adisucipto, Special Region of Yogyakarta, Indonesia

donnyfahrudi@gmail.com[1], izzaafkarina@gmail.com[2], muhammadfadli@gmail.com[3], rinnyasasun14@gmail.com[4], williearms1892@gmail.com[5], febriekasetyawan@gmail.com[6], maria.siregar@uin-suka.ac.id[7]
*correspondence author

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Abstrak

Berbagai macam permasalahan timbul dari perilaku kepribadian mahasiswa yang berubah. Oleh karena itu, diperlukan sistem cerdas untuk mengetahui tipe kepribadian mahasiswa. Penelitian ini menerapkan sistem cerdas dengan metode klasifikasi menggunakan algoritma Naïve Bayes untuk menentukan kepribadian mahasiswa berdasarkan kelas Sanguin, Koleris, Melankolis, dan Plegmatis terhadap Tipologi Hippocrates-Galenus. Atribut yang digunakan diantaranya jenis kelamin, usia, tahun angkatan, jawaban tes A, jawaban tes B, jawaban tes C, dan jawaban tes D. Pengujian sistem dilakukan dengan skema pembagian data latih dan data uji. Data yang digunakan adalah data kuesioner berdasarkan Tipologi Hippocrates-Galenus yang diisi mahasiswa sebanyak 130 data. Kemudian dibagi menjadi data latih untuk membentuk model klasifikasi sebanyak 117 data, dan terdapat 13 data yang digunakan sebagai data uji untuk pengujian akurasi. Proporsi data adalah 90:10 dengan menggunakan teknik 10-fold cross validation. Data yang dimiliki kemudian dilakukan perhitungan menggunakan algoritma naïve bayes. Berdarasarkan hasil pengujian, terdapat 12 mahasiswa tepat prediksi dan 1 mahasiswa tidak tepat prediksi, sehingga diperoleh akurasi sebesar 92.31% dengan laju error 7.69%.

Kata Kunci: *hippocrates-galenus, data training, data test, uji keakuratan, prediksi*

Abstract

Various kinds of problems arise from the changing personality behavior of students. Therefore, an intelligent system is needed to determine the personality type of students. This study applies an intelligent system with a classification method using the Naïve Bayes to determine the personality of the student based on Sanguine, Choleric, Melancholic, and Phlegmatic classes against Hippocrates-Galenus typology. The attributes used include gender, age, year of class, answers to test A, answers to test B, answers to test C, and answers to test D. System testing is carried out with a scheme for sharing training data and test data. The data used is questionnaire data based on the Hippocrates-Galenus typology which is filled out by 130 students. Then it is divided into training data to form a classification model of 117 data, and there are 13 pieces of data used as test data for accuracy testing. The proportion is 90:10 using 10-fold cross validation. The data held are then calculated using the nave Bayes algorithm. Based on the results, there were 12 students correctly predicted and 1 students did not predict correctly so that an accuracy of 92.31% was obtained with an error rate of 7.69%.

Keywords: *hippocrates-galenus, training data, test data, accuracy testing, prediction*

1. INTRODUCTION

Personality is a trait that is reflected and already possessed in a person so that it can distinguish it from others [1]. Students are in the transition phase from adolescence to adulthood. The transition period makes students still unstable to control their emotions. It makes curiosity about new things increase which then shows the characteristics of his personality. Problems can arise from changing personalities. In the educational environment this needs to be handled by the student department [2].

Based on Personality Plus book, Florence Littauer human personality types can be divided into 4: sanguine, choleric, melancholic, and phlegmatic. A person with a sanguine personality type prefers to prioritize feelings over thoughts. In addition, the sanguine personality type is also passionate about everyone he meets. The weakness of this type of personality does not like solitude, really dislikes sadness, and tends to often find ways to stay happy. Choleric personality type has a high spirit and is always optimistic. But his weakness is stubborn, irritable, domineering, impatient, likes a commotion that ends in a fight. Melancholic personality types often feel worried or afraid and include people who give up easily. Behind that, a melancholy is someone who is very creative and analytical. Meanwhile, the phlegmatic type does not like violence and always loves peace. A phlegmatic tends to avoid activities that can potentially lead to conflict. Phlegmatic also prefer serenity [3].

All humans have the characteristics of intelligence, there are indicators in each intelligence that work together across all cultures starting from basic pattern abilities that are expressed through hobbies and abilities that require special assistance [4].

The Naive Bayes method is a method to do classification that uses probability and statistics and was presented by a British scientist named Thomas Bayes. Based on past experience, the Naive Bayes algorithm predicts future opportunities, that is why it is known as Bayes' Theorem [5].

Reference [6] said that the use of Naïve Bayes as a data calculation method because it can find important factors for prediction, based artificial intelligent classification process with high accuracy and can run fast in big database.

Research with the tittle ”Perbandingan Akurasi Naive Bayes dan K-Nearest Neighbour pada Klasifikasi untuk Meramalkan Status Pekerjaan Alumni ITB Stikom Bali”, obtained results that show the Naïve Bayes method have better accuracy dan better MAPE compared to K-Nearest Neighbor [7]. The values are 83.83% and 16.17% for accuracy and MAPE’ the Naïve Bayes method, and the best K value is 9, accuracy 82.34% and MAPE 17.66% for K-Nearest Neighbor.

Nugraha and Siregar [8] have used the Naïve Bayes classifier to do sentiment analysis about the relocation of the capital city of Indonesia. Data for this research are obtained from tweets. The accuracy of this research is 76.74% with 90% of data used for training, and the rest is for testing.

Other research with the title “Comparison of Data Mining Classification Algorithm Model C4.5 and Naïve Bayes for Diabetes Prediction” obtained results of classification data had been evaluated with Confusion Matrix and ROC curve to know the level of accuracy with Decision Tree Algorithm in the amount of 73.30% while the Naive Bayes Algorithm is 74.13% [9]. It is found that, Naïve Bayes Algorithm has better performance for diabetes prediction.

Therefore, we need an intelligent system that can find out the students’ personality types to be able to deal with these problematic students. Therefore, we plan to do research on "Intelligent System for Classification of Student Personality with Naive Bayes Algorithm (Case Study: UIN Ar-Raniry)". By implemented this personality characteristic classification system, it is hoped that it can help the student liaison in knowing the personality characteristics of its students from the start. This will be useful if

one day there is a problem with a particular student, then the student liaison already understands the decisions or actions that must be taken to deal with these students according to their personality characteristics.

2. RESEARCH METHOD

The research method consists of data collection, study of literature, intelligent agent, preprocessing, Naïve Bayes algorithm, system analysis, implementation and testing.

1. Data Collection

Data was collected by distributing questionnaires to UIN Ar-Raniry students. The questionnaire used was adopted from the book Personality Plus by Florence Littauer. The distributed questionnaire was created using google forms consisting of 40 questions. The attributes used in this study consisted of seven attributes, namely gender, age, year of class, answers to test A, answers to test B, answers to test C and answers to test D. The number of respondents obtained is 130 students.

2. Study of Literature

This literature study was conducted to obtain information by collecting and studying literature through books, scientific works, and other sources related to the problems in research.

3. Intelligent Agent

An agent is a flexible autonomous entity capable of perceiving the environment through sensors connected to it which act on the environment through actuators [10]. An agent can also be said to be a computer system that is in an environment and has the ability to act autonomously in environmental situations according to the designed target [11]. The definition given does not cover the entire range of characteristics an agent must possess [10].

4. Preprocessing

At this stage, the data will be preprocessed before the classification and evaluation process is carried out on the method used for student data. The preprocessing stage includes data cleaning (data cleaning), data integration (data integration), data selection (data selection), and data transformation (data transformation) [12]. However, in this study only data transformation will be carried out. In this case, the data needs to be converted into a suitable format for processing in the classification method. The classification method requires a special data format before it can be applied. The classification method can only accept categorical and numeric data input [12]. Based on data collection, there are some data that are not aligned, such as the attributes of age and year of class, and the attributes of personality questions as many as 40 questions which then need to be categorized into 4 attributes based on answers A to answer D, so it is necessary to transform the data first. This process is called data transformation [12].

5. Naïve Bayes Algorithm

At this stage, the process carried out is to process raw data into quality data. In this case, there are 130 datasets consisting of training data and test data, 117 training data (90%) used to form a classification model with the naive Bayes algorithm, and 13 testing data (10%). To evaluate the algorithm, we used 10-fold cross validation technique. The determination of the label or class of the dataset is carried out based on secondary sources as in previous researchers, namely by looking at the characters that were chosen by the respondents including the Sanguine, Choleric, Melancholic, or Phlegmatic classes, so that it can be seen that the respondent's personality character is the most dominating which is the basic nature of personality traits college student [13]. The data used in testing the system is student data based on Hippocrates-Galenus Typology which contains 40 questions, then answered by each student according to their character and personality as much as 130 data. Of the 130 data, then divided into training data to form a classification model of 117 data, and there are 13 data used as test data to test accuracy using 10-fold cross validation and 90:10 proportion of data. The data held are then calculated using the nave Bayes algorithm.

The Naive Bayes method is a classification method that uses probability and statistics and was proposed by Thomas Bayes. The Naive Bayes algorithm predicts future opportunities based on past experience, so it is known as the Bayes theorem. Bayes theorem is usually applied to nominal data types, while for numeric or continuous data types using the Gaussian distribution.

The Bayes theorem equation for nominal data types is as shown in Formula 1 as follows [14]:

$$P(H|X) = \frac{P(X|H)P(H)}{P(X)} \quad (1)$$

where X = Data with unknown class, H = Hypothesis data of a specific class, $P(H|X)$ = Probability of H hypothesis based on X condition (posteriori probability), $P(H)$ = Probability of H hypothesis (prior probability), $P(X|H)$ = Probability of X based on H hypothetical conditions, and $P(X)$ = Probability of X.

While the Bayes theorem equation for numeric/ continuous data types is as given in Formula 2 as follows [15]:

$$P(X_i = x_i|Y_i = y_i) = \frac{1}{\sqrt{2\pi\sigma_{ij}}} e^{-\frac{(x_i-\mu_{ij})^2}{2\sigma^2 ij}} \quad (2)$$

where P = Probability, X_i = Attribute i, x_i = Value of the attribute i, Y = Class sought, y_i = Sub-class sought, μ= mean, and σ= standard deviation which represents the variance of all attributes.

6. System Analysis

Intelligent system analysis is carried out based on the results of data collection that has been carried out. System requirements analysis is carried out to determine what features are contained in the intelligent system.

7. Implementation

This implementation is a translation process from the design stage into the application form using the PHP programming language, MySQL database, and machine learning. The PHP was used to implement the user interface and the personality classification system, whereas machine learning was used to implement the evaluation of *k*-fold cross validation.

8. Testing

The next stage is to test the program that was built to find out the extent of the system performance and the accuracy of the method applied so as to be able to produce information as expected.

3. RESULT AND DISCUSSION

3.1 PEAS Description

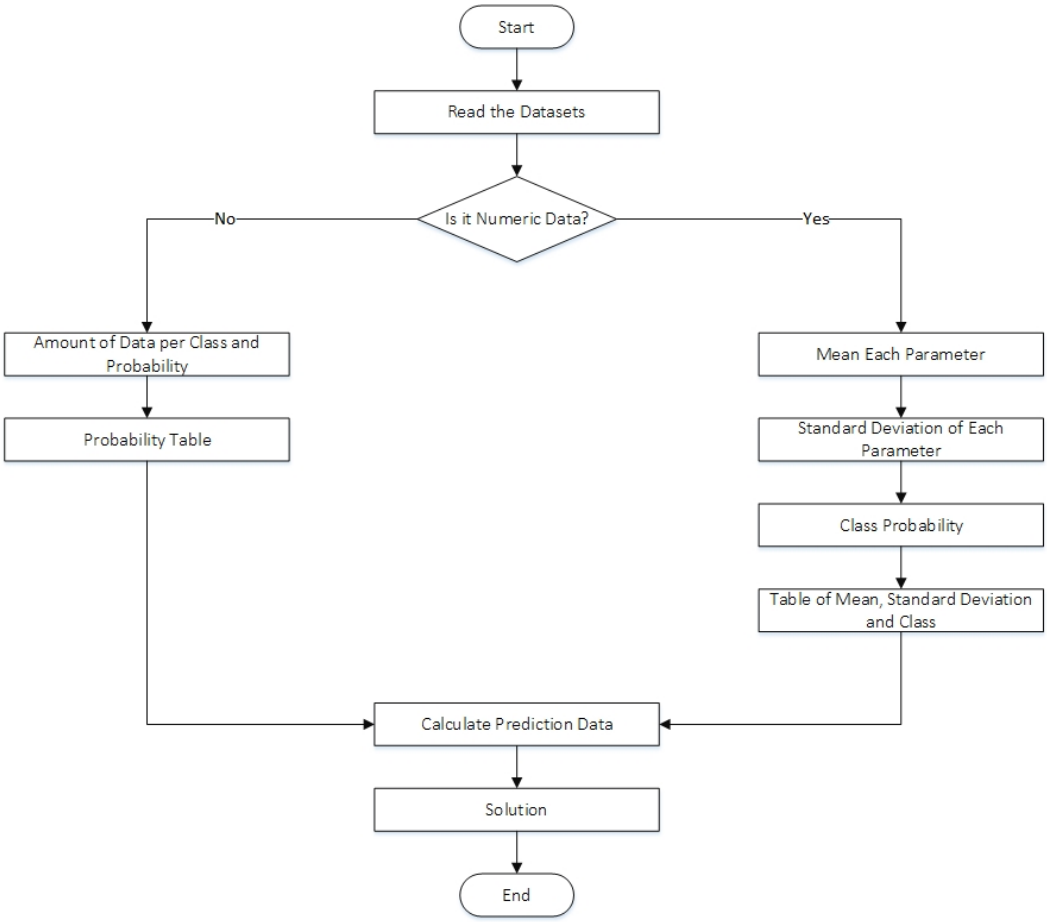
The implemented agent is the learning agent. Thus, our agent has other elements in addition to general elements of an agent (PEAS). PEAS (Performance measure, Environment, Actuators, Sensors) is an environment task on agents.

To design the learning agent must determine the activity environment. The elements of our learning agent is:

1. Critic: the questionnaire
2. Performance element: students
3. Learning element: the student liaison
4. Problem generator: advice for students

3.2 Naïve Bayes Method

The Naïve Bayes method (Picture 1) utilizes training data as data carried out by the training process to generate the probability of each criterion from a different class, so that the probability values of these criteria can be optimized to predict student personality characteristics based on the classification process carried out by the Naive Bayes method. In this study, to classify the characteristics of students by using some training data or training data. The training data set is used to form the classification model. In the test model, the classification model that has been formed is tested with test data. This is done in order to determine the level of accuracy of the classification model. The resulting classification model can be used to determine the class of the new data.



Picture 1. Nave Bayes Algorithm Flow [16]

3.3 Training Data

To determine the data to be analyzed using the Naïve Bayes method, the first step is to read the training data. Table 1 shows student training data.

Table 1. Training Data on the First Fold using 10-fold Cross Validation

No	Name	Gender	Age	Force Year	Answer A	Answer B	Answer C	Answer D	Original Class
1	Nabila Razani	P	22	2017	15	9	11	5	Sanguin
2	M. Hazaqil Afif	L	21	2017	2	4	19	15	Melankolis
3	Sri Wahyuni	P	24	2015	3	2	14	21	Plegmatis
4	Nadya Sari	P	21	2018	9	7	8	16	Plegmatis
5	Refiani putri	P	23	2015	21	8	7	4	Sanguin
6	Muhammad Sholehuddin	L	21	2017	7	13	12	8	Koleris
7	M. Hazaqil Afif	L	21	2017	2	4	19	15	Melankolis
8	NURKASIH	P	21	2017	7	14	10	9	Koleris
9	Rafiqah Rahmah	P	19	2020	0	2	0	38	Plegmatis
10	Maudhiani	P	21	2016	8	7	12	13	Plegmatis
...	...	...	...	...	...	...	...	...	...
117	Cut manda sari	P	24	2016	14	8	13	5	Sanguin

3.4 Accuracy Test

The probability of the previous criteria is then used to obtain the classification of the student's personality on the test data. Table 2 shows the first test data analyzed to obtain a classification of its characteristics.

Table 2. The First Fold Test Data using k = 10

No	Name	Gender	Age	Force Year	Answer A	Answer B	Answer C	Answer D	Original Class	Prediction Class
1	Muhammad Fuzari	L	21	2017	12	9	7	12	Sanguin	Sanguin
2	Ira	P	24	2016	2	24	14	0	Koleris	Koleris
3	Mawarnis	P	20	2018	6	9	16	9	Melankolis	Melankolis
4	Muhammad rizal	L	24	2015	15	10	9	6	Sanguin	Sanguin
5	Mulia Fitriana	P	23	2015	7	16	10	7	Koleris	Koleris
6	Zulfitri	L	23	2015	4	12	14	10	Melankolis	Melankolis
7	MUHAMMAD SAJAD AL KHAIRI	L	21	2017	0	0	39	1	Melankolis	Melankolis
8	Moncacantik	P	21	2015	10	7	19	4	Melankolis	Melankolis
9	Nisa Izzia	P	22	2017	9	9	9	13	Plegmatis	Plegmatis
10	Muhammad Haykal	L	23	2015	10	6	11	13	Plegmatis	Plegmatis
…										
13	Yasir Maulana	L	21	2018	10	10	14	6	Sanguin	Koleris

Calculation of the probability value of each class.

$$P(Class = Sanguin) = \frac{26}{117} = 0.2222$$

$$P(Class = Koleris) = \frac{34}{117} = 0.2906$$

$$P(Class = Melankolis) = \frac{25}{117} = 0.2137$$

$$P(Class = Plegmatis) = \frac{32}{117} = 0.2735$$

Calculation of test data for nominal data types is as follows.

- Attribute of Gender

$$P(Class = Sanguin|Gender = M) = \frac{6}{26} = 0.2308$$

$$P(Class = Koleris|Gender = M) = \frac{14}{34} = 0.4118$$

$$P(Class = Melankolis|Gender = M) = \frac{15}{25} = 0.6$$

$$P(Class = Plegmatis|Gender = M) = \frac{11}{32} = 0.3438$$

Calculation of test data for numeric/ continuous data types as follows.

- Attribute of Age

$$P(Age = 21|Class = Sanguin) = \frac{1}{\sqrt{2(3.14)(1.7418)}} e^{-\frac{(21-22.9231)^2}{(2)(1.7418)^2}}$$

$$P(Age = 21|Class = Koleris) = \frac{1}{\sqrt{2(3.14)(1.479}}$$

$$P(Age = 21|Class = Melankolis) = \frac{1}{\sqrt{2(3.14)(1.}}$$

$$P(Age = 21|Class = Plegmatis) = \frac{1}{\sqrt{2(3.14)(1.8}}$$

Calculating Final Probability Values on Each Test Data.

1. Sanguine Class

P(X | Sanguin) = P(Sanguin) * P(Gender = Female | Sanguin) * P(Age = 21 | Sanguin) * P(Force Year = 2017 | Sanguin) * P(Answer A = 12 | Sanguin) * P(Answer B = 9 | Sanguin) * P(Answer C = 7 | Sanguin) * P(Answer D = 12 | Sanguin) = 0.222222222222222 x 0.2308 x 0.124544146285459 x 0.22683234755212 x 0.0464085313697649 x 0.0954240667903401 x 0.11447132953254 x 0.0556741447864823 = 4.08883630530637E-08

2. Koleris Class

P(X | Koleris) = P(Koleris) * P(Gender = Female | Koleris) * P(Age = 21 | Koleris) * P(Force Year = 2017 | Koleris) * P(Answer A = 12 | Koleris) * P(Answer B = 9 | Koleris) * P(Answer C = 7 | Koleris) * P(Answer D = 12 | Koleris) = 0.290598290598291 x 0.411764705882353 x 0.249216391 x 0.295968343048519 x 0.0673318438280146 x 0.009402063820701 x 0.101934401767501 x 0.0203815765144251 = 1.16082376634042E-08

3. Melankolis Class

P(X | Melankolis) = P(Melankolis) * P(Gender = Female | Melankolis) * P(Age = 21 | Melankolis) * P(Force Year = 2017 | Melankolis) * P(Answer A = 12 | Melankolis) * P(Answer B = 9 | Melankolis) * P(Answer C = 7 | Melankolis) * P(Answer D = 12 | Melankolis) = 0.213675213675214 x 0.6 x 0.172060503751675 x 0.25788060292923 x 0.00716706416228831 x 0.0949237428452939 x 0.00448431571350002 x 0.0940303349218081 = 1.63187006175588E-09

4. Plegmatis Class

P(X | Plegmatis) = P(Plegmatis) * P(Gender = Female | Plegmatis) * P(Age = 21 | Plegmatis) * P(Force Year = 2017 | Plegmatis) * P(Answer A = 12 | Plegmatis) * P(Answer B = 9 | Plegmatis) * P(Answer C = 7 | Plegmatis) * P(Answer D = 12 | Plegmatis) = 0.273504273504274 x 0.34375 x 0.197509406762355 x 0.230389042309137 x 0.044766888567737 x 0.0473580728521167 x 0.0756386150448896 x 0.0330999217087815 = 2.2707948163354E-08

The highest final probability value is in the Sanguin class, then the test data are classified as Sanguinic personality characteristics. Table 3 shows this information. Pictures 2-3 show the system's testing.

Table 3. Confusion Matrix

		Prediction Results			
		Sanguin	Koleris	Melankolis	Plegmatis
Original Class	Koleris	3	0	0	0
	Melankolis	0	4	0	0
	Plegmatis	0	0	2	0
	Sanguin	1	0	0	3

$$Accuracy = \frac{3+4+2+3}{13}\ x\ 100\% = 92.31\%$$

$$Error = 100\% - 92.31\% = 7.69\%$$

4. CONCLUSION

The system was developed and has been able to classify student personalities based on the Typology of Hippocrates Galenus. Based on the tests that have been carried out on 13 test data, obtained an accuracy of 92.31% and an error of 7.69% with a total of 12 data correctly predicted and 1 data incorrectly predicted. From the results of these tests, it can be stated that the results of the accuracy of this intelligent classification system are quite good in classifying students' personalities. Some suggestions are that the determination of training data on system testing is still carried

out directly without preprocessing first, so that if there is noise data it can affect the method testing process. Therefore, before carrying out the prediction process, preprocessing is carried out on the training data first to eliminate (noise) that occurs in order to produce quality data. In addition, in order to get a better percentage of accuracy, more training data is needed for testing. Training data is used in the training process on the method and testing is carried out to test the accuracy of the method used, it should be done with another method in order to see which method is more accurate in classifying student personality characteristics..

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