NAIVE BAYES ALGORITHM IMPLEMENTATION TO DETECT HUMAN PERSONALITY DISORDERS

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Abstract— We live in a society that still sees problems regarding one's soul and personality as taboo, even though mental health is as important as physical health. A personality disorder itself is a disorder that can be seen from behavior, mindset, and attitude, which brings difficulties to life. Based on this problem, this study applies the method of Naive Bayes classifier as early detection of human personality disorders. Using a data set of 130 correspondences from the AMIKOM university scope with the age limit of 18-25 years and identified personality disorders is a borderline type disorder. The data obtained was 94 with undiagnosed classes and 36 with undiagnosed classes, with the research variables in the form of questionnaire questions as many as 13 questions. The testing process is done with 10 fold and 5 fold cross-validation, and confusion matrix with the results in the form of accurate 10 folds superior with a value of 88.8% compared to 5 folds that is 88.2%, for precision 10 folds superior with 88.7%, but for 5 fold recall superior with 88.3%, while the final results of these two performances in F1-Score, produce the same value, which is 86.1%.

Keywords: *Data Mining, Classification, Naïve Bayes, Personality Disorder*

Abstrak— *Kita hidup di masyarakat yang masih memandang permasalahan mengenai jiwa dan kepribadian seseorang adalah hal yang tabu, padahal kesehatan mental sama pentingnya dengan kesehatan fisik. Sebuah gangguan kepribadian sendiri adalah gangguan yang terlihat dari perilaku, pola pikir, dan juga sikap, yang membawa kesulitan ke dalam hidup. Didasari oleh masalah tersebut, penelitian ini menerapkan metode naive bayes classifier guna sebagai deteksi awal gangguan kepribadian manusia. Menggunakan data set sebanyak 130 korespodensi dari ruang lingkup universitas AMIKOM dengan batasan umur 18 – 25 tahun serta gangguan kepribadian yang diidentiifikasi adalah gangguan tipe ambang (borderline).Data yang diperoleh adalah 94 dengan kelas tidak terdiagnosis dan 36 dengan kelas terdiagnosis, dengan variabel penelitian berupa pertanyaan kusioner sebanyak 13 soal. Proses pengujian dilakukan dengan 10 fold dan 5 fold cross validation, serta confusion matrix dengan hasil berupa accuration 10 lipatan lebih unggul dengan nilai 88.8% dibandingkan 5 lipatan yaitu 88.2%, untuk precision 10 lipatan lebih unggul dengan nilai 88.7%, namun untuk recall 5 lipatan lebih unggul dengan nilai 88.3%, sedangkan hasil akhir dari dua peforma ini di dalam F1-Score, menghasilkan nilai yang sama, yaitu 86.1%.*

Kata Kunci: *Data Mining, Klasifikasi, Naïve Bayes, Gangguan Kepribadian*

PRELIMINARY

Diagnosis occurrence of personality disorders on a person can be a controversial thing, most people will give it a label or any particular stigma on them. As a result, individuals are increasingly reluctant to seek treatment and to isolate themselves. This happens due to lack of education and knowledge about mental health (Meiyuntariningsih & Yulia Maharani, 2018) itself. Stigma and discriminatory acts are often accepted by the patient or person who has been diagnosed, making the process of mental healing and therapies also be hampered, due to the lack of social trust on themselves.

The research related to mental health the research done by Roy Samuel Fernandus Sitorus that combines a forward chaining method and theory of probability based on previous cases that have occurred, is able to produce a system that can determine the type of personality disorder that may be suffered by prospective patients and handling (Sitorus, 2013).

Other studies are research by Zulfian Azmi and Kurniadi Syahputra with 3 main parameters of stress levels (Azmi & Syahputra, 2018), namely mild, moderate and severe, showing that Bayes theorem is able to be applied in calculating stress levels based on the probability of symptoms that have occurred in the previous case, resulted in a more objective decision.

Research by Deden Ardiansyah have the results of calculation of one of the 9 types of intelligence compound in the questionnaire system, shows that the accuracy of the resulting higher at 99.91% (Ardiansyah, 2014)

With the existence of these problems the authors wanted to do research for the detection of human personality disorder using Naive Bayes method with the purpose if the user can find out how likely he has a personality disorder threshold, then the person concerned can minimize it factors into the cause of it.

It is expected to reduce the number of cases of severe mental disorder which affects the country as well as the additional burden reduction for long-term productivity of their communities (Ikatan Dokter Indonesia, 2016). Also based on statistics by reading the positive concept of mental health, it can increase the tendency to participate in the management of mental health itself in order to be better (Zajonc, 1968).

Naive Bayes is a classification method that stems from Bayes theorem itself, assuming that between the explanatory variables are independent (independent). In this case, diamsusikan that the presence or absence of a particular occurrence of a variable group is not related to the presence or absence of other events variable groups (Sinawati & Praseptian M, 2018), (Tanius, Mulyawan, & Hendryli, 2018).

Naive Bayes classifier is very good compared to other models with higher accuracy levels (Xhemali, Hinde, & Stone, 2009), Research detection personality disorder using the naive Bayes using training data based on cases that have occurred with the assumption that the presence or absence of a specific incident of a group is not associated with the presence or absence of other events, in order to be able to produce results more accurate diagnosis , This study used two testing methods, namely K-Fold Cross Validation and Confusion Matrix that will be used to measure accurately. Cross Validation is a data validation techniques with randomly split into k parts and each part will do the classification process (Han, Kamber, & Pei, 2012), whereas Confusion matrix to give a decision obtained in training and testing.

MATERIALS AND METHODS

This study did several stages with the following methods:

1. Data collection

At this stage, the research centered on a wide range of data, be it on issues of personality to be observed, information about the mechanism of the algorithm that you want to implement, the process of interviewing the sources in the field of psychologists, as well as the audit process questionnaire distributed to 130 correspondence in region University AMIKOM the age limit 18-25 years, whose data will be used as a knowledge base in this system.

2. *Data Cleaning*

The initial step in the data mining process is to ensure that the data obtained does not contain null values, or values that are inconsistent with the values that should. In addition, in this process columns that are not used will be removed, as well as fix the empty field and also the header of the table is replaced with the variable name as in the database.

3. *Case Folding*

Case folding is used to make the overall existing data to lowercase.

4. *Data transformation*

Data transformation is a process by which data is converted into a form that can be processed by the algorithm. There are 3 steps to be taken in the process of data transformation:

a. Grouping
   Grouping is the stage to perform the classification of a class variable, with category 1 is diagnosed and category 2 are undiagnosed. And also move a column in the classroom the last column.
b. Discretization
   Discretization is the stage to transform data into a form shaped figure categorical.
c. Field Name Change
   In this last data processing, the field name that is too long and, in the form changed to fit already existing with the name of the field is shorter value and save database memory.

5. One Hot Coding

At this stage the change in value of each variable be binary, that can be received by a computer system, such as the variable P1 are aged, 18 and 25, from each value variable this will be a column and variable new in the database, and so on until variable third mercy.

6. Naïve Bayes Implementation and Testing

Next is the process of implementing Naive Bayes by using the library of sklearn and the Python programming language to find the probability values. Methods to evaluate the algorithm used is the 10-fold Cross Validation, 5-Fold Cross Validation, and confusion matrix which results in accuracy, precision, recall, F1-score.

RESULTS AND DISCUSSION

Starting with a base of knowledge, which is shown in Table 1.

Table 1 List of Questions

No.	Question
P1	How old are you now?
P2	Are your parents still currently exist and live in a house?
P3	Most people with borderline personality disorder have experienced childhood emotional abuse at her, for example, is pembullyan or humiliated either through words (slang) or physical (melee). Have you ever experienced any of these things, and really made an impression on your mind today?
P4	Do you have a great fear for the person left?
P5	Do you think you have a strong emotional over something, but the emotion is very up and down?
P6	How big is your ability to control feelings of anger?
P7	Have you ever feel that they have their own mindset?
P8	Oia by you alone, if you have difficulty controlling emotions that are in you?
P9	How often do you have difficulty in maintaining a relationship, be it with friends or colleagues?
P10	How often do you act first without thinking consequence of that?
P11	Have you ever thought about suicide? If so, how often it is?
P12	Do you feel there is an empty inside you, but do not know what it is?
P13	The next question would be more sensitive than existing data 73% of people with borderline personality disorder have experienced sexual harassment, whether it is genital or non-genital. Have you ever experienced that?

Source: (Nanda & Sari, 2019)

In this manual calculation the data used as test data is the 20th data as test data. Here are the things that are done to perform manual calculations.

a. For ease of calculation, the author of grouping data based on its class, the class is not diagnosed and undiagnosed class.
b. Do calculations based on the likelihood, there is a table of variables ranging from P1 to P13 that is a question that has been discussed before, and then answer or values are entered, the frequency of these answers are called in the class P = (undiagnosed) where the total class P = (undiagnosed) is 16 times.

Table 2 Calculation of Undiagnosed Class Variable

Variables	Answer	Frequency
P1	21	2/16 = 0.125
P2	Live separately	5/16 = 0.3125
P3	Ever	10/16 = 0.625
P4	Ordinary	13/16 = 0.8125
P5	Feel	4/16 = 0:25
P6	Bad	1/16 = 0.0625
P7	Several times	11/16 = 0.6875
P8	Yes	3/16 = 0.1875
P9	Difficulty	4/16 = 0:25
P10	Often	4/16 = 0:25
P11	Every time	1/16 = 0.0625
P12	Feel it every time	1/16 = 0.0625
P13	Yes	8/16 = 0.5
P = (undiagnosed)		16/20 = 0.5
All results in multiply		**3.90173227E-09**

Source:(Nanda & Sari, 2019)

c. Table 3 is the calculation of likelihood P = (diagnosed), but this time P = (undiagnosed) where the total class P = (undiagnosed) is 4 times, reversibility with the previous value, because the total data used is 20.

Table 3 Calculation of Diagnosed Class Variable

Variables	Answer	Frequency
P1	21	2/4 = 0.5
P2	live separately	4/4 = 1
P3	Ever	4/4 = 1
P4	Ordinary	1/4 = 0. 25
P5	Feel	3/4 = 0.75
P6	Bad	2/4 = 0. 5
P7	Several times	3/4 = 0.75
P8	Yes	4/4 = 1
P9	difficulty	4/4 = 1
P10	Often	3/4 = 0.75
P11	Every time	1/4 = 0. 25
P12	Feel it every time	1/4 = 0. 25
P13	yes	4/4 = 1
P = (undiagnosed)		4/20 = 0.2
All results in multiply		**0.00032959**

Source: (Nanda & Sari, 2019)

d. Having previously calculating the number of times a variable value appears in a class based on the goal, the next is calculate the value of a variable in the incoming test data regardless of its class. Table 4 shows the calculation of the variable regardless of class.

Table 4. Calculation of Variable without Looking Class

Variables	Answer	Frequency
P1	21	4/20 = 0.2
P2	Live separately	9/20 = 0:45
P3	Ever	14/20 = 0.7
P4	Ordinary	14/20 = 0.7
P5	Feel	7/20 = 0:35
P6	Bad	3/20 = 0:15
P7	Several times	14/20 = 0.7
P8	Yes	7/20 = 0:35
P9	Difficulty	8/20 = 0.4
P10	Often	7/20 = 0:35
P11	Every time	1/20 = 0. 1
P12	Feel it every time	1/20 = 0. 1
P13	Yes	12/20 = 0.6
All results in multiply		**4.76478E-07**

Source: (Nanda & Sari, 2019)

e. Next is the value at P (undiagnosed) and P (diagnosed) divided by the value of the variable regardless of class. Table 5 shows the calculation of the total value.

Table 5 Total Value Calculation

	P (undiagnosed)	P (undiagnosed)
	3.90173227E-09 / 4.76478E-07	0.00032959 / 4.76478E-07
result	**691.7203574**	**0.008188686**

Source: (Nanda & Sari, 2019)

f. The last to get the actual value, the results are normalized, with a formula that has been discussed before. Table 6 shows the results of the calculation of the normalized value.

Table 6 Calculation of Normalized Value

	P (undiagnosed)	P (undiagnosed)
	0.008188686 / (691.7203574 + 0.008188686)	691.7203574 / (691.7203574 + 0.008188686)
result	**1.18380E-05**	**0.999988162**

Source: (Nanda & Sari, 2019)

From the results shown in table 6 it can be seen that the test data which is the 20th data, has a tendency towards the diagnosed class at 99.9988162% and the undiagnosed class is only 0.0011838%.

Used validation test using the data 130 using 10-fold Cross Validation and 5-fold Cross Validation that the results are entered into the Confusion Matrix. Confusion Matrix itself is used to find the value of accuracy, error rate, precision, recall, and F1-Score. The purpose of the validation test itself is knowing the classification accuracy of the model has been made, by dividing the existing data sets to within 5 and 10 folds. Table 7 is a table that shows the performance of each crease.

Table 7. Results of 10 Fold Cross Validation

Fold	Parameter	Result (%)
Fold 1	Accuracy	92.8
	error Rate	7.1
	Precision	90
	recall	95
	F1-score	91
	The amount of data	13
Fold 2	Accuracy	100
	error Rate	0
	Precision	100
	recall	100
	F1-score	100
	The amount of data	13
Fold 3	Accuracy	85.7
	error Rate	14.2
	Precision	83.3
	recall	90
	F1-score	84.4
	The amount of data	13
Fold 4	Accuracy	92.8
	error Rate	7.1
	Precision	90
	recall	95
	F1-score	91
	The amount of data	13
Fold 5	Accuracy	100
	error Rate	0
	Precision	100
	recall	100
	F1-score	100
	The amount of data	13
Fold 6	Accuracy	100
	error Rate	0
	Precision	100
	recall	100
	F1-score	100
	The amount of data	13
Fold 7	Accuracy	83.4
	error Rate	16.3
	Precision	90.9
	recall	66.6
	F1-score	70
	The amount of data	13
Fold 8	Accuracy	91.6

Fold	Parameter	Result (%)
	error Rate	8.3
	Precision	95
	recall	83.3
	F1-score	87.3
	The amount of data	13
Fold 9	Accuracy	66.6
	error Rate	33.7
	Precision	62.8
	recall	66.6
	F1-score	62.5
	The amount of data	13
Fold 10	Accuracy	75
	error Rate	25
	Precision	75
	recall	83.3
	F1-score	73.4
	The amount of data	13
Average	Accuracy	88.8
	error Rate	11.1
	Precision	88.7
	recall	88
	F1-score	86.1
	The amount of data	130

Source: (Nanda & Sari, 2019)

Table 8 shows the value generated by the confusion matrix with 10 folds validation test.

Table 8. Confusion Matrix Naive Bayes 10 Folds

	Prediction undiagnosed	prediction undiagnosed	amount
Actually undiagnosed	84	10	94
actually diagnosed	4	32	36
amount	88	42	130

Source: (Nanda & Sari, 2019)

From Table 7, the highest accuracy is obtained in the crease to 2, 5 and 6 at 100%, while the accuracy of the lowest owned by folds to 9 with a value of 66.6% and for the error rate, precision, recall and F1-Score it is, 33.7%, 62.8%, 66.6%, 62.5%. On average Performance obtained from the confusion matrix in a 10-fold Cross Validation has a value of accuracy, error rate, precision, recall and F1-Score by, 88.8%, 11.1%, 88.7%, 88%, 86.1% of the total maximum amount of data 130.

In Table 8 there are 88 data is predicted to be in the class are not diagnosed, and there are 42 data is predicted in the class of diagnosis, but of the 88 data predicted undiagnosed no prediction error as much as 4 data, which is supposed to be in class undiagnosed, and to 42 the data the predicted class there are 10 data undiagnosed incorrect predictions and supposed to be in class undiagnosed. The tests with 5 folds are shown in Table 9.

Table 9 Results 5 Fold Cross Validation

Fold	Parameter	Result (%)
Fold 1	Accuracy	96.2
	error Rate	3.8
	Precision	94.4
	recall	97.3
	F1-score	95.7
	The amount of data	26
Fold 2	Accuracy	88.4
	error Rate	11.5
	Precision	85
	recall	92.1
	F1-score	86.8
	The amount of data	26
Fold 3	Accuracy	96.1
	error Rate	3.9
	Precision	93.7
	recall	97.3
	F1-score	95.3
	The amount of data	26
Fold 4	Accuracy	88.4
	error Rate	11.5
	Precision	93.1
	recall	78.5
	F1-score	82.7
	The amount of data	26
Fold 5	Accuracy	72
	error Rate	28
	Precision	71.1
	recall	76.1
	F1-score	70.2
	The amount of data	26
Average	Accuracy	88.8
	error Rate	11.1
	Precision	88.7
	recall	88
	F1-score	86.1
	The amount of data	130

Source: (Nanda & Sari, 2019)

Table 10 shows the value generated by the confusion matrix with 5 folds validation test.

Table 10 Confusion Matrix Naive Bayes 5 Folds

	Prediction undiagnosed	prediction undiagnosed	amount
Actually undiagnosed	83	11	94
actually diagnosed	4	32	36
amount	87	43	130

Source: (Nanda & Sari, 2019)

From Table 9, the highest accuracy is obtained in the crease to 1 with a value of 96%, while the accuracy of the lowest owned by the crease to 5 with a value of 72% and for the error rate, precision, recall and F1-Score it is, 28%, 71.1%, 76.1 %, 70.2%. On average Performance obtained from the confusion matrix on a 5-fold Cross Validation has a value of accuracy, error rate, precision, recall and F1-Score by, 88.2%, 11.7%, 87.5%, 88.3%, 86.1% of the total maximum amount of data 130.

In table 10 there are 87 data is predicted to be in the class are not diagnosed, and there are 43 data is predicted in the class of diagnosis, but of the 87 data predicted undiagnosed no prediction error as much as 4 data, which it shall be in the class of diagnosis, and to 43 the data the predicted at diagnosis class there are 11 data is incorrect predictions and supposed to be in class undiagnosed. Table 11 illustrates a performance comparison between the validation 5 and 10 folds.

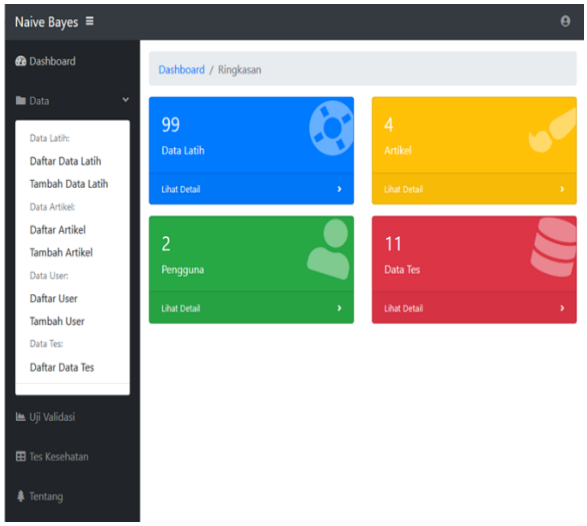
Table 11. Performance Comparison 5 and 10 folds

Performance	Fold = 5	Fold = 10
Accuracy	**88.2**	**88.8**
error Rate	**11.7**	**11.1**
Precision	**87.5**	**88.7**
recall	**88.3**	**88**
F1-Score	**86.1**	**86.1**

Source: (Nanda & Sari, 2019)

From table 11, it can be seen to the problem of accuracy, 10 folds superior to the value of 88.8% compared to 5 folds, that is 88.2%, whereas for precision, 10 folds superior to the value of 88.7%, but to recall five folds superior to the value of 88.3%, while the end result of these two Performance in F1-score, the same value, it is 86.1%

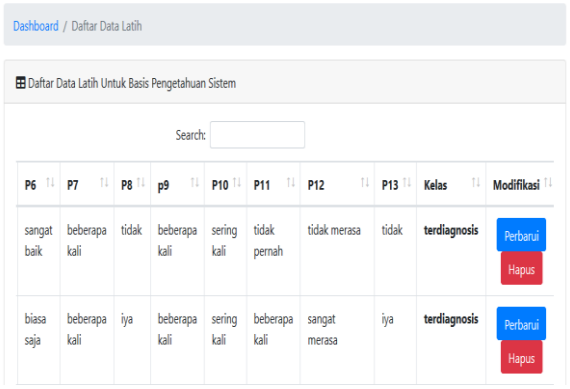
Figure 1 displays the dashboard page consists of a summary of how much training data, articles have been published, users and test data entry.



source:(Nanda & Sari, 2019)

Figure 1 Weather Dashboard

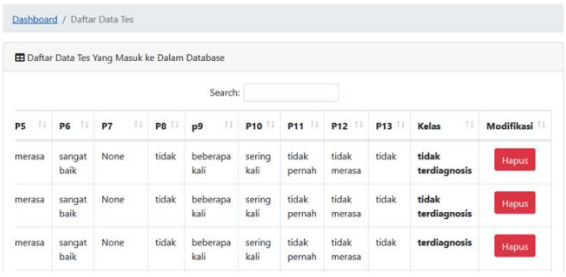
Figure 2 is a registered training data pages 13 variables which form the basis for a knowledge base system with the type of personality disorder detection threshold. This list is designed to use the data table, to facilitate the search for a specific data.



Source:(Nanda & Sari, 2019)

Figure 2 Train Data List page

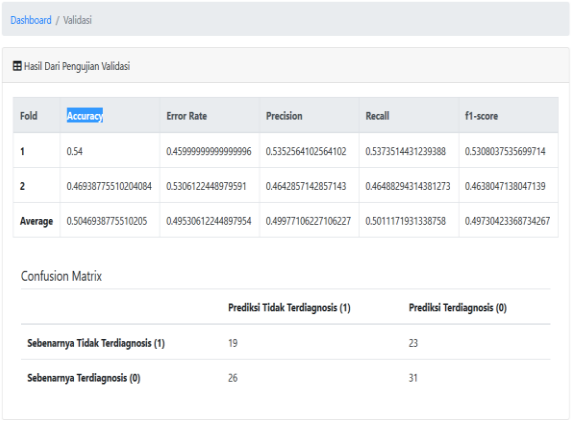
Test data saves data from users who have already taken a health test with the modification option to only delete data, shown in figure 3.



Source (Nanda & Sari, 2019)

Figure 3 Test Data List page

In Figure 4 displays the page validation of the data base used, consisting of cross validation, with k-fold, which gives the value of accuracy, error rate, precision, recall, F1 score, and also confusion matrix table.


Dashboard / Validasi

Hasil Dari Pengujian Validasi

Fold	Accuracy	Error Rate	Precision	Recall	f1-score
1	0.54	0.45999999999999996	0.5352564102564102	0.5373514431239388	0.5308037535699714
2	0.46938775510204084	0.5306122448979591	0.4642857142857143	0.46488294314381273	0.4638047138047139
Average	0.5046938775510205	0.49530612244897954	0.4997710622710622	0.5011171931338758	0.4973042336873426

Confusion Matrix

	Prediksi Tidak Terdiagnosis (1)	Prediksi Terdiagnosis (0)
Sebenarnya Tidak Terdiagnosis (1)	19	23
Sebenarnya Terdiagnosis (0)	26	31

Source:(Nanda & Sari, 2019)

Figure 4 Validation page

CONCLUSION

A study of 130 databases regarding diseases of personality types threshold using an algorithm naive Bayes implemented to perform class classification diagnosed or undiagnosed generate validation test with a 10 fold cross validation resulted in the average value of accuracy, error rate, precision, recall and F1-Score by, 88.8%, 11.1%, 88.7%, 88%, 86.1%, whereas for the 5 fold cross validation resulted in the average value of accuracy, error rate, precision, recall and F1-score of 88.2%, 11.7%, 87.5%, 88.3% and 86.1%. Based on the above, shows that K-Fold Cross Validation and Confusion Matrix, a testing method that is relatively stable, because the results were not much different, whether it is data that is folded as many as 5 or 10.

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