

Implementation of the decision tree method and C4.5 algorithm for teacher classification in obtaining web-based position promotion at SMK Al-Ihya Selajambe Kuningan

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Article Info	ABSTRACT (Nunito 9 pt)
Keywords: Classification, Decision Tree Method, C4.5 Algorithm, RapidMiner	The quality of education is one of the factors of change and development in the field of education. The role of teachers is very important, because the performance development carried out will be an assessment, consideration and reference for obtaining promotions. SMK Al-Ihya Selajambe conducts teacher assessments once a year. So far, the assessment carried out in determining the classification of promotion is still carried out conventionally or not computerized so that it requires a lot of time and the assessment is not necessarily accurate, and there is no method in the teacher assessment process. Therefore, it is necessary to have a computerized system and a method that can help the school. The method used is decision tree and C4.5 algorithm with testing using RapidMiner application. The final results of this study obtained training data with an Accuracy value of 90.00%, precision of 80.00% and recall of 100.00% which is classified as very good. As well as testing data with an Accuracy value of 60.00%, precision of 50.00% which is classified as quite good and recall of 100.00% which is classified as very good.
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INTRODUCTION

In the current era, there are many changes and developments taking place in the field of education. These changes can be seen in the quality of education. The role of teachers is very important because the quality of education depends on the performance and teaching methods applied by teachers. The improvement and development performance carried out by teachers will become an assessment, consideration and reference for obtaining promotions.

SMK Al-Ihya Selajambe is a private school educational institution that annually carries out an assessment of teachers to evaluate their performance and teaching methods which will later be taken into consideration in determining classification to obtain promotion. Apart from that, the assessment carried out is also one of the factors in the process and development to obtain accreditation and is an appreciation for teachers to be increasingly motivated in improving the quality of education at SMK Al-Ihya Selajambe.

However, so far the assessments carried out in determining promotion classifications for promotions are still conventional or not computerized, in the end they require a lot of time and the assessments are not necessarily accurate, and there is no method for the teacher assessment process. Therefore, a computerized system and methods are needed that can help and make it easier for schools to determine promotion classifications for promotions so that they are more efficient and accurate, namely by applying the decision tree method and the C4.5 algorithm.

In previous research conducted by Rozali Toyib and Surya Ade Saputera (2019) regarding "Application of the Teacher Performance Appraisal System with the Decision Tree Method Using the ID3 Algorithm (Case Study of SLTP Negeri 3 Marga Sakti North Bengkulu)" explained that filling in the questionnaire was done manually by filling in assessment on paper, using this system to assess teacher performance will take a long time, and an assessment like this does not provide a guarantee that the assessment is accurate. From this problem, a teacher assessment system application was created using a decision tree for classification and prediction. Based on the test results, a conclusion can be drawn: The results of the teacher's performance appraisal are greatly influenced by the principal's assessment, student assessment, education and work period. The advantage of this method is that it makes the teacher assessment process easier because it is faster and more accurate.

And in research conducted by Krisna Ferdinan Leo Simanjuntak, Anita Carolina Br Barus and Anita (2021) regarding "Implementation of the Decision Tree Method and C4.5 Algorithm for Classification of Community Personality" explains that in the village of Ujung Serdang Tanjung Morawa there is no personality classification in the community , caused by the local government's lack of attention in analyzing the personality of the community. As a result, many people criticize the government's performance, disobey and go against government regulations. Based on this problem, an implementation of the decision tree method and the C4.5 algorithm was carried out for classifying people's personalities. The results of the research show that the C4.5 Decision Tree Algorithm is accurately applied to determine human personality according to rules and is complex with results obtained from 40 community data, namely sanguine 17, choleric 6, melancholic 4, and phlegmatic 13. The advantages of this method are in the process Predicting the personality of people in the village of Ujung Serdang Tanjung Morawa becomes simpler and faster.

From the research above, it can be concluded that the decision tree method and the C4.5 algorithm can be used to determine teacher classification in obtaining promotions. The application of the decision tree method and the C4.5 algorithm is applied to a web-based application as a tool to carry out classification process calculations in obtaining promotions for teachers.

METHODS

Implementation

Implementation is a concept related to a number of indicators of success or often referred to as performance and achievement. Implementation is an act of implementing a plan that has been carefully prepared to obtain the desired results or achievements and goals.

Data Mining

Data mining is a field that is supported quite a lot by other branches of science in information technology, namely statistics, database technology, machine learning, expert systems, parallel algorithms, genetic algorithms, pattern recognition, data visualization, and others. Data mining is used to collect important information from large data so it is often called KDD (Knowledge Discovery Database).

Data Mining Stages

Before carrying out the data mining process, the data collection stage is carried out. At this data collection stage, observations and interviews were carried out at SMK Al-Ihya Selajambe to obtain data on assessment results from all existing teachers. Teacher data was taken on September 16 2023, which was sent online by the school to be processed using the decision tree method and the C4.5 algorithm and implemented on a website. After the teacher assessment data is obtained, the data will be processed in the following data mining stages:

a. Data Cleaning

This stage is carried out for the data cleaning process which is appropriate for the data mining modeling process so that it does not affect the final results.

b. Data Integration

At this stage, data is combined from several sources or carried out on attributes that identify entities such as name attributes, customer numbers, etc.

c. Data Selection

A data selection process is carried out, the results of which will be used for the data mining process.

d. Data Transformation

This stage data is converted into a form adapted for the data mining process.

e. Data Mining

At this stage, the data is divided into 2, namely training data and testing data with a ratio of 80%: 20%.

Decisin Tree

Decision Tree (Decision Tree) is a method that is quite easy for humans to interpret. The concept of a decision tree is to transform data into a decision tree and decision rules. A decision tree is a simple representation of a classification technique for a limited number of classes, where the internal nodes and root nodes are marked with attribute names, the edges are labeled with possible attribute values and the leaf nodes are marked with different classes.

Algorithm C4.5

The stages in implementing the C4.5 algorithm are:

- a. Calculate the Entropy value, using the following formula:

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

Where :

S = set of cases
n = number of S partitions
p_i = proportion of S_i to S

- b. Calculate the Gain Ratio value for each attribute, using the following formula:

$$Gain = Entropy(s) - \sum_{i=1}^n \frac{|S_i|}{|S|} * Entropy(S_i)$$

Where :

S = set of cases
A = attribute
n = number of attribute partitions
|S_i| = number of cases in partition i
|S| = number of cases in S

- c. The attribute that has the highest Gain Ratio is chosen to be the root and the attribute that has a Gain Ratio value lower than the root is chosen to be the branch.
d. Calculate the Gain Ratio value for each attribute again by not including the attribute selected as the root in the previous stage.
e. The attribute that has the highest Gain Ratio is selected as a branch.
f. Repeat steps d and e until the resulting Gain value = 0 for all remaining attributes.

Classification

The data classification process has two stages, the first stage is learning, namely the training data is analyzed using a classification algorithm. The second stage is classification: at this stage, test data is used to estimate accuracy or classification. If the accuracy is adjusted and the predictions are acceptable, the rules can be applied to other classifiers in the new data set.

Teacher

Teachers as educators have a very broad meaning, not limited to providing teaching materials but reaching ethics and aesthetics in facing the challenges of life in society. To be an ideal teacher, the teacher must always be careful in determining steps, be patient, be an example, and be responsive to situations and conditions.

Promotion

Promotion is a transfer from a lower position to a higher position which is of course followed by greater duties, authority and responsibility.

RESULTS AND DISCUSSION

The Data Collection Results

The total number of teacher assessment data obtained was 25 data in the following table:

Table 1. Teacher Assessment Data

No	Name	No Nuptk	Material Mastery	Education	Experience	Length of Teaching	Assessment Date
1	Yofi Silvianingsih, S.Pd	Don't Have	Good	S1	Experienced	2,4th	03/09/2023
2	Nurdin, S.Pd.I	Have	Enough	S1	Experienced	5th	03/09/2023
3	Renaldi, S.Pd	Don't Have	Enough	S1	Inexperienced	2,8th	03/09/2023
4	Iyus Setiawati, A.Md	Don't Have	Enough	D3	Inexperienced	1,3th	04/09/2023
5	Endang Ismail, S.Pd	Don't Have	Enough	S1	Experienced	2,5th	03/09/2023
6	Drs. Eyo Suhaya, M.H	Have	Good	S2	Experienced	6th	04/09/2023
7	Muhammad Harun, S.Pd	Don't Have	Not Enough	S1	Inexperienced	2,2th	04/09/2023
8	Enok Mustika V.H, S.Pd	Have	Not Enough	S1	Inexperienced	2,5th	03/09/2023
9	Tata, ST	Have	Good	S1	Inexperienced	5th	04/09/2023
10	Fitri Cahyani, A.Md	Don't Have	Enough	D3	Inexperienced	1,5th	03/09/2023
11	Desi Ratna Sari, S.Pd	Have	Good	S1	Inexperienced	4th	03/09/2023
12	Jihan Risnandar, S.Pd	Don't Have	Enough	S1	Experienced	2,4th	04/09/2023
13	Mimin Hatipah, S.Pd	Don't Have	Not Enough	S1	Inexperienced	2th	04/09/2023
14	Yogi Iskandar, M.Pd	Have	Good	S2	Experienced	5th	04/09/2023
15	Rini Apriyani, S.Pd	Have	Enough	S1	Inexperienced	3th	03/09/2023
16	Enursidin, S.Pd.I	Don't Have	Good	S1	Experienced	2,3th	03/09/2023
17	Ratna Sri Amalia, S.Pd	Have	Enough	S1	Experienced	3,7th	04/09/2023
18	Kusnandar, S.Pd.I	Don't Have	Enough	S1	Experienced	2,6th	03/09/2023
19	Doni Krisna Jaya, M.Pd	Have	Good	S2	Experienced	5,5th	04/09/2023
20	Maman Surahman, S.Pd	Have	Good	S1	Experienced	6th	04/09/2023
21	Mulyadi Agus, M.Pd	Have	Good	S2	Experienced	5th	04/09/2023
22	Haris, A.Md	Don't Have	Not Enough	D3	Inexperienced	1,9th	03/09/2023
23	Sri Kartika, S.Pd.I	Don't Have	Not Enough	S1	Inexperienced	2,7th	04/09/2023
24	Tito Rahayu Bachtiar, S.Kom	Don't Have	Good	S1	Inexperienced	2,5th	04/09/2023
25	Dian Lestari, M.Pd	Have	Enough	S2	Experienced	3,2th	03/09/2023

Data Mining Stage Process

a. Data Cleaning

In this study, the Assessment Date attribute was omitted to facilitate the next stage of data processing.

b. Data Integration

In this research, the Name attribute is combined with the NUPTK Number.

c. Data Selection

After all the required data has gone through the previous stages, the data will be saved in a separate file. In this research, data will be saved using Microsoft Excel in .xlsx format. From the integration data table above, the attributes that will be used

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in the C4.5 algorithm calculation process to obtain a decision tree to obtain classification results are obtained, as follows:

Table 2. Attributes

No	Attribute	Tipe
1	No. Nuptk	Varchar
2	Material Mastery	Varchar
3	Education	Varchar
4	Experience	Varchar
5	Length of Teaching	Varchar
6	Action	Varchar

d. Data Transformation

To make it easier to form a tree, data transformation occurs on 2 attributes, namely:

1. Length of Teaching, with the following conditions:

Table 3. Classification of Length of Teaching Attributes

Length of Teaching	Information
0 – 2,5th	Fase 1
>2,5th – 5th	Fase 2
>5th	Fase 3

2. To determine the action/classification attribute, it is expressed in 2 decisions, namely Yes and No, with the following conditions:

- If you have NO NUPTK and a minimum education of S1 and a minimum of 2nd phase of teaching, then the action is "Yes", which means that the teacher will receive a promotion.
- If you do not have NO NUPTK or education below Bachelor's degree or length of time teaching below phase 2 then the action is "No", which means that the teacher does not get a promotion.

Table 4. Data Transformation

No	No Nuptk	Material Mastery	Education	Experience	Length of Teaching	Action
1	Don't Have	Good	S1	Experienced	Phase 1	No
2	Have	Enough	S1	Experienced	Phase 2	Yes
3	Don't Have	Enough	S1	Inexperienced	Phase 2	No
4	Don't Have	Enough	D3	Inexperienced	Phase 1	No
5	Don't Have	Enough	S1	Experienced	Phase 1	No
6	Have	Good	S2	Experienced	Phase 3	Yes
7	Don't Have	Not Enough	S1	Inexperienced	Phase 1	No
8	Have	Not Enough	S1	Inexperienced	Phase 1	No
9	Have	Good	S1	Inexperienced	Phase 2	Yes
10	Don't Have	Enough	D3	Inexperienced	Phase 1	No
11	Have	Good	S1	Inexperienced	Phase 2	Yes
12	Don't Have	Enough	S1	Experienced	Phase 1	No
13	Don't Have	Not Enough	S1	Inexperienced	Phase 1	No
14	Have	Good	S2	Experienced	Phase 2	Yes
15	Have	Enough	S1	Inexperienced	Phase 2	No

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16	Don't Have	Good	S1	Experienced	Phase 1	No
17	Have	Enough	S1	Experienced	Phase 2	Yes
18	Don't Have	Enough	S1	Experienced	Phase 2	No
19	Have	Good	S2	Experienced	Phase 3	Yes
20	Have	Good	S1	Experienced	Phase 3	Yes
21	Have	Good	S2	Experienced	Phase 2	Yes
22	Don't Have	Not Enough	D3	Inexperienced	Phase 1	No
23	Don't Have	Not Enough	S1	Inexperienced	Phase 1	No
24	Don't Have	Good	S1	Inexperienced	Phase 1	No
25	Have	Enough	S2	Experienced	Phase 2	Yes

e. Data Mining

The previously prepared data is classified into 2, namely training data and testing data using systematic random sampling techniques. The comparison of trining data and testing data is 80%: 20%. The following are the calculations for collecting testing data:

Total data (N) = 25

Total testing data = 20% x 25 =5

Total sample (n) = 5

Sample interval (k) = N/n = 25/5 = 5

The first type for testing data (s) = 1

2nd type = s + k = 1 + 5 = 6

3rd type = s + 2k = 1 + 2(5) = 11

Etc...

From the results of obtaining the testing data above, there are 5 data, so that the training data is 25 – 5 = 20 data. The following table of training data and testing data is as follows:

Table 5. Training Data

No	No Nuptk	Material Mastery	Education	Experience	Length of Teaching	Action
1	Don't Have	Good	S1	Experienced	Phase 1	No
2	Have	Enough	S1	Experienced	Phase 2	Yes
3	Don't Have	Enough	S1	Inexperienced	Phase 2	No
4	Don't Have	Enough	D3	Inexperienced	Phase 1	No
5	Don't Have	Enough	S1	Experienced	Phase 1	No
6	Have	Good	S2	Experienced	Phase 3	Yes
7	Don't Have	Not Enough	S1	Inexperienced	Phase 1	No
8	Have	Not Enough	S1	Inexperienced	Phase 1	No
9	Have	Good	S1	Inexperienced	Phase 2	Yes
10	Don't Have	Enough	D3	Inexperienced	Phase 1	No
11	Have	Good	S1	Inexperienced	Phase 2	Yes
12	Don't Have	Enough	S1	Experienced	Phase 1	No
13	Don't Have	Not Enough	S1	Inexperienced	Phase 1	No
14	Have	Good	S2	Experienced	Phase 2	Yes
15	Have	Enough	S1	Inexperienced	Phase 2	No

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16	Don't Have	Good	S1	Experienced	Phase 1	No
17	Have	Enough	S1	Experienced	Phase 2	Yes
18	Don't Have	Enough	S1	Experienced	Phase 2	No
19	Have	Good	S2	Experienced	Phase 3	Yes
20	Have	Good	S1	Experienced	Phase 3	Yes

Table 6. Testing Data

No	No Nuptk	Material Mastery	Education	Experience	Length of Teaching	Action
1	Have	Good	S2	Experienced	Phase 2	Yes
2	Don't Have	Not Enough	D3	Inexperienced	Phase 1	No
3	Don't Have	Not Enough	S1	Inexperienced	Phase 1	No
4	Don't Have	Good	S1	Inexperienced	Phase 1	No
5	Have	Enough	S2	Experienced	Phase 2	Yes

C4.5 Algorithm Manual Calculation

a. Decision Tree

1. Calculating Entropy Values

Entropy calculations are carried out on total Entropy and Entropy in each attribute

a) Total Entropy:

$$\text{Entropy (S)} = \left(\left(-\frac{8}{20} \right) \times \log_2 \left(\frac{8}{20} \right) + \left(-\frac{12}{20} \right) \times \log_2 \left(\frac{12}{20} \right) \right) = 0,970951$$

b) Entropy of Each Attribute

Attribute No NUPTK, in the No NUPTK attribute there is a sub attribute Has:

$$\text{Entropy (S)} = \left(\left(-\frac{8}{10} \right) \times \log_2 \left(\frac{8}{10} \right) + \left(-\frac{2}{10} \right) \times \log_2 \left(\frac{2}{10} \right) \right) = 0.721928$$

And there is a sub attribute of Not Having:

$$\text{Entropy (S)} = \left(\left(-\frac{0}{10} \right) \times \log_2 \left(\frac{0}{10} \right) + \left(-\frac{10}{10} \right) \times \log_2 \left(\frac{10}{10} \right) \right) = 0$$

c) Perform the same calculation on each attribute.

2. After the entropy value is obtained, then calculate the gain value for each attribute as follows:

$$\text{a) Gain (NUP TK No)} = (0,970951) - \left(\left(\frac{10}{20} \right) \times 0,721928 \right) - \left(\left(\frac{10}{20} \right) \times 0 \right) = 0.609987$$

b) Perform gain calculations on each attribute.

The following is a table of entropy and gain calculation results :

Table 7. Entropy and Gain Calculation Results

Attribute	Sub attribute	Qty (S)	Yes (S1)	No (S2)	Entropy	Gain
Total		20	8	12	0,970951	
NO NUP TK						0,609987
	Have	10	8	2	0,721928	
	Don't Have	10	0	10	0	
Material Mastery						0,302547

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Education	Good	8	6	2	0,811278	0,282229
	Enough	9	2	7	0,764205	
	Not Enough	3	0	3	0	
Experience	D3	2	0	2	0	0,080342
	S1	15	5	10	0,918296	
	S2	3	3	0	0	
Length of Teaching	Experienced	11	6	5	0,99403	0,589177
	Inexperienced	9	2	7	0,764205	
	Phase 1	9	0	9	0	
	Phase 2	8	5	3	0,954434	
	Phase 3	3	3	0	0	

3. Perform entropy and gain calculations until the entropy value of gain is 0
So the Decision Tree obtained is as follows:

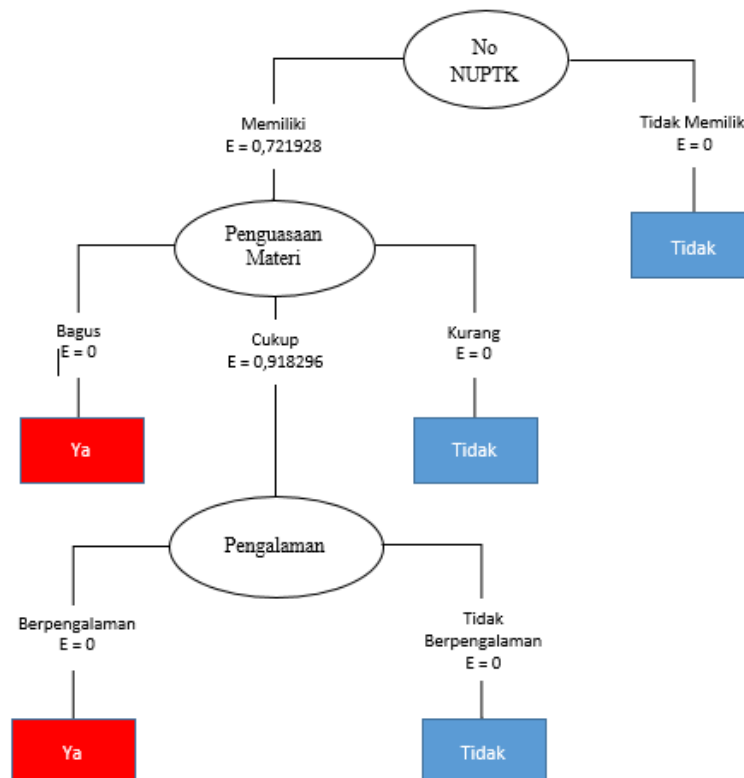


Figure 1. Decision Tree

b. Rule models

Based on the results of the final decision tree, a rule is obtained to obtain classification results in promotion for promotion. The rule model formed is as follows:

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Table 8. Rule Model

No	Rules
1	If you don't have a NUPTK number then no
2	If you have a NUPTK number, good mastery of the material, then yes
3	If you have a NUPTK number, your mastery of the material is lacking, then no
4	If you have a NUPTK number, sufficient mastery of the material, experience, then yes
5	If you have a NUPTK number, sufficient mastery of the material, no experience, then no

Confusion Matrix Testing

Confusion matrix testing on rapidminer was carried out to see the accuracy of implementing the C4.5 algorithm which forms a decision tree in the process that has been carried out.

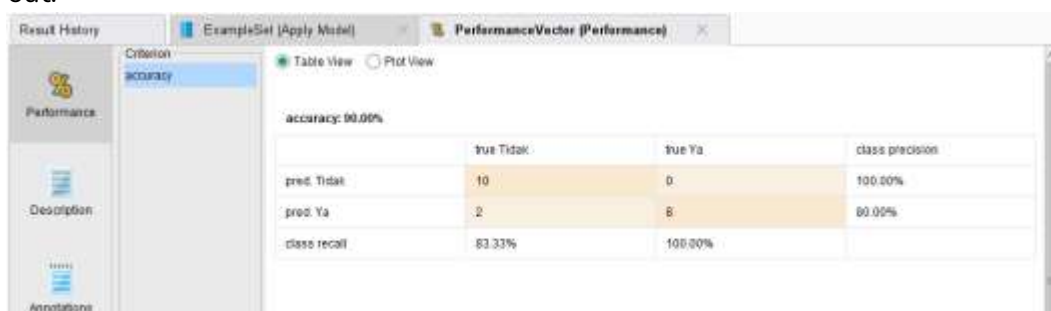


Figure 2. Accuracy of Training Data

The results of measuring the accuracy of the training data obtained reached an accuracy level of 90.00%. It is known that the prediction of No, true No is 10 and true Yes is 0. Prediction of Yes, true No is 2 and true Yes is 8.



Figure 3. Accuracy Data Testing

The results of measuring the accuracy of the training data obtained reached an accuracy level of 60.00%. It is known that the prediction of No, true No is 1 and true Yes is 0. Prediction of Yes, true No is 2 and true Yes is 2.

Results and Discussion

It can be seen from the results of the confusion matrix testing, that the conclusion of the confusion matrix testing is on training data with an accuracy value of 90.00% which is classified as very good, as well as on testing data with an accuracy value of 60.00%, which is classified as quite good. So the decision tree method and C4.5 algorithm used in this research are very accurate in determining promotion classifications.

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CONCLUSION

Based on the results of the research, discussion and testing that has been carried out, it can be concluded that the system that has been created can help schools in determining the classification results of promotions for promotions to be more effective and efficient. By applying the Decision tree method and the C4.5 algorithm, the accuracy results on the training data were 90.00%, which was included in the very good classification group, and the accuracy results on the testing data were 60.00%, which was included in the quite good classification group.

REFERENCE

- Abdussalaam, F., & Ramadhan, M. M. (2019). Perancangan sistem informasi work order dengan metode iteratif menggunakan framework codeigniter (Studi Kasus: CV Sirna Miskin Bandung). *Jurnal E-Komtek*, 3(1), 35-48.
- Andarista, R. R., & Jananto, A. (2022). Penerapan Data Mining Algoritma C4. 5 Untuk Klasifikasi Hasil Pengujian Kendaraan Bermotor. *Jurnal Tekno Kompak*, 16(2), 29-43.
- Billah, M. A., Ramdhani, A., & Muhima, R. R. (2023, March). Rancang Bangun Sistem Manajemen Inventory di Rumah Sakit Mayapada Surabaya. In *Prosiding Seminar Implementasi Teknologi Informasi dan Komunikasi* (Vol. 2, No. 1, pp. 144-150).
- Damanik, S. F., Wanto, A., & Gunawan, I. (2022). Penerapan Algoritma Decision Tree C4. 5 untuk Klasifikasi Tingkat Kesejahteraan Keluarga pada Desa Tiga Dolok. *Jurnal Krisnadana*, 1(2), 21-32.
- Febriani, S., & Sulistiani, H. (2021). Analisis Data Hasil Diagnosa Untuk Klasifikasi Gangguan Kepribadian Menggunakan Algoritma C4. 5. *Jurnal Teknologi Dan Sistem Informasi*, 2(4), 89-95.
- Helmud, E. (2021). Optimasi Basis Data Oracle Menggunakan Complex View Studi Kasus: PT. Berkas Optimis Sejahtera (PT. BOS) Pangkalpinang. *INFORMANIKA*, 7(01).
- Hidayah, A., & Yani, A. (2019). Membangun Website SMA PGRI Gunung Raya Ranau Menggunakan PHP Dan MYSQL. *JTIM: Jurnal Teknik Informatika Mahakarya*, 2(2), 41-52.
- Marlina, D., & Bakri, M. (2021). Penerapan Data Mining Untuk Memprediksi Transaksi Nasabah Dengan Algoritma C4. 5. *Jurnal Teknologi Dan Sistem Informasi*, 2(1), 23-28.
- Nasrullah, A. H. (2021). Implementasi algoritma Decision Tree untuk klasifikasi produk laris. *Jurnal Ilmiah Ilmu Komputer Fakultas Ilmu Komputer Universitas Al Asyariah Mandar*, 7(2), 45-51.
- Nasution, F. P., Batubara, R. O., & Maulana, M. I. (2022). Dasar Pengenalan HTML pada Desain Web. *PUBLIDIMAS (Publikasi Pengabdian Masyarakat)*, 2(1), 86-91.
- Ningrum, F. C., Suherman, D., Aryanti, S., Prasetya, H. A., & Saifudin, A. (2019). Pengujian black box pada aplikasi sistem seleksi sales terbaik menggunakan teknik equivalence partitions. *Jurnal Informatika Universitas Pamulang*, 4(4), 125-130.

- Nugraha, F. F., & Juliane, C. (2022). Penerapan Data Mining Dengan Metode Klasifikasi Menggunakan Algoritma C4. 5. JATISI (Jurnal Teknik Informatika dan Sistem Informasi), 9(4), 2862-2869. 115.
- Nugroho, I. S., Shalahudin, M. I., & Fitriansyah, A. (2021). Implementasi API Raja Ongkir Pada Fitur Pengiriman Di Aplikasi Tepokin. Jurnal Maklumatika, 47-57.
- Permatasari, A., & Suhendi, S. (2020). Rancang Bangun Sistem Informasi Pengelolaan Talent Film berbasis Aplikasi Web. Jurnal Informatika Terpadu, 6(1), 29-37.
- Prasetya, A. F., Sintia, S., & Putri, U. L. D. (2022). Perancangan Aplikasi Rental Mobil Menggunakan Diagram UML (Unified Modelling Language). Jurnal Ilmiah Komputer Terapan dan Informasi, 1(1), 14-18.
- Ridwan, R. (2023). Perancangan Sistem Informasi Monitoring Kegiatan Praktek Kerja Industri SMK Negeri 2 Kota Solok Berbasis Web. Jurnal Greenation Ilmu Teknik, 1(1), 1-8.
- Romli, I., & Zy, A. T. (2020). Penentuan jadwal overtime dengan klasifikasi data karyawan menggunakan algoritma C4. 5. J-SAKTI (Jurnal Sains Komputer dan Informatika), 4(2), 694-702.
- Sahadan, M. A., Rompas, P. T., & Munaiseche, C. P. (2023). Analisis Kepuasan Pelanggan Menggunakan Metode Algoritma C4. 5 Berdasarkan E-Survey Kejaksanaan Negeri Minahasa. JOINTER: Journal of Informatics Engineering, 4(01), 1-13.
- Saputera, S. A. (2019). Aplikasi Sistem Penilaian Kinerja Guru Dengan Metode Decision Tree Menggunakan Algoritma ID3 (Studi Kasus SLTP Negeri 3 Marga Sakti Bengkulu Utara). Journal of Technopreneurship and Information System, 2(1), 1-7.
- Saragih, F. M., & Huda, A. (2021). Rancang Bangun Sistem Informasi Kenaikan Pangkat Guru Berbasis Web Dengan Menggunakan Framework Laravel Pada SMK Negeri 2 Kisaran. ALGORITMA: JURNAL ILMU KOMPUTER DAN INFORMATIKA, 5(2).
- Simanjuntak, K. F. L., Barus, A. C. B., & Anita, A. (2021). Implementasi Metode Decision Tree Dan Algoritma C4. 5 Untuk Klasifikasi Kepribadian Masyarakat. JOISIE (Journal Of Information Systems And Informatics Engineering), 5(1), 51-59.
- Suryadi, S. (2019). Implementasi normalisasi dalam perancangan database relational. U-NET Jurnal Teknik Informatika, 3(2), 20-26.
- Syarif, M., & Nugraha, W. (2020). Pemodelan diagram uml sistem pembayaran tunai pada transaksi e-commerce. JTIK (Jurnal Teknik Informatika Kaputama), 4(1), 64-70.
- Taufik, A. (2019). Perancangan sistem informasi penjualan makanan kucing dan anjing berbasis web. Jurnal Manajemen Informatika (Jumika), 6(2).
- Widiastuti, T., Karsa, K., & Juliane, C. (2023). Evaluasi Tingkat Kepuasan Mahasiswa Terhadap Pelayanan Akademik Menggunakan Metode Klasifikasi Algoritma C4. 5. Technomedia Journal, 7(3 Februari), 364-380.
- Windarto, A. P., Irawan, E., Saputra, W., & Okprana, H. (2020, July). Penerapan Data Mining Menggunakan Algoritma C4. 5 Dalam Mengukur Tingkat Kepuasan Pasien BPJS. In Prosiding Seminar Nasional Riset Information Science (SENARIS) (Vol. 2, pp. 376-385).