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PENERAPAN ALGORITMA SUPPORT VECTOR MACHINE UNTUK KLASIFIKASI STRES TUGAS AKHIR MAHASISWA

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Abstract

In the context of higher education, the final assignment represents the last stage in a student's academic journey, a period where students are particularly susceptible to stress. Implementing machine learning techniques, such as the Support Vector Machine (SVM) method, presents a promising approach for early classification of students' stress levels and offers tailored stress management recommendations. This study adopts a quantitative research approach, aimed at classifying student stress levels using the SVM algorithm known for its high prediction accuracy. The research methodology encompasses stages like data collection, preprocessing, classification, results analysis, and accuracy evaluation. In this research, 80% of the dataset is allocated for training, while the remaining 20% is reserved for testing. The study finds that the most effective SVM kernel function is the Radial Basis Function (RBF) with a γ parameter value of 1, which, when applied using RapidMiner, achieves an accuracy of 93.33%. This research is anticipated to make a significant contribution to the development of early stress detection systems for students and offer valuable insights into leveraging machine learning technology for mental health applications. The findings demonstrate that the SVM method with the RBF kernel provides highly accurate classification results, making it a useful tool for effectively identifying student stress levels.

Keywords: Student Stress, Classification, SVM, RapidMiner

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1. INTRODUCTION

The final assignment for students is an obligation that must be completed by college students. For example, undergraduate college students (S1) are required to complete a final assignment in the form of a thesis. However, working on a thesis is not as easy as working on papers or assignments for courses in general.[1][2]

Many things can be obstacles to being able to complete a thesis. The more complex the activities related to the process of working on the final assignment, the higher the level of difficulty felt by students. This phenomenon can have implications for the emergence of various student reactions to the final assignment, such as anxiety, difficulty concentrating, and delaying working on the thesis, making students feel burdened and stressed.[3]

Stress is a condition that is often encountered by students, especially final year students. Students who are compiling their final assignments are individuals who are prone to stress. Students who experience stress tend to experience disorders in physical, emotional, cognitive, and behavioral functions that can have an impact on completion time.[4] [5][6]

In facing these challenges, it is important for educational institutions to understand and support students in dealing with stress during the final assignment writing process. The application of machine learning technology and methods, such as the Support Vector Machine method, can be a potential solution in helping to classify students' stress levels early and provide appropriate stress management recommendations.

SVM has been successfully applied in various fields, including text classification, facial recognition, and emotion analysis. In the context of research on the classification of students' stress levels towards final assignments, SVM can be used as a tool to build a classification model that can identify whether a student is experiencing low, medium, or high levels of stress based on the data collected.[7][8][9]

The application of SVM to classify students' stress levels in final assignments has several advantages. SVM can overcome classification problems on complex and high-dimensional data, which are often encountered in mental health analysis. In addition,

SVM also has good tolerance to overfitting, thereby reducing the risk of inaccurate and poorly generalizable models.

Stress level refers to the extent to which an individual feels or experiences stress in response to certain demands or pressures. It is a way to measure how much stress impacts a person's life and how strong their physiological and psychological responses are to certain situations. Stress levels can vary from mild to severe, and measuring stress levels can help in understanding and managing stress.[5] Here are some stress levels that are commonly used in research:

1. Low Stress:

At this level, individuals may feel some stress, but are still able to cope with the demands and pressures fairly well. Physiological responses may be within the normal range, and there are no significant psychological symptoms such as excessive anxiety or sleep disturbances.

2. Moderate Stress:

At this level, individuals may begin to feel a greater burden of stress, perhaps related to high job demands, relationship problems, or significant life changes. Physiological responses such as increased heart rate and blood pressure may be more pronounced. Individuals may experience psychological symptoms such as tension, higher anxiety, mild sleep disturbances, and perhaps fatigue.

3. High Stress:

At high stress levels, individuals may feel extremely overwhelmed by the demands and pressures they are facing. Physiological responses may be more intense, including increased release of stress hormones such as cortisol and adrenaline. Psychological symptoms such as significant anxiety, mild to moderate depression, serious sleep disturbances, and impaired concentration may occur. High levels of stress can have negative impacts on physical and mental health.

Students' stress levels can be influenced by various factors originating from the academic, social, personal, and economic environments.[10] The following factors are some that often play a role in influencing students' stress levels:

1. Academic Pressure:
   a) Heavy coursework, assignment deadlines, exams, and other academic demands can cause significant stress in students.
   b) Uncertainty about exam results and academic performance can also increase anxiety.
2. Environmental Changes:
   a) Students often experience major changes in their environment when they move from their parents' home to a dormitory or apartment on campus.
   b) Adapting to a new life and learning independently can be a source of stress.
3. Social and Personal Relationships:
   a) Problems in social relationships, such as conflicts with roommates, difficulty interacting socially, or feelings of loneliness, can be a source of stress.
   b) Romantic relationships and family problems can also affect students' stress levels.
4. Expectations and Pressure:
   a) High expectations from parents, professors, or society regarding academic achievement and future careers can put extra pressure on students.
   b) Students may feel the need to meet certain standards that they perceive are imposed by others.
5. Physical and Mental Health:
   a) a) Physical or mental health problems, such as chronic illness or anxiety disorders, can increase stress levels.
   b) b) Lifestyle imbalances, such as lack of sleep, lack of exercise, and poor diet, can also affect well-being.
   c) c) Loneliness, especially when students are away from home, can affect their emotional well-being and increase stress.

It is important to remember that each student has a unique experience, and the factors that influence stress levels can vary. Efforts to identify and manage these stressors, as well as seeking support from friends, family, and mental health professionals, can help students cope with stress and better navigate college life.

Support Vector Machine is a classification method that is widely developed and applied today. This method is rooted in statistical learning theory, the results of which are very promising to provide better results than other methods. SVM works very well on high-dimensional data sets, even SVMs that use kernel techniques must map the original data from its original dimensions to other relatively higher dimensions.[11][12][13]

Data Mining is a process that uses statistical, mathematical, artificial intelligence, and machine learning techniques. Data mining is used to extract and identify useful information and related knowledge from large databases. [14][15]

Confusion matrix is one of the classification performance evaluation methods. Basically, confusion matrix contains information that compares the system classification results with the classification results that should be. There are 4 final results of confusion matrix. True Positive (TP) is positive data that is detected as positive, False Positive (FP) is positive data that is detected as negative, True Negative (TN) is negative data that is detected as negative, False Negative (FN) is negative data that is detected as positive.

Table 1 Confusion Matrix

Reference	*Prediction*	
	Positive	*Negative*
Positive	*True Positive*	*True Negative*

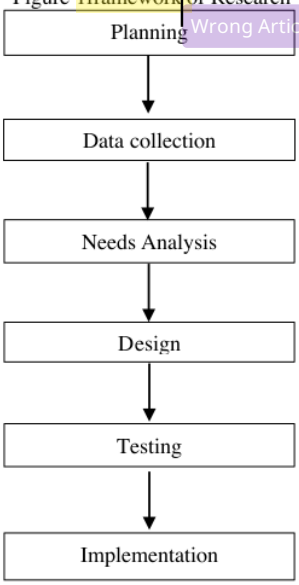
Negative	*False Positive*	*False Negative*

RapidMiner is a solution for performing analysis on data mining, text mining and predictive analysis. RapidMiner uses various descriptive and predictive techniques to provide insights to users so they can make the best decisions. [14]

2. RESEARCH METHOD

This research framework will help in planning, conducting, and evaluating research more systematically. It is also a useful tool for communicating with others about the objectives, methods, and results of the research.

Figure 1framework of Research



2.1 Planning

This study uses a quantitative approach with the main objective of classifying students' stress levels using the Support Vector Machine (SVM) algorithm. The research methodology includes the stages of data collection through questionnaires, data preprocessing, classification using SVM, and accuracy testing. The data obtained will be processed for classification, and the results will be assessed based on the distance of the test data to the nearest training data. The accuracy of the classification results is then tested by comparing the system results with the real conditions of the user.

2.2 Data collection

In this study, the data collection techniques used include two main methods:

1. Literature Study: Collecting and reviewing books, magazines, and other literature relevant to the problem and objectives of the study. This study is used to compare and improve the shortcomings of previous studies.
2. Observation: Conducting direct observations through questionnaires distributed to students. This questionnaire contains questions related to the final assignment, which aims to collect data on students' stress levels.

2.3 Needs Analysis

In this study, data collection was conducted at the State Islamic University of North Sumatra. The questionnaire was distributed to final year students at UINSU Tuntungan.

In this case, there are several research variables that affect students' stress levels, namely:

1. Personal
Student personality such as the habit of delaying working on thesis and getting angry easily.
2. Family
Pressure from parents to quickly complete the final assignment or thesis.
3. Lecturer
Difficulty meeting for guidance with the supervisor and continuous revisions.
4. Environment
Unstable environment such as frequent riots.

2.4 Design

The design of a Support Vector Machine (SVM) model involves several important steps to build an effective model. First, the dataset is divided into two subsets: training data to train the model and testing data to evaluate its performance. Data preprocessing processes, such as normalization or feature standardization, are performed to ensure model consistency. The SVM model is then trained with the training data to find the best hyperplane that separates the data classes, using support vectors. The validity of the

model is tested using cross-validation techniques to ensure model generalization. After training and validation, the model is tested on a separate testing dataset to measure performance using metrics such as accuracy, precision, recall, and F1-score. This step ensures that the SVM model can classify data accurately and effectively.

2.5 Testing

Testing the SVM model is essential to evaluate its performance in classifying data with high accuracy. The testing steps include splitting the dataset into training and testing data, training the model on the training data, and then testing it on unseen data to measure accuracy, precision, recall, and F1-score. Analysis of the confusion matrix is also performed to assess the model's ability to identify different classes. The results of these tests are important to ensure the reliability and generalization of the SVM model to new data.

2.6 Implementation

The application used in this study is RapidMiner which aims to help classify the level of student stress towards the final assignment based on the factors that cause stress in working on the final assignment. The output provides the results of the classification of the level of student stress towards the final assignment, then the results are evaluated to ensure a high level of accuracy. The researcher will ensure that the results obtained have an optimal level of accuracy. The results of this study are expected to provide a positive contribution to the campus related to providing accurate and useful information.

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3. RESULT AND DISCUSSION

3.1 Data analysis

This study uses the Support Vector Machine (SVM) algorithm to predict students' stress levels based on datasets obtained from questionnaires. This questionnaire was distributed to final year students of the Computer Science study program at the State Islamic University of North Sumatra and contained 8 questions related to the psychological side of students that affect stress levels. From this questionnaire, 4 features or input variables were identified that represented "mild", "moderate", and "high" stress levels.

Table 2 Questionnaire Result Data

No	Initials	X1		X2		X3		X4	
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
1	SR	3	3	2	2	2	2	2	2
2	FAY	2	3	3	2	1	1	1	1
3	DA	4	3	2	1	3	2	4	4
4	MK	2	2	3	4	4	4	4	3
5	NZ	4	4	3	3	3	3	2	3
6	MAA	2	3	2	3	2	3	3	2
7	AMH	3	3	2	3	3	3	3	3
8	DK	2	3	3	4	2	2	4	2
9	MRH	2	4	3	4	2	2	3	2
10	HF	3	3	2	2	2	2	2	2
.....									
.....									
.....									
141	EDH	4	3	2	3	2	2	3	1
142	SJR	1	3	3	2	3	3	3	4
143	Z	1	4	2	1	2	2	2	1
144	MTHL	2	4	1	3	3	1	2	2
145	ZIM	2	3	3	3	3	3	4	2
146	ARS	4	4	3	4	3	3	4	3
147	SAS	1	4	3	4	3	4	4	3
148	SJA	3	4	4	3	2	3	3	3
149	YLAR	1	3	2	2	1	1	3	3
150	RPH	2	2	3	3	1	1	2	3
151	AH	3	2	2	2	1	1	3	3

Research and testing in this study is by finding the highest level of accuracy in the Support Vector Machine algorithm. In this study, 80% of the dataset will be used as training data and 20% will be used as test data. To see whether the search for the highest level of accuracy is good or not, a performance analysis will be carried out based on the accuracy results of each dataset used. Where to measure the level of accuracy can use the following equation:

$$Accuracy = \frac{TP + TN}{P + N} \times 100\%$$
$$= \frac{number\ of\ correct\ predictions}{All\ data\ is\ predicted} \times 100\%$$

3.2 Data Processing Process

The data processing process is to group data in the form of numbers into Low, Medium, High level descriptions. Data in the form of numbers are added up and the maximum and minimum scores are sought. The following is the classification table.

Table 3 Data Selection Results

No	X1	X2	X3	X4	Total	Y
Mhs1	6	4	4	4	18	Moderate Stress
Mhs2	5	5	2	2	14	Moderate Stress
Mhs3	7	3	5	8	23	Moderate Stress
Mhs4	4	7	8	7	26	High Stress
Mhs5	8	6	6	5	25	High Stress
Mhs6	5	5	5	5	20	Moderate Stress
Mhs7	6	5	6	6	23	Moderate Stress
Mhs8	5	7	4	6	22	Moderate Stress
Mhs9	6	7	4	5	22	Moderate Stress
Mhs10	6	4	4	4	18	Moderate Stress
.....						
.....						
.....						
Mhs141	7	5	4	4	20	Moderate Stress
Mhs142	4	5	6	7	22	Moderate Stress
Mhs143	5	3	4	3	15	Mild stress
Mhs144	6	4	4	4	18	Moderate Stress
Mhs145	5	6	6	6	23	Moderate Stress
Mhs146	8	7	6	7	28	High Stress
Mhs147	5	7	7	7	26	High Stress
Mhs148	7	7	5	6	25	High Stress
Mhs149	4	4	2	6	16	Mild stress
Mhs150	4	6	2	5	17	Moderate Stress
Mhs151	5	4	2	6	17	Moderate Stress

Mhs151 5 4 2 6 17 Moderate Stress
Minimum score = lowest score scale * number of variables (x) = 2 * 4 = 8
Maximum score = highest score scale * number of variables (x) = 8 * 4 = 32
Mean = (max score + min score) / 2 = (32 + 8) / 2 = 20
So that the category of student stress level data is as follows:
Stress Category:
Mild $x < 16$
Moderate $16 \leq x < 24$
High $x \geq 24$
Where the value of x is the number of scores obtained. So in the calculation of the case of stress level classification in this student, the results are obtained as in Table 3.

3.3 SVM Training Process

In the SVM training process, 9 data will be taken randomly from the 151 data displayed.

Table 4 Student Data Used

Student Name	X_1	X_2	X_3	X_4	Y
Mhs 9	6	7	4	5	Moderate Stress
Mhs 11	6	4	2	2	Mild stress
Mhs 12	7	4	4	8	Moderate Stress
Mhs 14	6	6	6	7	High Stress
Mhs 20	5	5	4	5	Moderate Stress
Mhs 21	4	5	4	3	Mild stress
Mhs 22	6	5	8	8	High Stress
Mhs 59	6	7	7	5	High Stress
Mhs 60	4	3	3	6	Mild stress

Description:
X1: Personal
X2: Family
X3: Lecturer
X4: Environment
Y: Stress Level

3.4 Training Data Input

1. Level 1 training data

In the calculation of SVM level 1, the data to be executed is the data in class 1, namely the mild stress level. The executed data is given a value in the system class = 1 (positive class) and data other than the mild stress class will be given a system class = -1 (negative class). So there will be 6 training data shown in Table 5 below.

Table 5 Data Training Level 1

Student Name	Y	X_1	X_2	X_3	X_4	System Class
Mhs 11	Mild stress	6	4	2	2	1
Mhs 21	Mild stress	4	5	4	3	1
Mhs 9	Moderate Stress	6	7	4	5	-1
Mhs 20	Moderate Stress	5	5	4	5	-1
Mhs 14	High Stress	6	6	6	7	-1
Mhs 22	High Stress	6	5	8	8	-1

2. Data Training Level 2

In the level 2 training data process, data with a low stress level will not be processed again. So for level 2 training data, the positive system class (1) is shifted to a moderate stress level. Level 2 training data can be shown in Table 6.

Table 6 Data Training Level 2

Student Name	Y	X_1	X_2	X_3	X_4	System Class
Mhs 9	Moderate Stress	6	7	4	5	1
Mhs 20	Moderate Stress	5	5	4	5	1
Mhs 14	High Stress	6	6	6	7	-1
Mhs 22	High Stress	6	5	8	8	-1

3. Data Training Level 3

For training data level 3, the stress level is being removed and then the positive system class (1) is the high stress level. Training data level 3 can be explained in Table 7.

Table 7 Data Training Level 3

Student Name	Y	X_1	X_2	X_3	X_4	System Class
Mhs 14	Stres Tinggi	6	6	6	7	1
Mhs 22	Stres Tinggi	6	5	8	8	1

3.5 SVM Testing Process

The testing data used is data other than the training data that has been applied to the previous SVM training process. So based on Table 4.12, the testing data is selected as in Table 7 below.

Table 8 Testing Data

Student Name	Y	X_1	X_2	X_3	X_4
Mhs 60	Stress Ringan	4	3	3	6
Mhs 12	Stres Sedang	7	4	4	8
Mhs 59	Stres Tinggi	6	7	7	5

The calculation process of SVM kernel on the testing data that will be applied in this case is RBF kernel, linear kernel, and polynomial kernel. As an example of manual calculation, the testing data in Table 4.13 row 1 is used with SVM level 1 training data in Table 4.6 rows 1 and 2. So that the results are as follows.

1. RBF Kernel Calculation

Carrying out the RBF kernel calculation process with the formula K (u, v) = e ^ ((- ⟦y | (| u-v |) | ⟧ ^ 2)) and using the gamma value (□) = 1

For an example of the RBF kernel calculation process using mhs60 and mhs 11 data as follows:

$$K = (m_{60}, m_{11})$$

$$= e^{(-1(4-6)^2+(3-4)^2+(3-2)^2+(6-2)^2)}$$

$$= e^{(-1.22)}$$

$$= e^{-22}$$

$$= 2{,}789$$

For example, the RBF kernel calculation process uses mhs60 and mhs 21 data as follows:

$$K = (m_{60}, m_{11})$$

$$= e^{(-1(4-4)^2+(3-5)^2+(3-4)^2+(6-3)^2)}$$

$$= e^{(-1.14)}$$

$$= e^{-14}$$

$$= 8{,}315$$

The results of the overall calculation 5 the RBF kernel value for the 1st level 1 testing data can be seen in Table 9.

Table 9 RBF Kernel Testing Data Calculation Results

Id	$K_{(x,y)}$
1	2,789
2	8,315
3	2,789
4	0,001
5	1,026
6	8,533

2. Linear Kernel Calculation

In the linear kernel calculation, table 4.6 and the calculation formula K(u,v)=u.v will be used

For an example of linear kernel calculation of mhs60 and mhs11 data as follows

$K = (m_{60}, m_{11}) = (4.6) + (3.4) + (3.2) + (6.2)$

$= 54$

For example, the linear kernel calculation for mhs60 and mhs21 data is as follows

$K = (m_{60}, m_{21}) = (4.4) + (3.5) + (3.4) + (6.3)$

$= 61$

The overall calculation results for the Linear kernel value for level 1 testing data can be seen in Table 10.

Table 10 Linear Kernel Testing Data Calculation Results

Id	$K_{(x,y)}$
1	54
2	61
3	87
4	77
5	102
6	111

3. Kernel Polynomial Calculation

In this kernel polynomial calculation, a polynomial degree 2 will be used, which means the value of p or power = 2 is an example of the calculation, the formula K(u,v)=(1+u,v)^d,d≥1 is used.

Example of kernel polynomial calculation for mhs60 and mhs 11 data. As follows:

$K = (m_{60}, m_{11}) = (1 + (4.6) + (3.4) + (3.2) + (6.2))^2$

$= (1 + 54)^2$

$= 3025$

Example of kernel polynomial calculation for mhs60 and mhs 11 data. As follows:

$K = (m_{60}, m_{21}) = (1 + (4.4) + (3.5) + (3.4) + (6.3))^2$

$= (1 + 61)^2$

$= 3844$

The results of the overall calculation of the RBF kernel value for the 1st level 1 testing data can be seen in Table 11.

Table 11 Kernel Polynomial Testing Data Calculation Results

1	3025
2	3844
3	7744
4	6084
5	10609
6	12544

Based on the calculation results of the RBF kernel, linear kernel and polynomial kernel, it can be seen that no kernel produces the least numerical value.

3.6 SVM Classification Results

SVM classification for all data is done using RapidMiner Software. The parameters used in SVM classification using RBF kernel are γ (gamma). The value of the parameter γ (gamma) used is 10−3 , 10−2 , 10−1 , and 1.

Table 12 RBF Kernel Accuracy Comparison

Parameter γ	Akurasi
0,001	73,33
0,01	80%
0,1	93,33%
1	76,67%

Based on the table, it shows that the best accuracy is obtained by using the parameter γ = 0.1 with the resulting accuracy value of 93.33%. The calculation of the accuracy of the classification results on the confusion matrix is shown as follows:

Table 13 Confusion Matrix With Parameter γ = 0.001

Confusion Matrix		Actual Value		
		True Stress Moderate	True High Stress	True Light Stress
Prediction Value	Medium Stress Pred	22	3	5

	High Stress Pred	0	0	0
	Mild Stress Pred	0	0	0

Based on the confusion matrix of the SVM classification results using the RBF kernel with parameter γ = 0.001 in Table 4.5, it shows that there are 22 "moderate stress" classes that are correctly predicted as "moderate stress" classes and 3 "high stress" classes are predicted as "moderate stress" classes and 5 "mild stress" classes are predicted as "moderate stress" classes. So that the accuracy calculation is obtained as follows:

$$Accuracy = \frac{22}{22+3+4+1} \times 100\%$$

$$Accuracy = 73{,}33\%$$

Table 14 Confusion Matrix With Parameter γ = 0.01

Confusion Matrix		Nilai Aktual		
		True Stress Moderate	True High Stress	True Light Stress
Prediction Value	Medium Stress Pred	22	3	5
	High Stress Pred	0	0	0
	Mild Stress Pred	0	0	2

Based on the confusion matrix of the SVM classification results using the RBF kernel with parameter γ = 0.01 in Table 4.5, it shows that there are 22 "moderate stress" classes that are correctly predicted as "moderate stress" classes and 3 "high stress" classes are predicted as "moderate stress" classes and 3 "mild stress" classes are predicted as "moderate stress" classes and 2 "mild stress" classes are correctly predicted as "mild stress" classes. So that the accuracy calculation is obtained as follows:

$$Akurasi = \frac{22+2}{22+3+3+2} \times 100\%$$

$$Akurasi = 80\%$$

Table 15 Confusion Matrix With Parameter γ = 0.1

Confusion Matrix	Nilai Aktual		
	True Stress Moderate	True High Stress	True Light Stress
Prediction Value: Medium Stress Pred	22	1	1
Prediction Value: High Stress Pred	0	2	0
Prediction Value: Mild Stress Pred	0	0	4

Based on the confusion matrix of the SVM classification results using the RBF kernel with parameter γ = 0.1 in Table 4.5, it shows that there are 22 "moderate stress" classes that are correctly predicted as "moderate stress" classes, there is 1 "high stress" class predicted as "moderate stress" class, and 2 "high stress" classes that are correctly predicted as "high stress" classes and 1 "mild stress" class predicted as "moderate stress" class and 4 "mild stress" classes that are correctly predicted as "mild stress" classes. So that the accuracy calculation is obtained as follows:

$$Akurasi = \frac{22+2+4}{22+1+1+2+4} \times 100\%$$

$$Akurasi = 93{,}33\%$$

Table 16 Confusion Matrix With Parameter γ = 1

Confusion Matrix		Nilai Aktual		
		True Stress Moderate	True High Stress	True Light Stress
Prediction Value	Medium Stress Pred	22	3	4
	High Stress Pred	0	0	0
	Mild Stress Pred	0	0	1

Based on the confusion matrix of the SVM classification results using the RBF kernel with parameter γ = 1 in Table 4.5, it shows that there are 22 "moderate stress" classes that are correctly predicted as "moderate stress" classes and 3 "high stress" classes are predicted as "moderate stress" classes and 4 "mild stress" classes are predicted as "moderate stress" classes and 1 "mild stress" class is correctly predicted as "mild stress" class. So that the accuracy calculation is obtained as follows:

$$Akurasi = \frac{22+1}{22+3+4+1} \times 100\%$$

$$Akurasi = 76{,}67\%$$

3.7 RapidMiner Implementation

The following is a classification model created using RapidMiner.

Figure 2 Classification Process Model

The best accuracy results were obtained by using the parameter γ = 0.1 with the resulting accuracy value being 93.33%.

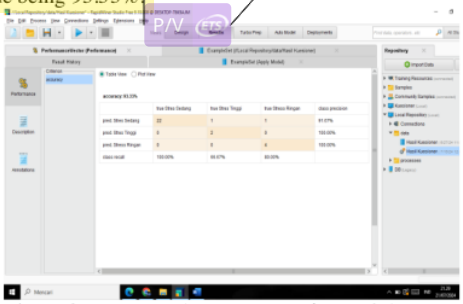

Figure 3 Parameter Accuracy Results γ = 0.1

4. CONCLUSION

Based on the results of the study, it can be concluded that the RBF (Radial Basis Function) kernel is the most optimal for use in the SVM method, producing minimal numerical values with parameters γ = 1. The dataset in this study was divided a ratio of 80:20, where 121 data (80%) were used as training data and 30 data (20%) as test d. Of the 151 student data collected, 71.5% (108 students) were the moderate stress category, 17.2% (2 students) in the mild stress category, and 11.2% (17 students) in the high stress category. The results of the SVM classification applied using RapidMiner showed the best accuracy of 93.33%.

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