Jurnal Mantik, 5 (2) (2021) 512-516

Published by:Institute of Computer Science (IOCS)

Jurnal Mantik

Journal homepage: www.iocscience.org/ejournal/index.php/mantik/index

Maintainability Prediction in Eclipse Mylyn Software Program Code Using Mamdani's Fuzzy Inference System Approach

Mochammad Abdul Azis[1] , Imam Nawawi[2] Ahmad Fauzi[3], Ginabila[4] , Abdul Hamid[5], Ahmad Hafidzul Kahfi[6]

[1,2,3,4,5]Information Systems, Faculty of Information Technology, Bina Sarana Informatika University, Indonesia

[6]Informatics Study Program, Faculty of Information Technology, Nusa Mandiri University, Jakarta, Indonesia

E-mail: mochamad.mmz@bsi.ac.id[1], imam.imw@bsi.ac.id[2], ahmad.aau@bsi.ac.id[3],gina.gnb@bsi.ac.id[4], hamid.adh@bsi.ac.id[5], ahmad.azx@nusamandiri.ac.id[6]

A R T I C L E I N F O

Article history:
Received: 01/05/2021
Revised: 25/05/2021
Accepted: 30/06/2021

Keywords:
Fuzzy Inference System, Chidamber Kemerer, Eclipse mylyn

A B S T R A C T

Software quality can be assessed using certain measures and methods, as well as using software testing. ISO is used as one of the benchmarks of software quality that has been created by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). Software testing can use metrics to increase productivity, this software is very useful in simplifying the testing process by focusing the programmer on the code quality part of the program. The ability of software to be modified includes correction, improvement or adaptation to changes in the environment, requirements, and functional specifications. Metrics can be used to measure the quality level of a model's program code based on indicators from Chidamber Kemerer (CK) by performing Maintainability Predictions which are tested on the metrics bug prediction found in the eclipse mylyn application which consists of four properties, namely WMC, DIT, NOC, and , RFCs. To be able to help carry out the process of calculating software quality based on CK Metrics on mylyn eclips data using the Mamdani fuzzy inference system, it can prove the classification into Low, Medium, High forms. In this case, the defuzzification method is confirmed using the COA (centre of area) method to determine the final value obtained from the membership function formed from the composition process of all outputs.

1. Introduction

An important factor for the success of an application development company is if it can provide quality software to users. To develop a new system from scratch is very expensive and takes a long time. It is generally assumed that reuse of existing software will improve the state of the software to be new.

Software quality metrics can be used to measure the quality of structured and object-oriented software. Structured software quality is calculated using traditional metrics like Lines of Codes (LOC), Cyclomatic Complexity and others. In object-oriented software, measurement is centered on parts of the class such as data and procedures. According to Prather and Weyuker, object-oriented quality assessment is easier to assess mathematically than structured programming [1]

In this study, an object-oriented software program was chosen because this approach has been developed and is used to develop large-scale systems according to time and cost constraints [2] The metric value is used as input to the Fuzzy Inference System to get a conclusion in the form of a value that indicates the quality factor. Maintainability The fuzzy approach is able to draw more varied conclusions [3][4], thus enabling developers to measure the external quality of the software accurately.

The concept of OOM was introduced by researchers Chidamber and Kemerer (1994). CK developed a set of six types of metrics called the CK metrics suite Weighted methods per class (WMC), depth of inheritance tree (DIT), number of children (NOC), coupling between object classes (COB), response for a

class (RFC) , lack of cohesion method (LOCM) which projects that data mining algorithms such as classification and clustering can be used to estimate bugs [5][6].

2. Methods

The Mamdani Fuzzy Inference System (FIS) seems to be a potentially suitable approach. FIS is able to reduce uncertainty when solving complex problems, and the advantages of FIS are summarized [7] as follows: 1. FIS allows explicit expression of system knowledge through fuzzy ‘‘if–then’ rules. 2. FIS deals with subjective uncertainty (vagueness, ambiguity, and imprecision) inherent in the way experts approach their problems. 3. FIS can combine numeric and categorical data. 4. FIS provides a solid mathematical foundation.

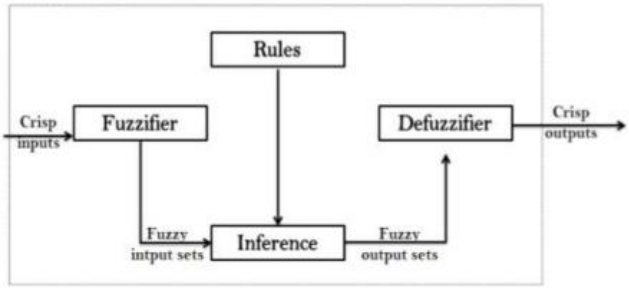

Fig 1. Fuzzy Inference System

2.1 Fuzzy Set Formation

The indicators used in the software quality [8] assessment sample consist of four design properties (WMC, DIT, RFC and NOC) and will focus on determining the quality of maintainability by determining the LOW, MEDIUM and HIGH levels. The test instrument is in the form of a data set that will be used to make measurements with the aim of producing accurate quantitative data in accordance with the threshold CK metrics. In table 1, it can be seen the threshold value used in this study:

TABLE 1
TRESHOLD CK RESEARCH

CK Metrics	Treshold
WMC	0 - 20
RFC	0- 71
DIT	1 - 5
NOC	0 - 9

2.2 Trapezoidal Curve

Trapezoidal curve basically resembles a triangle shape, it's just that there are some points that have a membership value of one. The representation of the membership function for a trapezoidal curve is as parameter {a, b, c, d} (where a<b<c<d) determines the x-coordinates of the four corners of the trapezoidal membership function.

$$\text{Trapesium}(x,a,b,c,d) \begin{cases} a; & ; x \geq a \\ (x-a)/(b-a) & ; a \leq x \leq b \\ 1; & ; b \leq x \leq c \\ (d-x)/(d-c) & ; c \leq x \leq d \end{cases} \quad (1)$$

Accredited “Rank 4”(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

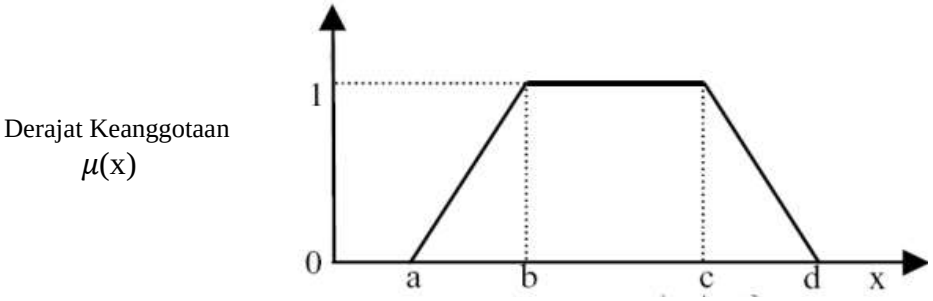

Fig 2. Trapezoid membership function

3. Result

3.1. System Analysis and Design

The criteria to be analyzed are used as fuzzy variables, from four metrics with a trapezoidal membership function having the shape as shown in Fig 2 and specified by four parameters {a, b, c, d} such as equation 1 Parameter {a, b, c, d} (where a<b<c<d) determines the x-coordinates of the four corners of the trapezoidal membership function.

Formation of fuzzy sets by the Mamdani method, both input and output variables are divided into one or more fuzzy sets. The fuzzy set is taken from the membership function which is expressed as a certain mathematical function as shown in Fig 3:

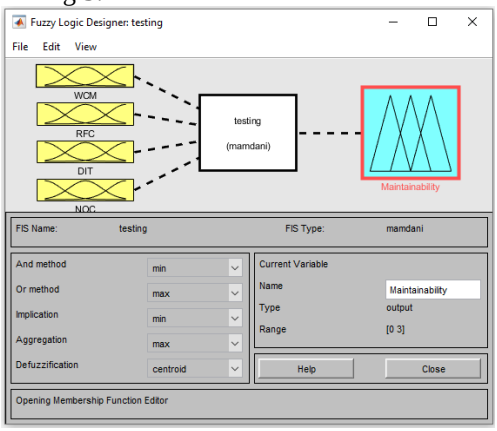

Fig 3. Mamdani Editor Fuzzy Inference System

To complete the trapezoidal function, the values of a, b, c and d parameters are determined for each input metric variable. Below is Fig 4 as an example of input metrics from Weight Methods per Class.

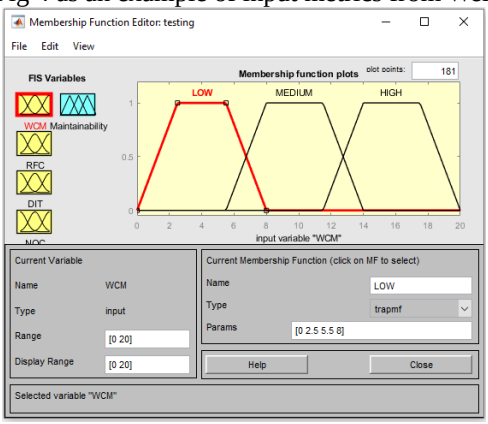

Fig 4. Weight Methods per Class

3.2. Application Function Implication

Decision making (fuzzy inference) applies fuzzy rules to fuzzy input that maps between input-output, this is done after the formation of the fuzzy set. In this study there are several rules and all the rules that are formed to determine software quality, the Integrity Rule to determine the level of quality and reusability will

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

be classified into four levels of bugs from the three metrics tested.

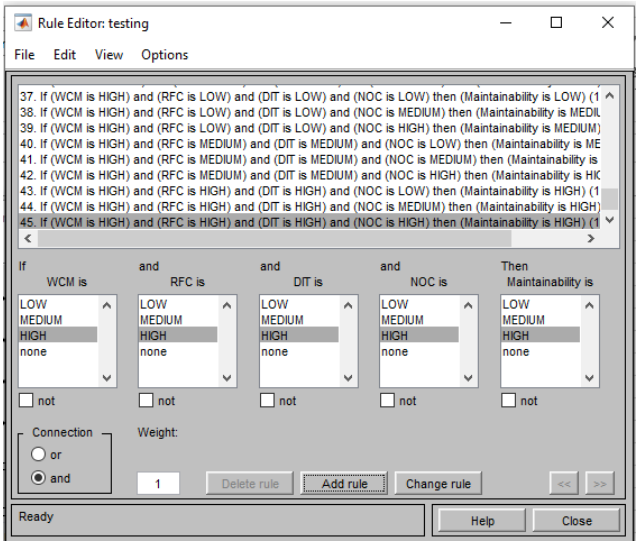

Fig 5. fuzzy inference

3.3. Deffuzzification Process

The defuzzyfication method in this case was carried out using the COA (centre of area) method. The crisp x value is obtained from the membership function formed from the composition process of all outputs. The calculation below describes the results of the defuzzification method taken from an example of the Property weighted methods for class.

$$COA = \frac{(5.5 * 0) + (8 * 1) + (11.5 * 1) + (14 * 0)}{0 + 1 + 1 + 0} \quad (2)$$

$$= \frac{0 + 8 + 11.5 + 0}{2}$$

$$= 10$$

Fig 6 is a test of the deffuzzification method with MATLAB 2018b. In Fig 6 the yellow color indicates the composition of the input variable whose value can be changed manually by entering the value in the input field in the lower left corner. The results for the output can be displayed and are in the top right box. The results of the defuzzification above will be applied to the test data. Based on the software quality assessment sample of the four design properties, it will focus on determining the quality of Maintainability regarding how high the level of ease of understanding a software module developed based on the eclipse mylyn data set is used as research material.

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

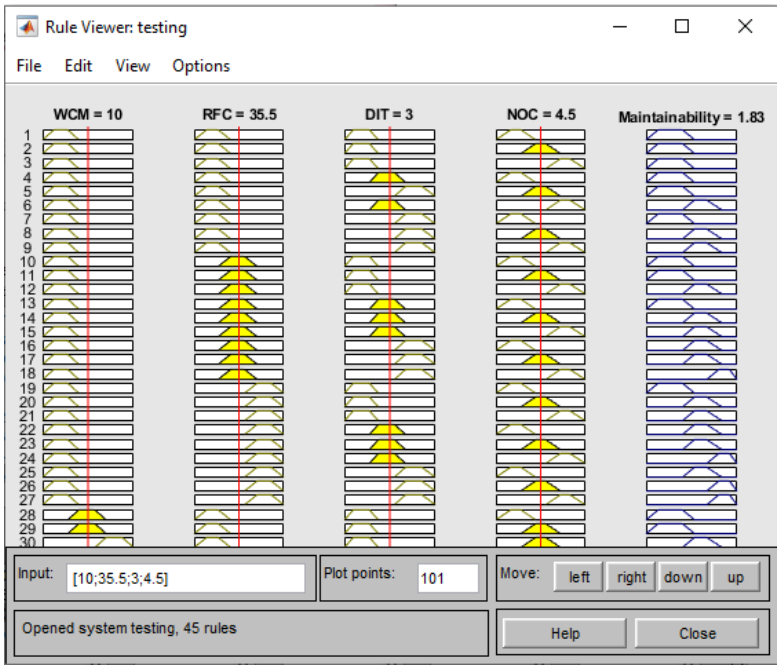

Fig 6. Fuzzy Inference System Model Mamdani Integrity Editor

4. Conclusion

In calculating the prediction of quality and maintainability using the Mamdani fuzzy inference system approach, the level of good quality has a relatively small number. If the calculation results of the four metrics are high, the Maintainability level is very low. The results obtained will be categorized into 3 classification levels, namely: LOW, MEDIUM, HIGH. From the data set tested, it has a very good level of reusability so that it falls into the LOW category. The fuzzy logic method can be applied to comparative analysis on fuzzy logic systems by using several defuzzification methods, namely the COA (center of area), bisector MOM (mean of maximum), LOM (largest of maximum), and SOM (smallest of maximum) at predictor of software quality and maintainability.

5. References

[1] K. Letelay and S. N. Azhari, "Evaluasi Kualitas Perangkat Lunak dengan Metrics Berorientasi Objek," *Semin. Nas. Inform. ...*, vol. 2012, no. semnasIF, pp. 139–145, 2015.

[2] M. Nazir, R. A. Khan, and K. Mustafa, "A Metrics Based Model for Understandability Quantification," no. April, 2010.

[3] E. Suryawati, "Fuzzy model for predicting reusability factor of a software model = Model Fuzzy untuk memprediksi faktor reusability sebuah perangkat lunak," *Inkom*, vol. 7, no. 1, pp. 21–27, 2013.

[4] A. Fauzi, "Prediksi Understandability Pada CK Metrics Object Oriented Menggunakan Fuzzy Inference System," vol. 5, no. 2, pp. 132–137, 2020.

[5] P. K. Bhatia and R. Mann, "An Approach to Measure Software Reusability of OO Design An Approach to Measure Software Reusability of OO Design," no. January 2008, 2015.

[6] L. Cheikhi, R. E. Al-Qutaish, A. Idri, and A. Sellami, "Chidamber and kemerer object-oriented measures: Analysis of their design from the metrology perspective," *Int. J. Softw. Eng. its Appl.*, vol. 8, no. 2, pp. 359–374, 2014, doi: 10.14257/ijseia.2014.8.2.35.

[7] E. Haryatmi and M. Y. Mashuri, "Penerapan Fuzzy Logic Inference System Metode Mamdani Sebagai Penunjang Diagnosis Kanker Paru," no. April, 2016.

[8] A. Halim, A. Xandra, and A. Sim, "Mengukur Tingkat Reusability dan Efficiency dari Kode Program dengan Pendekatan Fuzzy Logic," vol. 4, pp. 109–114, 2015.