Levenberg Marquardt Backpropagation Algorithm in Predicting Potential Mortality in Heart Failure

Verdi Yasin[1], Selli Oktaviani[2], Muryan Awaludin[3] and Ifan Junaedi[1]
[1]*Faculty of Computer Science, STMIK Jayakarta, Jakarta, Indonesia*
[2]*Engineering Study Program, STIKOM Tunas Bangsa, Pemtangsiantar, Indonesia*
[3]*Faculty of Industrial Technology, Universitas Dirgantara Marsekal Suryadarma, Jakarta, Indonesia*

Keywords: Levenberg Marquardt Backpropagation Algorithm, Predicting Potential Mortality, Heart Failure.

Abstract: Heart failure is one of the most common disorders that attack the heart and blood vessels throughout the world, resulting in a high average population death rate, and illness also has an impact financially, especially for the elderly. This study focuses on predicting the potential for death in heart failure using the Levenberg Marquart algorithm. The data for predicting the potential for death in heart failure was taken from Kaggle, which consisted of 299 records. Attributes used to predict potential death in heart failure consist of 11 attributes, namely age, gender, anaemia, creatinine phosphokinase, diabetes, ejection fraction, high blood pressure, platelets, serum creatinine, serum sodium, smoking, and death events. The results of this study are predictions of potential death in heart failure with MSE training and testing = 0.0150. With 11-7-1 architecture.

1 INTRODUCTION

Artificial Intelligence (AI) is a general term that suggests using computers to shape intelligent behaviour with minimal human intervention. There are many methods in AI, one of which is Artificial Neural Network Backpropagation (Haring et al., 2022; Zuhrufillah et al., 2022). Heart failure is a complex collection of symptoms where a patient has various symptoms in the form of shortness of breath at rest or when doing activities accompanied by fatigue (Prihatiningsih and Sudyasih, 2018). Backpropagation is a type of supervised Artificial Neural Network training method. This network architecture consists of an input layer, a hidden layer, and an output layer (Sonang et al., 2021). The Levenberg-Marquardt algorithm is a development of the Backpropagation error algorithm. This algorithm was built to overcome some of the deficiencies that exist in the error algorithm (Andriani et al., 2019; Maulana and Muslim, 2015; Sitompul, 2018).

2 RESEARCH METHODOLOGY

2.1 Methods of Data Collection

The method of data collection was carried out starting from literature studies (sources used for various purposes in the world of education both from scientific journals and internet sources)(Abdullah and Handayani, 2019; Lisa, 2015; Mokosuli et al., 2014).

2.2 Data Source

The data used in this study was taken from the data website www.kagle.com, in the form of medical records of heart failure data consisting of 299 data (Hikmayanti et al., 2014; Gultom et al., 2021; Ritha et al., 2016). The data used for training is 100 records, and the data used for testing is 100. The following are 299 attributes in the form of data that influence the occurrence of potential death in heart failure (Yasin and Junaedi, 2022; Zuhri, 2021).
Information:

X1 = Age
X2 = Gender
X3 = Anemia
X4 = Creatinine Phosphokinase
X5 = Diabetes

Yasin, V., Oktaviani, S., Awaludin, M. and Junaedi, I.
Levenberg Marquardt Backpropagation Algorithm in Predicting Potential Mortality in Heart Failure.
DOI: 10.5220/0012444100003848
Paper published under CC license (CC BY-NC-ND 4.0)
In *Proceedings of the 3rd International Conference on Advanced Information Scientific Development (ICAISD 2023)*, pages 72-75
ISBN: 978-989-758-678-1
Proceedings Copyright © 2024 by SCITEPRESS – Science and Technology Publications, Lda.

Table 1: Heart Failure Medical Records Data.

No	X1	X2	..	X10	X11	T
1	75	0	..	1	0	1
2	55	0	..	1	0	1
3	65	0	..	1	1	1
4	50	1	..	1	0	1
5	65	1	..	0	0	1
6	90	1	..	1	1	1
7	75	1	..	1	0	1
8	60	1	..	1	1	1
..	..	..	..	..	..	..
299	50	0	..	1	1	0

X6 = Ejection Fraction
X7 = High Blood Pressure
X8 = Platelet
X9 = Serum Creatinine
X10 = Serum Sodium
X11 = smoking
Target = Death Event

Heart failure medical record data is converted with the following rules:

1. Age:
   a. Toddler Age: 0–5 years = 0.1
   b. Childhood: 5–11 years = 0.2
   c. Early Adolescence: 12–16 years = 0.3
   d. Late Adolescence: 17–25 years = 0.4
   e. Early adulthood: 26–35 years = 0.5
   f. Late adulthood: 36–45 years = 0.6
   g. Early Old Age: 46–55 years = 0.7
   h. Late Old Age: 56–65 years = 0.8
   i. Age of Seniors: ¿ 65 years = 0.9
2. Anemia; if you have anemia = 1, otherwise = 0
3. Creatinine phosphokinase; if normal = 0 otherwise = 1
4. Diabetes if you have a history of diabetes = 1; otherwise = 0
5. Ejection fraction If normal = 0 otherwise = 1
6. High blood pressure If normal = 0 otherwise = 1
7. Platelets If normal = 0 otherwise = 1
8. Serum creatinine If normal = 0 otherwise = 1

The target of predicting the potential for death in heart failure is if it causes death, then the value is 1; If not, then the value is 0. The results of converting medical record data for heart failure can be seen in Table 2.

Table 2: Heart Failure Medical Conversion Data.

No	X1	X2	X3	..	X8	X11	T
1	0.9	1	0	..	0	0	1
2	0.7	1	0	..	0	0	1
3	0.8	1	0	..	0	1	1
4	0.7	1	1	..	0	0	1
5	0.8	0	1	..	0	0	1
6	0.9	1	1	..	0	1	1
7	0.9	1	1	..	1	0	1
8	0.8	1	1	..	1	1	1
..	..	..	..	..	..	..	..
299	0.7	1	0	..	0	1	0

2.3 Research Framework

In completing this research, the authors compiled the research framework as follows:

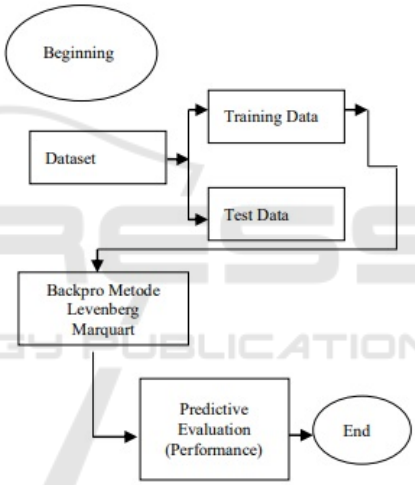

Figure 1: Research framework.

2.4 Architectural Design

The architecture consists of 1 input layer block, one hidden layer block and one output layer block. Figure 2, example of the 11-3-1 architecture .

3 RESULTS AND DISCUSSION

3.1 Best Training and Testing Results

Training data and predictive testing of potential death from heart failure using the Mathlab 2011a application with the Levenberg Marquardt method backpropagation algorithm. The best training and testing results are 11-7-1 with performance testing = 0.0150.

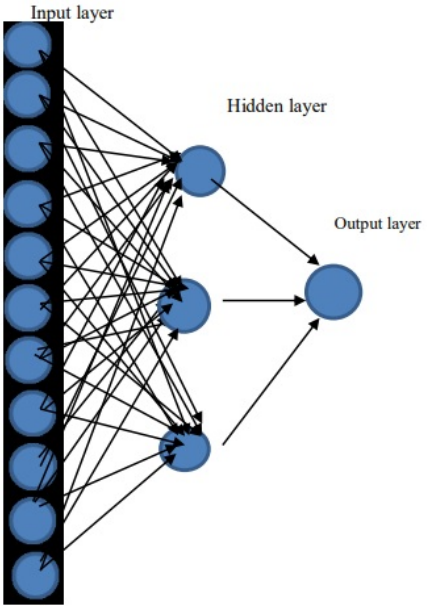

Figure 2: Architectural Design.

3.2 Comparison of Training Results and Testing of the Levenberg Marquardt Method

After training and testing the Levenberg Markquard method backpropagation algorithm with 11-2-1,11-3-1,11-8-1,11-10-1,11-5-1,11-6-1,11 architecture -7-1,11-4-1, the following is a comparison of the Levenberg Marquardt architecture with eight architectures.

Table 3: Training and Testing.

No	Architecture	Epoch (iterations)	Performance Testing	Performance Training
1	11-2-1	454	0.0846	0.0846
2	11-3-1	1347	0.0780	0.0780
3	11-8-1	1174	0.0693	0.0693
4	11-10-1	126	0.0150	0.0150
5	11-10-1	126	0.0150	0.0150
6	11-5-1	514	0.0150	0.0150
7	11-6-1	96	0.0350	0.0350
8	11-7-1	59	0.0150	0.0150
9	11-4-1	100000	0.0426	0.0426

4 CONCLUSIONS

Based on the results and discussion described above, it can be concluded that the Levenberg Marquart backpropagation method can predict potential mortality in heart failure with MSE training and testing = 0.0150 with 11-7-1 architecture (Covid, 2022; Solikhun et al., 2020a). Determination of the method in backpropagation training is so influential on the results, and it's just that the determination of the method and pattern must be adjusted to the needs (Solikhun et al., 2020b; Solikhun and Wahyudi, 2021).

REFERENCES

Abdullah, N. and Handayani, L. (2019). Peramalan rate of return saham menggunakan metode brown's weighted exponential moving average dengan optimasi levenberg-marquardt: Forecasting the stock rate of return using the brown's weighted exponential moving average method with optimization of leven. *Nat. Sci. J. Sci. Technol*, 8(3):171–176,.

Andriani, Y., Wanto, A., and Handrizal, H. (2019). Jaringan saraf tiruan dalam memprediksi produksi kelapa sawit di pt. kre menggunakan algoritma levenberg marquardt. *Pros. Semin. Nas. Ris. Inf. Sci*, 1(September):249,.

Covid, M. (2022). Analisis quantum perceptron untuk memprediksi jumlah pengunjung ucokopi pematangsiantar pada.

Gultom, W., Wanto, A., Gunawan, I., Lubis, M., and Kirana, I. (2021). Application ofthe levenberg marquardt method in predict the amount of criminality in pematangsiantar city. *J. Comput. Networks, Archit. High-Performance Comput*, 3(1):21–29,.

Haring, M., Grotli, E., Riemer-Sorensen, S., Seel, K., and Hanssen, K. (2022). A levenberg-marquardt algorithm for sparse identification of dynamical systems. *IEEE Trans. Neural Networks Learn. Syst*, pages 1–14,.

Hikmayanti, H., Kom, H., Komarudin, O., Si, S., and Kom, M. (2014). Penggunaan algoritma backpropagation levenberg marquardt dan teknik pengolahan citra digital untuk identifikasi nominal uang kertas. *J. Ilm. Solusi*, 1(2):16–33,.

Lisa, Y. (2015). Levenberg marquardt dan regularisasi bayes untuk prediksi curah hujan.

Maulana, M. and Muslim, M. (2015). Sistem prediksi tagihan listrik usaha jasa laundry menggunakan jaringan syaraf tiruan backpropagation. *Unnes J. Math*, 4(1).

Mokosuli, L., Weku, W., and Latumakulita, L. (2014). Prediksi tingkat kriminalitas menggunakan jaringan syaraf tiruan backpropagation: Algoritma levenberg marquardt di kota manado berbasis sistem informasi geografi,"d'cartesian.

Prihatiningsih, D. and Sudyasih, T. (2018). Perawatan diri pada pasien gagal jantung. *J. Pendidik. Keperawatan Indones*, 4(2).

Ritha, N., Bettiza, M., and Dufan, A. (2016). Prediksi curah hujan dengan menggunakan algoritma levenberg-marquardt dan backpropagation,"j. *Sustain*, 5(2):11–16,.

Sitompul, H. (2018). Optimasi pemulusan eksponensial dengan algoritma levenberg-marquardt hery andi sitompul, s.si, m.si dosen kopertis wilayah i sumut, dpk universitas darma agung.

Solikhun, L. and Wahyudi, M. (2021). Ann : Predicting of state retail sukuk based on region in indonesia. *J. Phys. Conf. Ser*, 1830(1).

Solikhun, M., Safii, M., and Zarlis, M. (2020a). Backpropagation network optimization using one step secant (oss) algorithm. *IOP Conf. Ser. Mater. Sci. Eng*, 769(1).

Solikhun, M., Safii, M., and Zarlis, M. (2020b). Resilient algorithm in predicting fertilizer imports by major countries. *IOP Conf. Ser. Mater. Sci. Eng*, 769(1).

Sonang, S., Defit, S., and Ramadhan, M. (2021). Jepin (jurnal edukasi dan penelitian informatika) analisis optimasi fungsi pelatihan machine learning neural network dalam peramalan kemiskinan. Online]. Available:.

Yasin, V. and Junaedi, I. (2022). Algoritma backpropagation metode powell-beale untuk prediksi penyakit stroke.

Zuhri, A. (2021). Seminar nasional sains dan teknologi informasi (sensasi) optimasi levenberg-marquardt backpropagation dalam mempercepat pelatihan backpropagation. *Semin. Nas. Sains dan Teknol. Inf*, 3(1):627–630,. Online]. Available:.

Zuhrufillah, I., Anggraini, F., and Dewantara, R. (2022). Peramalan jumlah kasus baru hiv menurut provinsi menggunakan machine learning dengan teknik levenberg-marquardt. *J. Comput. Syst. Informatics*, 3(4):212 221,.

SCITEPRESS
SCIENCE AND TECHNOLOGY PUBLICATIONS