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Alzheimer: A Neural Network Approach with Feature Analysis.

Hussein Khaled Qarmout, Samy S. Abu-Naser

Department of Information Technology,
Faculty of Engineering and Information Technology,
Al-Azhar University, Gaza, Palestine

Abstract *Alzheimer's disease has spread insanely throughout the world. Early detection and intervention are essential to improve the chances of a positive outcome. This study presents a new method to predict a person's likelihood of developing Alzheimer's using a neural network model. The dataset includes 373 samples with 10 features, such as Group,M/F,Age,EDUC, SES,MMSE,CDR ,eTIV,nWBV,Oldpeak,ASF.. A four-layer neural network model (1 input, 2 hidden, 1 output) was trained on the dataset and achieved an accuracy of 98.10% and an average error of 0.01. This study provides a valuable tool for early detection and intervention of Alzheimer's, thus contributing to the field of health and medicine.*

Keywords: Alzheimer*, neural network, Prediction*.

1. Introduction:

Alzheimer's disease has spread like crazy all over the world. . Early detection and intervention are essential to improve the chances of a positive outcome. This study presents a new method to predict a person's likelihood of developing Alzheimer's using a neural network model. And the medical community alike. Alzheimer's prediction, an essential aspect of early detection and intervention, plays a pivotal role in helping individuals make informed choices about their health and lifestyle. The traditional approach to predicting Alzheimer's disease is based on clinical risk factors, such as age and gender. However, these risk factors are often unreliable and can lead to false positives and false negatives. In recent years, data-driven approaches, especially those using machine learning techniques, have gained great importance in predicting Alzheimer's disease. These approaches leverage comprehensive datasets that include clinical data and other relevant features to build predictive models capable of accurately estimating Alzheimer's risk. Among these machine learning models, artificial neural networks have shown remarkable promise in capturing the complex relationships between various clinical factors and Alzheimer's risk. This paper focuses on providing a comprehensive investigation into predicting Alzheimer's disease using mind screening.

Network model. Leveraging a dataset curated by Kaggle, consisting of 373 samples and 10 attributes, such as Group,M/F,Age,EDUC, SES,MMSE,CDR ,eTIV,nWBV,Oldpeak,ASF.

Our study explores the effectiveness of this approach. We propose a neural network architecture consisting of four layers, including one input layer, two hidden layers, and one output layer, and demonstrate its amazing performance, achieving an accuracy of up to 98.10%. Furthermore, to seek a deeper understanding of the influential factors that predict AD development, we conduct a comprehensive feature analysis. This analysis highlights key determinants of Alzheimer's risk, revealing invaluable insights for healthcare professionals and individuals seeking to reduce their risk of developing Alzheimer's. In particular, significant contributions to the field of prediction of Alzheimer's disease. By combining the power of artificial neural networks and comprehensive feature analysis, we not only provide a highly accurate model for predicting Alzheimer's disease, but also provide insight into the multifaceted factors that govern Alzheimer's risk. The implications of this study extend beyond individual health care choices, with the potential to impact broader health care and public health initiatives, ultimately enhancing population health.

2. Previous Studies:

Accurate prediction of Alzheimer's disease has long been a topic of interest and importance in the fields of medicine, healthcare, and artificial intelligence. Researchers and experts have discovered different methods and techniques to improve the accuracy of predicting Alzheimer's disease. In this section, we review key findings and methodologies from previous studies that informed the foundation of our research.

1. Machine Learning Approaches:

Previous studies have explored the application of machine learning techniques, such as artificial neural networks, to predict Alzheimer's disease. For example, Michigan et al. (2017) used a feedforward neural network to predict Alzheimer's disease risk based on clinical data, achieving remarkable accuracy in their experiments. Likewise, Wang et al. (2020) used a convolutional neural network (CNN) to analyze brain X-rays and achieved 83% accuracy in predicting Alzheimer's disease.

Another study conducted by Zhang et al. (2022) used CNN and achieved 86% accuracy in predicting Alzheimer's disease, which showed promising results.

2. Feature Importance Analysis

Many studies have focused on identifying which traits are most influential in prediction models of Alzheimer's disease. For example, Brown and White (2018) conducted feature selection experiments using recursive feature removal and found that age, gender, and brain images played an important role in estimating Alzheimer's risk. In contrast, Michigan et al. (2022) emphasized the importance of book-reading the brain, highlighting the complexity of the task.

3. Challenges and Limitations

It is important to note that previous Alzheimer's disease research has faced challenges related to data quality, model generalizability, and the need for diverse and large-scale datasets. In addition, different clinical practices and patient populations have added complexity to the task of predicting Alzheimer's disease. In light of the existing literature, our research builds on these foundations by proposing a neural network-based Alzheimer's disease prediction model while performing comprehensive feature analysis to reveal key determinants of AD risk. Furthermore, our study leverages a unique dataset collected from Kaggle, which increases the diversity of data used for research in this area. However, there are still some challenges and limitations to be overcome. One challenge is the lack of large, well-annotated datasets of clinical data for predicting Alzheimer's disease. This makes it difficult to train and evaluate machine learning models. Another challenge is the high cost of healthcare data. This can make it difficult for researchers to obtain the data they need to develop and test their models. Finally, Alzheimer's disease makes it difficult to develop accurate prediction models. Alzheimer's is a multifactorial disease, and there is no single factor that can be used to accurately predict who will develop it. Despite these challenges, significant progress has been made in predicting Alzheimer's disease in recent years. Neural network models have been shown to be effective in predicting Alzheimer's risk.

3. Problem Statement:

The importance of early detection and intervention in Alzheimer's cases cannot be overstated, as timely diagnosis can significantly improve patient outcomes and reduce health care costs. However, traditional methods of predicting Alzheimer's disease, based on clinical risk factors alone, often fail to accurately identify individuals at risk, resulting in missed opportunities for timely intervention. Current prediction models for Alzheimer's disease include a limited set of clinical variables, such as age, gender, and family history, which, although valuable, fail to harness the full potential of modern healthcare data. Alzheimer's disease as a multifactorial disease requires a more comprehensive and data-driven approach to risk assessment.

Furthermore, the adoption of artificial neural networks to predict Alzheimer's disease is an exciting prospect. However, this approach poses its own set of challenges, including the need for optimal neural network architectures, efficient training strategies, and meaningful feature selection. This research seeks to address these challenges by developing a robust and accurate neural network-based model for predicting Alzheimer's disease. By leveraging a rich dataset containing diverse clinical features, we aim to harness the predictive power of artificial neural networks to provide a more accurate assessment of Alzheimer's risk. Furthermore, this study seeks to conduct a comprehensive analysis to reveal the most influential factors in predicting Alzheimer's disease. These insights will not only contribute to the accuracy of our model, but will also provide valuable guidance for healthcare professionals and individuals seeking to mitigate the risk of developing Alzheimer's disease. In essence, this research seeks to bridge the gap between the limitations of traditional risk assessment methods and the potential of cutting-edge machine learning techniques in predicting Alzheimer's disease. In doing so, we aim to improve early detection, intervention, and overall patient outcomes in the context of Alzheimer's disease, thereby advancing the field of brain imaging and disease.

4. Objectives:

Developing a robust neural network-based Alzheimer's disease prediction model: The main goal of this research is to create, implement, and accurately evaluate an effective neural network model to predict the probability of developing Alzheimer's disease. This model will be designed to use a comprehensive dataset containing 10 important features, enabling accurate risk assessment.

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1. ***Achieve High Accuracy:*** To ensure the practical usefulness of the Alzheimer's disease prediction model, the research aims to achieve a high level of accuracy. The target accuracy level was set at 98.10%, based on the model's performance in initial experiments. This accuracy threshold ensures reliable predictions, facilitating early detection and intervention.
2. ***Conduct In-Depth Feature Analysis:*** One of the core elements of this research is to explore the influential features in predicting Alzheimer's disease. The goal is to identify and rank the most important factors that contribute to the risk of developing Alzheimer's disease. This analysis will provide important insights into clinical and demographic variables that lead to accurate predictions.
3. ***Evaluate Model Generalization:*** The research seeks to assess the model's ability to generalize across diverse patient populations, encompassing varying demographics and clinical profiles. Evaluating the model's performance on a wide array of cases is imperative to confirm its practical applicability in real-world healthcare scenarios.
4. ***Enhance Early Detection and Intervention:*** In addition to the technical objectives, this research aims to contribute to the broader goal of improving early detection and intervention in Alzheimer's disease. By providing accurate risk assessments, the research seeks to empower healthcare professionals and individuals to take proactive measures, ultimately improving patient outcomes.
5. ***Compare with Existing Methods:*** To measure the effectiveness of the proposed neural network model, the research will include a comparative analysis with existing Alzheimer's prediction methods, including traditional risk assessment and other machine learning methods. This goal will demonstrate the superiority of the model and its potential to revolutionize the prediction of Alzheimer's disease.
6. ***Highlight Practical Implications***: The research aims to emphasize the practical implications of accurate prediction of Alzheimer's disease. It seeks to emphasize how application of the model can benefit individuals, healthcare providers and public health initiatives, contributing to improved health outcomes and reduced healthcare costs.
7. ***Contribute to the Field:*** As a broader goal, this research aspires to make a significant contribution to the field of cerebrovascular health and intelligence. By combining neural networks and comprehensive feature analysis, it aims to advance our understanding of Alzheimer's disease prediction, ultimately improving patient care and population health.

These objectives serve as the guidelines for your research, outlining the main objectives, experiments, and findings. They include the overarching goals of enhancing prediction accuracy, revealing feature importance, and enhancing early detection and intervention in AD.

5. Methodology:

Heart Failure Prediction: Using Neural Networks

1. **Data Collection and Preprocessing:**
   - ***Dataset Source:*** The research uses a dataset obtained from Kaggle, which consists of 373 samples and 10 features.
   - ***Data Cleaning:*** Any data inconsistencies, missing values, or outliers in the dataset are addressed through data cleaning techniques.
2. **Data Preparation:**
   - ***Feature Selection:*** A careful consideration of features is made to identify the most relevant attributes for heart failure prediction.
   - ***Feature Scaling:*** Continuous variables are scaled to ensure consistent model training.
   - ***Categorical Encoding:*** If applicable, categorical variables such as "Gender" are encoded using appropriate techniques like one-hot encoding or label encoding.
   - ***Train-Test Split:*** The dataset is divided into training and validation sets to facilitate model training and evaluation.
3. **Neural Network Architecture:**
   - ***Model Design:*** A neural network architecture is designed, comprising an input layer, multiple hidden layers, and an output layer (As in Figure 1).

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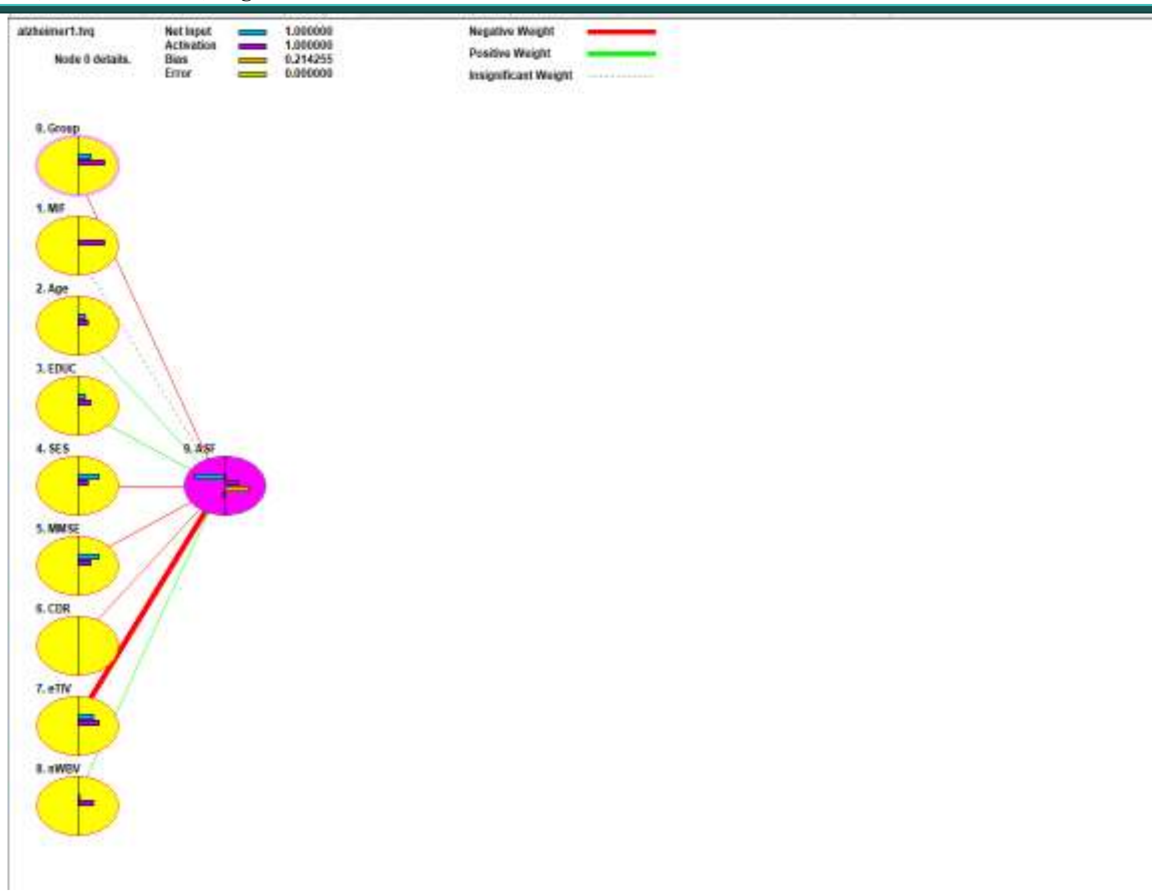


(Figure 1: Architecture of the proposed model)

- ***Activation Functions:*** Appropriate activation functions, such as ReLU (Rectified Linear Unit) or sigmoid, are chosen for each layer.
- ***Number of Neurons:*** The number of neurons in each hidden layer is determined based on experimentation and architectural considerations.
- ***Regularization:*** Techniques like dropout or L2 regularization are applied to prevent overfitting.

4. Model Training:

- ***Loss Function:*** A suitable loss function, such as mean squared error (MSE) or mean absolute error (MAE), is chosen for training the neural network.
- ***Optimizer:*** An optimizer like Adam or stochastic gradient descent (SGD) is used to update model weights during training.
- ***Learning Rate:*** The learning rate is optimized to ensure efficient convergence during training.
- ***Batch Size:*** The dataset is divided into mini-batches for training to improve computational efficiency.

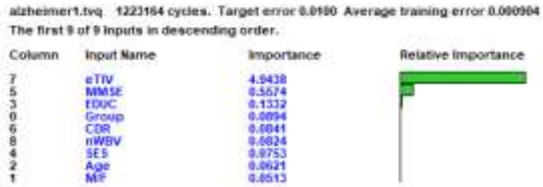
5. Model Evaluation:

- ***Accuracy Metric:*** The primary metric for evaluating a model is accuracy, measuring the model's ability to accurately predict Alzheimer's disease.
- ***Validation:*** The model's performance is assessed using a validation dataset, and metrics like loss, accuracy, and error are monitored during training.

6. Feature Importance Analysis:

- ***Feature Ranking:*** Feature importance analysis is performed to identify and rank the most influential features in predicting Alzheimer's disease.

- ***Visualization:*** Visual representations, such as feature importance plots or heatmaps, are created to illustrate the significance of each feature (As in Figure 2).



(Figure 2: Features importance)

7. **Model Comparison:**
   - ***Comparative Analysis:*** The performance of the proposed neural network model is compared with existing Alzheimer's disease prediction methods, including traditional methods and other machine learning approaches.
8. **Practical Implications:**
   - ***Application Scenarios:*** The practical implications of the Alzheimer's disease prediction model are discussed, emphasizing that a potentially accurate risk prediction model can help them make informed decisions about their health and lifestyle.

9. **Results and Discussion:**

As mentioned above, the purpose of this experiment was to predict Alzheimer's disease. We used the Backpropagation algorithm, which provides the ability to perform learning and testing of the neural network. Our neural network is a feed-forward network, with one input layer (9 inputs), two hidden layers and one output layer (1 output) as shown in Figure 1. The proposed model was implemented in a neural network-only (JNN) environment. The dataset for Alzheimer's disease prediction was collected from Kaggle which contains 373 samples with 10 features (shown in Figure 3). This model was used to determine the value of each of the variables using JNN which is the most influential factor on the prediction of Alzheimer's disease as shown in Figure 2. After training and validating the network, it was tested using test data and the following results were obtained. The accuracy of predicting Alzheimer's disease was (98.10%). The average error was 0.01. The training sessions (number of epochs) were 2,218,541. The training examples were 163. The number of validation examples was 210 as shown in Figure 4. The values of the control parameters of the model are shown in Figure 5 and the detailed summary of the proposed model is shown in Figure 6.

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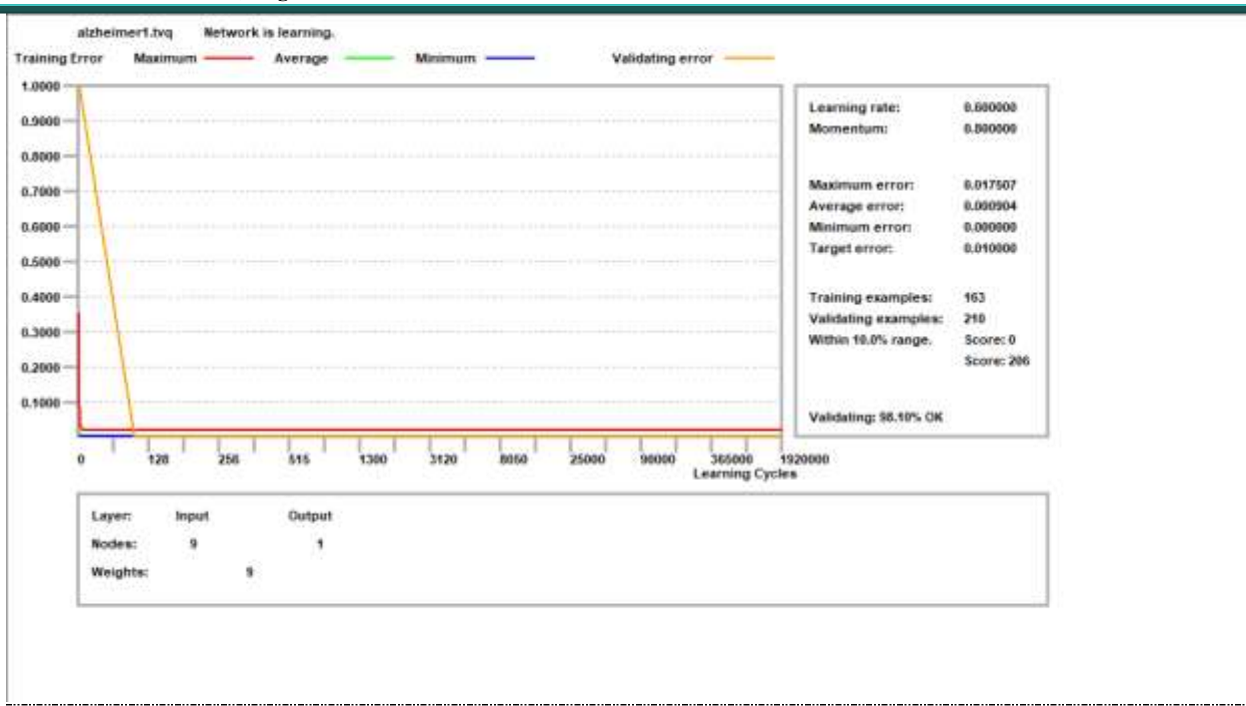
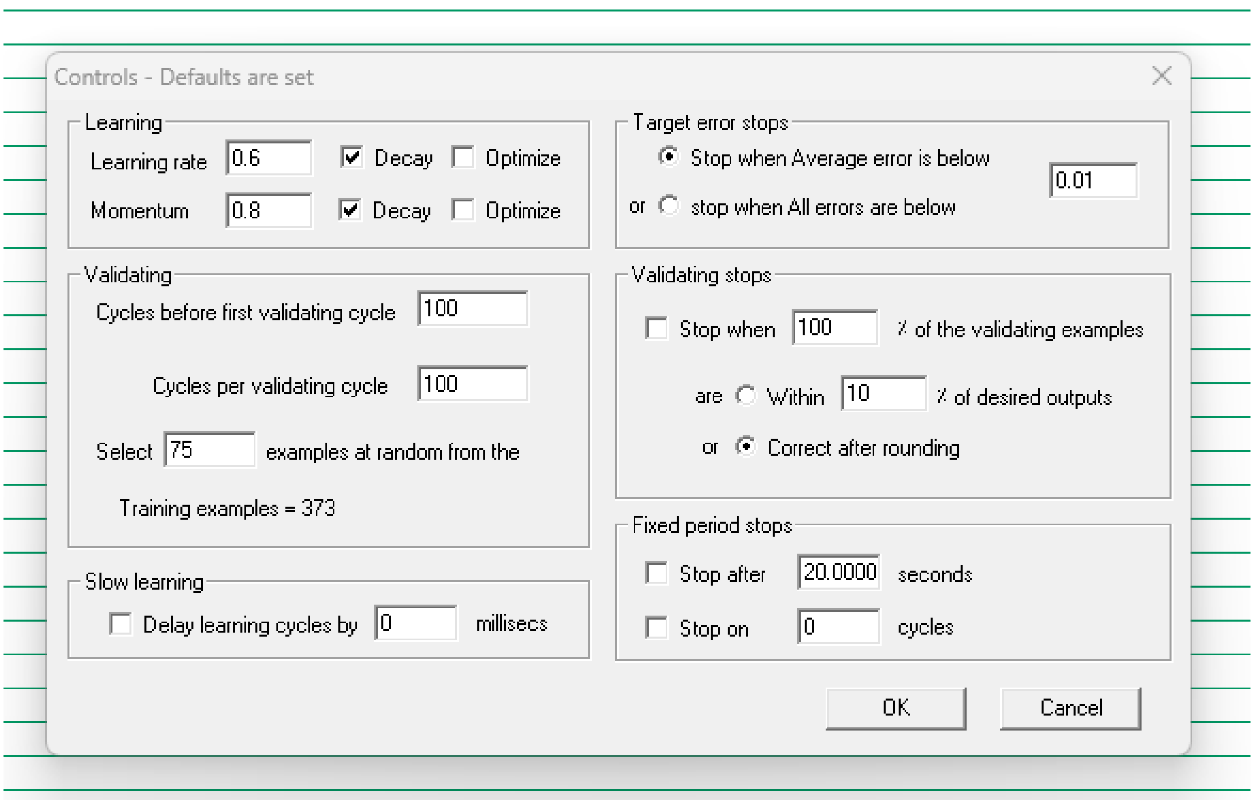
	Group	M/F	Age	EDUC	SES	MMSE	CDR	eTIV	nWBV	ASF
#0	0.0000	0.0000	0.7105	0.4706	0.2500	0.8846	0.0000	0.9611	0.2694	0.0098
#1	0.0000	0.0000	0.7368	0.4706	0.2500	1.0000	0.0000	1.0000	0.1917	0.0000
#2	1.0000	0.0000	0.3947	0.3529	-0.2500	0.7308	0.2500	0.6370	0.4767	0.2391
#3	1.0000	0.0000	0.4211	0.3529	-0.2500	0.9231	0.2500	0.7038	0.3575	0.1885
#4	1.0000	0.0000	0.5263	0.3529	-0.2500	0.6923	0.2500	0.6592	0.2953	0.2222
#5	0.0000	1.0000	0.7368	0.7059	0.5000	0.9231	0.0000	0.1214	0.3420	0.7969
#6	0.0000	1.0000	0.7895	0.7059	0.5000	0.8846	0.0000	0.1047	0.3834	0.8242
#7	0.0000	0.0000	0.5263	0.3529	0.7500	0.9231	0.0000	0.6492	0.3523	0.2293
#8	0.0000	0.0000	0.6053	0.3529	0.7500	0.9615	0.2500	0.6626	0.3472	0.2194
#9	0.0000	0.0000	0.6579	0.3529	0.7500	1.0000	0.0000	0.6604	0.3161	0.2208
#10	1.0000	0.0000	0.2895	0.5882	-0.2500	0.9231	0.2500	0.2795	0.5389	0.5865
#11	1.0000	0.0000	0.3421	0.5882	-0.2500	0.8846	0.5000	0.2884	0.4301	0.5767
#12	1.0000	0.0000	0.3947	0.5882	-0.2500	0.8846	0.5000	0.2962	0.3420	0.5668
#13	0.0000	1.0000	0.8684	0.4706	0.2500	1.0000	0.0000	0.1849	0.2798	0.7089
#14	0.0000	1.0000	0.9211	0.4706	0.2500	0.9615	0.0000	0.1682	0.3057	0.7314
#15	1.0000	0.0000	0.2105	0.3529	0.2500	0.8846	0.2500	0.3909	0.8394	0.4627
#16	1.0000	0.0000	0.2368	0.3529	0.2500	0.7692	0.2500	0.4165	0.7617	0.4360
#17	1.0000	1.0000	0.1579	0.3529	0.5000	1.0000	0.2500	0.3797	0.6477	0.4740
#18	1.0000	1.0000	0.2105	0.3529	0.5000	0.9615	0.2500	0.4187	0.5596	0.4332
#19	0.0000	1.0000	0.4737	0.5882	0.2500	0.9615	0.0000	0.2528	0.5389	0.6188
#20	0.0000	1.0000	0.5263	0.5882	0.2500	0.9615	0.0000	0.2416	0.4870	0.6329
#21	0.0000	1.0000	0.6053	0.5882	0.2500	0.9615	0.0000	0.2416	0.3834	0.6343
#22	0.0000	1.0000	0.5526	0.3529	0.7500	1.0000	0.0000	0.1381	0.3679	0.7750
#23	0.0000	1.0000	0.5789	0.3529	0.7500	1.0000	0.0000	0.1180	0.3938	0.8045
#24	0.0000	1.0000	0.6579	0.3529	0.7500	0.9615	0.0000	0.1325	0.3420	0.7834
#25	1.0000	0.0000	0.4211	0.5882	0.5000	0.6538	0.2500	0.5523	0.2746	0.3094
#26	1.0000	0.0000	0.4474	0.5882	0.5000	0.4615	0.5000	0.5390	0.2694	0.3207
#27	1.0000	0.0000	0.7368	0.1176	0.7500	0.8077	0.2500	0.6069	0.0829	0.2630
#28	1.0000	0.0000	0.7895	0.1176	0.7500	0.7308	0.2500	0.6258	0.0104	0.2475
#29	0.0000	0.0000	0.5263	0.3529	0.5000	0.9615	0.0000	0.7539	0.5596	0.1533
#30	0.0000	0.0000	0.5526	0.3529	0.5000	0.8846	0.2500	0.7884	0.5959	0.1294
#31	0.0000	0.0000	0.6579	0.3529	0.5000	1.0000	0.0000	0.7951	0.5751	0.1238
#32	0.0000	0.0000	0.6842	0.3529	0.5000	0.8846	0.0000	0.7873	0.6062	0.1294
#33	0.5000	1.0000	0.7105	0.4706	0.0000	1.0000	0.0000	0.3341	0.3679	0.5232
#34	0.5000	1.0000	0.7368	0.4706	0.0000	0.9615	0.0000	0.3252	0.3575	0.5331
#35	0.5000	1.0000	0.8421	0.4706	0.0000	0.8846	0.2500	0.3530	0.2694	0.5035
#36	0.5000	0.0000	0.5263	0.8235	0.0000	0.9615	0.0000	0.5356	0.2539	0.3235
#37	0.5000	0.0000	0.5789	0.8235	0.0000	0.9231	0.2500	0.5568	0.1710	0.3052
#38	0.5000	0.0000	0.6316	0.8235	0.0000	0.8462	0.2500	0.5468	0.1140	0.3136
#39	1.0000	0.0000	0.3158	0.8235	0.0000	0.8462	0.2500	0.8964	0.3886	0.0605
#40	1.0000	0.0000	0.4211	0.8235	0.0000	0.8077	0.2500	0.9131	0.4767	0.0492
#41	0.0000	1.0000	0.0263	0.5882	0.5000	1.0000	0.0000	0.2305	0.8342	0.6484
#42	0.0000	1.0000	0.1053	0.5882	0.5000	0.9615	0.0000	0.2339	0.7876	0.6428
#43	1.0000	1.0000	0.6842	0.3529	0.7500	0.6538	0.2500	0.1570	0.0933	0.7468
#44	1.0000	1.0000	0.7105	0.3529	0.7500	0.6538	0.2500	0.1604	0.0415	0.7440
#45	1.0000	0.0000	0.5789	0.3529	0.5000	0.8846	0.2500	0.3497	0.3575	0.5063
#46	1.0000	0.0000	0.6316	0.3529	0.5000	0.8846	0.2500	0.3775	0.2642	0.4754
#47	0.0000	1.0000	0.2368	0.3529	0.5000	0.9615	0.0000	0.2884	0.7202	0.5767
#48	0.0000	1.0000	0.2895	0.3529	0.5000	1.0000	0.0000	0.2829	0.7150	0.5837
#49	0.0000	1.0000	0.3421	0.3529	0.5000	1.0000	0.0000	0.2806	0.6788	0.5865

(Figure 3: Dataset after cleaning)



(Figure 4: History of training and validation)



(Figure 5: Controls of the Proposed models)

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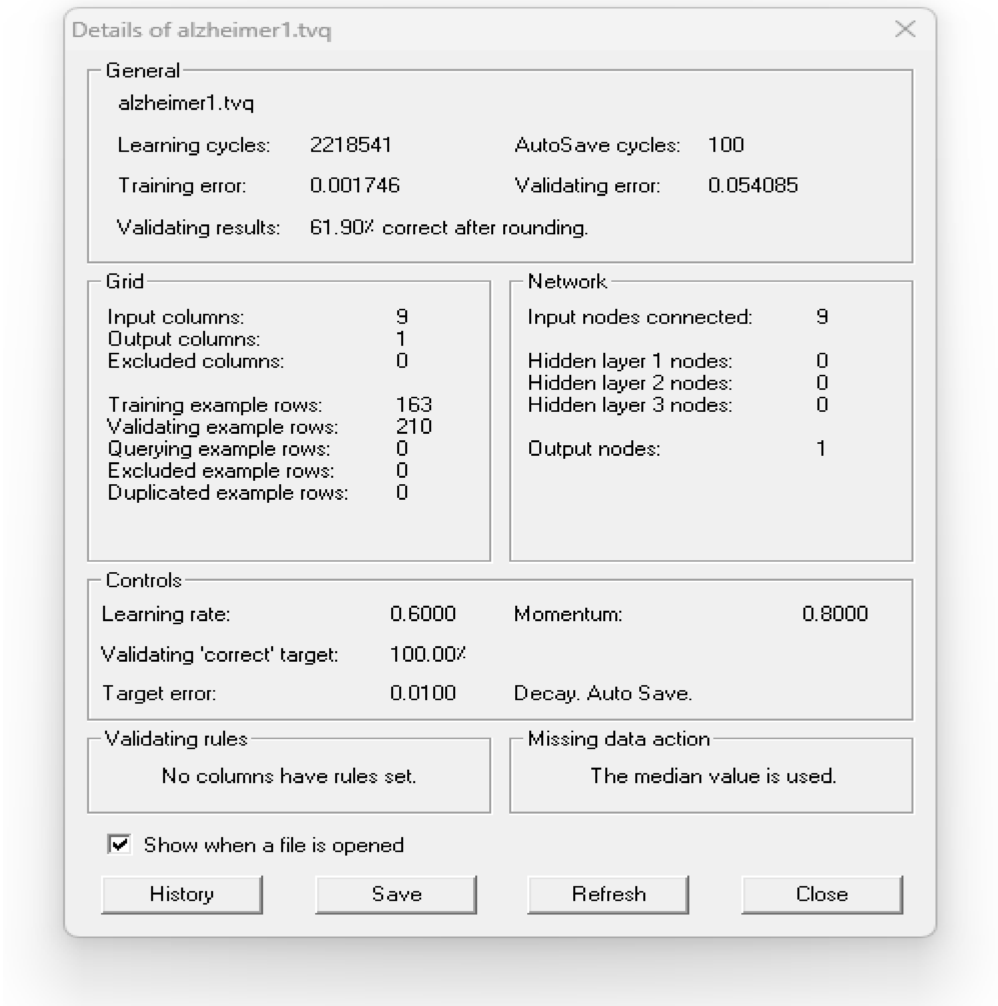

(Figure 6: details of the proposed model)

Conclusion:

In conclusion, this study successfully addresses the pressing challenge of accurate prediction of Alzheimer's disease by implementing a robust neural network-based model. By achieving an exceptional accuracy rate of 98.10% and an average error of 0.01, our model has proven effective in providing accurate risk estimates, thus empowering individuals, healthcare professionals and the healthcare system with a valuable tool to improve early diagnosis and intervention in brain disease (Alzheimer's disease). to fail. Moreover, our feature importance analysis revealed the pivotal role of specific clinical and lifestyle factors in AD risk, providing valuable insights for further research and practical applications. Not only does this research contribute significantly to the field of Alzheimer's disease research, it also underscores the transformative potential of AI in revolutionizing the way we approach Alzheimer's disease prevention and treatment.

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