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ANN for Lung Cancer Detection

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Abstract**:** *The effectiveness of cancer prediction system helps the people to know their cancer risk with low cost and it also helps the people to take the appropriate decision based on their cancer risk status. The dataset is collected from the data world website. In this paper, we proposed an Artificial Neural Network for detecting whether lung cancer is found or not in human body. Symptoms were used to diagnose the lung cancer, these symptoms such as Yellow fingers, Anxiety, Chronic Disease, Fatigue, Allergy, Wheezing, Coughing, Shortness of Breath, Swallowing Difficulty and Chest pain. They were used and other information about the patient as input variables for the proposed ANN model. The proposed model was trained, and validated using the lung cancer dataset. The proposed model was evaluated and tested. The accuracy rate it gave us was 99.01 %.*

Keywords: Machine Learning, Prediction, Artificial Neural Networks, Lung Cancer.

1. INTRODUCTION

Cancer is a wide term. It labels the illness that outcome once cellular changes cause the uncontrolled growth and division of cells. Most of the body's cells have particular functions and fixed lifetimes. However, cell death is part of a natural phenomenon called apoptosis. A cell takes directions to die so that the body can substitute it with a newer one that functions better. Cancerous cells lack the mechanisms that train them to stop dividing and to die. Thus, they grow in the body, using oxygen and nutrients that would usually feed other cells. Cancerous cells can form tumors, damage the immune system and cause other deviations that prevent the body from functioning right. Lung cancer is a malignant lung tumor considered by uncontrolled cell growth in lung tissues. Lung cancer is the primary cause of cancer-related death [1]. The primary goal of our research is to diagnose the presence of lung cancer cells based on attributes, which are set of human symptoms, and information. The study explores the possibility of using an Artificial Neural Network model to detect the presence of a lung cancer in someone's body. The purposes of this study are [2]:

- To recognize some appropriate factors that cause lung cancer
- To model an Artificial Neural Network that can be used to detect the presence of lung cancer

Artificial neural networks (ANNs) are alike to our neural networks and offer a quite good technique, which solves the problem of classification and prediction [3]. An ANN is a mathematical model that is encouraged by the organization and functional feature of natural neural networks[4], Neural networks involve input and output layers, as well as (in most cases) hidden layers that transform the input into something so the output layer can use [5]. When a neural network used for cancer detections, the ANN Model go through two levels, training and validation. First, the network is trained on a dataset. Then the weights of the connections between neurons are fixed so the network is validated to determine the classifications of a new dataset [6]. ANN Architecture is shown in figure 1. In this paper, we used about 67% of the total sample data for network training, and 33% for network validation.

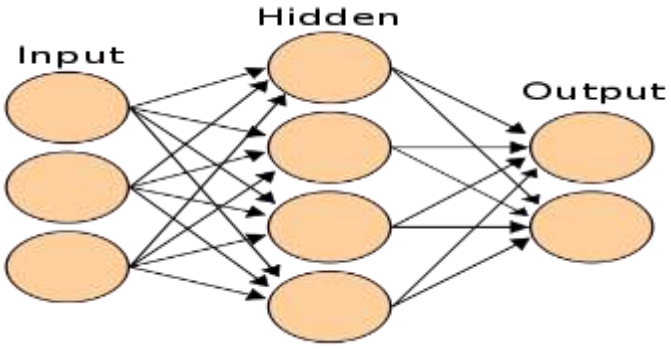

Figure 1: ANN Architecture

2. LITERATURE REVIEW

Artificial Neural Networks have been used many fields. In Education such as: Predicting Student Performance in the Faculty of Engineering and Information Technology using ANN[53], Prediction of the Academic Warning of Students in the Faculty of Engineering and Information Technology in Al-Azhar University-Gaza using ANN[49], Arabic Text Summarization Using AraBERT Model Using Extractive Text Summarization Approach[6].

In the field of Health such as: Parkinson's Disease Prediction [50], Classification Prediction of SBRCTs Cancers Using ANN [17], Predicting Medical Expenses Using ANN[51], Predicting Antibiotic Susceptibility Using Artificial Neural Network[43], Predicting Liver Patients using Artificial Neural Network[47], Blood Donation Prediction using Artificial Neural Network[11], Predicting DNA Lung Cancer using Artificial Neural Network[40], Diagnosis of Hepatitis Virus Using Artificial Neural Network[46], COVID-19 Detection using Artificial Intelligence[52].

In the field of Agriculture: Plant Seedlings Classification Using Deep Learning [23], Prediction of Whether Mushroom is Edible or Poisonous Using Back-propagation Neural Network[15], Analyzing Types of Cherry Using Deep Learning[21], Banana Classification Using Deep Learning[13], Mango Classification Using Deep Learning[45], Type of Grapefruit Classification Using Deep Learning[7], Grape Type Classification Using Deep Learning[30], Classifying Nuts Types Using Convolutional Neural Network[27], Potato Classification Using Deep Learning[32], Age and Gender Prediction and Validation Through Single User Images Using CNN[5].

In other fields such as : Predicting Software Analysis Process Risks Using Linear Stepwise Discriminant Analysis: Statistical Methods [34], Predicting Overall Car Performance Using Artificial Neural Network [8,18], Glass Classification Using Artificial Neural Network [29], Tic-Tac-Toe Learning Using Artificial Neural Networks[25], Energy Efficiency Predicting using Artificial Neural Network[42], Predicting Titanic Survivors using Artificial Neural Network[24], Classification of Software Risks with Discriminant Analysis Techniques in Software planning Development Process[33-38], Handwritten Signature Verification using Deep Learning[12], Email Classification Using Artificial Neural Network[14], Predicting Temperature and Humidity in the Surrounding Environment Using Artificial Neural Network[22], English Alphabet Prediction Using Artificial Neural Networks[39].

3. METHODOLOGY

The dataset was downloaded which represents whether the patients have lung cancer or not. This dataset can be found in the Data World website [57].
We did some preprocessing on the data, and then we trained our ANN model and validated it.

3.1 Dataset description

The collected dataset consists of 309 samples with 15 features as input variables and one attribute as output variables as shown if Table 1.

Table 1: Original Dataset attributes description

#	Attribute	Scope	Type of Variable
1.	Gender	Male =1, Female=0	Input
2.	Age	Age of the patient	Input
3.	Smoking	YES=1, NO=0	Input
4.	Yellow fingers	YES=1, NO=0	Input
5.	Anxiety	YES=1, NO=0	Input
6.	Peer pressure	YES=1, NO=0	Input
7.	Chronic Disease	YES=1, NO=0	Input
8.	Fatigue	YES=1, NO=0	Input
9.	Allergy	YES=1, NO=0	Input
10.	Wheezing	YES=1, NO=0	Input
11.	Alcohol	YES=1, NO=0	Input
12.	Coughing	YES=1, NO=0	Input
13.	Shortness of Breath	YES=1, NO=0	Input
14.	Swallowing Difficulty	YES=1, NO=0	Input

15.	Chest pain	YES=1, NO=0	Input
16.	Lung Cancer	YES=1, NO=0	Output

4. Dataset Preprocessing

We did some preprocessing and transformation so the data is more suitable for predictive analysis. We used the first 15 attributes as inputs to our model and the lung cancer attribute as the predicted output based on the input attributes. We normalized the values of the attributes: gender, age, lung cancer. Gender scope becomes 1 for male , 0 for female, lung cancer scope becomes 1 (yes) , 0 (No). However, age attribute normalized to become real because that is better for ANN. Age was categorized as follows:

Table 2: Age Categorization

Age Range	**Category**
21-54	0
55-60	1
61-65	2
66-70	3
71-more	4

5. The Neural Network model

The proposed dataset was imported from the "csv" file into JNN environment. Then the imported dataset were split into two groups: Training and validation Group. The training group consists of 209 samples and the validation group contains the remaining 100 samples (as seen in Figure 2). The split was done randomly by the JNN tool. Then control parameters for ANN Model was set as in Figure 3. The ANN Model architecture was created as shown in Figure 4.

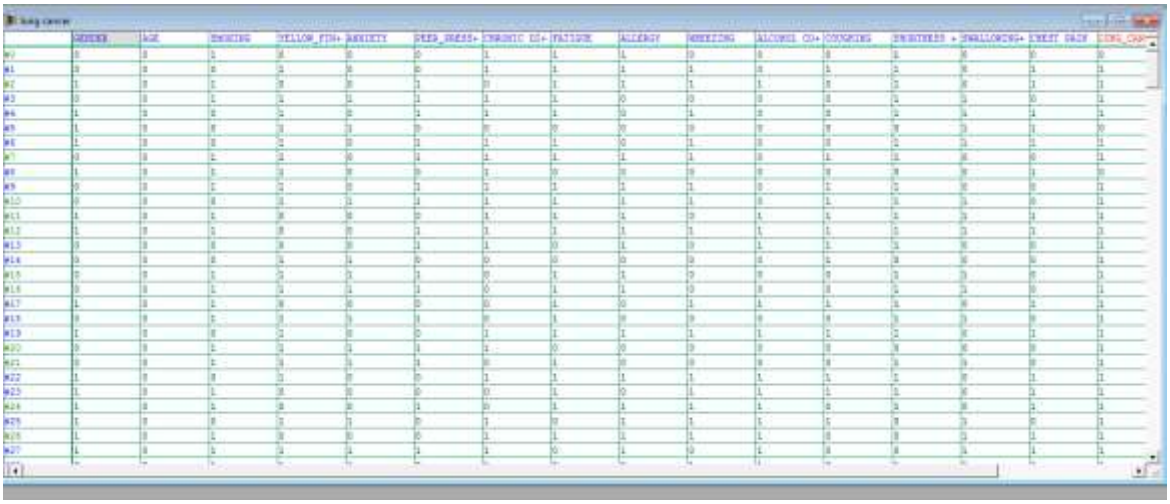

Figure 2: Imported dataset from the "csv" file into JNN environment

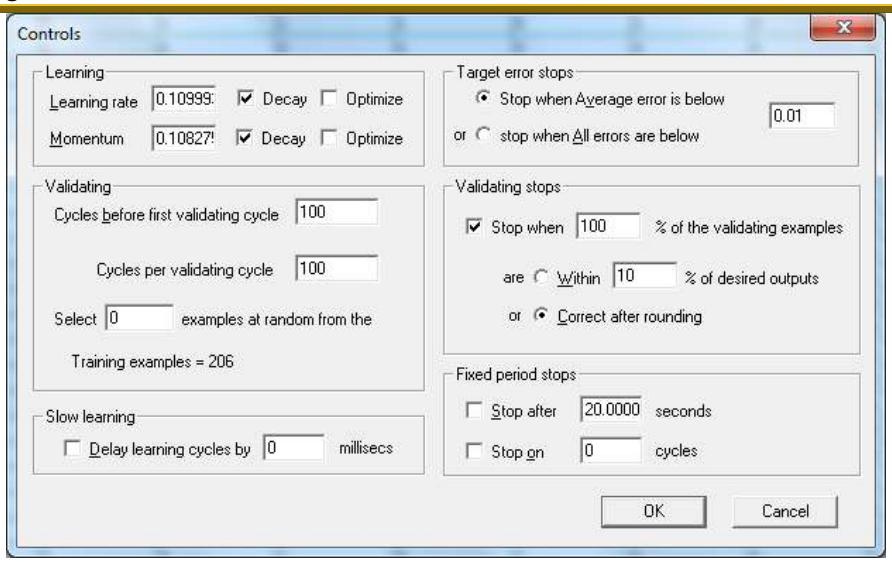

Figure 3: Control parameters for ANN Model

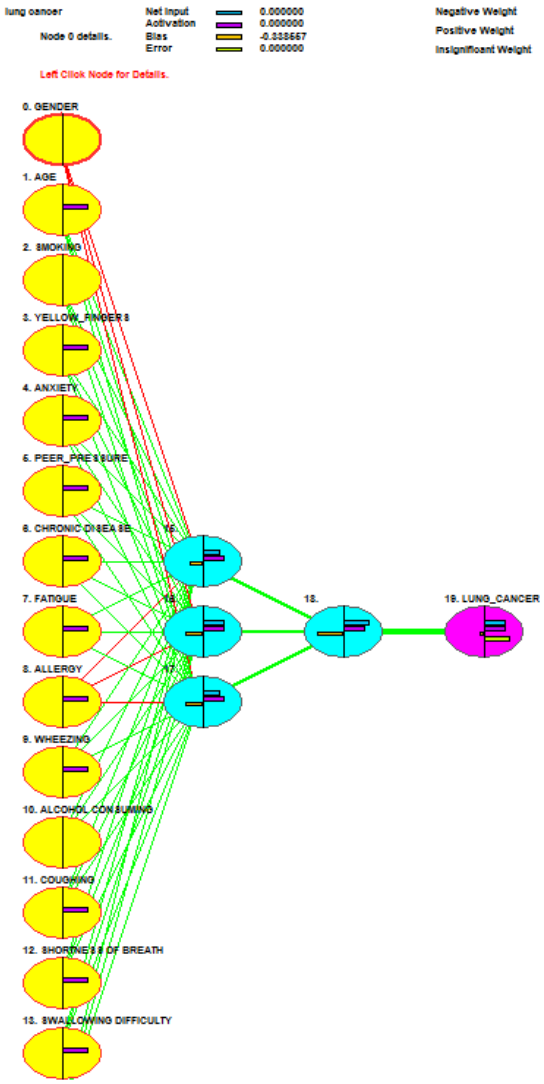

Figure 4: Architecture of proposed ANN model

6. Evaluation of ANN model

The proposed ANN model was trained for 2605 cycles on a regular PC. The trained proposed ANN model was able to predict the presence of lung cancer with 99.01% accuracy. The error rate was 0.002 as seen in Figure 5. In addition, the proposed ANN model showed that the most attribute that has effect on the lung cancer presence is smoking as seen in Figure 6. The details of the proposed model are shown in Figure 7.

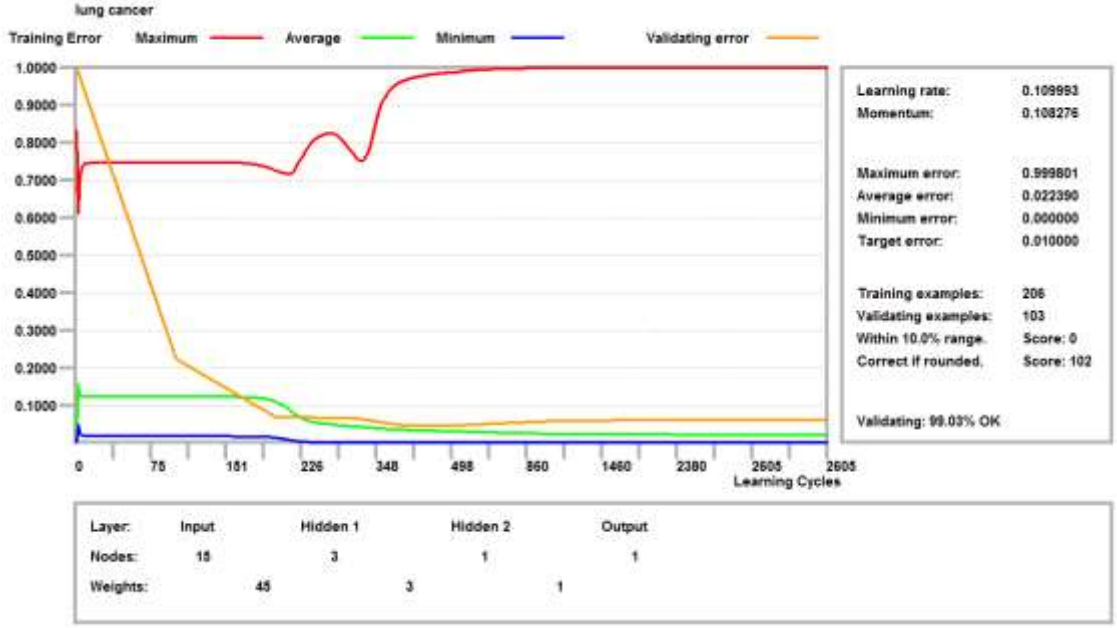

Figure 5: Validation and errors rates

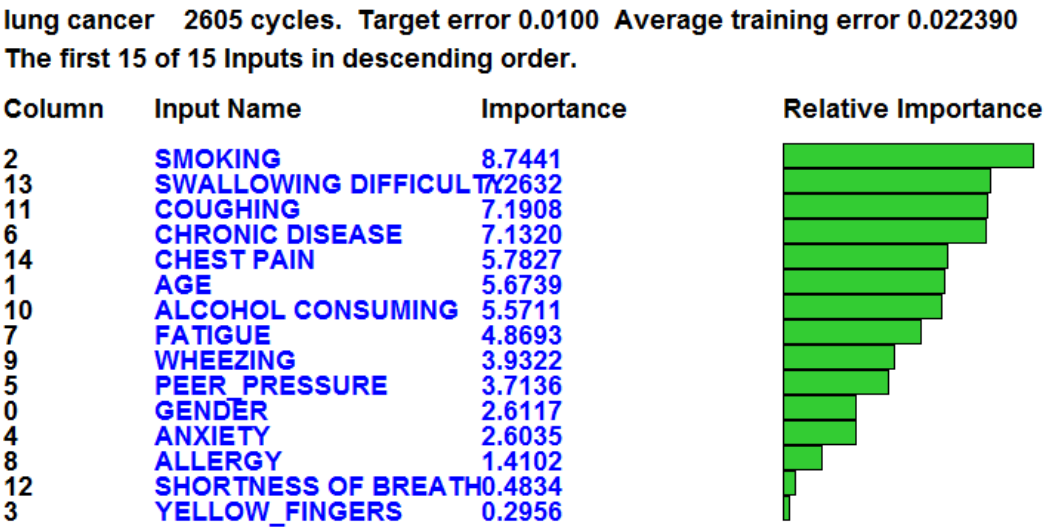

Figure 6: Attributes Importance

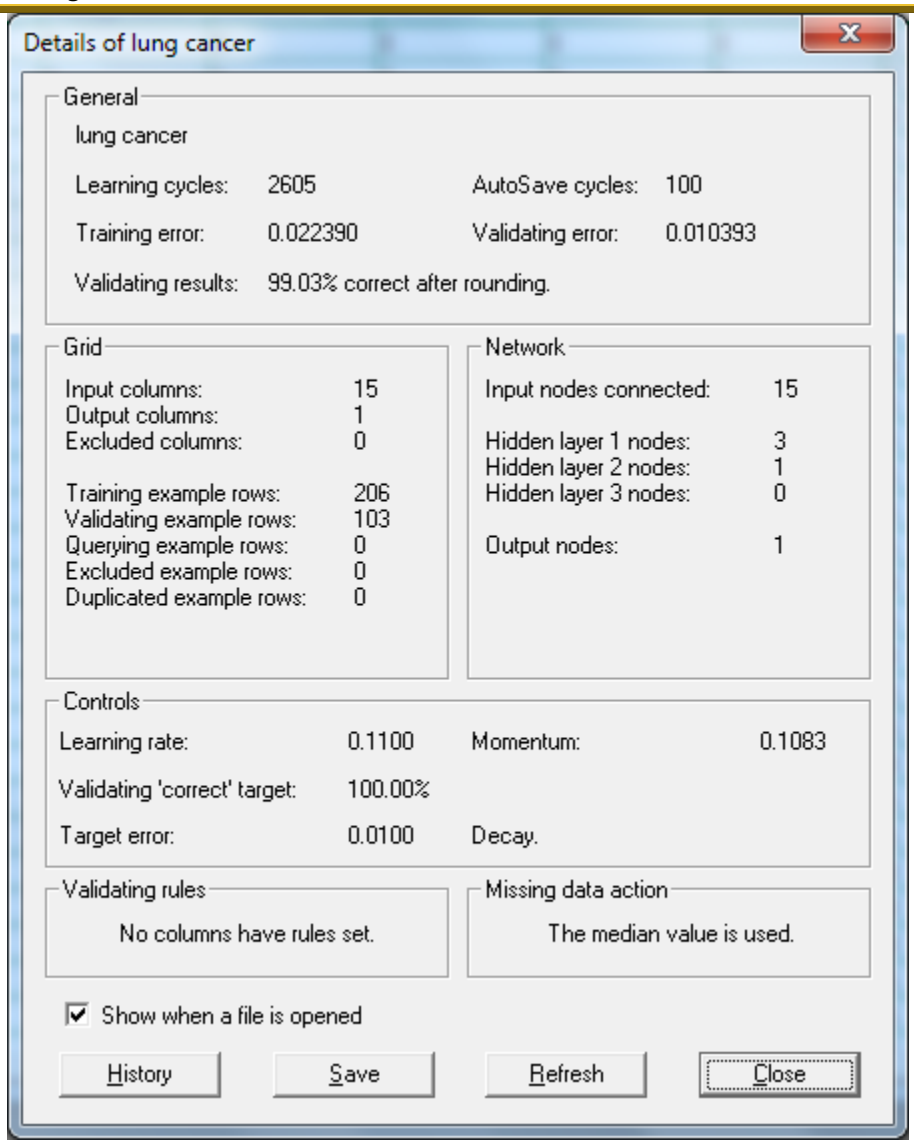

Figure 7: Details of ANN model

7. Conclusion

An artificial Neural Network for diagnose the presence or absence of lung cancer in patients was developed. The model was validated gave an accuracy of 99.01%. This study showed that neural network is able to diagnose lung cancer, so it can used as a diagnose tool by physician.

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