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ANN for Predicting DNA Lung Cancer

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Abstract: *Lung cancer is the top reason of cancer-associated deaths globally. Surgery is the typical treatment for early-stage non-small cell lung cancer (NSCLC). Advancement in the knowledge of the biology of non-small cell lung cancer has shown molecular evidence used for systemic cancer therapy aiming metastatic disease, with a significant impact on patients' overall survival (OS) and eminence of life. Though, a biopsy of overt metastases is an invasive technique restricted to assured positions and not effortlessly satisfactory in the clinic. The examination of peripheral blood samples of cancer patients embodies a new basis of cancer-derived material, recognized as liquid biopsy, and its constituents (circulating tumour cells (CTCS), circulating free DNA (cfDNA), exosomes, and tumour-educated platelets (TEP)) may be gotten from nearly any body liquids. These constituents have shown to imitate features of the status of both the primary and metastatic diseases, aiding the clinicians to go towards a tailored medicine. In this paper, the reasons of lung cancer will be recognized and the risk elements that initiated the increase of infection, for instance Smoking, Disclosure to secondhand smoke, Disclosure to radon gas, Disclosure to asbestos and other compounds, Family past history of lung cancer, and decrease of the spread of disease and approaches of handling and prevention of lung cancer.*

Keywords: DNA Lung Cancer, Artificial Neural Network, ANN, JustNN.

1. INTRODUCTION

1.1 Cancer:

Cancer is when cells in the body altered and grow out of control. One's body is made up of little building chunks named cells. Normal cells propagate when one's body wants them, and die when one's body does not want them anymore. Cancer is made up of irregular cells that develop even though one's body doesn't want them. In utmost cancers, the abnormal cells cultivate to produce a lump or mass named a tumor. If cancer cells are in the body for sufficient time, they can develop into (invade) nearby areas. They can even extent to other parts of the body (metastasis).

1.2 Lung cancer:

Lung cancer is the world's foremost cause of cancer-related death. Nearly 80% of all lung cancer cases are non-small-cell-lung cancer (NSCLC) patients, the common of who existing with a locally advanced or metastatic disease. Most of patients are diagnosed at late stages and have local or systemic advanced disease (stage III or IV) with 5-year survival rates of <5%. More than 50% of lung cancer patients die during the first year of diagnosis. Consequently, there is a great demand for new diagnostic and treatment choices based on specific biomarkers, preferably detectable in tumor surrogate specimens derived by non-invasive procedures. The discovery of extracellular DNA circulating in blood, the so-called cell-free DNA (cfDNA), may greatly impact molecular diagnostics of lung cancer patients due to a simple, non-invasive access to genetic material detectable in the plasma and serum by sensitive molecular biology techniques .

Lung cancer is cancer that begins in the cells that structure the lungs. Many other types of cancer, such as breast or kidney, can feast (metastasize) to the lungs. When this occurs, the cancer is not called lung cancer. This is because cancer is called for--and treatment is based on--the place of the original tumor. For instance, if breast cancer spreads to the lungs, it will be treated as metastatic breast cancer, not lung cancer.

1.3 Understanding the lungs:

The lungs are sponge-like organs in ones chest. The job of the lungs is to transport oxygen into the body and to remove carbon dioxide. When one inhale, it enter ones lungs over ones windpipe. The windpipe is splits into tubes named bronchi, which go in the lungs. These are splits into minor branches named bronchioles. At the end of the bronchioles are small air bags named alveoli. The alveoli transfer oxygen from the air into ones blood. They throw carbon dioxide out of the blood. This go out of one's body when one exhale.

A person right lung is separated into 3 segments (lobes). A person left lung has 2 lobes.

1.4 Types of lung cancer:

Lung cancer is split into 2 key categories: Small Cell Lung Cancer (SCLC) and Non-Small Cell Lung Cancer (NSCLC). These 2 types nurture and feast in different ways. They are frequently treated differently.

1.4.1 Non-small cell lung cancer (NSCLC)

About 84% to 91% of lung cancers are non-small cell. This cancer has 3 categories. They are sorted by the type of lung cell the cancer began in and by how the cells appear under a microscope. They have slight differences among them. But they incline to have the same view (prognosis) and are commonly treated in similar way:

- **Adenocarcinoma.** This is the utmost mutual type of NSCLC. It's the utmost mutual type of lung cancer within people who do not smoke. But it's originated usually in smokers or previous smokers. It inclines to develop in the outside edges of the lungs. It frequently develops more gradually than other kinds of lung cancer.
- **Squamous cell carcinoma (epidermoid carcinoma).** This type of NSCLC grows usually in smokers or previous smokers. These cancers incline to begin in the central part of the lungs close to the key airways (the bronchi).
- **Large cell carcinoma.** This is the least public type of NSCLC. It inclines to rapidly develop and feast to the other organs. This can make it difficult to treat.

1.4.2 Small cell lung cancer (SCLC)

Only about 11% to 16% of persons with lung cancer have small cell lung cancer. It is likewise named oat cell cancer. It develops and feasts more rapidly than non-small cell lung cancer. It frequently feasts to the other parts of the body at an initial stage.

1.5 How lung cancer spreads

Lung cancer, similar to all cancers, can act in different ways in every person, subject on the type of lung cancer it is and the phase it is in. Nonetheless once lung cancer feasts outer the lungs, it frequently goes to similar places. The first place lung cancer typically feasts to is the lymph nodes in the middle of the chest. These lymph nodes are named mediastinal lymph nodes. Lung cancer might likewise feast to the lymph nodes in the lower neck. In its advanced phases, lung cancer might feast (metastasize) to distant parts of the body, like the liver, brain, or bones.

1.5.1 Risk factors:

A number of features might increase a person risk of lung cancer. Certain risk features can be controlled, for example, by giving up smoking. And other features can't be controlled, such as ones family history.

Risk features for lung cancer contains:

- **Smoking.** Your risk of lung cancer will increase with the quantity of cigarettes you smoke every day and therefore the number of years you have got smoke-cured. Quitting at any age will considerably lower your risk of developing lung cancer.
- **Exposure to smoking person.** Even if you are not smoker, your risk of lung cancer upsurges if you're exposed to a person who smokes.
- **Exposure to radon gas.** Radon is created by the normal breakdown of uranium in soil, rock and water that ultimately develops part of the air a person breathe. Dangerous altitudes of radon can mount up in any building, comprising homes.
- **Exposure to asbestos and other carcinogens.** Office exposure to asbestos and other materials recognized to cause cancer — for example arsenic, chromium and nickel — likewise can upsurge one risk of developing lung cancer, especially if a person is a smoker.
- **Family history of lung cancer.** People with a father, mother, brother, sister or child with lung cancer have an enlarged risk of this disease.

1.5.2 Complications

Lung cancer can generate difficulties, such as:

- **Shortness of breath.** Persons that have lung cancer may have shortness of breath if cancer develops to block the major airways. Lung cancer can also cause fluid to accumulate around the lungs, making it tougher for the pretentious lung to enlarge completely when a person breath.
- **Coughing up blood.** Lung cancer can generates blood loss in the airway, which make a person to cough up blood (hemoptysis). Sometimes bleeding can become severe. Treatments can control the bleeding.
- **Pain.** Radical lung cancer that feasts to the lining of a lung or to other areas of the body, such as a bone, may cause pain. One should inform his doctor if he feel pain, because several treatments method are exist to control pain.
- **Fluid in the chest (pleural effusion).** Lung cancer can generates fluid deposited in the space that surrounds the pretentious lung in the chest cavity (pleural space).

Fluid deposited in the chest can cause shortness of breath. Treatments exist to drain the fluid from a person chest and decrease the risk that pleural effusion will happen all over again.

- **Cancer that feasts to other parts of the body (metastasis).** Lung cancer frequently feasts (metastasizes) to other parts of the body, for instance the bones and the brain.
  Cancer that feasts can cause nausea, headaches, pain, or other signs and indications contingent on what organ is pretentious. Once lung cancer has feast afar the lungs, it's normally not curable. Treatments exist to reduce signs and symptoms and to help a person live longer.

1.5.3 Prevention

There's no guaranteed way to stop lung cancer, but one can decrease a person risk if he:

- **Does not smoke.** If one has never smoked, he should not start. Children awareness about not smoking so that they can comprehend how to elude this main risk feature for lung cancer. Start chats about the hazards of smoking with your children early so that they see how to respond to peer pressure.
- **Stop smoking.** Any person should stop smoking today. Stopping decreases a person risk of lung cancer, even if one has smoked for years. He should talk to his doctor about methods and stop-smoking aids that can help him to quit. Choices comprise nicotine replacement products, medications and support groups.
- **Avoid sitting next to a smoker.** If one lives or work with a smoker, he should urge him to quit. At the very least, he should be ask him to smoke outside. One should avoid areas where people smoke, for example bars and restaurants, and look for smoke-free places.
- **Test of one's home for radon.** Have the radon levels in one's home tested, mainly if one lives in an area where radon is recognized to be a problem. High radon levels can be cured to make one's home harmless. For evidence on radon testing, contact one's local department of public health or a local chapter of the Lung Association.
- **Avoid carcinogens at work.** Take safety measures to safeguard oneself from disclosure to toxic chemicals at work. Follow one employer's precautions. For example, if one is given a face mask for safety, continuously wear it. One should ask his doctor what more he can do to protect himself at work. One risk of lung injury from workplace carcinogens upsurges if one smokes.
- **Eat a diet full of vegetables and fruits.** One should select a healthy diet with a diversity of fruits and vegetables. Food sources of vitamins and nutrients are the greatest. One should avoid taking big doses of vitamins in pill forms, as they may be dangerous. For example, researchers eager to reduce the risk of lung cancer in heavy smokers provide them beta carotene supplements. It has been shown the supplements actually increased the risk of cancer in smokers.

2. ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI) has been well-known as the area of computer science dedicated to producing programs capable of refined, intelligent[30-55], computations like to those that the human brain regularly makes. It contains approaches, tools and systems dedicated to simulate human procedures of logical and inductive knowledge acquisition, reasoning of brain doings for resolving problems. There are 2 key types of AI developments. The first comprises approaches and systems that simulate human knowledge and draw conclusions from a group of rules, for example expert systems. The second comprises systems that model the way the brain works, such as, Artificial Neural Networks (ANNs)

2.1 Artificial neural networks

An artificial neural network is a biologically motivated computational model made from hundreds of single units, artificial neurons, connected with coefficients (weights) which establish the neural structure. They are well-known as processing elements (PE) as they process information.
Every PE has weighted inputs, transfer function and one output. PE is fundamentally an equation which balances inputs and outputs. ANNs are similarly named connectionist models as the connection weights signify the memory of the system.

Though a single neuron can do specific simple information processing jobs, the power of neural computations come from connecting neurons in a network. The hypothetical intelligence of artificial neural networks is a matter of argument. Artificial neural networks often have more than a few hundred or a few thousand PEs, whereas the human brain has 100 billion neurons.

There are various kinds of neural networks intended by now and new ones are designed every week but all can be defined by the transfer functions of their neurons, by the connection formula and by the learning rule.

2.2 Neurons

The artificial neuron is the structure component of the ANN intended to mimic the function of the biological neuron[8-28]. The incoming signals, named inputs, multiplied by the connection weights (adjusted) are first summed (combined) and then passed

through a transfer function to yield the output for that neuron[29-39]. The activation function is the weighed sum of the neuron's inputs and the most frequently used transfer function is the sigmoid function (Fig. 2.).

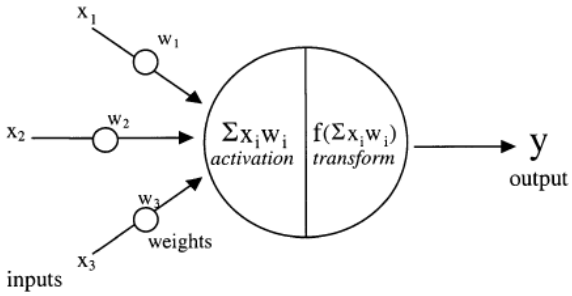

Figure 2: sigmoid function

2.3 Connection formula

The technique that the neurons are connected to each other has a important impact on the process of the artificial neural network. Just similar to real neurons, artificial neurons can take both excitatory and inhibitory inputs. Excitatory inputs cause the summing mechanism of the next neuron to add while the inhibitory inputs cause it to subtract. A neuron can also inhibit other neurons in the same layer. This is named lateral inhibition.
The network wants to 'choose' the highest probability and inhibit all others. This concept is also named competition.
Feedback is another kind of connection where the output of one layer goes back to the input of a previous layer, or to same layer. Two kinds of architecture may be recognized conferring to the absence or presence of feedback connection in a network. Feedforward architecture does not have a connection back from the output to the input neurons and therefore does not keep a record of its previous output values (Fig. 3).

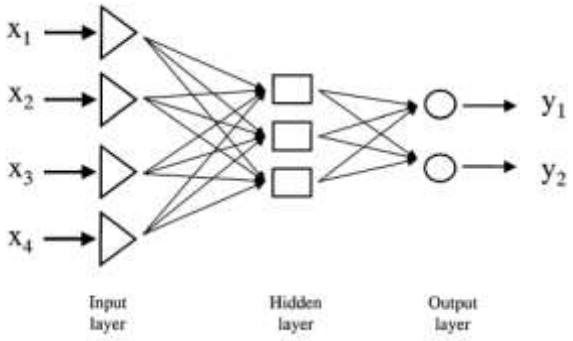

Figure 3: Feedforward architecture does not have a connection back

Feedback architecture has connections from output to input neurons. Each neuron has one extra weight as an input that will permit an extra degree of freedom when trying to minimize the training error. Such a network retains a memory of previous state so that next state be governed by not only on input signals but also on the previous states of the network.

2.4 Learning rule

There are numerous dissimilar learning rules but the most frequently used is the Delta rule or Back-propagation rule. A neural network is trained to map a set of input data by iterative adjustment of the weights. The use of the weighted links is vital to the ANN's recognizing abilities. Information from inputs is fed forward through the network to enhance the weights between neurons. Optimization of the weights is done by backward propagation of the error during training or learning phase.
The ANN reads the input and output values in the training data set and changes the value of the weighted links to decrease the difference between the predicted and target values. The error in prediction is minimized across numerous training cycles until network reaches specified level of accuracy.

3. METHODOLOGY

By looking deeply through the literature and soliciting the experience of DNA Lung Cancer, a number of factors that are considered to have an effect on the performance of a DNA Lung Cancer were outlined. These factors were cautiously studied and synchronized into a convenient number appropriate for computer coding within the environment of the ANN modeling. These factors were classified as input variables. The output variables embody some likely levels of performance of a DNA Lung Cancer where the patient has adenocarcinoma lung cancer or not.

2.5 The Input Variables

Input variable represent gene names were given numeric abbreviations (row 1) as seen in figure 1.
These variables were converted into a format suitable for neural network analysis in Just Neural Network (JNN) tool environment as seen in figure 1.

	A	B	C	D	E	F	G	H	I	J
1	17	80	123	214	348	388	446	Record Na	Class	OUTPUT
2	R	R	R	R	R	R	R	C	C	R
3	I	I	I	I	I	I	I	U	U	O
4	114.31	46.18	54.28	63.2	423.72	91.59	666.18	AD043	AD	1
5	32.48	35.66	67.52	965.47	198.04	67.52	332.53	AD111	AD	1
6	101.705	83.9	216.965	2940.51	402.73	173.205	389.07	AD114	AD	1
7	100.605	77.185	251.77	64.07	219.995	68.54	261.395	AD115	AD	1
8	126.53	2.07	314.15	3451.94	325.21	98.22	682.2	AD118	AD	1
9	109.79	0	253.55	185.79	620.31	81.72	677.09	AD119	AD	1
10	29.48	44.515	224.455	87.105	268.06	70.91	312.305	AD120	AD	1
11	11.66	0	140.82	48.94	741.72	119.59	985.13	AD122	AD	1
12	161.465	0	279.25	35.715	408.495	95.255	537.14	AD123	AD	1
13	0	366.3	191.99	540.97	373.62	52.3	373.62	AD249	AD	1
14	60.26	0	257.87	2621.88	285.01	172.73	747.86	AD250	AD	1
15	333.7	96.72	570.1	363.82	121.9	56.31	307.29	AD252	AD	1
16	130.93	364	281.68	2593.88	358.49	183.92	474.16	AD253	AD	1
17	739.787	1660.21	1554.3	5591.65	265.603	198.987	536.717	AD255	AD	1
18	292.665	111.047	666.43	4302.77	335.088	156.68	595.327	AD258	AD	1
19	543.22	1.36	1136.42	2098.52	856.91	197.85	1060.23	AD259	AD	1
20	171.28	304.57	438.43	4985.82	591.63	209.12	990.195	AD260	AD	1
21	2400.99	987.28	3352.69	749.51	454.81	325.73	992.71	AD261	AD	1
22	2250.74	155.77	3055.18	1342.93	335.045	112.075	943.43	AD262	AD	1
23	84.07	324.09	209.54	3575.75	683.5	221.43	778.65	AD266	AD	1
24	690.91	1525.01	1195.69	5181.95	138.06	172.23	439.31	AD267	AD	1
25	96.28	12.1733	358.93	70.0167	133.073	58.4667	179.09	AD268	AD	1
26	0	767.06	172.52	3360.72	155.38	99.03	522.49	AD269	AD	1
27	111.97	0	200.44	41.91	263.11	106.44	470.5	AD275	AD	1
28	37.6	0	111.52	307.58	228.815	206.415	481.645	AD276	AD	1

Figure 1: input variables.

3.2 The Output Variable

The output variable represents the performance of a DNA Lung Cancer of whether patient has adenocarcinoma lung cancer or not. The output variable is based on the current DNA Lung Cancer Data.

4. EVALUATION

The dataset contains 2 Classes: 139 adenocarcinoma and 17 normal lung samples. The training samples consists of 103 training and 53 test samples. The dataset was obtained from http://www.research.dfci.harvard.edu/meyersonlab/lungca/data.html. The original data contains 675 attributes. Seven of the most significant are given in the current dataset. Numeric abbreviations are given for gene names.
The final ANN architecture used form training the LUNG Dataset is shown in figure 4. The most important factors affecting the DNA Lung Cancer were outlined as shown in Figure 5. JNN tool read the data set and was trained and validated and tested. The accuracy reached 100% as seen in Figure 6.

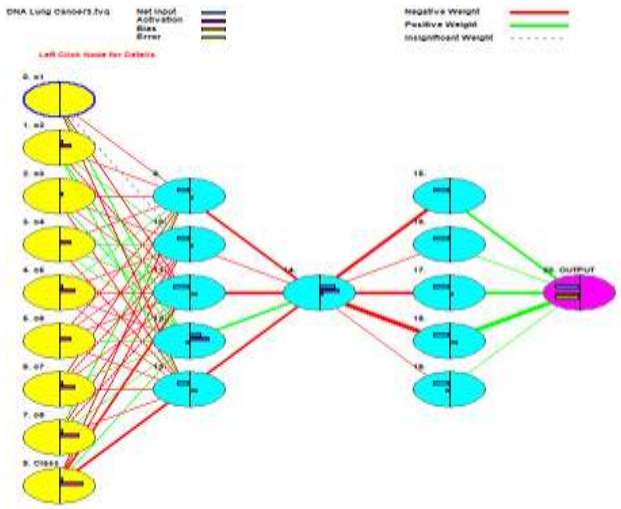

Figure 4: shows the final ANN architecture of DNA Lung Cancer

DNA Lung Cancer3.tvq 101 cycles. Target error 0.0100 Average training error 0.000085
The first 9 of 9 Inputs in descending order.

Column	Input Name	Importance	Relative Importance
8	Class	10.3448	
5	c6	3.5116	
2	c3	2.6068	
7	c8	2.4391	
0	c1	2.3059	
6	c7	2.1698	
4	c5	1.2282	
1	c2	1.1675	
3	c4	1.1071	

Figure 5: shows the most important factors affecting the DNA Lung Cancer.

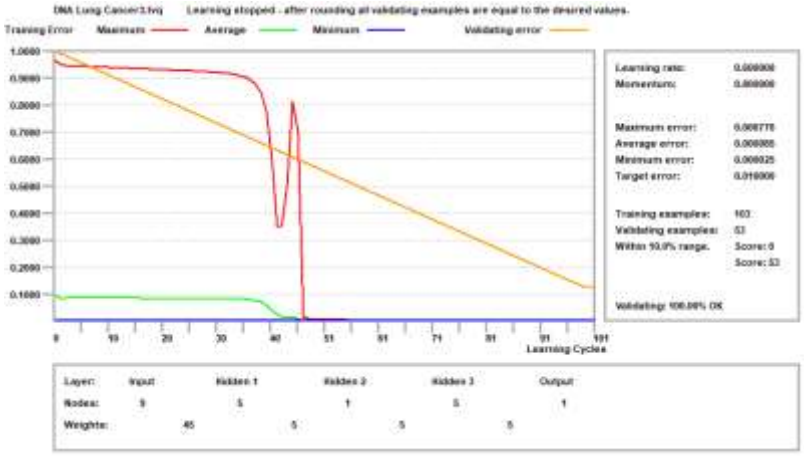

Figure 6 shows the training and validating of the dataset DNA Lung Cancer.

5. CONCLUSION

Lung cancer is a very dangerous disease worldwide in the course of revealing the lung cancer this disease plays a very significant role to evade grave phases and to decrease its development in the world. Artificial Neural network model is a diagnostic system that achieves at an accuracy level is Built. The prediction of Lung cancer diseases can aid doctor to plan for an improved medication and offer the patient with timely diagnosis. In this paper, ANN model was trained, validated, tested, and the accuracy was 100%. Just Neural Network (JNN) was used for the training and valuation and testing.

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