A Computational Prototype for the Characterization of Jaundice Blood and Comparative Study on the Efficacy of Allopathy and Unani Treatments Using Spectral Data

S.Djodilatchoumy

Dept. of Computer Science & Applications, Pachaiyappa's College, Chennai-600030*, India.*
djodilatchoumy@hotmail.com

Abstract

The goal of this study is to train the prototype (Neural Network [NN]) to identify jaundice blood from the normal type. Also to make a comparative study on the efficacy of Allopathy and Unani treatments using the prototype which is already trained to identify the Jaundice blood.

Keywords: Jaundice, Blood, Neural Network.

1. Introduction

Jaundice, also known as icterus, is a yellowish discoloration of the skin, the conjunctival membranes over the sclerae and other mucous membranes caused by hyperbilirubinemia. This hyperbilirubinemia subsequently causes increased levels of bilirubin in the extracellular fluids. Typically, the concentration of bilirubin in the plasma must exceed 1.5 mg/dL (Guyton et al., 2005) (> 35 micromoles/L), three times the usual value of approximately 0.5 mg/dL, for the coloration to be easily visible. Jaundice comes from the French word **jaune**, meaning yellow.

One of the first tissues to change color as bilirubin levels rise in jaundice is the conjunctiva of the eye, a condition sometimes referred to as scleral icterus. However, the sclera themselves are not "icteric" but rather the conjunctival membranes that overlie them. The yellowing of the white of the eye is thus more properly conjunctival icterus.

When a pathological process interferes with the normal functioning of the metabolism and excretion of bilirubin just described, jaundice may be the result. Jaundice is classified into three categories, depending on which part of the physiological mechanism the pathology affects. The three categories are Pre-hepatic in which the pathology is located prior to the liver, Hepatic in which the pathology is located within the liver and Post-Hepatic in which the pathology is located after the conjugation of bilirubin in the liver.

Though investigations on characterisation of Jaundice blood and Comparative study on the efficacy of Allopathy and Unani treatments on Jaundice patients have been done by many, not much work is done on automation of this investigation.

The goal of this study is to train the prototype (Neural Network [NN]) to identify whether the given blood sample is Jaundice or not, across the dose range on R1, R2, R3 and R4 where R1, R2, R3, R4 are Intensity Ratio Parameters. R1 is given by A_{1170}/A_{1080} which is due to the ratio of intensities of ring vibrational mode of C-O-H and C-O-C bonds and C-O stretch of glucose region. R2 is given by A_{1652}/A_{1543} which is due to the ratio of intensities of amide- I band mainly due to C= O stretching vibration amide groups and amide – II bond due to the N-H bending vibration strongly coupled to the C-N stretching vibration of protein. R3 is given by A_{2960}/A_{2873} which is due to the ratio of the intensities of asymmetric stretching vibration of CH_3 of proteins and lipids and symmetric stretching vibrations of methyl group of proteins and lipids. R4 is given by A_{3303}/A_{3068} which is due to the ratio of intensities of amide-A and amide-B bands (Uthra, 2007) and also to make a comparative study on the efficacy of Allopathy and Unani treatments using the prototype which is already trained to identify the Jaundice blood (Djodilatchoumy et al., 2008).

2. Experimental Description

For characterization of Jaundice blood, three-layered feed forward back propagation network is used. The prototype consists of 3 layers namely (i) input layer, (ii) hidden layer (iii) output layer with 1 neuron. The value of the output neuron varies from 0 to 1(value 0 indicates the most healthy blood and value 1 indicates the most diseased blood).

Two ml of blood samples were collected from 18 healthy subjects and 18 jaundice patients from Vijaya Hospital, Chennai, India. For the characterization of Jaundice blood, the FTIR spectra of blood sera of the collected 36 samples were recorded and fed as input to train the model (Ronald et al., 2000). The training sample numbers 1-9 and 19-27 identify the healthy group and training sample numbers 10-18 and 28-36 identify the diseased group (Table 3).

The model has 4 neurons in the input layer each corresponding to R1, R2, R3 and R4. Then it is trained by varying the number of neurons in the hidden layer. The calculated weight is given in Table 1.

The comparative study on the efficacy of the treatment Allopathy and Unani for jaundice patients is made using the prototype that is already trained to characterize the jaundice blood across the dose range R1, R2, R3 and R4 where R1, R2, R3, R4 are Intensity Ratio Parameters.

To make a comparative study on efficacy of allopathy and Unani treatment, the blood samples were collected from Vijaya Hospital, Chennai, India. Thirty patients were chosen for the investigation and the patients were divided into two groups A and B. Group A was prescribed with Allopathic medicine and Group B with Unani medicine. A final check up was performed over a period of 3 months after the treatment was initiated.

Before the drug therapy, the FTIR spectra of blood sera of both the groups were recorded and the spectral data were fed as input to the model and the output was noted down (pre-treatment). To find the efficacy of Allopathy and Unani, the FTIR spectra were recorded after 3 months and the spectral data were fed as input to the model and the final output were noted down (post treatment) (Uthra, 2007).

Table .1 *The calculated weight*

Weight	Value
Weight IH 1 – 1	-0.496033
Weight IH 1 – 2	0.036973
Weight IH 1 – 3	-0.055712
Weight IH 1 – 4	-0.334834
Weight IH 2– 1	2.970681
Weight IH 2 – 2	-3.623341
Weight IH 2 – 3	-2.564096
Weight IH 2 – 4	2.333155
Weight IH 3 – 1	-1.886706
Weight IH 3 - 2	2.149901
Weight IH 3 – 3	1.632985
Weight IH 3 – 4	-1.043687
Weight IH 4 – 1	-2.660404
Weight IH 4 – 2	3.544345
Weight IH 4 – 3	2.265600
Weight IH 4 – 4	-1.824172
Weight OH 1 – 1	5.558615
Weight OH 2– 1	-6.887596
Weight OH 3 – 1	-4.061912
Weight OH 4 – 1	3.672770

Table .2 *the hidden layer (33,720 iterations)*

No. of neurons in hidden layer	No. of iterations
1	1,37,317
2	59,614
3	69,106
4	33,720
5	36,818

Table .3 *Testing - Training Samples*

Sample No.	R1	R2	R3	R4	Output
1	0.896200	1.105000	1.340200	1.680100	0.000045
2	0.891200	1.129500	1.355300	1.721800	0.000029
3	0.929700	1.132200	1.412600	1.670900	0.000033
4	0.930900	1.134400	1.353000	1.692900	0.000035
5	0.942500	1.141300	1.359800	1.716300	0.000029
6	0.929600	1.181500	1.375100	1.705300	0.000045
7	0.910400	1.188500	1.392200	1.718300	0.000040
8	0.931800	1.191900	1.403000	1.722400	0.000042
9	0.947700	1.173300	1.408300	1.740600	0.000032
10	0.992200	1.245300	1.221600	1.495200	0.999469
11	0.997700	1.249600	1.170500	1.516900	0.999545
12	0.961500	1.279800	1.258900	1.527100	0.999690
13	0.987100	1.287600	1.262800	1.530100	0.999674
14	0.989600	1.296800	1.279100	1.602400	0.997986
15	0.973200	1.210000	1.293400	1.549900	0.973129
16	0.980000	1.221900	1.314400	1.561200	0.952387
17	0.988100	1.285400	1.289000	1.591100	0.998215
18	0.999400	1.295000	1.320400	1.609800	0.984798
19	0.950800	1.187700	1.434100	1.773400	0.000039
20	0.955200	1.198900	1.410500	1.778800	0.000048
21	0.931900	1.134400	1.353000	1.692900	0.000035
22	0.942500	1.141300	1.359800	1.716300	0.000029
23	0.929600	1.181500	1.375100	1.705300	0.000045
24	0.910400	1.188500	1.392200	1.718300	0.000040
25	0.929700	1.132200	1.412600	1.670900	0.000033
26	0.930900	1.134400	1.353000	1.692900	0.000035
27	0.942500	1.141300	1.359800	1.716300	0.000029
28	0.999400	1.254600	1.202500	1.595900	0.998622
29	0.985500	1.245100	1.254100	1.524500	0.999442
30	0.984500	1.236500	1.235400	1.532400	0.999238
31	0.991200	1.267500	1.262200	1.552300	0.999644
32	0.981500	1.265500	1.256300	1.562400	0.999604
33	0.979900	1.245600	1.264500	1.532400	0.999326
34	0.982100	1.263500	1.264500	1.542300	0.999643
35	0.991100	1.267700	1.262300	1.545500	0.999676
36	0.986800	1.257900	1.259900	1.561200	0.999465

Table .4 *Testing – Random Samples*

Random Sample : 1
Give the input(R1) - 0.8994 Give the input(R2) - 1.1131 Give the input(R3) - 1.3952 Give the input(R4) - 1.5987
Result - .000087
Random Sample : 2
Give the input(R1) - 0.9891 Give the input(R2) - 1.2901 Give the input(R3) - 1.3101 Give the input(R4) - 1.5987
Result - .998937

Table .5 *Allopathy Treatment*

Pre					
Sample No.	R1	R2	R3	R4	Output
1	0.987100	1.287600	1.262800	1.530100	0.999674
2	0.989600	1.296800	1.279100	1.602400	0.997986
3	0.973200	1.210000	1.293400	1.549900	0.973129
4	0.980000	1.221900	1.314400	1.561200	0.952387
5	0.988100	1.285400	1.289000	1.591100	0.998215
6	0.999400	1.295000	1.320400	1.609800	0.984798
7	0.999400	1.254600	1.202500	1.595900	0.998622
8	0.985500	1.245100	1.254100	1.524500	0.999442
9	0.984500	1.236500	1.235400	1.532400	0.999238
10	0.991200	1.267500	1.262200	1.552300	0.999644
11	0.981500	1.265500	1.256300	1.562400	0.999604
12	0.979900	1.245600	1.264500	1.532400	0.999326
13	0.982100	1.263500	1.264500	1.542300	0.999643
14	0.991100	1.267700	1.262300	1.545500	0.999676
15	0.986800	1.257900	1.259900	1.561200	0.999465
Post					
1	0.919900	1.146700	1.392300	1.699700	0.000028
2	0.926600	1.181100	1.374600	1.711100	0.000042
3	0.998400	1.154000	1.372500	1.700900	0.000031
4	0.954800	1.153100	1.365200	1.695200	0.000033
5	0.945800	1.158500	1.348500	1.599500	0.000293
6	0.955900	1.189500	1.300100	1.589300	0.089111
7	0.961400	1.150600	1.310200	1.639800	0.000149
8	0.964500	1.171200	1.375200	1.652800	0.000074
9	0.923800	1.164200	1.369800	1.592300	0.000286
10	0.938800	1.185400	1.380500	1.689500	0.000057
11	0.931000	1.168500	1.379300	1.685200	0.000042
12	0.940100	1.177700	1.365600	1.624700	0.000232
13	0.931100	1.167800	1.380600	1.698500	0.000036
14	0.934500	1.157400	1.380200	1.685200	0.000035
15	0.971200	1.134600	1.276900	1.623500	0.000678

3. Results and Discussion

Fixing the value of the learning parameters to 0.9, the network is trained by varying the number of neurons in the hidden layer. It is observed that the model is trained effectively with 4 neurons in the hidden layer (33,720 iterations) which is shown in Table 2. The results secured by using this model confirmed beyond the doubt that the training samples and random samples are correctly identified which is shown in Table 3 and Table 4 respectively.

The output of pre-treatment (Pre) and post-treatment (Post) for Group A are given in Table 5 and for Group B in Table 6. The percentage of efficacy of the treatments is calculated using the formula (Pre-Post)/Pre * 100 and the results are given in Table 7 and Table 8. The significance of result is also verified statistically using Mann-Whitney U test which is shown in 9.

Table. 6 *Unani Treatment*

Pre					
Sample No.	R1	R2	R3	R4	Output
1	0.987300	1.352200	1.128000	1.399700	0.999716
2	1.003300	1.353100	1.130800	1.401700	0.999716
3	1.028500	1.401600	1.153300	1.424500	0.999716
4	1.038900	1.410100	1.187000	1.361800	0.999716
5	1.049300	1.410900	1.250500	1.433500	0.999716
6	1.078500	1.459700	1.283900	1.288900	0.999552
7	1.095300	1.438600	1.235600	1.454400	0.999716
8	1.049100	1.328300	1.164300	1.411500	0.999716
9	1.059900	1.369000	1.190400	1.401100	0.999716
10	1.021300	1.395400	1.171200	1.399500	0.999716
11	1.035200	1.383400	1.169500	1.312500	0.999716
12	1.021500	1.362400	1.171100	1.295400	0.999716
13	1.034500	1.351200	1.163700	1.380000	0.999716
14	1.045200	1.384700	1.165200	1.401200	0.999716
15	1.012300	1.384600	1.174200	1.361200	0.999716
Post					
1	0.969600	1.199500	1.323200	1.698700	0.000214
2	0.929900	1.195200	1.323400	1.685400	0.000258
3	0.922200	1.156800	1.385200	1.669800	0.000038
4	0.931500	1.145600	1.299800	1.642700	0.000172
5	0.935200	1.152400	1.378900	1.623700	0.000067
6	0.924100	1.159600	1.295600	1.674500	0.000123
7	0.937500	1.165200	1.285400	1.625800	0.001401
8	0.934500	1.158900	1.369900	1.614700	0.000116
9	0.939900	1.164700	1.341600	1.598900	0.000553
10	0.945600	1.152300	1.344500	1.614700	0.000148
11	0.923200	1.148900	1.362400	1.657400	0.000047
12	0.933300	1.157800	1.365600	1.589800	0.000244
13	0.935400	1.162400	1.335700	1.574500	0.001864
14	0.945800	1.164500	1.369800	1.658500	0.000060
15	0.912900	1.157800	1.348700	1.588200	0.000424

Table 7

Sample No.	Efficacy - Allopathy
1	99.997240
2	99.995804
3	99.996832
4	99.996511
5	99.970627
6	90.951342
7	99.985110
8	99.992576
9	99.971375
10	99.994333
11	99.995798
12	99.976803
13	99.996393
14	99.996529
15	99.932148

4. Conclusion

NNs are being used in the detection of various diseases such as hyperlipidemia, chronic renal failure, head and neck squamous cell carcinoma and a variety of health-related indices can also be monitored. (Ronald et al., 2000, Djodilatchoumy et al., 2008) The onset of a particular medical condition could be associated with a very complex combination of changes on a subset of the variables being monitored in medicines. NNs have been used to recognize this predictive pattern, so that the appropriate treatment can be prescribed. FTIR spectroscopy allows accurate lipids concentration determination. Since our NN is trained to distinguish the Jaundice blood with the fine details of FTIR spectra, it can improve the diagnostic accuracy and rate of Jaundice treatment at a faster rate with more accuracy. It can also be used to make a Comparative study between different treatments on Jaundice patients.

Table .8

Sample No.	Efficacy – Unani
1	99.978601
2	99.974230
3	99.996191
4	99.982763
5	99.993309
6	99.987733
7	99.859892
8	99.988404
9	99.944706
10	99.985203
11	99.995258
12	99.975616
13	99.813501
14	99.993994
15	99.957636

Table. 9 *Mann-Whitney U test*

H0: Unani and Allopathy are equally effective.			
H1: Unani and Allopathy are not equally effective.			
Allopathy	Rank1	Unani	Rank2
0.000028	1	0.000214	19
0.000042	7.5	0.000258	22
0.000031	2	0.000038	6
0.000033	3	0.000172	18
0.000293	24	0.000067	12
0.089111	30	0.000123	14
0.000149	17	0.001401	28
0.000074	13	0.000161	15
0.000286	23	0.000553	26
0.000057	10	0.000148	16
0.000042	7.5	0.000047	9
0.000232	20	0.000244	21
0.000036	5	0.001864	29
0.000035	4	0.000060	11
0.000678	27	0.000424	25
Total	194	Total	271
R1=194 R2=271			
n1=15 n2=15			
The value of U statistic is given by $U= n1n2+ \frac{n_1(n_1+1)}{2} -R1 = 15x15+\frac{15(15+1)}{2} -194 = 225+120-194 =151$			
The mean $\mu U = \frac{n_1(n_1+1)}{2} =15x15/2 =112.5$			
The S.D $\sigma_u = \sqrt{\frac{n_1 n_2(n_1+n_2+1)}{12}} = \sqrt{581.25} = 24.109$			
Since n1=n2=15≥10, the sample distribution of U statistics can be approximated by the normal distribution.			
$Z= \frac{U-\mu U}{\sigma U} = \frac{151-112.5}{24.109} =1.598>1.28$			
Therefore H0 is rejected.			
Conclusion: Unani and Allopathy are not equally effective.			

5. References

1. Djodilatchoumy S, Rama N and Gunasekaran S (2008), An intelligent system for the characterization of hyperlipidemic blood and a comparative study on the efficacy of statins, Oriental Journal of Computer Science and Technology, vol1(1), 69-74 .
2. Djodilatchoumy S, Rama N and Gunasekaran S (2008), An intelligent system for the characterization of Chronic Renal failure blood and study on the efficacy of Simvastatin, International Journal of Algorithms, Computing and Mathematics, vol1(2), 7-12.
3. Meneveau N, Schiele F, Vuillemenot A, et al. (1997), Streptokinase vs alteplase in massive pulmonary embolism. A randomized trial assessing right heart haemodynamics and pulmonary vascular obstruction. Eur. Heart J., 18 (7): 1141–8.
4. Pete McCollum (1998), An Introduction To Back-Propagation Neural Networks.
5. Ronald J Gerstle, Stephen R. Aylward, Sharon Kromhour-Schiro and Suresh K. Mukherji (2000), The Role of Neural Networks in improving the accuracy of MR Spectroscopy for the diagnosis of head and neck squamous cell carcinoma, American Journal of Neuroradiology, 21, 1133-1138.
6. Uthra D (2007), Analysis on some materials of Pharmaceutical and Biological interest – Spectroscopic Approach, University of Madras