PREDICTION OF HEART DISEASE USING NEURAL NETWORK

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ABSTRACT

- Heart disease is a deadly disease that large population of people around the world suffers from.
- Traditional way of diagnosis is not sufficient for such an illness.
- System is developed based on deep neural network algorithm with backpropagation algorithm and principal component analysis
- The model is trained with help of clinical features .
- Input :-13 clinical features
- Output :- 0 indicates no heart disease , 1 indicates heart disease

OBJECTIVES

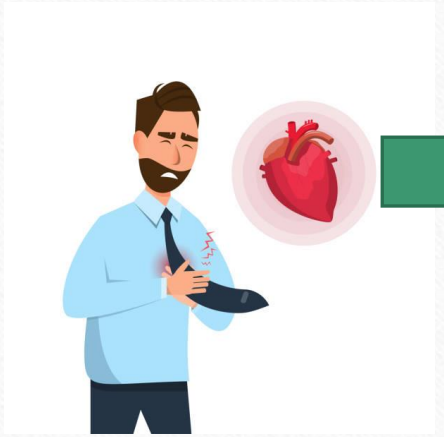
- Better approach in prediction of heart disease rather traditional way.
- Understand the working of Artificial Neural Network .
- How neural network plays important role in prediction of heart disease.
- How the model is created and implemented to predict the disease.
- Advantages of neural network in Diagnosis of heart disease rather than traditional approach.
- Principle Component Analysis in ANN.

INTRODUCTION

- Heart disease is the number one killer according to World Health Organization
- Prediction of heart disease plays a crucial role for the treatment.
- If heart disease could be predicted before, lots of patient deaths would be prevented.
- We can develop a medical diagnosis system to predict if a patient is suffering from heart disease.
- Developing such a system provides better accuracy rather than traditional approach.
- Also saves the time and cost of both patient as well as the doctors.

Real Life Scenario

1) Patient is suffering from certain symptoms.



Normal(traditional method)

2)Doctors tell him to perform certain tests.

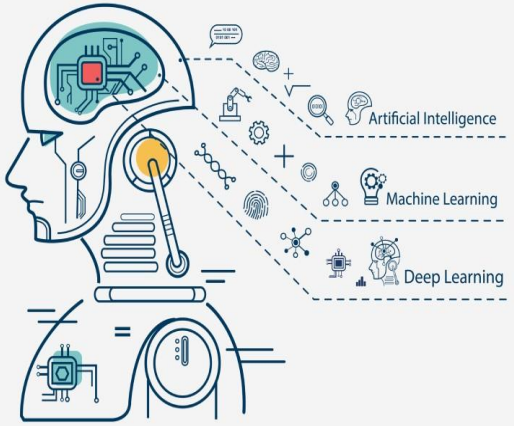
3)Patient performs certain tests . and submits the report

4) Doctors analyse the report and then comes up with conclusion and treatment .

Traditional Methods

- Electrocardiogram
- Cardiac computerized tomography scan (CT scan)
- Cardiac magnetic resonance imaging (MRI)

- But the question is what is the problem with traditional approach in diagnosis of heart disease?
- Traditional diagnostic methods are time consuming and costly
- Then the next question is how will automated medical diagnosis/predict heart disease.
- The answer is using deep learning algorithm
  – **Artificial Neural Network**.



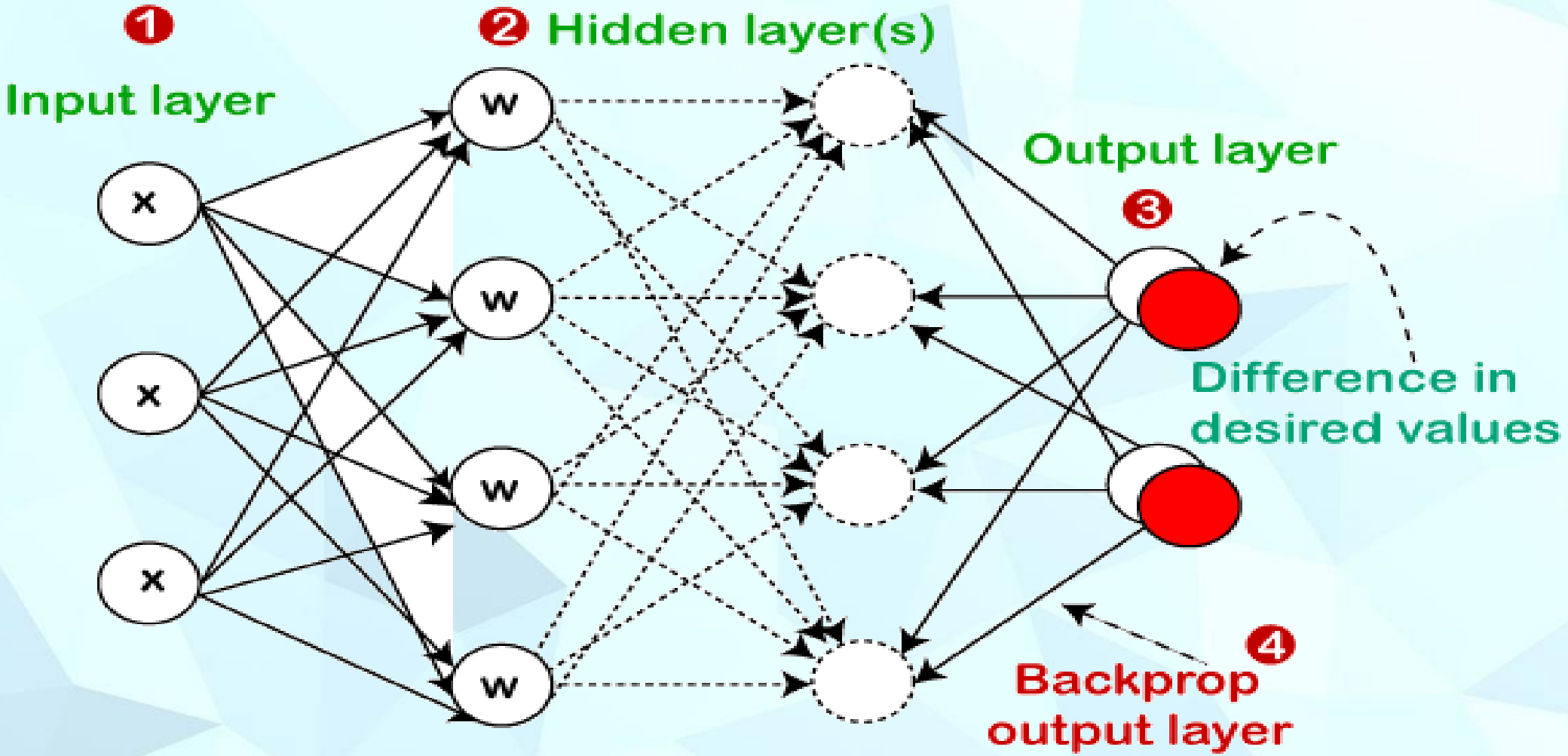
METHODOLOGY

- Prediction is based on input(features) provided by the user.
- Output is categorical (present/absent).
- Algorithm used is Artificial neural Network with Back Propagation.
- Dataset is divided into training , testing and validation.
- The model is trained by providing input(datasets).
- Predict and Principal Component Analysis (PCA) to improve the accuracy of the algorithm.

METHODLOGY

TABLE I.
CLINICAL FEATURES AND THEIR DESCRIPTIONS.

Clinical Features	Description
Age	Age
Ca	Number of major vessels (0-3) colored by flourosopy
Chol(mg/dl)	Serum cholesterol
Cp	Chest pain type
Exang	Exercise induced angina
Fbs	Fasting blood sugar
Num	Diagnosis of heart disease
Oldpeak	ST depression induced by exercise relative to rest
Restecg	Resting electrocardiographic results
Sex	Gender
Slope	The slope of the peak exercise ST segment
Thal	3=normal ; 6 = fixed defect; 7= reversible defect
Thalach	Maximum heart rate achieved
Trestbps(mmHg)	Resting Blood Pressure


1
Input layer
2 Hidden layer(s)
Output layer
3
x
x
x
w
w
w
w
Difference in
desired values
4
Backprop
output layer

METHODOLOGY

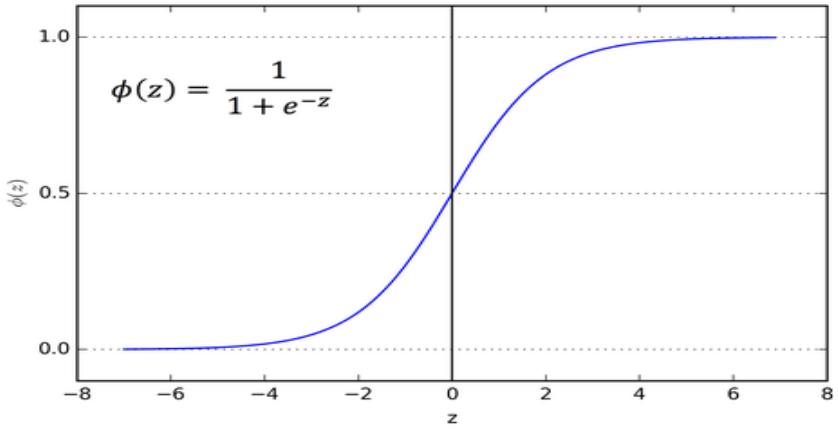
- Input Layer :- Takes 13 input features used for prediction.
- Hidden Layer:- Actual computation begins . Hidden layer includes Sigmoid function. There can be more than 1 hidden layers . Here we have taken 3 hidden layers
- Output Layer:- The actual output obtained to classify the presence or absence of disease .

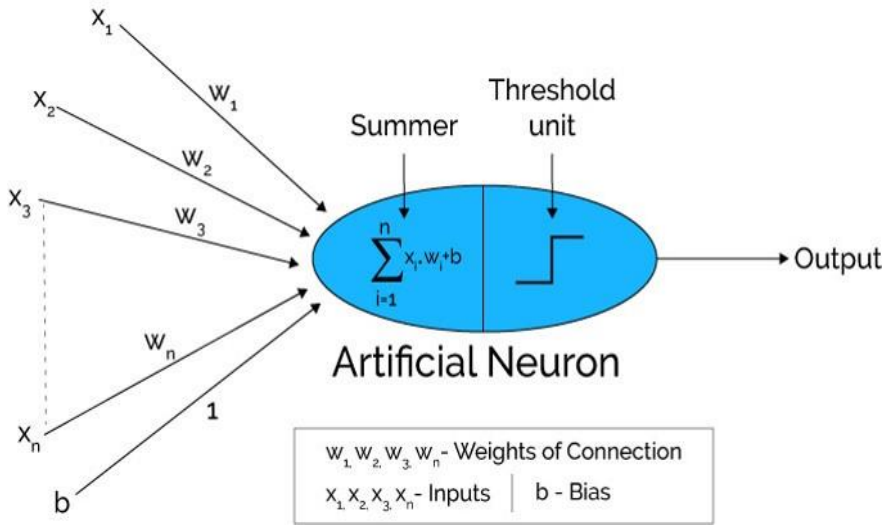
METHODOLOGY

1. ANN has 3 layers input, hidden and output layers.
2. Backpropagation Algorithm :- calculate error and update the weights

- Network weights are initialized to small random numbers.
- Training data is received as input and output is computed

$$o = \sigma(\vec{w} \cdot \vec{x}) \qquad \sigma(y) = \frac{1}{1+e^{-y}}$$





- Error term ∇k is calculated for each network output unit k

$$\delta_k \leftarrow o_k(1-o_k)(t_k-o_k) \qquad (2)$$

METHODOLOGY

- Error term ∇h is calculated for each hidden unit h

$$\delta_h \leftarrow o_h(1-o_h) \sum_{k \in outputs} w_{kh}\delta_k \qquad (3)$$

- Each network weight is updated where

$$w_{ji} \leftarrow w_{ji} + \Delta w_{ji} \quad \text{where } \Delta w_{ji} = \eta \delta_j x_{ji} \qquad (4)$$

- The dataset consists of 303 instances , 13 features and 1 target attribute.

RESULT OBTAINED

- Performance evaluation was based on accuracy , precision and recall.
- Accuracy was computed using

$$Accuracy=(TP+TN)/(TP+TN+FP+FN)$$

- Precision was computed using

$$Precision=TP/(TP+FP)$$

- Recall was calculated using

$$Recall=TP/(TP+FN)$$

- To improve the accuracy the size of hidden layers were changed from 3 to 12 neurons
- Accuracy was compared with/without PCA (Principal Component Analysis)

CLASSIFICATION PERFORMANCE WITHOUT PCA(Principal Component Analysis)

Hidden Layer Size	Accuracy	Recall	Precision
3	82.222222%	85.714286%	78.260870%
4	75.555556%	77.777778%	66.666667%
5	84.444444%	86.206897%	89.285714%
6	75.555556%	85.185185%	76.666667%
7	82.222222%	82.222222%	84.000000%
8	86.666666%	86.666667%	86.956522%
9	71.111111%	71.111111%	70.833333%
10	86.666667%	86.666667%	80.952381%
11	77.777778%	77.777778%	73.913043%
12	84.444444%	84.444444%	83.333333%

CLASSIFICATION PERFORMANCE WITH PCA(Principal Component Analysis

Hidden Layer Size	Accuracy	Recall	Precision
3	91.111111%	84.615385%	100.00000%
4	88.888889%	95.454545%	84.000000%
5	88.888889%	88.888889%	92.307692%
6	86.666667%	89.473684%	80.952381%
7	93.333333%	100.00000%	89.285714%
8	95.555556%	95.454545%	95.454545%
9	91.111111%	95.833333%	88.461538%
10	91.111111%	100.00000%	85.185185%
11	95.555556%	100.00000%	91.666667%
12	91.111111%	95.652174%	88.000000%

CONCLUSION

- The proposed heart disease prediction system has been designed as a Multilayer Perceptron Neural Network.
- The neural network in the system used 13 clinical data which are obtained from Cleveland Dataset as input.
- It was trained with Backpropagation Algorithm in order to predict whether heart disease present or not in the patient.
- As a further study, the proposed methodology can be enhanced as a hybrid model with other classification algorithms and try applying other feature selection techniques

References

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THANK YOU