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APPLICATION OF HEPTAGONAL FUZZY NUMBER IN NEURAL NETWORK

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A B S T R A C T **RESEARCH ARTICLE**

In this paper we find out which person most affected in ricemill, by using heptagonal fuzzy number in feed forward neural network.

Keywords:

Fuzzy number, heptagonal fuzzy number, neural network, feed forward neural network and feed forward algorithm.

1. Introduction

In 1965, Zadeh Introduced the Fuzzy sets to represent and information possessing non-statistical certainties. However, the story of fuzzy logic started much earlier. The rotation of an infinite valued logic was "Fuzzy Set" where he described the mathematics of fuzzy set theory, and by extension fuzzy logic. Many operarations were carried out using fuzzy numbers. Fuzzy neural networks are usually based on neural network architecture with fuzzification of inputs, outputs, weights, or rules that are applied using fuzzy system.

2. Preliminaries

2.1 Definition: Fuzzy Number a fuzzy number A is a fuzzy set on the real line R, must satisfy the following conditions;
i)$\mu_{\tilde{A}}(x_0)$ is piecewise continuous
ii)There exist at least one $x_0 \in R$ with
$\mu_{\tilde{A}}(x_0) = 1$
iii)$\mu_{\tilde{A}}$ must be normal and convex.

2.2 Types of fuzzy numbers :
There are many types of fuzzy numbers they are
Triangular Fuzzy Number
Trapezoidal Fuzzy Number
Pentagonal Fuzzy Number
Hexagonal Fuzzy Number
Heptagonal Fuzzy Number
Octagonal Fuzzy Number

In this section feed-forward neural network is to solve heptagonal fuzzy number

Definition2.3 (Triangular fuzzy number). Triangular fuzzy number is defined as $\tilde{A} = \{a,b,c\}$ where all a,b,c are real numbers and its membership function is given below

$$\frac{(x-a)}{(b-a)}, \quad \text{for } a \le x \le b$$

$$\mu_{\tilde{A}}(x_0) = \begin{cases} \frac{(c-x)}{(c-b)}, & \text{for } b \le x \le c \\ \frac{(c-x)}{(c-b)}, & \text{for } b \le x \le c \\ 0, & \text{otherwise.} \end{cases}$$

Definition 2.4 (Pentagonal fuzzy number). A pentagonal fuzzy number of a fuzzy set P is defined as P={a,b,c,d,e} and its membership functions is given by

$$\mu_P(x) = \begin{cases} 0, & \text{for } x<a \\ \frac{(x-a)}{(b-a)}, & \text{for } a \le x \le b \\ \frac{(x-b)}{(c-a)}, & \text{for } b \le x \le c \\ 1, & \text{for } x=c \\ \frac{(d-x)}{(d-c)}, & \text{for } c \le x \le d \\ \frac{(e-x)}{(e-d)}, & \text{for } d \le x \le e \\ 0, & \text{for } x > e \end{cases}$$

Definition 2.5 Hexagonal Fuzzy number: A fuzzy number $\tilde{A}_h$ is a hexagonal fuzzy number denoted by

$\tilde{A}_h = (a_1, a_2, a_3, a_4, a_5, a_6)$ are real numbers satisfying $a_2-a_1 \le a_3-a_2$ and $a_5-a_4 \le a_6-a_5$, if its membership function $\mu_{\tilde{A}h}(x)$ is given by,

$$\mu_{\bar{A}\,h}(x) = \begin{cases} 0, & \text{for } x < a_1 \\ \frac{1(x-a1)}{2(a2-a1)}, & \text{for } a_1 \le x \le a_2 \\ \frac{1}{2}+\frac{1(x-a2)}{2(a3-a2)}, & \text{for } a_2 \le x \le a_3 \\ 1, & \text{for } a_3 \le x \le a_4 \\ 1-\frac{1(x-a4)}{2(a5-a4)}, & \text{for } a_4 \le x \le a_5 \\ \frac{1(a6-x)}{2(a6-a5)}, & \text{for } a_5 \le x \le a_6 \\ 0, & \text{for } x > a_6 \end{cases}$$

Definition 2.6 Heptagonal Fuzzy Number: A Heptagonal Fuzzy number $\bar{A}_{hp} = (a_1,a_2,a_3,a_4,a_5,a_6,a_7)$ is a subset of fuzzy number in R with following membership function,

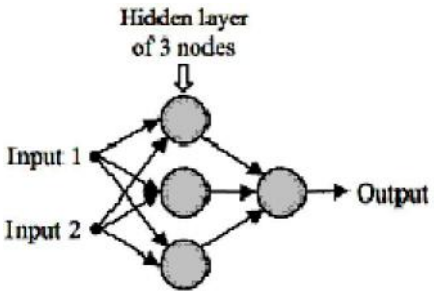
$$\mu_{\bar{A}\,hp}(x) = \begin{cases} \frac{1(x-a1)}{2(a2-a1)}, & \text{for } a_1 \le x \le a_2 \\ \frac{1}{2}, & \text{for } a_2 \le x \le a_3 \\ \frac{1(X-a4)}{2(a4-a3)} + 1, & \text{for } a_3 \le x \le a_4 \\ \frac{1(a4-x)}{2(a5-a4)} + 1, & \text{for } a_4 \le x \le a_5 \\ \frac{1}{2}, & \text{for } a_5 \le x \le a_6 \\ \frac{1(a7-x)}{2(a7-a6)}, & \text{for } a_6 \le x \le a_7 \\ 0, & \text{otherwise} \end{cases}$$

3. Neural Network

An artificial neural network is an information processing system that has certain performance characteristics in common with biological neural network. Artificial neural networks have been developed as generalizations of mathematical models of human cognition or neural biology, based on the assumptions that:

i) Information processing occurs at many simple elements called neurons.
ii) Signals are passed between neurons over connection links.
iii) Each connection link has an associated weight, which multiplies the signal transmitted.
iv) Each neuron applies an activation function (Usually nonlinear) to its net input (Sum of Weighted Input Signals) to determine its Output Signals.

The following figure illustrates a fully connected two input, Single-output, feed-forward, multilayer network with a single hidden layer consisting of three nodes.



3.1 Feed Forward Fuzzy Neural Networks

A feedforward neural network is an artificial neural network wherein connections between the units do not form a cycle. As such, it is different from recurrent neural networks. The feedforward neural network was the first and simplest type of artificial neural network devised. In this network, the information moves only one direction, forward, from the input nodes, through the hidden nodes (if any) and to the output nodes.

3.2 Activation Function

According to Faqs. Org [2010] activation function are needed for hidden layer of the NN to introduce non-linearity. Without them NN would ne same as plain perceptions. If linear function were used, NN would not be as powerful as they are. Activation function can be linear, threshold or sigmoid function. Sigmoid activation function is usually used for hidden layer because it combines nearly linear behavior, curvilinear behavior and nearly constant behavior depending on the input value Larose. To explain activation function figure 2 will be used.

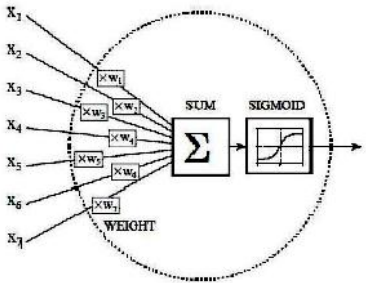


FIGURE 2

SUM is collection of the output nodes from hidden layer that have been multiplied by connection weights, added to get single number output through sigmoid function (activation function). Input to sigmoid is any value between negative infinity and positive infinity number while the output can only be a number between 0 and 1.

4. Algorithm for feed forward Neural Network

In this section feed forward Neural network is to solve heptagonal fuzzy number

Step 1: Gather the imprecise estimation needed for the problem which is in the form of heptagonal fuzzy number.

Step 2 : Convert the element of heptagonal fuzzy number into its membership function.

Step 3: Set the element of hetagonal fuzzy number is weight of the FFN

Step 4: Assume the input value 0 and 1
Step 5: Calculate the weighted sums $m=\sum x_i w_i$
Step 6: The output of a neuron (s) is a function of the weighted sum S=f(m)
Step 7: Calculated sigmoid function by f(m)=1.0/(1.0+exp(-m))
Step 8: Determine the minimum value of f(m).

5. Numerical example

Suppose there are three working men m_1, m_2, m_3. Let the Possible attributes to the above men w={a, b, c, d, e, f, g} as universal set , where a, b, c, d, e, f, g, represents the disease Phlegm, Dyspnea, Skin disease, Respiratory disease, Hearing Problem, Lungs Problem, nose irritation . Estimate the heptagonal fuzzy number in three men m_1, m_2, m_3 by considering to most affected person in ricemill.

Step1: $\mathbf{W_1}$=(1, 2, 3, 4, 5, 6, 7) $\mathbf{W_2}$=(2, 3, 4, 5, 6, 7,8) $\mathbf{W_3}$=(3, 4, 5, 6, 7,8,9)

Step2: Convert the heptagonal fuzzy number into membership function,

$\mathbf{W_1}$=(0.0,0.1, 0.2,.0.3,0. 0.4, 0.5, 0.6,) $\mathbf{W_2}$=(0.2, 0.3, 0.4, 0.5, 0.6, 0.7,0.8) $\mathbf{W_3}$=(0.3, 0.4, 0.5, 0.6, 0.7,0.8,0.9)

Step3: Consider the heptagonal fuzzy number is fuzzy weights w_{ij}
$\mathbf{w_{11}}$=0.0, $\mathbf{w_{12}}$=0.1, $\mathbf{w_{13}}$=0.2, $\mathbf{w_{14}}$=0.3, $\mathbf{w_{15}}$=0.4, $\mathbf{w_{16}}$=0.5, $\mathbf{w_{17}}$=0.6
$\mathbf{w_{21}}$=0.2**,** $\mathbf{w_{22}}$=0.3, $\mathbf{w_{23}}$=0.4, $\mathbf{w_{24}}$=0.5, $\mathbf{w_{25}}$=0.6, $\mathbf{w_{26}}$=0.7, $\mathbf{w_{27}}$=0.8

$\mathbf{w_{31}}$=0.3, $\mathbf{w_{32}}$=0.4, $\mathbf{w_{33}}$=0.5, $\mathbf{w_{34}}$=0.6, $\mathbf{w_{35}}$=0.7, $\mathbf{w_{36}}$=0.8, $\mathbf{w_{37}}$=0.9

Step 4: Assume input value
X = (0,0,0,1,1,1,1)
x_1=0, x_2=0, x_3=0, x_4=1, x_5=1, x_6=1, x_7=1.
Setp 5: Calculate the weighted sum $m=\sum w_{ij}\ x_i$ Where i,j=1,2,3,4,5,6,7
$M_1= w_{11}x_1+w_{12}x_2+w_{13}x_3+w_{14}x_4+w_{15}x_5+w_{16}x_6+w_{17}x_7$
=(0.0)(0)+(0.1)(0)+(0.2)(0)+(0.3)(1)+(0.4)(1)+(0.5)(1)+(0.6)(1)
=0+0+0+0.3+0.4+0.5+0.6
M_1=1.8
M_2=w21x1+w22x2+w23x3+w24x4+w25x5+w26x6+w27x7
=(0.1)(0)+(0.2)(0)+(0.3)(0)+(0.4)(1)+(0.5)(1)(0.6)(1)+(0.7)(1)
=0+0+0+0.4+0.5+0.6+0.7
M_2 =2.2
$M_3=w_{31}x_1+w_{32}x_2+w_{33}x_3+w_{34}x_4+w_{35}x_5+w_{36}x_6+w_{37}x_7$
=(0.2)(0)+(0.3)(0)+(0.4)(0)+(0.5)(1)+(0.6)(1)+(0.7)(1)(0.8)(1)
M_3=2.6
Step 6: The output neuron is
$S_1 = f(m_1) = 1.8$
$S_2 = f(m_2) = 2.2$
$S_3 = f(m_3) = 2.6$
Step 7: Calculate the sigmoid function
f(m)=1.0/(1.0+exp(-m)
$f(m_1)$=1.0/(1.0+exp(-m_1)
f(-1.8)=1.0/(1.0+exp(-1.8)
=0.85814
$f(m_2)$=1.0/(1.0+exp(-m_2)
f(-2.2)=1.0/(1.0+exp(-2.2)
=0.90024
f(m)=1.0/(1.0+exp(-m)
$f(m_3)$=1.0/(1.0+exp(-m_3)
f(-2.6)=1.0/(1.0+exp(-2.6)
$f(m_3)$ =0.93086
Step 8: Determine the minimum value
$f(m_1)$=0.85814
$f(m_2)$=0.90024
$f(m_3)$=0.93086
The minimum value is 0.85814
so m_1 the most affected person.

Conclusion

Thus we have recalled some basic definition and we have taken three working people in rice mill. Finally the conclusion for most affected person using heptagonal fuzzy number in feed forward neural network. Thus m_1 is the most affected person.

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