NEURAL NETWORK BASED FORECASTING OF DAILY TYRE PRODUCTION AT LOADSTAR (PVT)LTD

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OUTLINE

- Introduction
- Objective
- Mathematical background
- Methodology
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- Discussion

Introduction

Loadstar

- In 1984 Loadstar company was created with the corporation between Belgium Solidial Company and the pioneer Sri Lankan engineering technologists Jinasena group of companies.

- Midigama tyre factory is a one of major factory in a Jinasena group companies.

Introduction (Cont'd)

Loadstar

- There are 16 modules functioning in the factory.
- Each module contain approximately 30-40 machines.
- They production of Industrial solid tyres, Industrial air tyres, Rubber tracks, wheels for industrial vehicles.

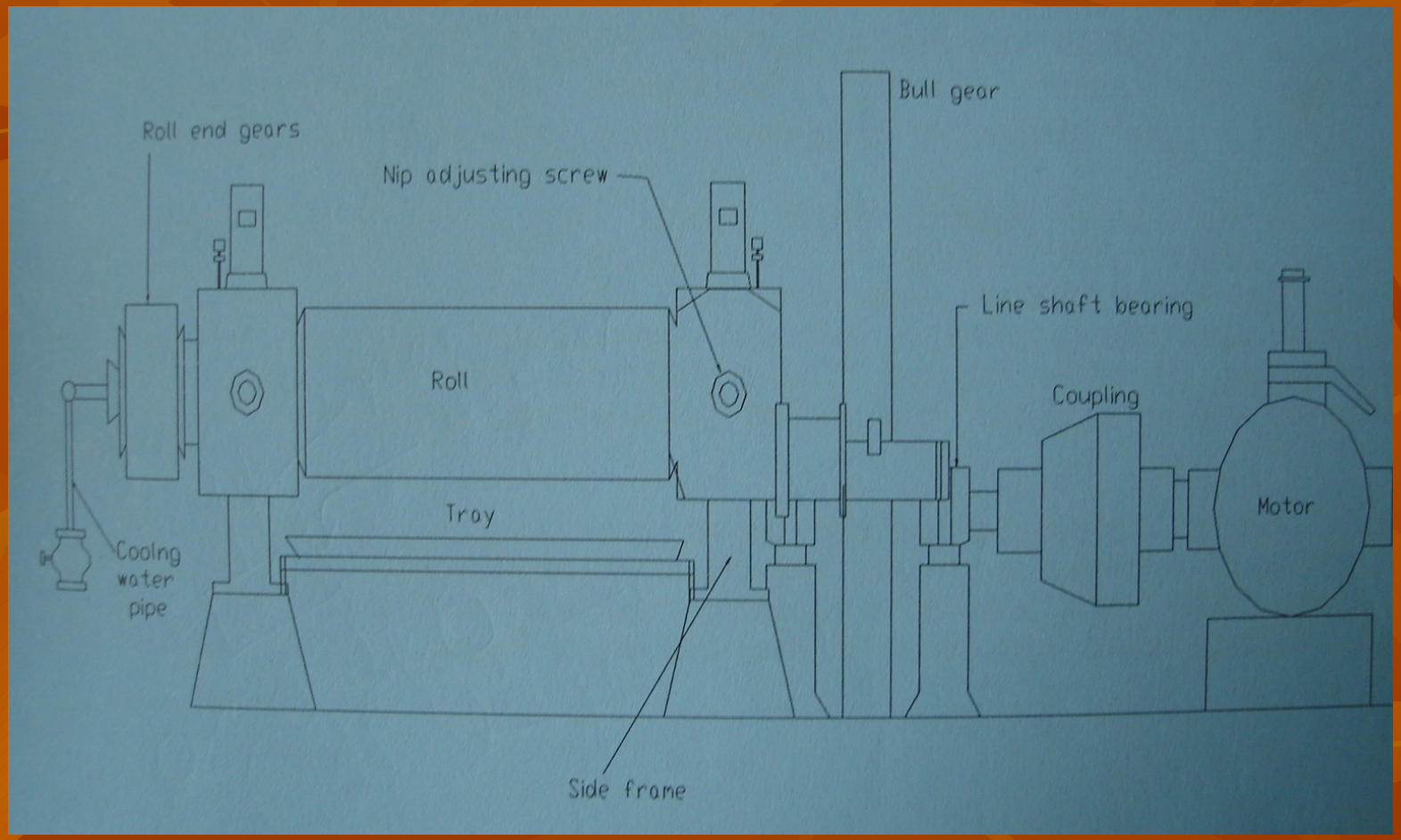
Loadstar

Tracks

Loadstar

Air tyre

Architecture of Mill machine



Introduction

Neural network

- Neural Network is model of human brain (Artificial Intelligent). This model represents the physical architecture of human brain. Some function of human brain can describe using this model.

Introduction (Cont'd)

Neural network

- The function named as parallel distributed processing.
- Normal computer (Pc's) unable to work as parallel processing.
- So Neural Network model is better solution to describe human brain than computer

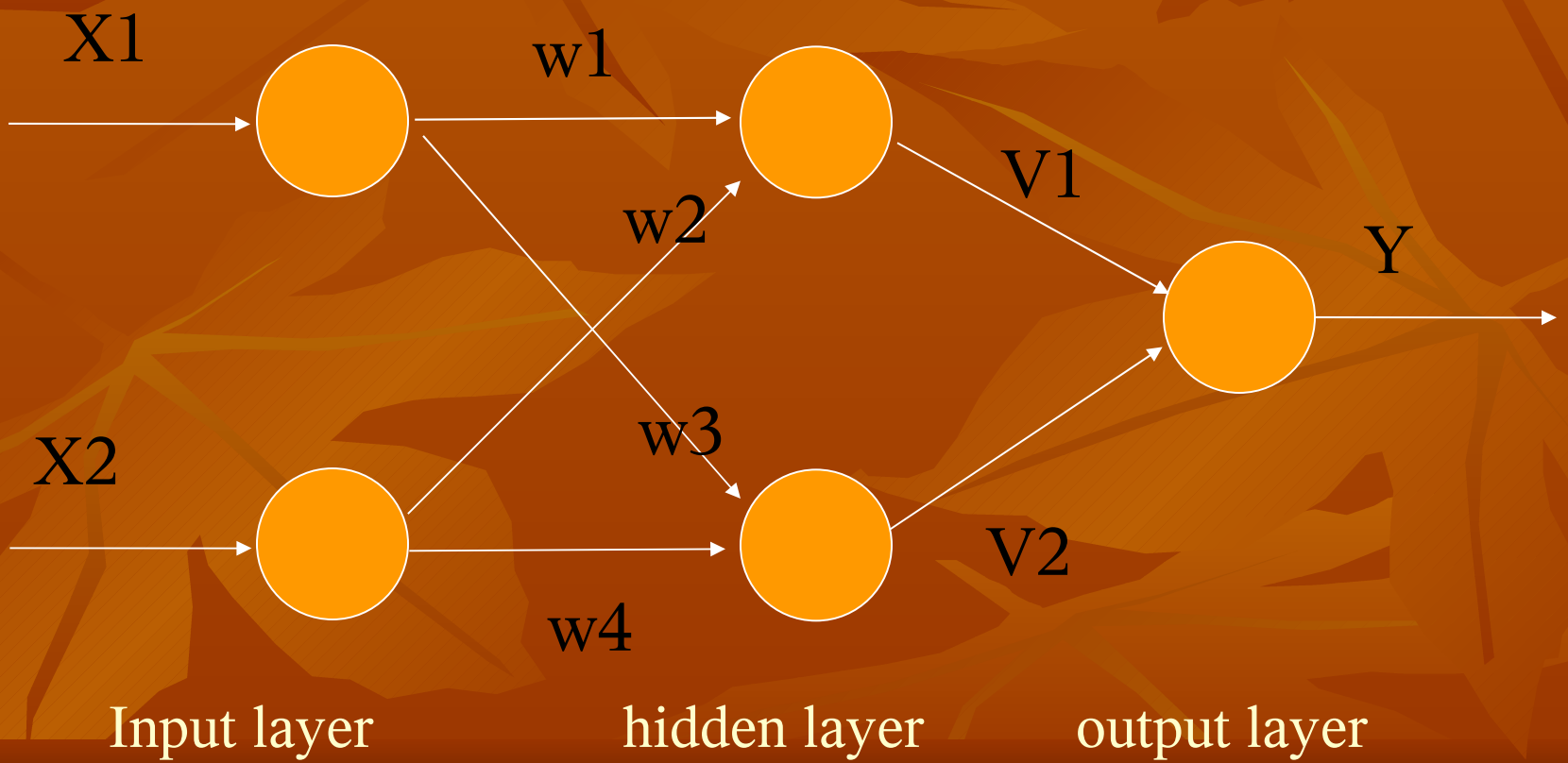
Introduction (Cont'd)

Backpropagation network

- Backpropagation is a systematic method of training of multilayer artificial neural networks.
- It is built on high mathematical foundation and has very good application potential.
- Even though it has its own limitations, it is applied to a wide range of practical problems and successfully demonstrated its power.

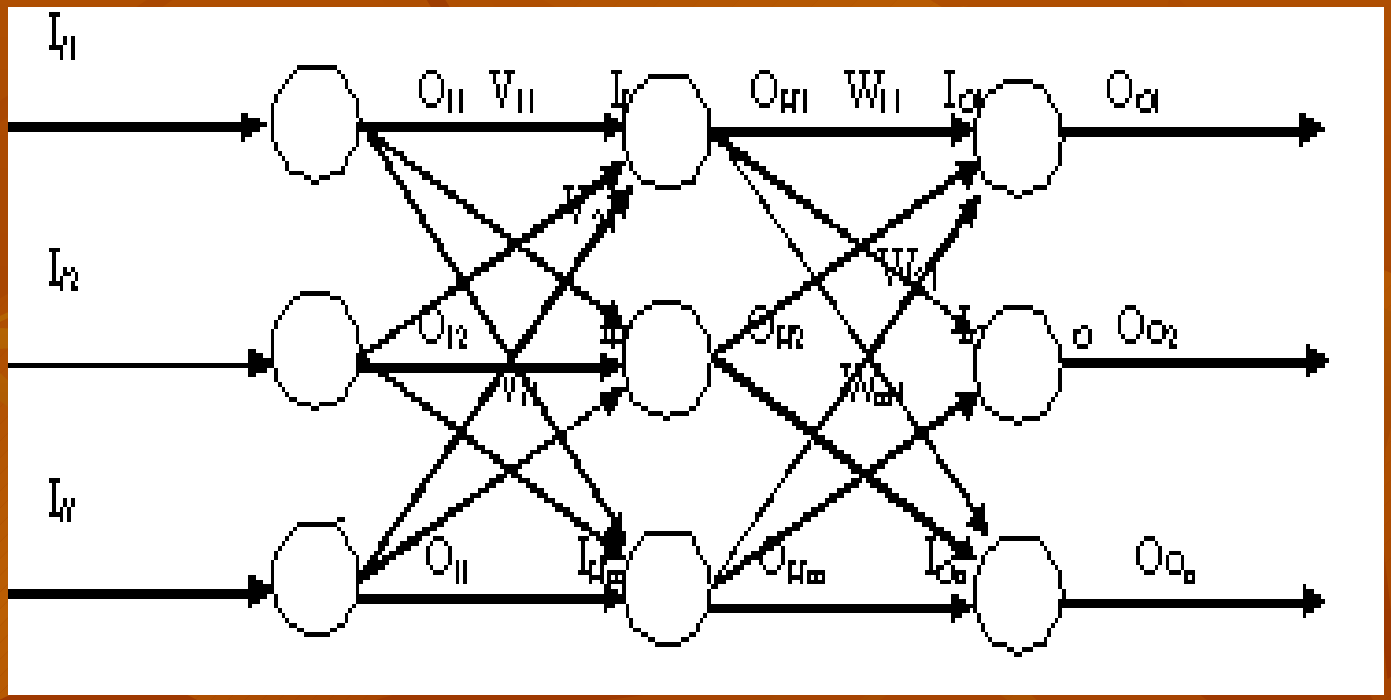
Introduction (Cont'd)

Neural network Structure



Backpropagation Learning

- Consider the learning as shown in Figure1.1 where the subscripts I, H, O denote input, Hidden and output neurons



Input Layer Computation

- Conceder learning activation function the output of the input layer is input of input layer (considering g = tanφ =1). Taking one set of data.

$$\{O\}_I = \{I\}_I$$

$$l \times 1 \qquad l \times 1$$

- The input to the hidden neuron is the weighted some of the outputs of the input neuron to get I_{Hp}

$$I_{Hp} = V_{1p} O_{I1} + V_{2p} O_{I2} + \ldots\ldots\ldots + V_{1p} O_{Il}$$

$$(p = 1, 2, \ldots\ldots, m)$$

- Denoting weight matrix $\{I\}_H = [V]^T \{O\}_I$

$$m \times 1 \quad m \times l \quad l \times 1$$

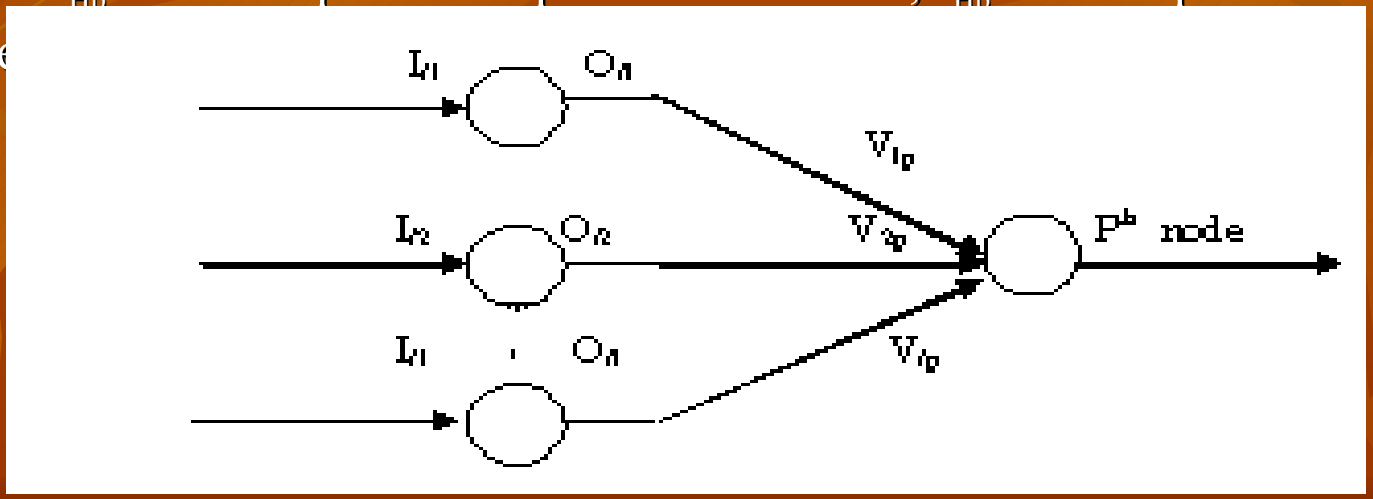
Back

Hidden Layer Computation

- Considering sigmoid function

$$O_{Hp} = \frac{1}{(1 + \exp^{(-\lambda (IHp - \theta Hp))})}$$

Where O_{Hp} is the output of the p^{th} hidden neuron, I_{Hp} is the input of the p^{th} ne



Back

Hidden Layer Computation (Cont'd)

- Now, output to the hidden neuron is given by

$$\{O\}_H = \left\{ \begin{matrix} \\ - \\ - \\ \dfrac{1}{(1 + \exp(-\lambda (I_{Hp} - \theta_{Hp}))} \\ - \\ - \\ \\ \end{matrix} \right\}$$

To get I_{Oq}, $I_{Oq} = W_{1q} O_{H1} + W_{2q} O_{H2} + \ldots\ldots\ldots + W_{mq} O_{Hm}$

$(q = 1,2,\ldots\ldots\ldots n)$

Denoting weight matrix, $\{I\}_O = [W]^T \{O\}_H$

$n \times 1 \quad n \times m \quad m \times 1$

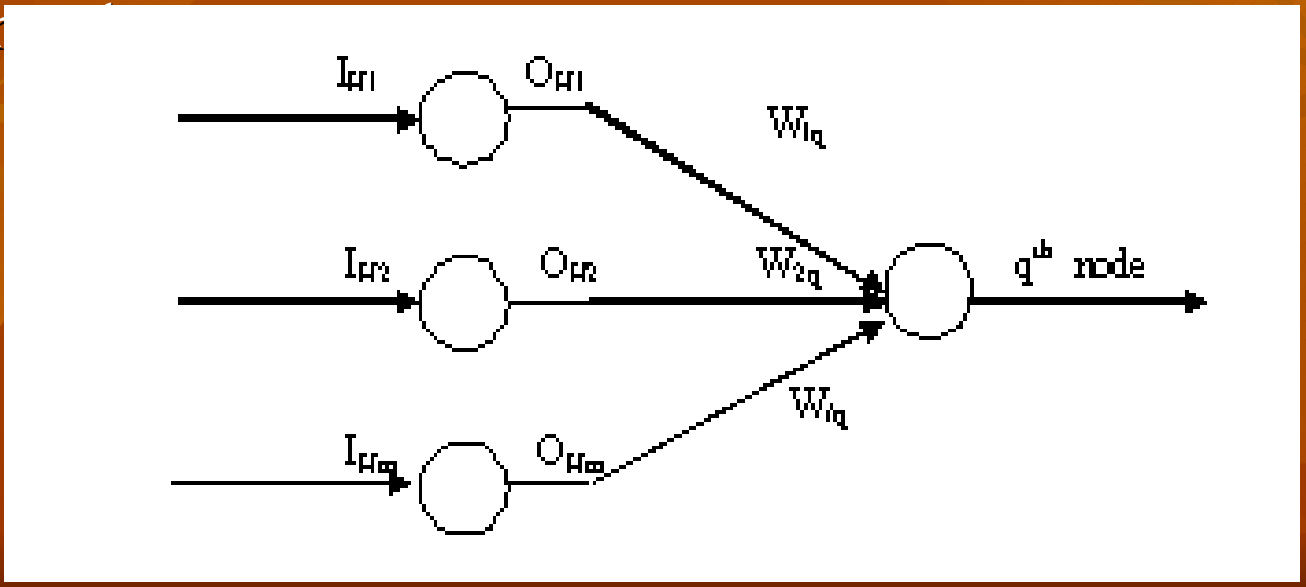
Back

Output Layer Computation

- Considering sigmoidal function

$$O_{Oq} = \frac{1}{(1 + \exp(-\lambda (I_{Oq} - \theta_{Oq}))}$$

Where, O_{Oq} is the output of the q^{th} output neuron, I_{Oq} is the input to th



Back

Output Layer Computation (Cont'd)

- **the output of output neuron are given by**

$$O_{Oq} = \left\{ \frac{1}{(1 + \exp(-\lambda (I_{Oq} - \theta_{Oq}))} \right\}$$

Back

Calculation of Error

- Considering any r^{th} output neuron

$$E_r^1 = (1/2)e_r^2 = (1/2)(T-O)^2$$

The Euclidian norm of error E1 for the first training pattern

$$E_1 = (1/2)\sum_{r=1}^{nset} (T_{Or} - O_{Or})^2$$

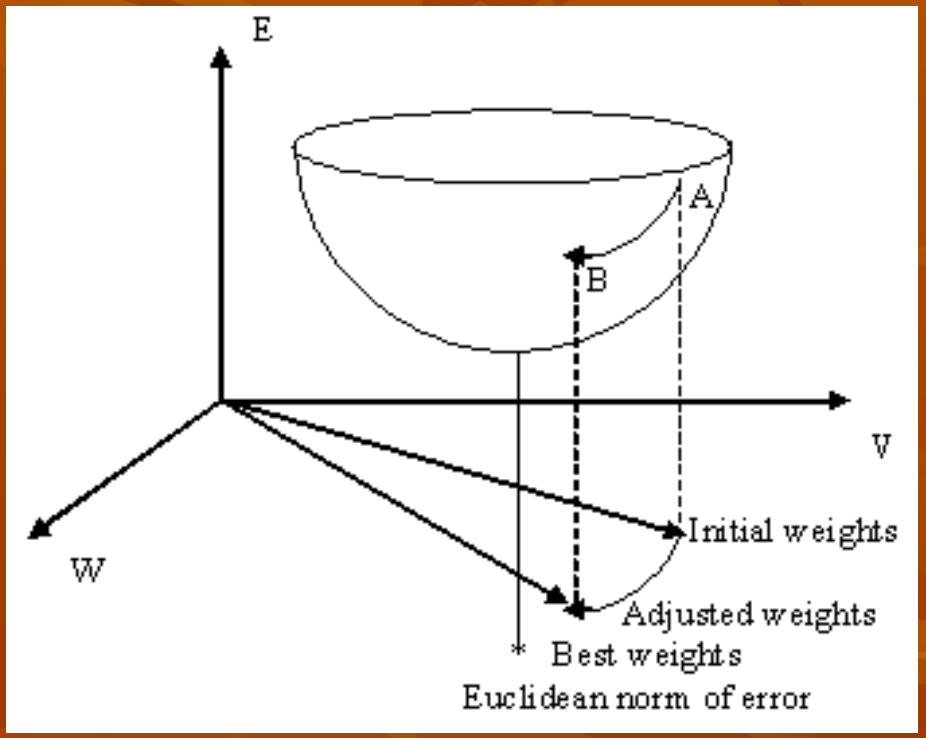
All the training patterns, we get

$$E(V,W) = \sum_{n=1}^{nset} E_j(V,W,I)$$

Method of Steepest Descent

- The Error surface is given by

$$E = \sum_{p=1}^{nset} E_p(V,W,I)$$



Introduction

Breakdown

- The tyre is based on the machine.
- These machines are probable to breakdown due to the production manner.
- The sudden breaking of the machine is called breakdown.

Introduction (Cont'd)

Breakdown

Characteristics of breakdown

1. Mechanical BD
2. Hydraulic BD
3. Electrical BD
4. Pneumatic BD
5. Hoist BD
6. Toggle BD
7. Stem BD
8. Other BD

Introduction (Cont'd)

Breakdown

Mechanics at work

Introduction (Cont'd)

Objectives

- To Design a method to forecast the daily production for given a failure pattern of the module 04 machine.

- To design a method to forecast the most probable failure pattern for given a target production and hence and to identify the affecting tyre of failure.

Methodology

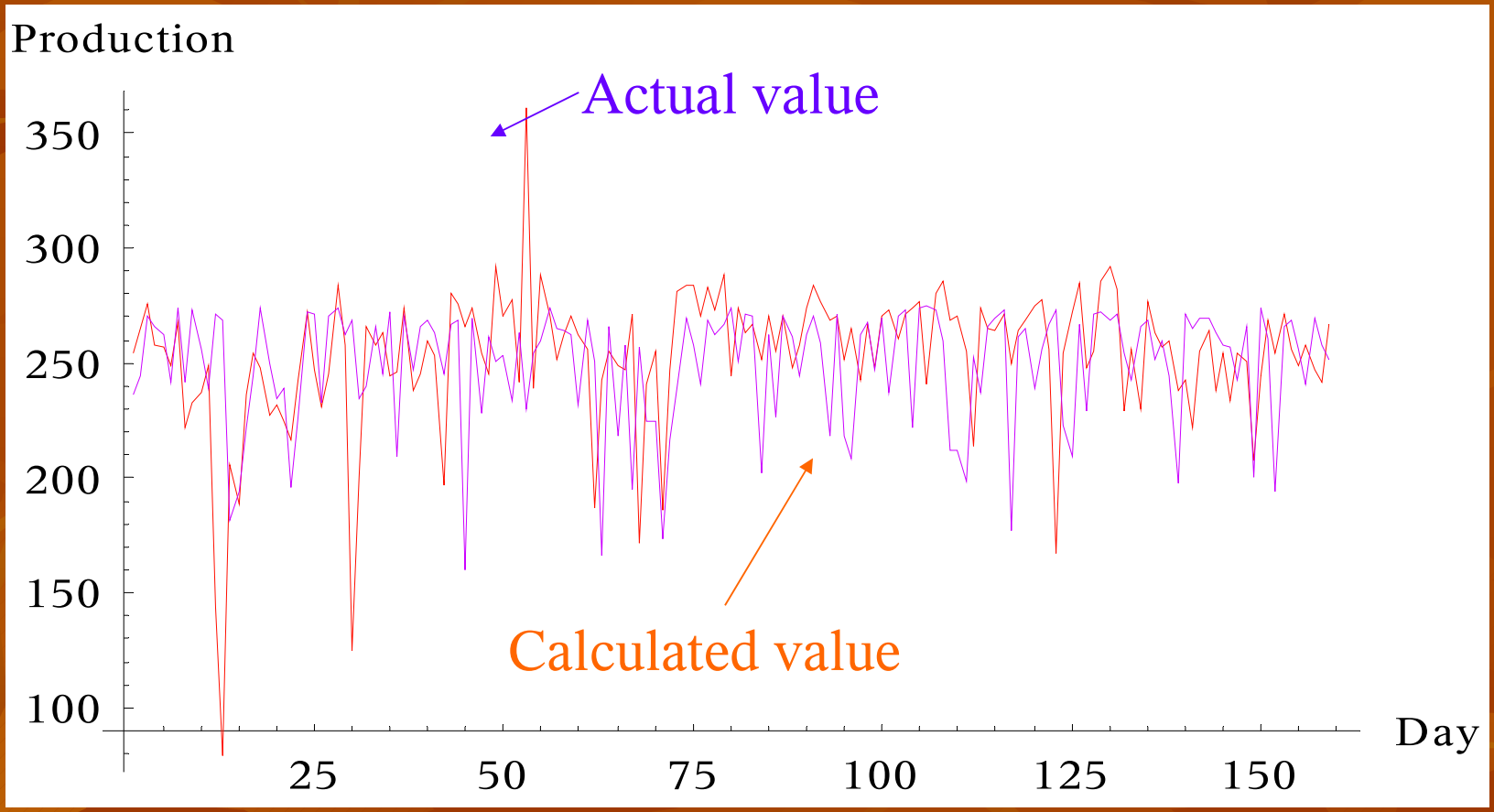
- Data gathering

DAILY PRODUCTION AND BRAKE DOWN -MODULE 04

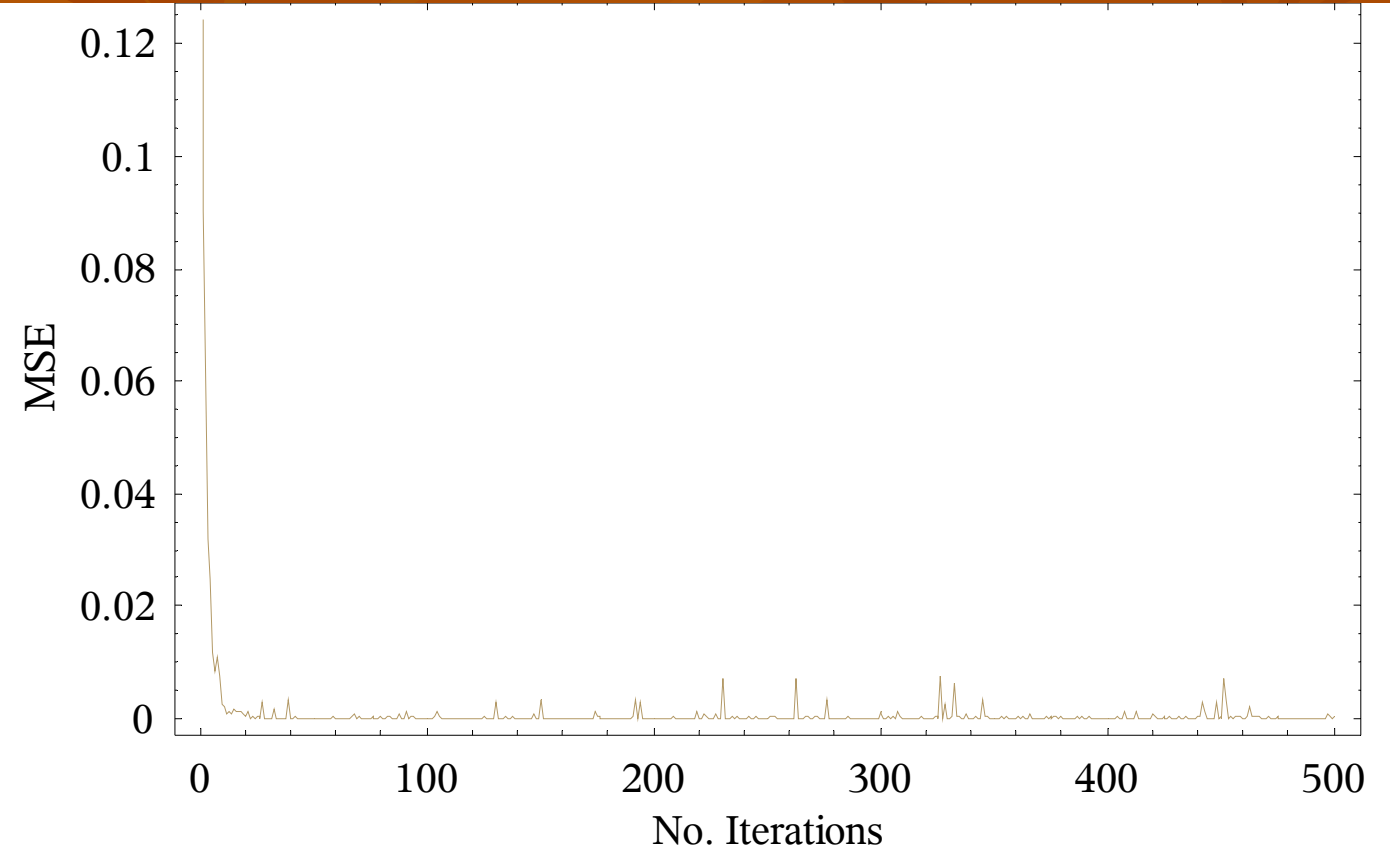
			Tyre losses Due to Machine Break Downs							
DATE	PLANING CA TYRES	ACTUAL No. Of Produced Tyres	Mechani	Electrica	Hydrauli	Mould	Steam	Hoist	Toggle	Other
1-Sep-04	275	227		9			7	10		
2-Sep-04	275	226		11		2				
3-Sep-04	275	224		7	3	4				
4-Sep-04	275	243	13			2				
5-Sep-04	275	265				3				
6-Sep-04	275	229								
7-Sep-04	0	0								
8-Sep-04	275	213					3			
9-Sep-04	275	221			34					
10-Sep-04	275	253								
11-Sep-04	275	248								
12-Sep-04	275	261	3							
13-Sep-04	275	270				1				
14-Sep-04	275	229								
15-Sep-04	275	242								
16-Sep-04	275	242						1		
17-Sep-04	275	264								
18-Sep-04	275	258					2			
19-Sep-04	275	265		3						
20-Sep-04	275	264								
21-Sep-04	275	238	8							
22-Sep-04	275	244		3						
23-Sep-04	275	194			64					

Results

Daily production function

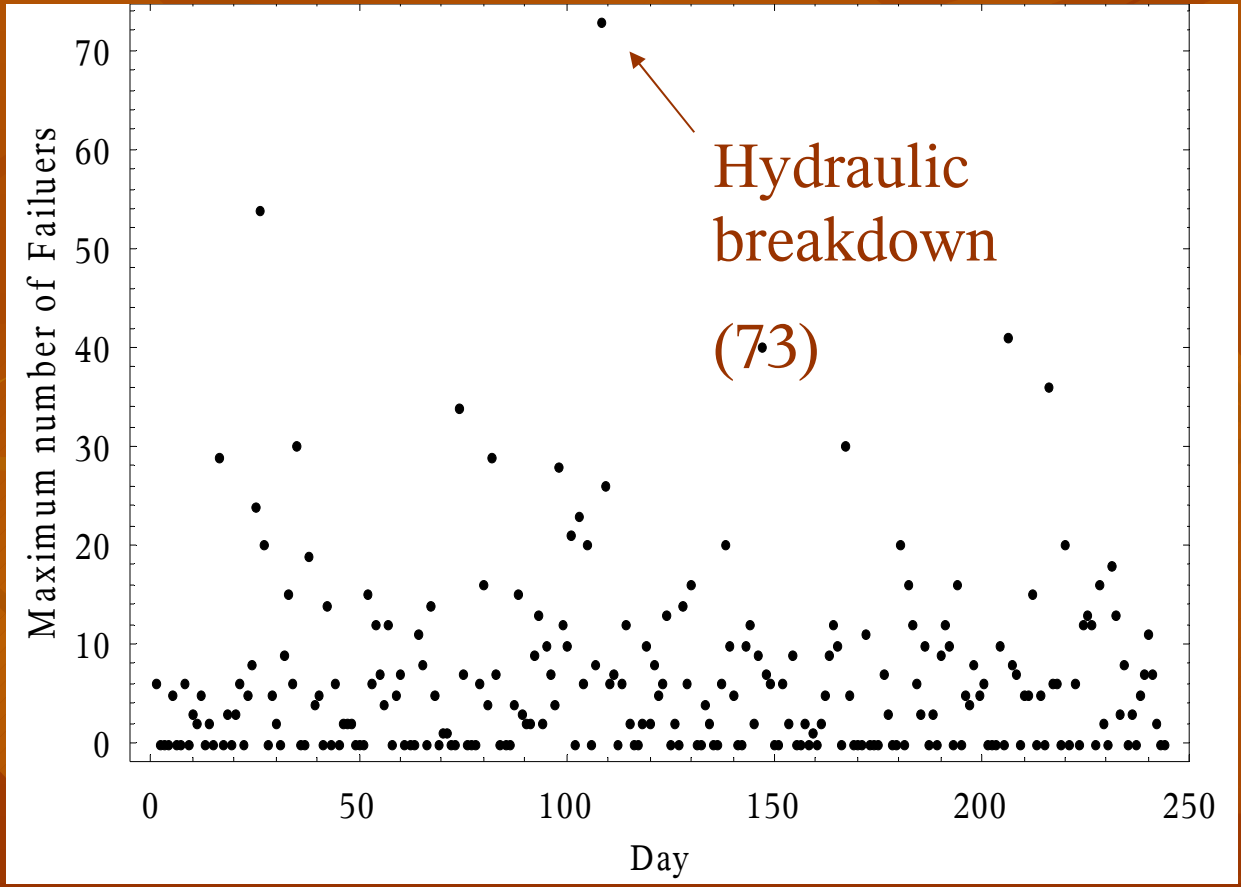


Convergence of Mean Square Error



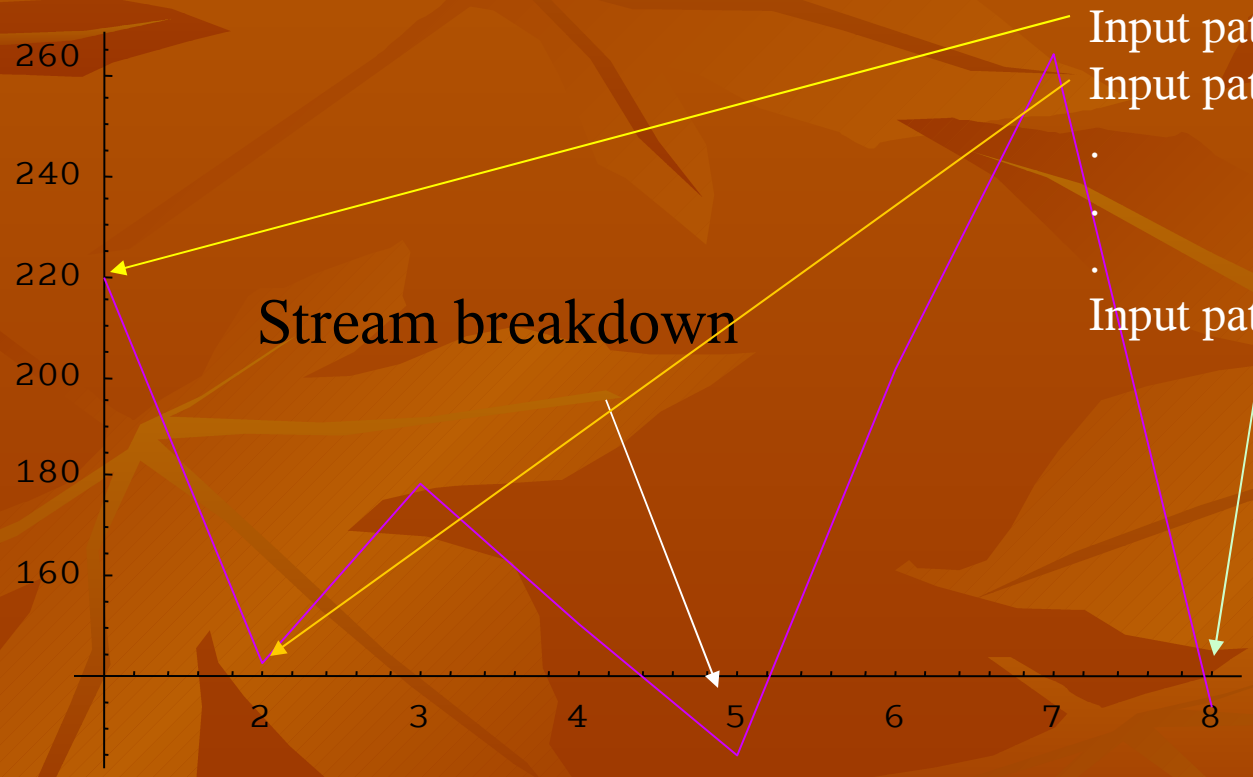
Results (cont'd)

- Maximum number of failure



Results (cont'd)

- Which failure have highest on the production



Input pattern 1 = (73,1,1,1,1,1,1,1),
Input pattern 2 = (1,73,1,1,1,1,1,1),
.
.
.
Input pattern 8 = (1,1,1,1,1,1,,173)

Discussion

- In the Loadstar plant have many modules and many machines. According to my project I studied one machine in one module.
- I have one problem, which is This Neural network theory newly I must be learned.
- Therefore So many time spend in this project.
- I have to reduces the number of input variables because time is limited.

Discussion (Cont'd)

- We have been faced the practically difficulty of, when all input Zero state, but the decided output has taken multi values. Generally, this could not be happen in the neural network, become of, neural network is limitary for one identification. For one input pattern, there could not be multiple decided outputs.
- All input patterns must be normalized how it

  I get norm in the all input patterns, all input patterns divided by norm.

Discussion (Cont'd)

- In the training of neural network, we should update the weights. It must be done only for weights with minimum error rates. To do this we must change the weights for all inputs patterns.
- By executing the program multiple times, we can reduce the error. That means Maximizing the number of iteration. By the value of the training coefficient (η) , we can find the value which is for error converge to minimum value. This is not is a simple process. Because, the training of the neural network is as a very difficult activity.

Father development

- The Loadstar Company (Midigama) has so many Modules (around 16) . But I analyzed only one module. As same way we can apply this method every modules.

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Thank You