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where  $r$  is a random number from  $[0..1]$ .

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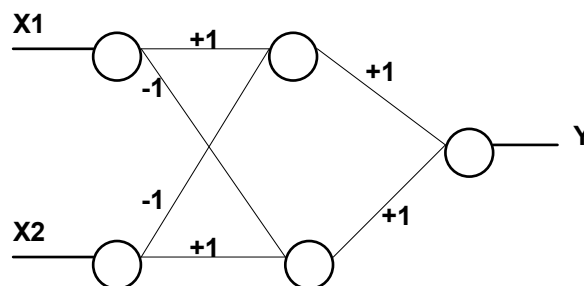
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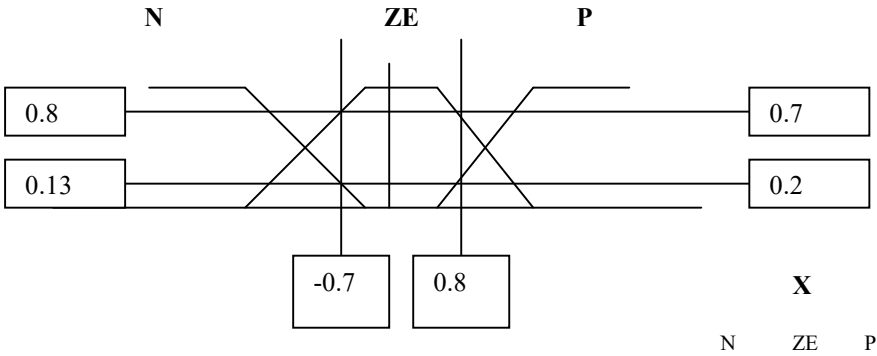
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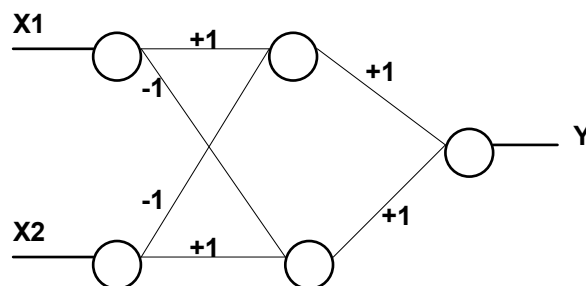
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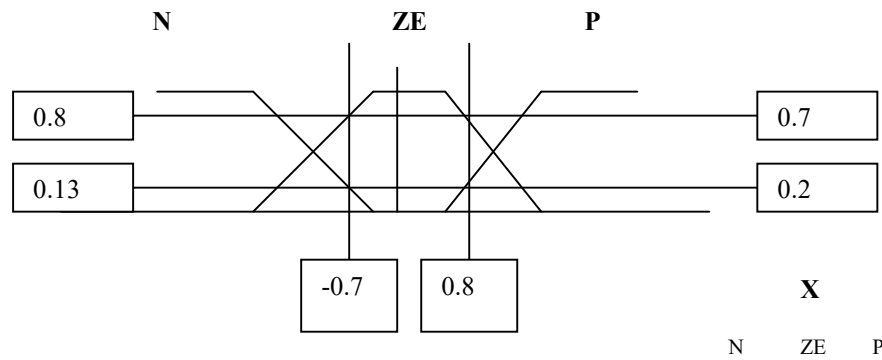
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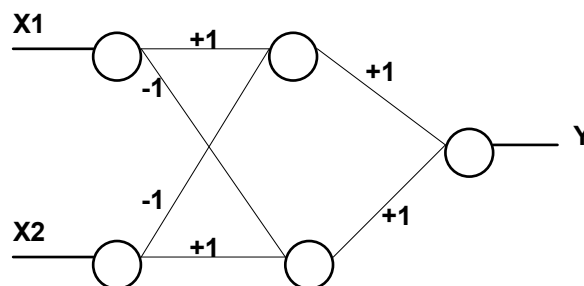
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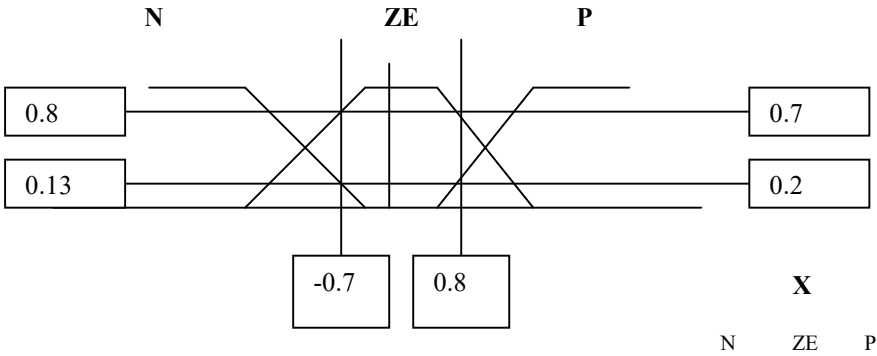
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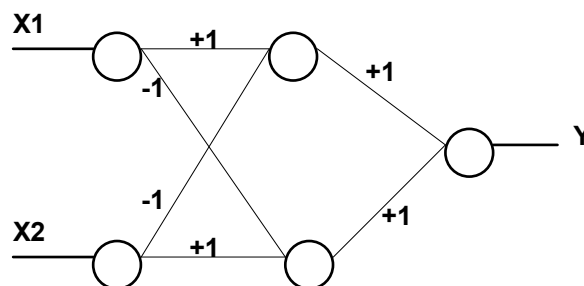
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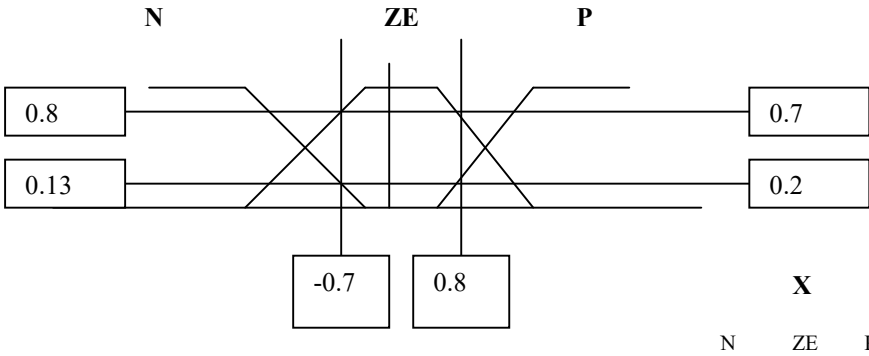
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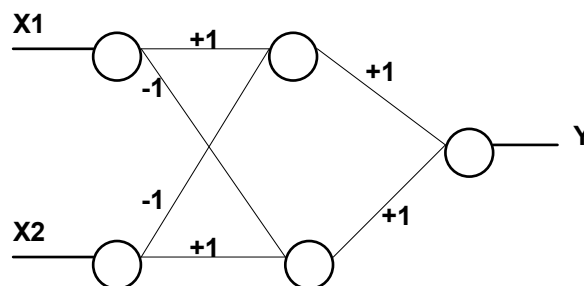
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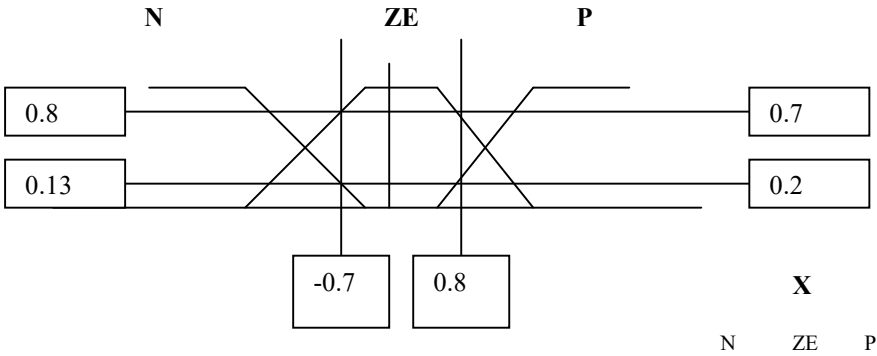
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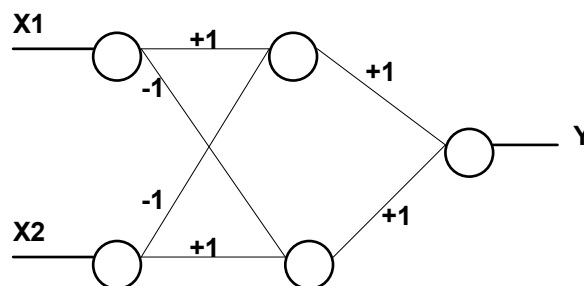
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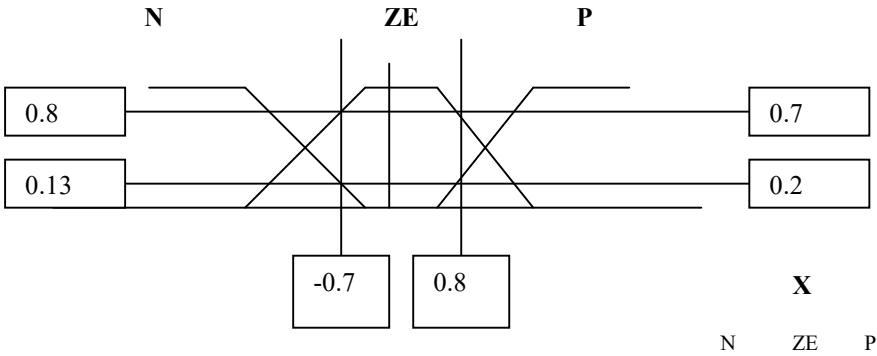
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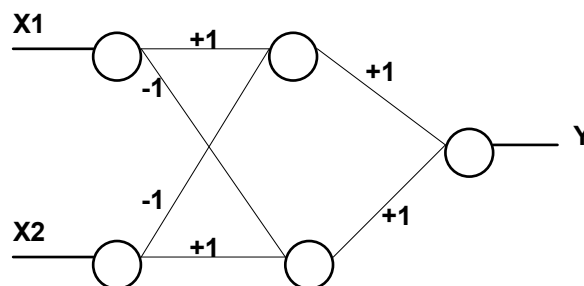
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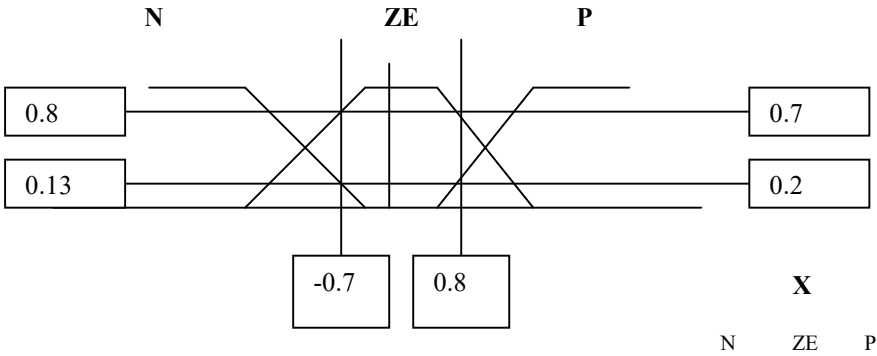
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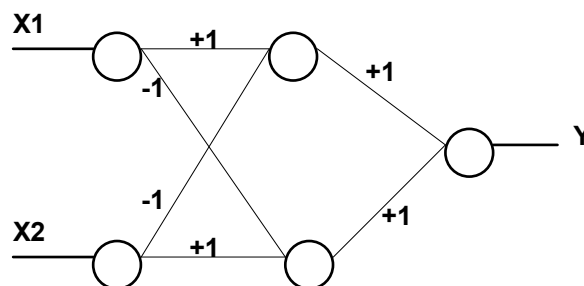
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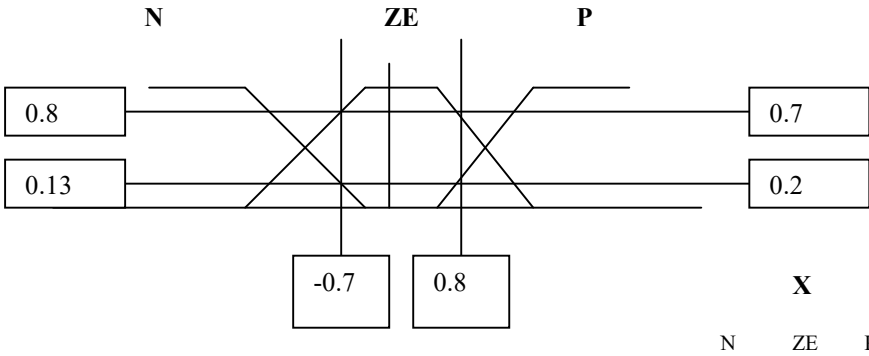
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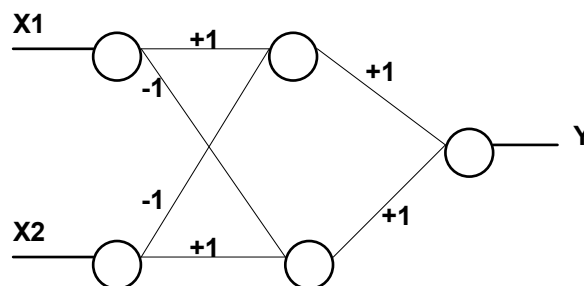
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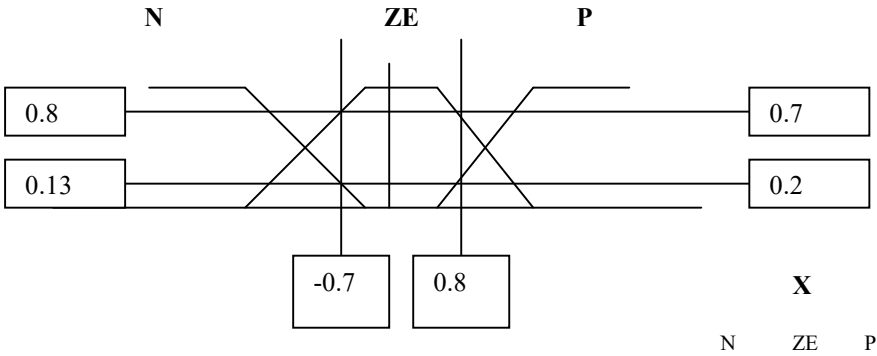
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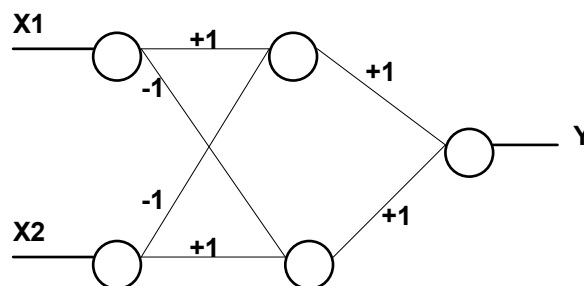
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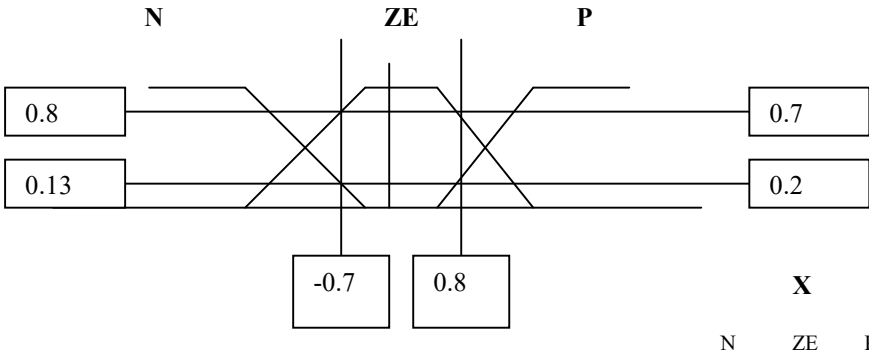
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	P				
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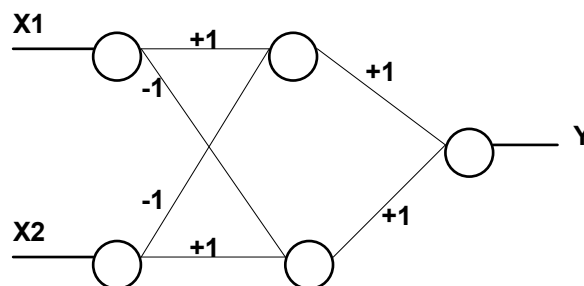
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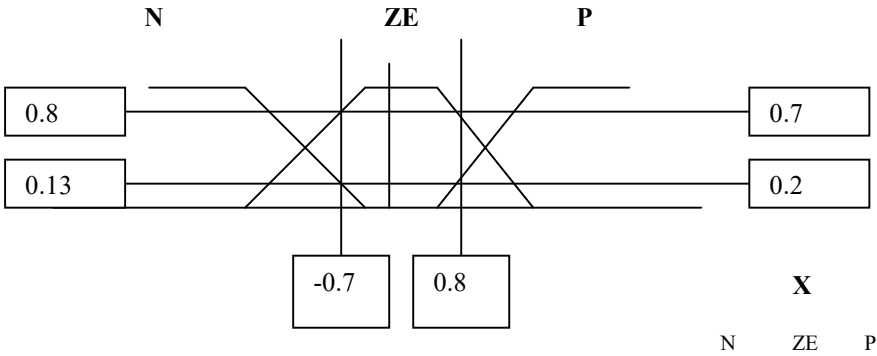
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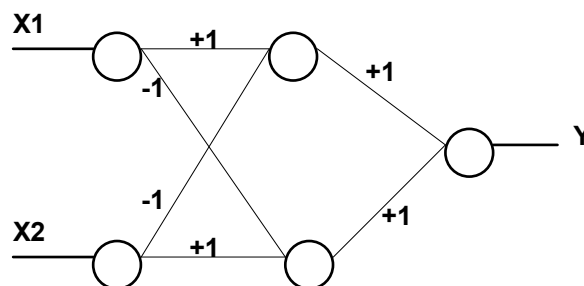
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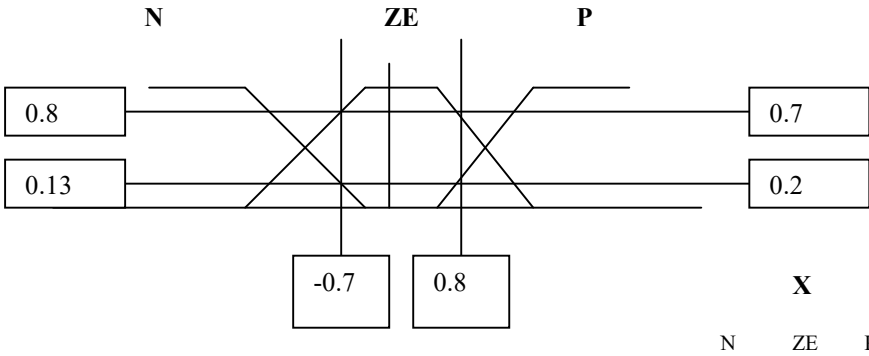
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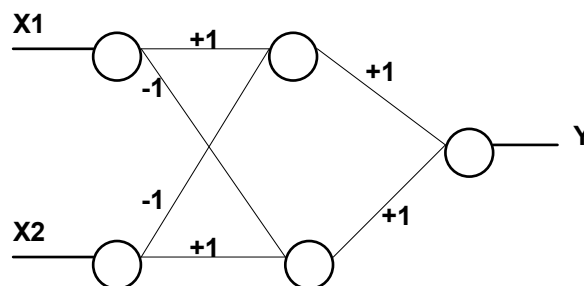
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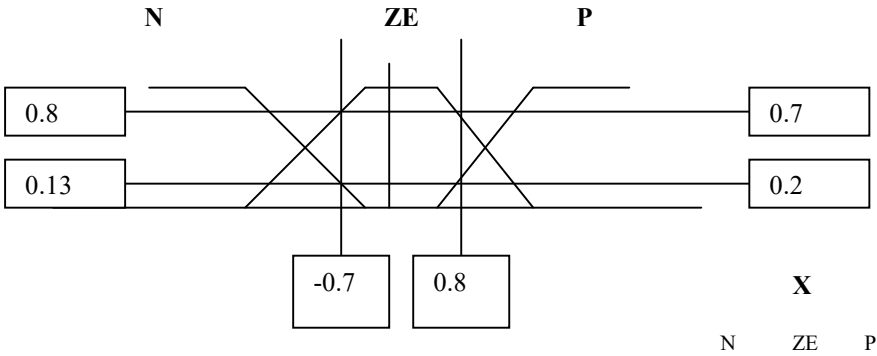
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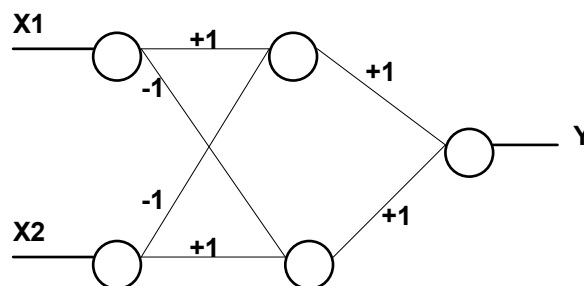
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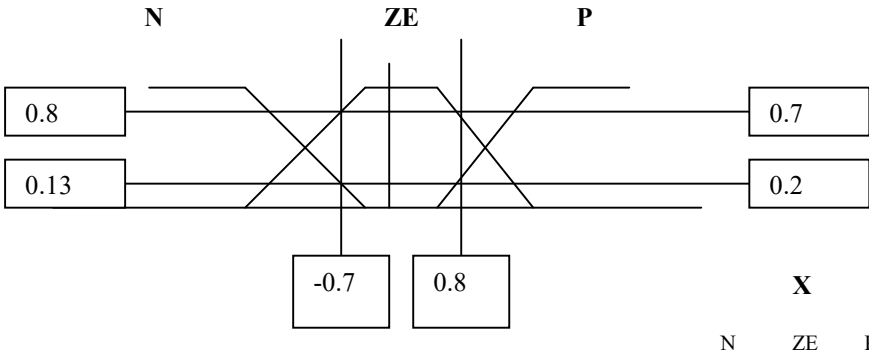
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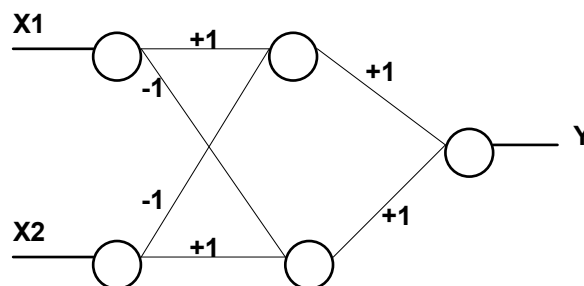
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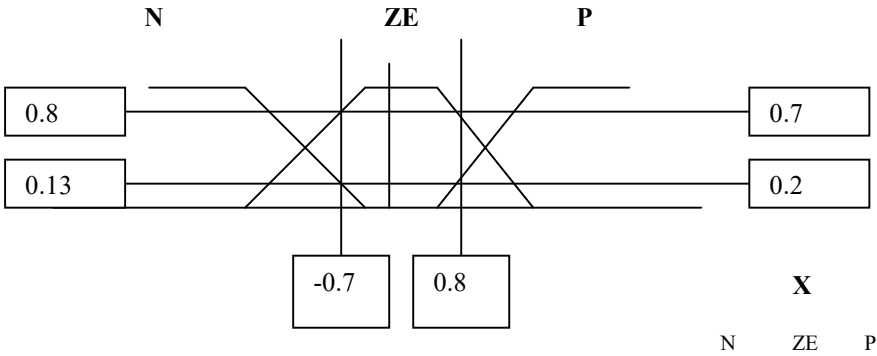
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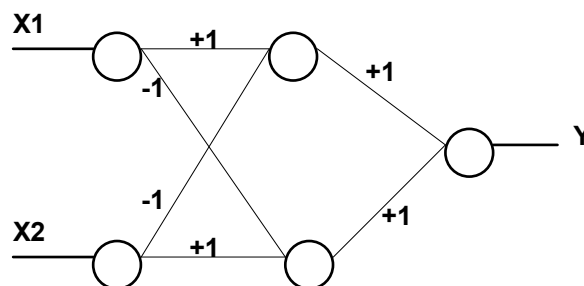
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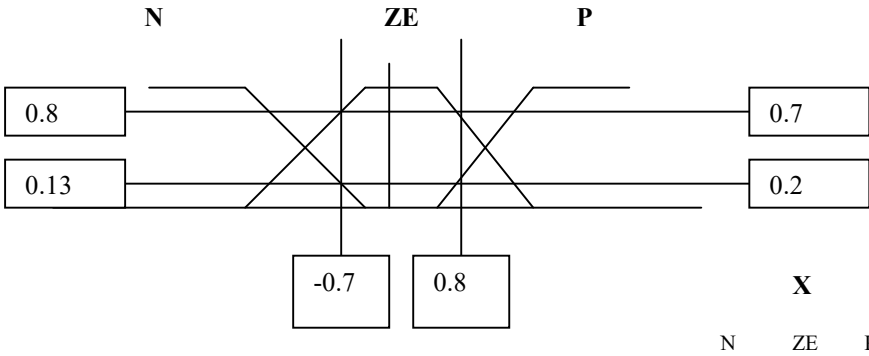
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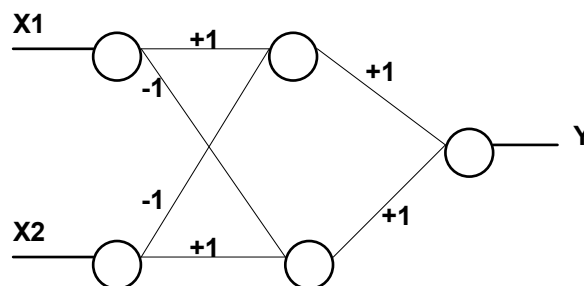
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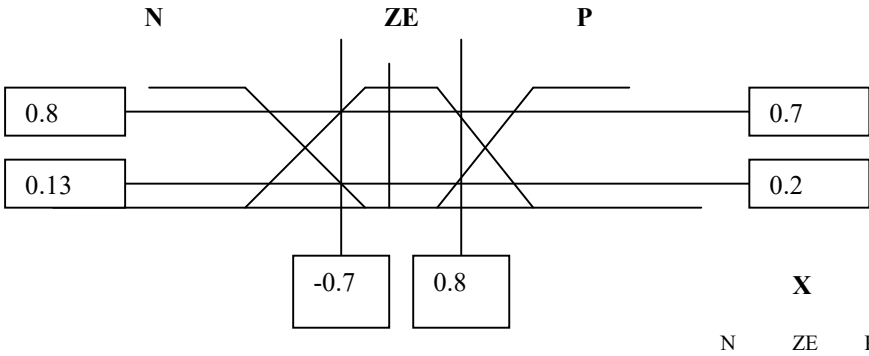
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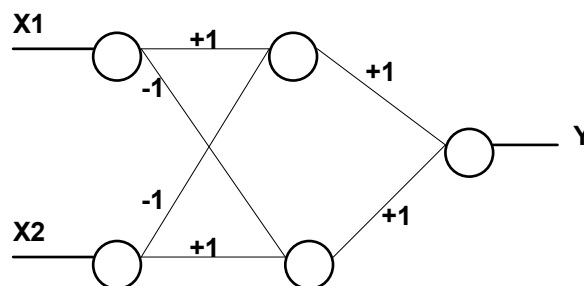
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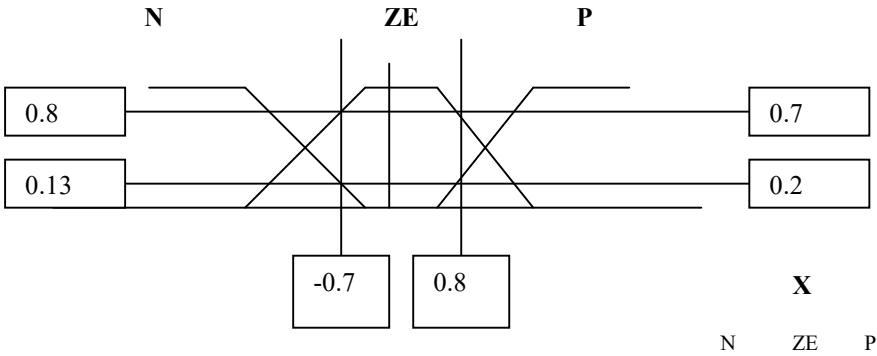
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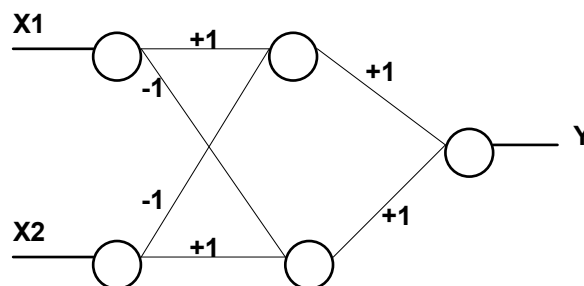
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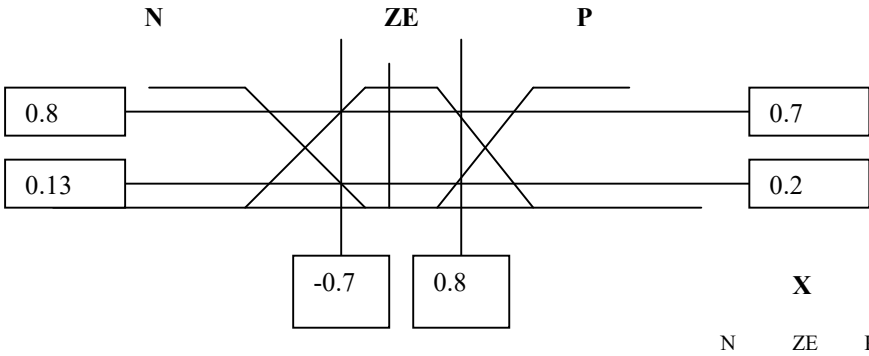
and applying the following activation function,

$$f(x) = \begin{cases} 1 & x > 0 \\ 0 & x \leq 0 \end{cases}$$

Compute the outputs  $Y$  for inputs  $(X1, X2)$  equal to the following,  
 $(0,0), (0,1), (1,0), (1,1)$ .

What function do you think this network emulates.

6-Given two forces  $X=0.8$  and  $Y=-0.7$  with the degrees of ‘positiveness’ and ‘negativeness’ shown in the fuzzy sets below.



And given the following Fuzzy Associative Memory (FAM) where:

ZE = 0.01

NS = -0.1      NL = -1.5

PS = 0.1              PL = 1.5

Find the resultant Output.

		X		
		N	ZE	P
Y	N	NL	NS	NS
	ZE	NS	ZE	PS
	P	PS	PS	PL

**FAM**

- 1- Crossover and mutation are the main operators of a Genetic Algorithm.
- a- Differentiate between single-point and multiple-point crossover, on both binary and floating point representations.
  - b- Show by example- using binary strings- how can a 2-point crossover be carried out.
  - c- Explain the operation of the mutation operator on both binary and floating point representations.
  - d- Discuss the mechanics of non-uniform mutation on floating point representation- Apply using the following function:

$$\Delta(t, y) = y \cdot (1 - r^{(1-t/T)})$$

where  $r$  is a random number from  $[0..1]$ .

- 2- According to the schema theorem, what happens to highly fit schemata in successive generations? What are the effects of selection, crossover and mutation according to the theorem? Why use crossover and mutation?

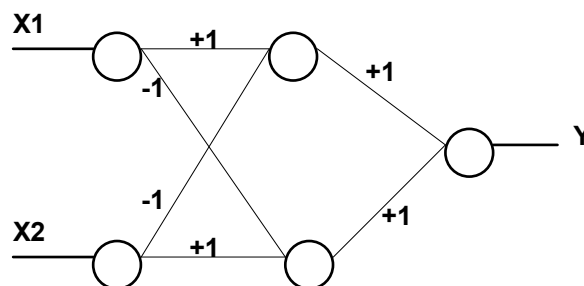
3-

- a- Prove that any string of length  $m$  is an instance of  $2^m$  different schemas.
- b- Define the fitness  $f$  of bit string  $x$  with length  $m = 4$ , to be the integer represented by the binary number  $x$ . (eg.  $f(0011)=3$ ,  $f(1111)=15$ ). What is the average fitness of the schema  $1***$  under  $f$ ? What is the average fitness of schema  $0***$  under  $f$ ?

4-

- a- Derive the Generalized Delta Rule (GDR) for training feedforward neural networks .
- b- What is the effect of the momentum term on the process of training? Write the weights update equation with the momentum term.

- 5- Given the following feedforward neural network with weights,



and applying the following activation function,

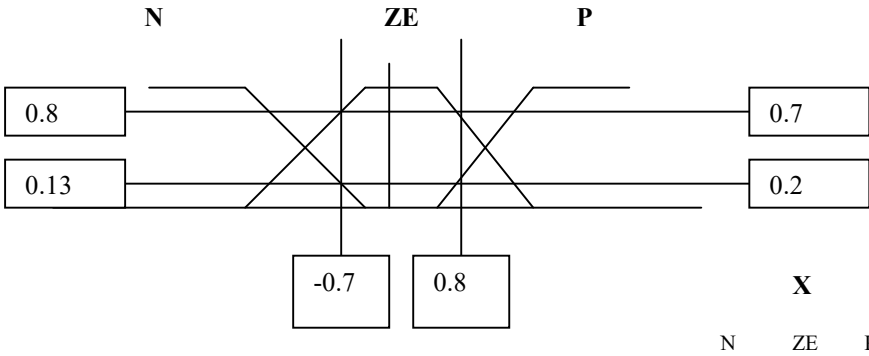
$$f(x) = \begin{cases} 1 & x > 0 \\ 0 & x \leq 0 \end{cases}$$

Compute the outputs  $Y$  for inputs  $(X1, X2)$  equal to the following,

$(0,0), (0,1), (1,0), (1,1).$

What function do you think this network emulates.

6-Given two forces  $X=0.8$  and  $Y=-0.7$  with the degrees of ‘positiveness’ and ‘negativeness’ shown in the fuzzy sets below.



And given the following Fuzzy Associative Memory (FAM) where:

$ZE = 0.01$

$NS = -0.1$        $NL = -1.5$

$PS = 0.1$                $PL = 1.5$

Find the resultant Output.

		X			
		N	ZE	P	
Y	N	NL	NS	NS	<b>FAM</b>
	ZE	NS	ZE	PS	
	P	PS	PS	PL	