NEURAL NETWORKS

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Question 1

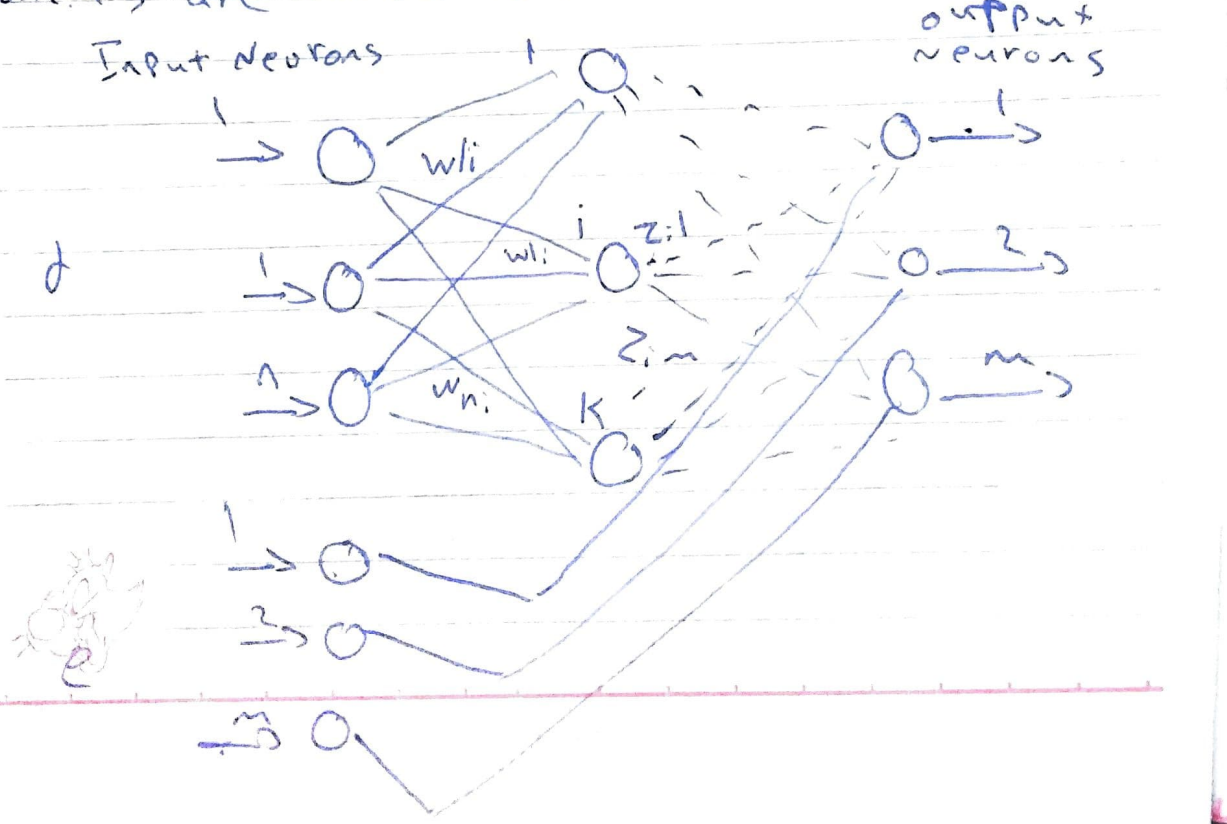
a) What is Counter Propagation neural network?

- Counter ProPation Networks (CPN) are multi layer network based on a Combination of input, Competitive and output layer.

Counter propagation networks training include two stages:

1- Input vectors are clustered are Formed using dot product metric or Euclidean norm metrics.

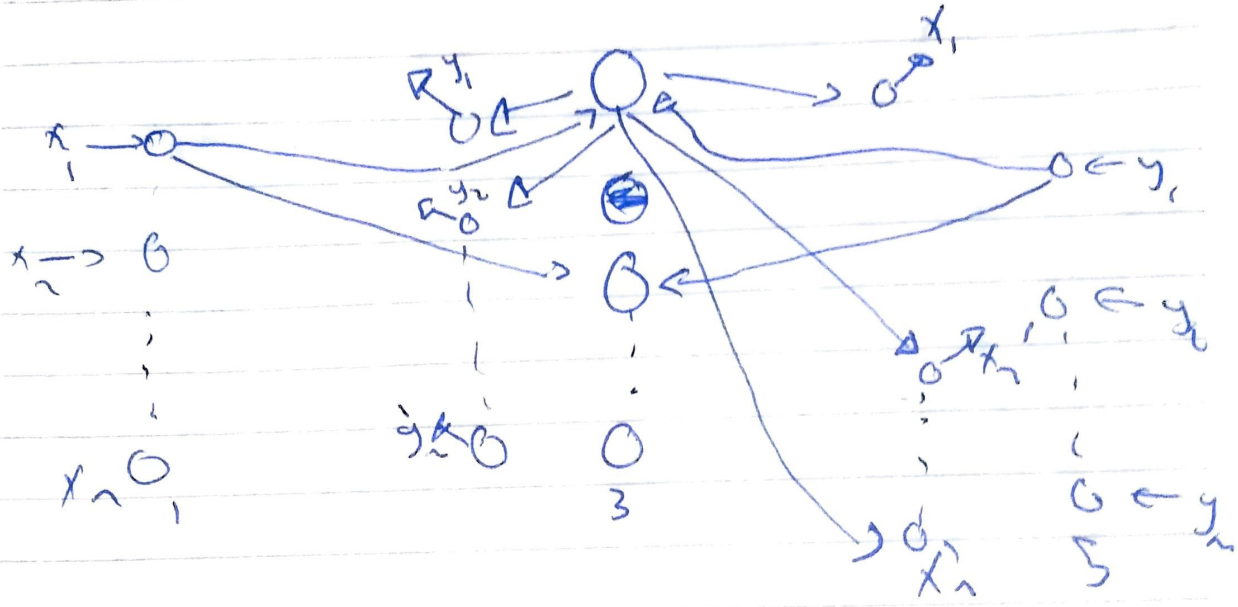
2. weights From Cluster units to outputs units are made to produre the desired respons



b) we have two types

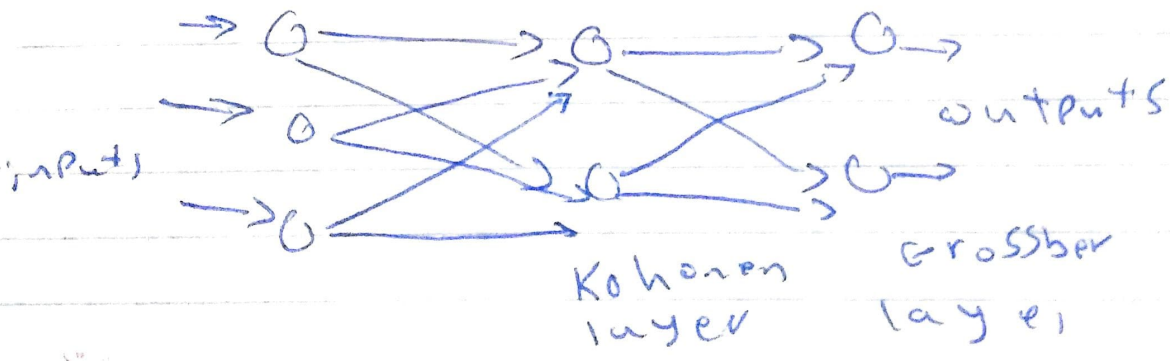
1- full CPNN

Consists 5 layers: two input layers, two output layers and one hidden layer



2- Feed forward CPNN

Cosist of 3 layers



100 times faster than ~~back~~ backpropagation network

Question (2)

Explain with an example how neural networks can be used for pattern recognition

A:

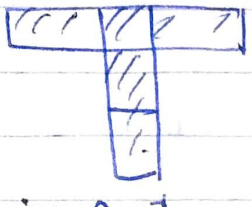
Pattern recognition can be implemented using feed forward NN.

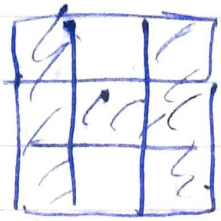
During training, the network is trained to associate outputs with input spatterns

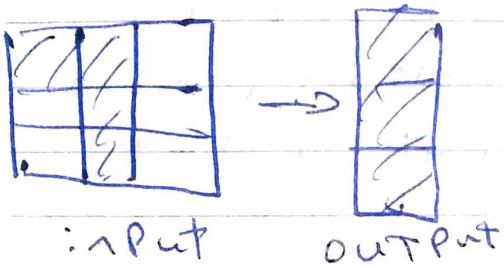
when the network is used, it identifies the input pattern and tries (output) the associated output pattern.

If a pattern thas has no output pattern associated with it is input to the network. The network gives the output that corresponds to a taught input pattern that is least different from the given patter

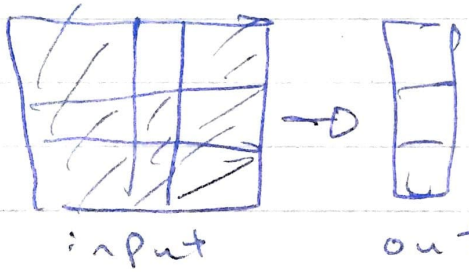
Suppose a network is trained to recognize the pattern T and H. The associated patterns are all black and all white. respectively as shown below.



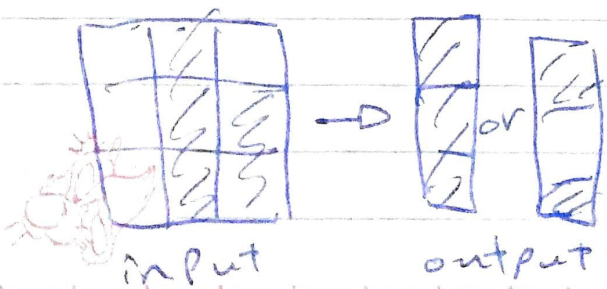




The input pattern looks more like an T. The network sees it as closely resembling T and output the pattern that represent T.



The input resembles H with a slight difference. network classifies it as an H and output pattern an H



Top row of the input It is 2 errors away from a T and 3 errors away from an H the top output is black

Middle row of the input:
1 error away from T and 1 error away from H.
Therefore the output is random

Bottom row of the input:
1 error away from T and 2 errors away from H

therefore the output is black.
Since the input ressmbles a T more than an H, the output of the network is in favor of a T

Question (3)

using the chain rule:

$$\frac{\partial E}{\partial w_3} = \frac{\partial E}{\partial out_1} * \frac{\partial out_{o_1}}{\partial net_{o_1}} * \frac{\partial net_{o_1}}{\partial w_3}$$

$$\frac{\partial E}{\partial out_{o_1}} = \frac{\partial}{\partial out_{o_1}} [A - out_{o_1}]^2 \cdot \frac{1}{2}$$

$$= 2 * \frac{1}{2} (A - out_{o_1}) * -1$$

$$= -A + out_{o_1} \longrightarrow (1)$$

$$\frac{\partial out_{o_1}}{\partial net_{o_1}} = \frac{\partial}{\partial net_{o_1}} \left[\frac{1}{1 + e^{-net_{o_1}}} \right]$$

$$= out_{o_1} * (1 - out_{o_1}) \cdots (2)$$

$$\frac{\partial net_{o_1}}{\partial w_3} = \frac{\partial}{\partial w_3} [out_{h_1} * 3 + out_{h_2} * w_4]$$

$$= out_{h_1} \text{ --->(3)}$$

Combining (1), (2), and (3) we have

$$\frac{\partial E}{\partial w_3} = (-A + out_{o_1}) * out_{o_1} * (1 - out_{o_1}) * out_{h_1}$$

Total Error

The total error is the sum of the errors of output neorons. The Calculation is carried out using the squared error function.

$$E_{total} = \sum \frac{1}{2}(target - out)^2$$

The $\frac{1}{2}$ is included to cancel the exponent when the function is differentiated.