Q1. a Characteristics of Supervised Learning is Labelled data and that of unsupervised Learning is redundency in data,

b.
- Examples of Supervised Learning for artificial neural networks are associative net and perceptron.
- Examples of UnSupervised Learning for artificial neural networks are Elastic net and Kohonen.

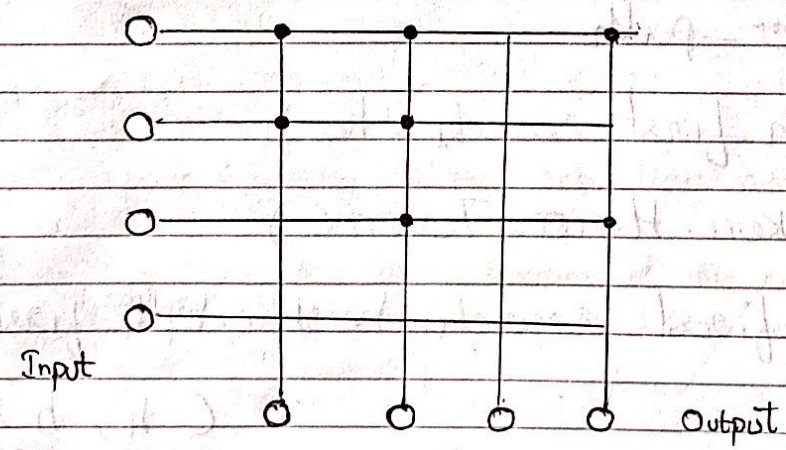
c
- Associative net (Associative Memory) is an example of supervised learning in the brain.
- Topographic maps in visual cortex is an example of unsupervised learning in the brain.

d Rate Coding - Applications are measurement of joint angle and Detection of light intensity.

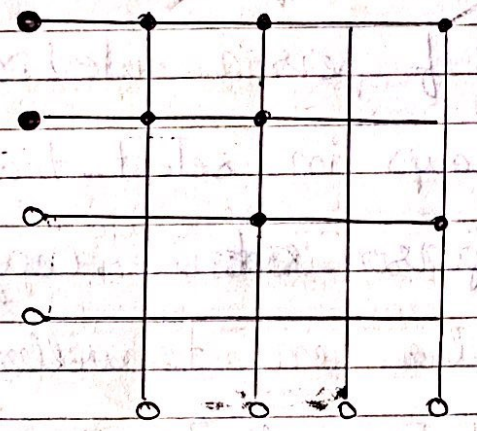
Temporal Coding - Applications are ~~Bra~~ Echolocation in bats

Q2 a. The association for the input pattern and output pattern are (1000) and (0100) respectively.

b.



Q2 c.



Input pattern

(1100)

M = 2

2	2	0	1	Input sum
2	2	2	2	Threshold
1	1	0	0	Output pattern

d. When some synapses are missing : each output unit needs to know the maximum input it can receive.

e. To convert a hetero associative memory to auto associative memory is to change its connectivity from feed-forward connectivity to recurrent connectivity.

Q3 a. Three methods are

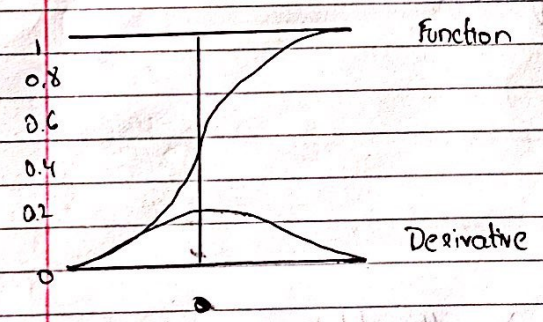
1. Add long-range lateral inhibition and short-range excitation to the network.
2. Calculate the inp activation of the output units as a function of inputs x_j and Weights w_{ij} and hard pick the output unit with the largest activation y_i.
3. Comparing the output units with current input vector and choose the closest.

Q3 b. The first method is the mostly biologically realistic.
The second method is the most efficient one.
The Third method is used in kohonen's Self organising maps.

c.
- Phonetic typewriter
- Travelling salesman problem
- Learning similiarities between animal.

d.
- 1D input space onto 2D output space is bat auditory cortex.
- 2D input space onto 2D output space is mapping random input vectors.
- Higher Dimension input space onto 2D output space is somatosensory map

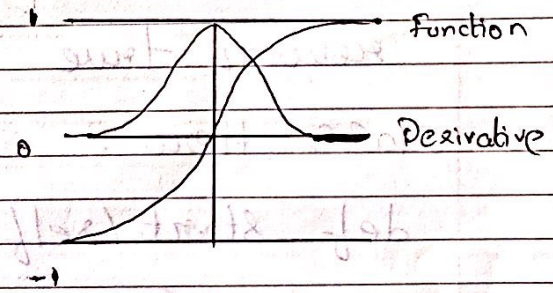
Q4 a.
- Sigmod function



$$g(x) = \frac{1}{1+e^{-x}}$$

$$g'(x) = g(x)(1 - g(x))$$

- Tanh function



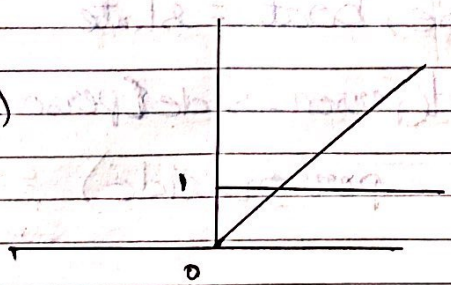
$$g(x) = \frac{e^{x} - e^{-x}}{e^{x} + e^{-x}}$$

$$g'(x) = 1 - g(x)^2$$

- ReLU function

$$g(x) = \max(0, x)$$

$$g(x) = \begin{cases} 1 & x > 0 \\ 0 & \text{otherwise} \end{cases}$$



Q4 b. • Expressibility :

Classes that can be expressed by neural networks

• Efficiency :

The number of resources required by neural networks to approximate a given class function.

• Learnability :

The learning speed and with which neural networks learn good parameter to approximate a given function.

c. i. False
ii. True
iii. False

Q5 a. i. True
ii. False
iii. True

b. Examples of Convolutional ~~network~~ neural network are :
- Cat and Dog classifier
- Face recognition.

c. i. $F = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$ $A = \begin{bmatrix} 2 & 0 & 10 & 0 & 7 \\ 5 & 0 & 10 & 0 & 7 \\ 3 & 0 & 10 & 0 & 3 \\ 3 & 0 & 10 & 0 & 3 \\ 3 & 8 & 10 & 7 & 3 \end{bmatrix}$

$2\times0 + 0\times0 + 0\times10 +$
$3\times0 + 0\times0 + 10\times0 + = 13$ .....
$3\times1 + 1\times0 + 10\times1$

.... $\begin{bmatrix} 13 & 10 & 13 \\ 13 & 10 & 13 \\ 21 & 25 & 20 \end{bmatrix}$ is resultant matrix

ii. $F = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix}$

$\begin{bmatrix} 30 & 0 & 17 \\ 30 & 0 & 13 \\ 30 & 7 & 9 \end{bmatrix}$

iii. $F = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 1 \\ 1 & 1 & 1 \end{bmatrix}$

$\begin{bmatrix} 33 & 10 & 27 \\ 33 & 10 & 23 \\ 41 & 25 & 26 \end{bmatrix}$

iv.
- The first filter highlights the features with less sparsity
- The second filter highlights the features with high pixel value
- The third filter highlights the features with high density.