SRM INSTITUTE OF SCIENCE AND TECHNOLOGY, RAMAPURAM CAMPUS
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ANSWER KEY SUBMISSION

Date of Exam & Session	**16/11/2022 & FN**	**Category of Exam**	**CLA3**
Course Name	**Artificial Neural Networks**	**Course Code**	**18CSE388T**
Name of the Faculty submitting	**Ms.L.Sasikala**	**Date of submission of Answer Key**	**18/11/2022**
Department to which the faculty belongs to	**CSE**	**Total Marks**	**50**

PART - A (10x1 = 10)

ANSWER ALL THE QUESTIONS

Q.No	Questions	Marks
1	In which type of neural network, the data is grouped based on its distance from a center point? a) Recurrent Neural Network b) Modular Neural Network **c) Radial Basis Functions Neural Network** d) Convolution Neural Network	1
2	What does ART stands for? a) Automatic Resonance Theory b) Artificial Resonance Theory **c) Adaptive Resonance Theory** d) Activation Recurrent Theory	1
3	What is the objective of backpropagation algorithm? a) To develop learning algorithm for multilayer feedforward neural network b) To develop learning algorithm for single layer feedforward neural network **c) To develop learning algorithm for multilayer feedforward neural network, so that network can be trained to capture mapping implicitly.** d) To develop learning algorithm for singlelayer feedforward neural network, so that network can be trained to capture mapping implicitly.	1
4	What type learning involved in ART? a) Supervised **b) Unsupervised** c) Reinforcement d) Supervised and unsupervised	1
5	What is unsupervised learning? **a) Weight adjustment based on deviation of desired output from actual input** b) Weight adjustment based on desired output only c) Weight adjustment based on local information available to weights d) Weight adjustment based on input only	1
6	The network that involves backward links from outputto the input and hidden layers is called as ____ a) Self-organizing maps b) Perceptrons **c) Recurrent neural network** d) Multi layered perceptron	1
7	Why is the XOR problem exceptionally interesting toneural network researchers? a) because it can be expressed in a way that allows you to use a neuralnetwork b)because it is complex binary operation that cannot be solved usingneural networks	1

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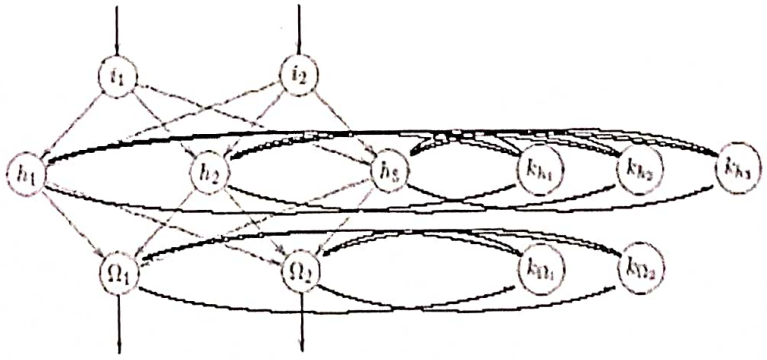
	c) because it can be solved by a single layer perceptron **d) because it is the simplest linearly inseparable problem that exists**	
8	A 4-input neuron has weights 1, 2, 3 and 4. The transferfunction is linear with the constant of proportionality beingequal to 2. The inputs are 4, 10, 5 and 20 respectively. Theoutput will be: **a) 238** b) 76 c) 119 d) 123	1
9	What does RBF stand for? **a) Radial Basis Function** b) Recurrent Base Function c) Recurrence Basic Function Radial Basic Function	1
10	Which of the following is true for neural networks? (i) The training time depends on the size of the network. (ii) Neural networks can be simulated on a conventionalcomputer. (iii) Artificial neurons are identical in operation tobiological ones. a) (i) and (iii) are true b) (ii) is true **c) (i) and (ii) are true** d) (i) is true	1

PART - B (4x4= 16)

ANSWER ALL THE QUESTIONS

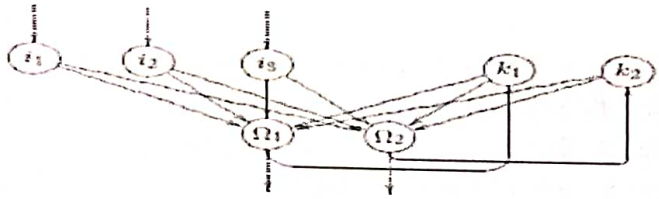
Q.No	Questions	Marks
11	**Explain the role of the context layer in an Elman network.** The Elman networks is an MLP have context neurons, too, but one layer of context neurons per information processing neuron layer. The outputs of each hidden neuron or output neuron are led into the associated context layer and from there it is reentered into the complete neuron layer during the next time step. Compared with Jordan networks the Elman networks often have the advantage to act more purposeful since every layer can access its own context. 	2 2
12	**Describe the methods to determine centers and widths of RBF neurons.** Accuracy of RBF networks can be increased by adapting the widths and positions of the Gaussian bells in the input space to the problem that needs to be approximated. There are several methods to deal with the centers c and the widths of the Gaussian bells: • **Fixed selection:** The centers and widths can be selected in a fixed manner and	4

	regardless of the training. • **Conditional, fixed selection:** The centers and widths are fixed, but we have prior knowledge of the approximated functions and adhere to it. • **Adaptive to the learning process:** This is definitely the most elegant variant, but certainly the most challenging one also.	
13	**Brief about Growing RBF networks.** In growing RBF networks, the number |H| of RBF neurons is not constant. A certain number |H| of neurons as well as their centers ch and widths σh are previously selected (e.g. by means of a clustering method) and then extended or reduced. Neurons are added to areas where error values are high.After generating this initial configuration the vector of the weights G is analytically calculated. Then all specific errors Errp concerning the set P of the training samples are calculated and the maximum specific error is given as, $\max_{p}(\mathrm{Err}_p)$	4
14	**List the applications of SOMs.** • A SOM has been used to classify statistical data describing various quality of life factors such as state of health, nutrition, educational services etc. • Countries with similar quality of life end up clustered together. • The countries with better quality of life are situated towards the upper left and the most povert stricken countries are towards the lower right. • Such maps can be colored using a SOM, since we can take the colors that the SOM chose for each group and apply it to our world map. • In this case, we got the data set from the World Bank containing all 39 indicators of human development, processed them into a SOM, and then applied that to a world map.	4
15	**Define Topology function and explain how a learning neuron influences its neighbors?** • The topology function h is not defined on the input space but on the grid and represents the neighborhood relationships between the neurons, i.e. the topology of the network. • It can be time-dependent which explains the parameter t. The parameter k is all the neurons, and the parameter i is the winner neuron. • The topology function must be uni-modal, i.e. it must have exactly one maximum.This maximum must be next to the winner neuron i, for which the distance to itself certainly is 0. • On a two-dimensional grid we could apply, for instance, the Euclidean distance or on a one-dimensional grid we could simply use the number of the connections between the neurons i and k. • The topology function h(i, k, t) describes the neighborhood relationships in the topology. It can be any uni-modal function that reaches its maximum when i = k gilt. Time-dependence is optional, but often used.	4
16	**Explain the steps involved in training SOM.** **Step 1** – Initialize the weights, the learning rate α and the neighborhood topological scheme. **Step 2** – Continue step 3-9, when the stopping condition is not true.	4

	Step 3 – Continue step 4-6 for every input vector **x**. **Step 4** – Calculate Square of Euclidean Distance for **j = 1 to m** **Step 5** – Obtain the winning unit j where ***D(j)*** is minimum. **Step 6** – Calculate the new weight of the winning unit by the following relation **Step 7** – Update the learning rate α by the following relation **Step 8** – Reduce the radius of topological scheme. **Step 9** – Check for the stopping condition for the network.	

PART - C (2x12 = 24)

ANSWER THE QUESTIONS

Q.No	Questions	Marks
17(a)	**Explain about training recurrent networks.** • Jordan network without a hidden neuron layer for our training attempts so that the output neurons can directly provide input. • This approach is a strong simplification because generally more complicated networks are used. • But this does not change the learning principle.  **Unfolding in time:** • The back propagation of error, which back propagates the delta values. • In recurrent networks the delta values would back propagate cyclically through the network again and again, which makes the training more difficult. • We cannot know which of the many generated delta values for a weight should be selected for training, i.e. which values are useful. • We cannot definitely know when learning should be stopped. • The advantage of recurrent networks is great state dynamics within the network. • One learning approach would be the attempt to unfold the temporal states of the network. • Recursions are deleted by putting a similar network above the context neurons. • We have to backtrack the recurrences and place "'earlier"' instances of neurons in the network thus creating a larger, but forward-oriented network without recurrences. • This enables training a recurrent network with any training strategy developed for non-recurrent ones. • Here the input is entered as teaching input into every "copy" of the input neurons. • This can be done for a discrete number of time steps. • These training paradigms are called unfolding in time	6 6

17(b) **Distinguish between Radian Basis Function Neural Network and Multi-layer Perceptron Feed-Forward Neural Network.**

Input dimension:

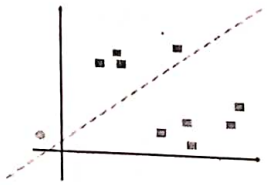
We must be careful with RBF networks in high dimensional functional spaces since the network could very quickly require huge memory storage and computational effort. 4

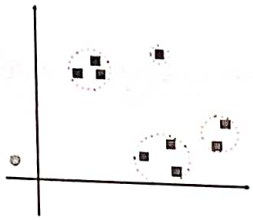
A multilayer perceptron would cause less problems because its number of neurons does not grow exponentially with the input dimension.

Center selection:

However, selecting the centers c for RBF networks is still a major problem. Such problems do not occur with the MLP.

Single layered perceptron networkRadial basis function network 2





Output dimension:

- The advantage of RBF networks is that the **training is not much influenced** when the output dimension of the network is high.
- For an MLP, a learning procedure such as **backpropagation thereby will be very time-consuming.**

Extrapolation: 2

- Advantage as well as disadvantage of RBF networks is the **lack of extrapolation capability.**
- An RBF network returns the result 0 far away from the centers of the RBF layer.
- On the one hand it does not extrapolate, unlike the MLP it cannot be used for extrapolation.

Lesion tolerance: 2

- For the output of an MLP, it is not so important **if a weight or a neuron is missing.**
- It will only worsen a little in total.
- If a weight or a neuron is missing in an RBF network then large parts of the output remain practically uninfluenced.
- But one part of the output is heavily affected because a Gaussian bell is directly missing.

Spread: 2

- Here the MLP is "advantaged" since RBF networks are used considerably less often – which is not always understood by professionals.
- The MLPs seem to have a considerably longer tradition and they are working too good.

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18(a)	**What is ART? Explain the structure and learning process of an ART network.** It is divided to top-down and bottom-up learning. • The two-piece learning procedure of the theory: On the one hand we train the top-down matrix W, on the other hand we train the bottom-up matrix V. **Pattern input and top-down learning:** • When a pattern is entered into the network it causes - an activation at the output neurons and the strongest neuron wins. • Then the weights of the matrix W going towards the output neuron are changed such that the output of the strongest neuron Ω is still enhanced. **Resonance and bottom-up learning:** • The training of the backward w eights of the matrix V is a bit tricky. • Only the weights of the respective winner neuron are trained towards the input layer and our current input pattern is used as teaching input. Thus, network is trained to enhance input vectors. **Adding an output neuron** • It's possible that the neurons are equally active or that many neurons are triggered, resulting in a network that is undecided. • In this case, the control neurons' methods activate a signal that causes a new output neuron to be inserted. **Extensions:** • The ART networks have often been extended. • ART-2 is extended to continuous inputs and additionally offers (in an extension called ART-2A) enhancements of the learning speed which results in additional control neurons and layers. • ART-3 improves the learning ability of ART-2 by adapting additional biological processes such as the chemical processes within the synapses.	4 4 4
18(b)	**Demonstrate in detail about variations of SOMs.** **A neural gas is a SOM without a static topology:** • Neural gas is an artificial neural network, inspired by the self-organizing map and introduced in 1991 by Thomas Martinetz and Klaus Schulten. • The neural gas is a type of self-organizing map that was created to solve the challenge of mapping complex input data that occurs only in subspaces of the input space or even alters the subspace. • In a nutshell, the goal of a neural gas is to create a SOM without a grid framework. • A truly dynamic neighborhood function distinguishes a neural gas from a SOM. • **A Multi-SOM consists of several separate SOMs:** • What should we do with input patterns that are known to be limited to a few (perhaps discontinuous) areas? • Here, the idea is to use not only one SOM but several ones. • A multi-self-organizing map, shortly referred to as M-SOM. • A multiSOM is nothing more than the simultaneous use of M SOMs. • This learning process is analog to that of the SOMs. • **A multi-neural gas consists of several separate neural gases**	9 3

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