BRAINWARE UNIVERSITY

Term End Examination 2024-2025
Programme – B.Tech.(CSE)-DS-2021
Course Name – Deep Learning
Course Code - PEC-CSD701A
(Semester VII)

Full Marks : 60 **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A
(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) Choose the most appropriate application of Boltzmann Machines in machine learning.
a) Clustering unstructured data b) Predicting stock market prices
c) Modeling complex probability distributions d) Sorting numerical data

(ii) Choose the correct advantage of using Restricted Boltzmann Machines (RBMs) over traditional Boltzmann Machines.
a) RBMs require more training data b) RBMs have a simpler network structure, making them easier to train
c) RBMs are only used for small datasets d) RBMs do not utilize hidden layers

(iii) Identify the point of communication between two neurons
a) Axon b) Synapse
c) Dendrite d) Soma

(iv) State the role of the myelin sheath in a biological neuron
a) Generate electrical impulses b) Receive chemical signals
c) Speed up signal transmission d) Store neurotransmitters

(v) Classify the following as a technique used to avoid overfitting in neural networks:
a) Increasing the number of layers b) Decreasing the learning rate
c) Regularization d) Using fewer training examples

(vi) List the primary components of a Feed Forward Neural Network.
a) Nodes, Weights, Activation Function b) Bias, Loss Function, Regularizer
c) Layers, Loss Function, Backpropagation d) Epochs, Gradient Descent, Dataset

(vii) Identify the primary task of Gradient Descent in a neural network.
a) Increase the number of neurons b) Initialize weights randomly
c) Minimize the loss function d) Update the bias term

(viii) Select the type of learning applied in feed forward networks.
a) Supervised Learning b) Unsupervised Learning
c) Reinforcement Learning d) Self-supervised Learning

(ix) Identify the neural network structure used in backpropagation.

a) Convolutional Network b) Multilayer Perceptron
c) Hopfield Network d) Recurrent Neural Network

(x) Identify the reason behind using filters in CNNs.
a) To apply normalization b) To reduce dimensionality
c) To extract features d) To increase data size

(xi) Select the neural network architecture designed for handwritten digit recognition.
a) AlexNet b) VGG
c) LeNet d) ResNet

(xii) Choose the main application area of Boltzmann Machines.
a) Supervised learning tasks b) Unsupervised learning tasks
c) Reinforcement learning tasks d) Semi-supervised tasks

(xiii) Choose the key factor for successful training of DBNs.
a) Good initialization b) Large dataset
c) Regularization d) Overfitting prevention

(xiv) Choose the challenge that Deep Boltzmann Machines help to address in deep learning networks.
a) Vanishing gradients b) Overfitting
c) Gradient explosion d) Computational inefficiency

(xv) State the Perceptron Learning Algorithm will fail to converge if
a) The data is linearly separable b) The data is not linearly separable
c) The learning rate is too high d) The number of inputs is large

Group-B
(Short Answer Type Questions) 3 x 5=15

2. Determine the key innovations in LeNet that made it a pioneer in CNNs. (3)
3. Define Feed Forward Networks in neural networks. (3)
4. Describe the Perceptron Learning Algorithm with a simple binary classification example. (3)
5. Choose one advantage of using autoencoders in unsupervised learning. (3)
6. Classify the variants of the basic convolution function and determine their uses. (3)

OR

Explain the process of CNNs classify images using deep architectures. (3)

Group-C
(Long Answer Type Questions) 5 x 6=30

7. Construct a simple example to illustrate how a Deep Belief Network is formed from multiple layers of RBMs. Discuss the training process involved. (5)
8. Consider the role of contrastive divergence in training RBMs. How does it improve the efficiency of the training process. (5)
9. *Given a linear perceptron with weights $w = [1, 2]$, input $x = [3, 4]$, and a bias $b = -1$, calculate the net input and the output using a step activation function. What is the decision boundary equation for this perceptron?* (5)

10. Evaluate the impact of the number of hidden layers in Deep Belief Networks on their ability to learn complex representations. (5)
11. Tell the key functions of a biological neuron with diagram and describe how its structure supports these functions in the nervous system. (5)

12. Estimate the perceptron learning algorithm in detail. How does it adjust the weights, and under what conditions does it guarantee convergence? Discuss the implications of the convergence property in practical applications. (5)

OR

Consider a simple MLP with two input neurons, one hidden neuron with a sigmoid activation function, and one output neuron. The weights from the input to the hidden layer are $w_1 = 0.5$, $w_2 = -0.5$, *and the bias is* $b_h = 0.1$. *The weight from the hidden neuron to the output neuron is* $w_o = 1$ *and the bias is* $b_o = -0.2$. *Calculate the output for inputs* $x_1 = 1$ *and* $x_2 = 2$. *Use the sigmoid function* $\sigma(z) = \frac{1}{1+e^{-z}}$. (5)

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