[This question paper contains 7 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : **3537 I**

Unique Paper Code : 6203450012

Name of the Paper : Deep Learning

Name of the Course : **B. Voc. (Software Development)**

Semester : VI

Time : 3 Hours ***Maximum Marks : 90***

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) The paper has **two** sections. Section A is compulsory. Each question is of 5 marks.

(c) Attempt any **four** questions from Section B. Each question is of 15 marks.

(d) Students are allowed to use a scientific calculator.

Section - A

1. (a) What is deep learning ? Describe any **three** major areas where it is commonly applied. 5

P.T.O.

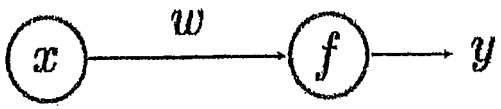
(b) Compare and contrast the single – layered model and the multi – layered perceptron model. 5

(c) What is padding in the context of convolutional neural networks (CNNs) ? Explain its purpose and the different types. 5

(d) What is the difference between parameters and hyperparameters in convolutional layers ? List some examples of each. 5

(e) Differentiate between feedforward neural networks and recurrent neural networks (RNNs). 5

(f) Given a single-layer perceptron with input x, weight w, and bias b = 0. Compute $\frac{\partial L}{\partial W}$ for the mean squared error loss $L = \frac{1}{2}(\hat{y} - y^2)$ and update the weight w. 5



Section - B

2. (a) Consider a Convolutional Neural Network (CNN) architecture that uses the following notations : 10

(i) **CONV-K-N :** A convolutional layer with N filters, each of size K × K. Padding = 0, Stride = 1

(ii) **POOL-K :** A pooling layer with filter size K × K, stride = K and padding = 0

(iii) **FC-N :** A fully connected layer with N neurons.

For each layer, calculate the number of weights, the number of biases and the size of the associated feature maps.

Layer	Activation Map Dimension	Number of Weights	Number of Biases
INPUT	228*228*3	0	0
CONV – 9-32			
POOL-2			
CONV-5-64			

POOL-2

CONV-5-64

POOL-2

FC-3

(b) What is hyperparameter optimization in deep learning ? Explain its importance in model performance and training efficiency. 5

3. (a) What are the key challenges in training deep neural networks (DNNs) ? Describe how these challenges affect the overall performance of the model. 8

(b) Perform the convolution operation on the given 2D image 'Input' using the provided filter 'Kernel'. Assume a stride of 1 and no padding (padding = 0). Clearly show all the steps involved in the calculation. 7

3	0	1	2	7	4
1	5	8	9	3	1
2	7	2	5	1	3
0	1	3	1	7	8
4	2	1	6	2	8
2	4	5	2	3	9

Input

*

1	0	−1
1	0	−1
1	0	−1

Kernel

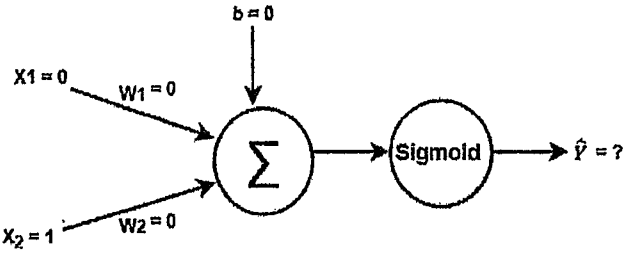
= ?

4. (a) What are the critical design considerations when developing a recurrent neural network for sequence modeling tasks and what challenges are commonly encountered during its training process ? 8

(b) What are the differences between Standard Gradient Descent, Stochastic Gradient Descent and Mini – Batch Gradient Descent ? 7

5. (a) Explain batch normalization in the context of deep neural networks. Describe the key steps involved in performing batch normalization during training a model. 8

(b) Given a single-layer perceptron with input $X_1=0$, $X_2=1$, $W_1=0$, $W_2=1$, $b=0$ and target output $Y = 0$ and network output $\hat{Y}$. Compute $\frac{\partial L}{\partial w_1}, \frac{\partial L}{\partial w_2}$ and $\frac{\partial L}{\partial b}$ for the Mean Squared Error loss $L=\frac{1}{2}(\hat{y}-y^2)$ and update the weight values. 7



6. (a) Explain the Sigmoid, Tanh and ReLU activation functions used in deep learning. Describe the main advantages and limitations of each function. 8

(b) What are max pooling, average pooling and global average pooling in CNNs ? Perform max pooling on the given 2D image using a 2 × 2 filter and a stride of 2. Show all steps clearly. 7

9	4	2	1
2	1	1	7
8	4	2	3
5	6	6	2

Max Pool
Filter– (2×2)
Stride– (2,2)

7. (a) Explain the architecture and working principle of an autoencoder in deep learning. What are its primary uses and how does it differ from traditional neural networks ? 8

(b) What is a long short – term memory cell and how does it differ from a traditional recurrent neural network ? 7

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