C/L/TX

Reg. No: 21BCE2620

VIT
Vellore Institute of Technology

Final Assessment Test – November 2024

Course: **BCSE332L - Deep Learning**

Class NBR(s): **1745/1747/1750/1753/1756**

Slot: **D1+TD1**

Time: **Three Hours**

Max. Marks: **100**

- **KEEPING MOBILE PHONE/ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

Answer ALL Questions

(10 X 10 = 100 Marks)

1. Design and elaborate an Artificial Neural Network (ANN) for predicting stock market prices using features such as historical data and market indicators. The ANN should have an input layer with 10 neurons representing these features, followed by two hidden layers with 64 and 32 neurons respectively, each utilizing ReLU activation functions. Finally, include an output layer with a single neuron using a linear activation function to predict the stock price. Design a ANN model for above, explain it.

2. How can we effectively perform hyper-parameter tuning in Artificial Neural Networks (ANNs) to optimize their performance, and what are some examples of key hyper-parameters that need to be tuned, such as the number of hidden layers, the number of neurons per layer, the learning rate, and the choice of activation functions?

3. Identify the concept of dynamic learning in optimization algorithm, including the necessary mathematical derivations, and analyze the performance of two optimization functions, such as Adam and AdaGrad, within the framework of dynamic learning.

4. Analyze the concepts of overfitting and underfitting in deep learning using an example of predicting house prices. Compare the two phenomena, discussing their definitions, causes, and impacts on model performance.

5. Given the following (4 x 4) input matrix:

$$\begin{bmatrix} 1 & 4 & 7 & 2 \\ 2 & 5 & 8 & 3 \\ 3 & 6 & 9 & 0 \\ 0 & 1 & 4 & 5 \end{bmatrix}$$

apply a convolutional layer with a single (2 x 2) filter:

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

Using a stride of 1 and no padding to calculate the resulting feature map. Then, apply a (2 x 2) max pooling layer with a stride of 2 to the resulting feature map from the convolutional layer and calculate the final output feature map.

6.a) Compare three pre-trained deep neural models commonly used in real-world applications. Based on your comparison, determine which model is most suitable for hand written letter recognition tasks and explain your reasoning.

OR

6.b) Given a large-scale image classification task with limited computational resources, would you choose ResNet or VGG16, and why?
Discuss the trade-offs involved in this decision.

7.a) Polysemy is common in natural languages. For example, the word "bank" has different meanings in contexts "i went to the bank to deposit cash" and "i went to the bank to sit down". How can we design a neural network model such that for a given context sequence and a word, a vector representation of the word in the correct context will be returned? Identify a neural architecture is preferred for handling polysemy and elaborate with its design.

OR

7.b) How can Bidirectional Recurrent Neural Networks (BRNNs) be used for Named Entity Recognition (NER: To identify and classify entities in text, such as names, dates, and locations)? Design a neural architecture representing NER.

8. Design a patient monitoring system using a custom GRU-based Recurrent Neural Network (RNN) to analyze time-series data like heart rate and blood pressure, detailing the steps involved and the specific components of the GRU architecture?

9. Explain the architecture of a Generative Adversarial Network (GAN) with an example, and describe how GANs can be used to generate adversarial examples?

10. *Describe* the fundamental concepts and mechanisms of deep reinforcement learning, including the functioning of a Deep Q-Network (DQN) as an example, and discuss its applications across various fields.

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