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Question Paper Code: 2436039

B.E. / B.Tech. DEGREE EXAMINATIONS, NOV / DEC 2024

Sixth Semester

Artificial Intelligence and Data Science

U20AI604 – DEEP LEARNING

(Regulation 2020)

Time: Three Hours

Maximum: 100 Marks

Answer ALL questions

PART – A

(10 x 2 = 20 Marks)

1. Analyze after training a neural network, you observe a large gap between the training accuracy (100%) and the test accuracy (42%). Which method is commonly used to reduce this gap?
2. Build the gradient of the following function at  $x = y = 0$ ?  
$$f(x, y) = (x - 2)^3 \sin(y)$$
3. Consider, in a convolution neural network we supply  $32 \times 32 \times 3$  input volume along with ten  $5 \times 5$  filters with stride=1 and pad=2, what is the number of parameters in this layer?
4. Analyze the difficulties that computer vision algorithms face in dealing with images. i.e. two characteristics of image formation that make it difficult to recover the image content.
5. How deep learning system Overfitting and underfitting issues might occur. Identify the role of Dropout in solving those issues?
6. How is weight adjustment done in back propagation network?
7. Which deep learning architecture is best suited for time series forecasting? Why?
8. Is using pooling layer mandatory in CNN models? If yes, what is the necessity?
9. Which deep learning models suits good for developing auto caption for a video? Justify.

10. Consider, you are supposed to develop a facial recognition system using deep learning model. Which architecture will be well suited for this? Justify your answer.

PART – B

(5 x 16 = 80 Marks)

11. (a) Construct the detailed work flow for training and evaluating a Deep learning model with a suitable diagram. (16)

(OR)

- (b) What are the different activation functions used in Deep learning systems? Let us consider we develop a system to predict the rainfall for a particular date and city, what type of activation function suits good? Explain why it suits good. (16)

12. (a) Assume we have a set of data from patients who have visited PA hospital during the year 2011. A set of features (e.g., temperature, height) have been also extracted for each patient. Our goal is to decide whether a new visiting patient has any of diabetes, heart disease, or Alzheimer (a patient can have one or more of these diseases). (16)

(OR)

- (b) (i) We have decided to use a neural network to solve this problem. We have two choices: either to train a separate neural network for each of the diseases or to train a single neural network with one output neuron for each disease, but with a shared hidden layer. Which method do you prefer? Justify your answer. (8)
- (ii) Some patient features are expensive to collect (e.g., brain scans) whereas others are not (e.g., temperature). Therefore, we have decided to first ask our classification algorithm to predict whether a patient has a disease, and if the classifier is 80% confident that the patient has a disease, then we will do additional examinations to collect additional patient features. In this case, which classification methods do you recommend? Justify your answer. (8)

13. (a) Explain how you implement auto encoder in detail. (16)

(OR)

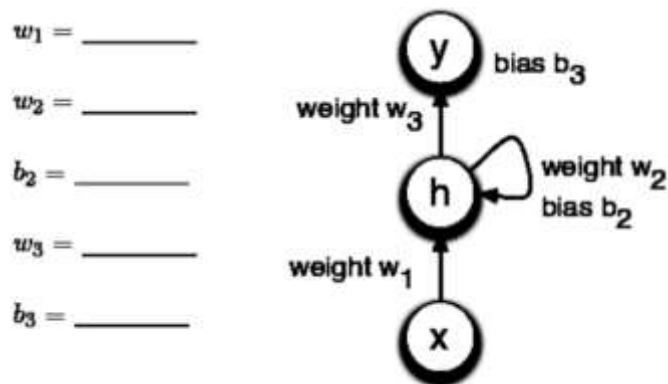
(b) What is AlexNet network? Explain how it improves the performance of a deep learning system. (16)

14. (a) Consider a recurrent neural network (RNN) takes in an input vector  $x_t$  and a state vector  $h_{t-1}$  and returns a new state vector  $h_t$  and an output vector  $y_t$ :

$$h_t = f(w_1x_t + w_2h_{t-1} + b_2)$$

$$y_t = g(w_3h_t + b_3),$$

The following diagram depicts a single RNN unit, where  $x_t$ ,  $h_{t-1}$ ,  $h_t$  and  $y_t$  are all scalars as a state machine: (16)



$w_1 = \underline{\hspace{2cm}}$   
 $w_2 = \underline{\hspace{2cm}}$   
 $b_2 = \underline{\hspace{2cm}}$   
 $w_3 = \underline{\hspace{2cm}}$   
 $b_3 = \underline{\hspace{2cm}}$

Suppose that  $f$  is a binary threshold unit and  $g$  is a linear unit:

$$f(x) = \begin{cases} 0 & \text{if } x < 0 \\ 1 & \text{if } x \geq 0 \end{cases}$$

$$g(x) = x.$$

Fill in weights ( $w_1$ ,  $w_2$ ,  $w_3$ ), biases ( $b_1$ ,  $b_2$ ) so that the RNN initially outputs 0, but as soon as it receives an input of 1, it switches to outputting 1 for all subsequent time steps. For instance, the input 0001010 produces the output 0001111. The hidden unit has an initial value of 0.

(OR)

- (b) i) You are supposed to develop a deep learning model to identify an object in a given image. Explain the detection process with necessary architecture. (8)
- ii) Which architecture suits good for building an automatic image captioning system? Explain the working of the model with example. (8)

15. (a) Design a novel natural language processing (NLP) application using Word2Vec embeddings to analyze and categorize user-generated text data from social media platforms. Specify the preprocessing steps, feature extraction methods, and machine learning algorithms to be used. Implement the application prototype and evaluate its performance in terms of accuracy, scalability, and computational efficiency. (16)

(OR)

- (b) Develop a facial recognition system for access control in a corporate environment, incorporating state-of-the-art deep learning models and techniques. Design the system architecture, including data acquisition, preprocessing, feature extraction, model training, and deployment stages. Evaluate the system's performance using real-world data, considering factors such as accuracy, speed, robustness to variations in lighting and pose, and privacy concerns. (16)