Important Questions

Deep Learning (20CS41008)

UNIT–I

1. Explain the architecture and working principles of the McCulloch–Pitts neuron. How does it model thresholding logic?
2. Describe the Perceptron Learning Algorithm. Derive the weight update rule with a suitable example.
3. Discuss the representation power of Multi-Layer Perceptrons (MLPs). Why are they considered universal function approximators?
4. What is Gradient Descent? Explain batch, mini-batch, and stochastic GD with advantages and disadvantages.
5. Compare sigmoid neurons with threshold logic units in terms of learning capability and differentiability.
6. Explain feedforward neural network architecture and discuss its representational limitations and strengths.

UNIT–II

7. Derive the Backpropagation Algorithm for a 2-layer neural network with mathematical expressions.
8. Compare Standard GD, Momentum-based GD, and Nesterov Accelerated Gradient (NAG).
9. Explain AdaGrad, RMSProp, and Adam optimizers. Discuss when each optimizer is preferred.
10. Define Eigenvalues and Eigenvectors. Explain how eigenvalue decomposition aids dimensionality reduction.
11. Explain Principal Component Analysis (PCA). Derive PCA using eigenvalue decomposition and interpret its components.
12. Discuss the concept of Singular Value Decomposition (SVD) and explain its role in data compression and noise reduction.

UNIT–III

13. Explain the working of a basic autoencoder and its relation to PCA.
14. Write short notes on Denoising Autoencoders, Sparse Autoencoders, and Contractive Autoencoders.
15. Explain the Bias–Variance trade-off with examples. How does deep learning address this trade-off?
16. Describe L2 regularization, early stopping, and data augmentation. How do they improve generalization?
17. Discuss the role and mechanism of Dropout. Why does dropout act as an ensemble technique?
18. Explain Batch Normalization, including forward and backward passes, and its impact on training stability.

UNIT–IV

19. Explain the convolution operation and pooling operation with examples. Why are these considered strong priors?
20. Compare major CNN architectures: LeNet, AlexNet, ZFNet, VGGNet, GoogLeNet, and ResNet.
21. Describe variants of convolution such as dilated convolution, transposed convolution, and depthwise separable convolution.
22. What are structured outputs in CNNs? Discuss applications like segmentation and object detection.
23. Explain Guided Backpropagation, DeepDream, and Fooling CNNs with illustrations or examples.
24. Discuss how CNNs handle different data types such as images, video frames, and multi-channel feature maps.

UNIT–V

25. Explain Recurrent Neural Networks (RNNs) and derive the Backpropagation Through Time (BPTT) algorithm.
26. Describe the vanishing and exploding gradient problem in RNNs. How do LSTM/GRU mitigate these issues?
27. Compare GRU and LSTM architectures. Discuss situations where GRU is preferred.
28. Explain Truncated BPTT. Why is it required and how does it reduce computational complexity?

29. Describe an Encoder–Decoder model for machine translation. Explain training procedure and challenges.

30. Explain the Attention mechanism, its mathematical formulation, and demonstrate how attention over images works.