

DEEP LEARNING

UNIT 1: Introduction to Deep Learning

Syllabus Topics:

- Biological Neuron
- Computational Units
- McCulloch–Pitts Neural Model
- Linear Perceptron
- Perceptron Learning
- Feed Forward Networks
- Backpropagation Networks

Possible Questions:

1. Explain the structure and functioning of a biological neuron. How is it modeled in artificial networks?
 2. What are computational units in deep learning? Give examples.
 3. Describe the McCulloch–Pitts Neural Model with truth table.
 4. What is a linear perceptron? Derive its learning rule.
 5. Explain the Perceptron Learning Algorithm with steps and example.
 6. What is a feedforward neural network? How does information flow in it?
 7. Explain the backpropagation algorithm with diagram and mathematical expressions.
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UNIT 2: Feedforward Networks

Syllabus Topics:

- Multilayer Perceptron (MLP)
- Gradient Descent
- Backpropagation
- Empirical Risk Minimization
- Regularization
- Autoencoders

Possible Questions:

1. Describe the architecture of a Multilayer Perceptron. What are its applications?
2. What is gradient descent? Explain the algorithm with a diagram.
3. Differentiate between stochastic, batch, and mini-batch gradient descent.

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4. Explain Empirical Risk Minimization with example.
 5. What is regularization in deep learning? Compare L1 and L2 regularization.
 6. What are autoencoders? Describe their architecture and use.
 7. Explain how autoencoders can be used for dimensionality reduction.
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UNIT 3: Convolutional Networks

Syllabus Topics:

- Convolution Operation
- Variants of Convolution Function
- Structured Outputs
- Efficient Convolution Algorithms
- Random/Unsupervised Features
- LeNet
- AlexNet

Possible Questions:

1. Explain the convolution operation with an example (include padding, stride, filters).
 2. What are different variants of the basic convolution function?
 3. What are structured outputs in CNN? How are they different from traditional outputs?
 4. Name and explain any two efficient convolution algorithms.
 5. What are random features in CNNs? How do unsupervised features help in learning?
 6. Describe the architecture and functioning of LeNet.
 7. Compare LeNet and AlexNet in terms of architecture and performance.
 8. What were the innovations introduced by AlexNet?
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UNIT 4: Recurrent Neural Networks

Syllabus Topics:

- Bidirectional RNNs
- Deep Recurrent Networks
- Recursive Neural Networks
- LSTM
- Other Gated RNNs

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Possible Questions:

1. What is a Bidirectional RNN? How is it different from a standard RNN?
 2. Explain the architecture of Deep Recurrent Networks with diagram.
 3. What are Recursive Neural Networks? Where are they used?
 4. Describe the structure and working of LSTM with gates.
 5. Compare LSTM with GRU.
 6. What are gated RNNs? How do they solve vanishing gradient problem?
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UNIT 5: Deep Generative Models

Syllabus Topics:

- Boltzmann Machines
- Restricted Boltzmann Machines (RBMs)
- MCMC and Gibbs Sampling
- Gradient Computations in RBMs
- Deep Belief Networks (DBNs)
- Deep Boltzmann Machines (DBMs)

Possible Questions:

1. What is a Boltzmann Machine? Describe its structure.
2. Explain the working and structure of Restricted Boltzmann Machines.
3. What is the difference between Boltzmann Machines and RBMs?
4. Explain the concept of Gibbs Sampling with example.
5. What is Markov Chain Monte Carlo (MCMC) in the context of deep learning?
6. How are gradients computed in RBMs?
7. What is a Deep Belief Network? How is it trained?
8. Compare Deep Belief Networks with Deep Boltzmann Machines.