SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)
SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

QUESTION BANK

VII SEMESTER

1908013 - DEEP LEARNING AND ITS APPLICATIONS

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QUESTION BANK

SUBJECT   : 1908013 DEEP LEARNING AND ITS APPLICATIONS

SEM/YEAR : VII Sem / IV Year

UNIT - I: INTRODUCTION TO MACHINE LEARNING BASICS
Scalars – Vectors – Matrices – Tensors – Identity and Inverse Matrices – Linear Dependence and Span – Eigen Decomposition – Probability – Random Variables – Conditional Probability – Expectation – Variance – Covariance –Bayes' Rule – Supervised Learning Algorithm – Unsupervised Learning Algorithm –Stochastic Gradient Descent.

PART – A			
Q.No	**Question**	**BT Level**	**Competence**
1	What is Deep Learning?	BTL-1	Remember
2	Differentiate scalar and vector.	BTL-2	Understand
3	What is the difference between deep learning and machine learning?	BTL-1	Remember
4	What is the difference between vectors and matrices?	BTL-1	Remember
5	Define Singular matrix.	BTL-1	Remember
6	Define Eigen vector and Eigen value.	BTL-1	Remember
7	Define frequentist probability and Bayesian probability.	BTL-1	Remember
8	State the Bayes rule.	BTL-1	Remember
9	List out some supervised learning algorithms.	BTL-1	Remember
10	Can principle component analysis be viewed as unsupervised learning algorithm? Examine.	BTL-2	Understand
11	List any two unsupervised learning algorithms.	BTL-1	Remember
12	What is stochastic gradient descent model?	BTL-2	Understand
13	Specify the formula for conditional probability.	BTL-1	Remember
14	What is support vector machine.	BTL-1	Remember
15	Show the formula for Variance.	BTL-1	Remember

16	Define linear combination and span of a set of vectors.	BTL-2	Understand
17	Define Eigen Decomposition.	BTL-1	Remember
18	What is random variable?	BTL-1	Remember
19	What is probability theory in the context of science and engineering?	BTL-1	Remember
20	Define linearly independent vectors.	BTL-1	Remember
21	Define tensor.	BTL-1	Remember
22	What is identity matrix?	BTL-1	Remember
23	What is the purpose of matrix inverse in computations?	BTL-1	Remember
24	Define linear dependence of vectors.	BTL-1	Remember

PART – B

1	Outline the main steps of PCA and its role in dimensionality reduction. (13)	BTL-3	Analyze
2	i. Analyze the structural relationship among AI subsystems across different domains, supported with a diagram. (9) ii. Summarize the key milestones in Deep Learning development. (4)	BTL-3	Analyze
3	Evaluate the role of deep learning as a subset of representation learning, using a Venn diagram to support your argument. (13)	BTL-5	Evaluate
4	Elaborate the concept of Deep Learning with an illustrative example. (13)	BTL-6	Create
5	i. Assess the role of scalars in computational models. (7) ii. Evaluate how vectors contribute to multidimensional data representation. (6)	BTL-5	Evaluate
6	i. Give the Difference between deep learning and machine learning. ii. Give the various concepts of probability.	BTL-4	Apply
7	Develop a brief technical report covering: i. Vectors. (6) ii. Matrices. (7)	BTL-6	Create
8	i. Outline the concept of Eigen Decomposition and its purpose. (7) ii. Describe the basic idea of tensors and their applications. (6)	BTL-3	Analyze
9	Assess the following: i. Expectation. (5) ii. Variance. (4) iii. Covariance. (4)	BTL-5	Evaluate
10	Apply the chain rule and conditional probability concepts to solve a complex probability scenario. (13)	BTL-4	Apply
11	Evaluate the effectiveness of Stochastic Gradient Descent in optimizing deep learning models. (13)	BTL-5	Evaluate

12	i. Apply the concept of PCA to dimensionality reduction. (6) ii. Analyze how SVMs work and when to use them. (7)	BTL-4	Apply
13	Explain supervised learning algorithm. (13)	BTL-4	Apply
14	Critically evaluate unsupervised learning algorithms and their effectiveness in clustering tasks. (13)	BTL-5	Evaluate
15	Demonstrate the working of the k-Means Algorithm with a relevant example. (13)	BTL-3	Analyze
16	Apply the gradient descent algorithm to optimize a cost function, with a suitable example.	BTL-4	Apply
17	Design a deep learning model architecture to classify plant leaf diseases using image data. Describe the choice of layers, activation functions, loss function, and evaluation metrics. Justify each design decision based on the problem requirements.	BTL-6	Create

PART – C

1	Assess the historical developments in deep learning. (15)	BTL-6	Create
2	Critically analyze the roles of scalars and vectors in deep learning, and justify the importance of matrix operations with suitable examples. i. Scalars and Vectors (6) ii. Matrices (7)	BTL-5	Evaluate
3	Construct an illustrative explanation demonstrating the use of: i. Random Variables in prediction tasks. (6) ii. Probability in model learning. (7)	BTL-5	Evaluate
4	Develop a supervised learning algorithm and explain in detail.(15)	BTL-6	Create
5	Provide a critical evaluation of a supervised learning model by discussing its structure, training process, and application in a real-world scenario.	BTL-5	Evaluate

UNIT - II: DEEP NETWORKS

Deep Feed Forward Network: Learning XOR – Gradient Based Learning- Hidden Units – Architecture Design – Back Propagation Algorithms. Regularization for Deep Learning: Parameter Norm Penalties – Regularization and unconstrained Problems – Dataset Augmentation – Noise Robustness – Semi supervised Learning – Challenges in Neural Network Optimization.

PART – A

Q.No	Questions	BT Level	Competence
1	List the different types of layers used in feedforward neural networks.	BTL-1	Remember
2	What is the role of the activation function in neural networks?	BTL-1	Remember
3	Compare linear models and neural networks in terms of learning capacity.	BTL-2	Understand
4	Give three generalizations of ReLU with non-zero slope.	BTL-2	Understand
5	What is a deep feedforward neural network?	BTL-1	Remember

6	List commonly used hidden unit types in neural networks.	BTL-1	Remember
7	What is the drawback of using ReLU as an activation function?	BTL-1	Remember
8	Show how gradient descent is used in training machine learning models.	BTL-2	Understand
9	Give an example of a feedforward neural network.	BTL-2	Understand
10	Define the chain rule in calculus and mention its use in backpropagation.	BTL-1	Remember
11	List some classification problems where data augmentation is commonly applied.	BTL-1	Remember
12	Mention the significance of the universal approximation theorem for feedforward neural networks.	BTL-2	Understand
13	What are critical points or stationary points in a function?	BTL-1	Remember
14	List out the ways regularization techniques help in avoiding overfitting in deep learning.	BTL-2	Understand
15	What is semi-supervised learning?	BTL-1	Remember
16	Show the role of derivatives in the working of the gradient descent algorithm.	BTL-2	Understand
17	What is dataset augmentation in machine learning?	BTL-1	Remember
18	why the chain rule is essential in training deep neural networks.	BTL-2	Understand
19	What is meant by the term "network" in neural networks?	BTL-1	Remember
20	Define a computational graph.	BTL-1	Remember
21	What does the term "feedforward" signify in neural networks?	BTL-1	Remember
22	Show why the XOR operation is important in evaluating neural network learning capabilities.	BTL-2	Understand
23	Define the term "cost function" in deep learning.	BTL-1	Remember
24	Give reasons why dataset augmentation is essential for training models.	BTL-2	Understand

PART – B

1	Evaluate the architecture and functionalities of deep feed forward networks with examples. (13)	BTL-5	Evaluate
2	i. Apply the concept of cost function in gradient-based learning. (6) ii. Apply maximum likelihood methods to learn conditional distributions. (7)	BTL-4	Apply
3	i. Evaluate how conditional statistics are learned in gradient-based learning. (7) ii. Assess the use of linear units in Gaussian output distributions. (6)	BTL-5	Evaluate
4	Apply the concept of output units in feedforward networks with relevant examples. (13)	BTL-4	Apply
5	i. Construct a justification for the importance of ReLU in hidden layers. (5) ii. Create a Bernoulli distribution output using sigmoid units. (8)	BTL-6	Create

6	i. Apply softmax units for Multinoulli output distributions. (7) ii. Apply the properties of hidden units in a neural network. (6)	BTL-4	Apply
7	i. Evaluate the effectiveness of ReLU and its variations in deep networks. (7) ii. Critically assess logistic sigmoid and hyperbolic tangent activations. (6)	BTL-5	Evaluate
8	i. Analyze the functionality of Radial Basis Function, Softplus, and Hard Tanh. (7) ii. Develop architectural design strategies for deep networks. (6)	BTL-3	Analyze
9	i. Create a backpropagation algorithm for a given network. (7) ii. Develop a regularization method suitable for deep learning. (6)	BTL-6	Create
10	Apply the universal approximation theorem and discuss network depth implications. (13)	BTL-4	Apply
11	Evaluate different methods of dataset augmentation in training deep models. (13)	BTL-5	Evaluate
12	Analyze a dataset by developing it to demonstrate robustness to noise. (13)	BTL-3	Analyze
13	Evaluate the chain rule of calculus in the context of neural networks. (13)	BTL-5	Evaluate
14	Analyze the use of computational graphs for model optimization. (13)	BTL-3	Analyze
15	Apply dataset augmentation in various machine learning tasks. (13)	BTL-4	Apply
16	Analyze the concept and implementation of multi-task learning. (13)	BTL-3	Analyze
17	Develop a comparative evaluation of computational graphs using diagrams. (13)	BTL-6	Create
PART – C			
1	Evaluate a deep feedforward network model and justify its application in solving a specific problem. (15)	BTL-5	Evaluate
2	Develop routines for forward propagation computation and implement them for a sample input. (15)	BTL-6	Create
3	Create a comparative analysis between linear models and neural networks based on accuracy and complexity. (15)	BTL-6	Create
4	Assess your own use-case scenario using computational graphs and evaluate the benefits. (15)	BTL-5	Evaluate
5	Evaluate and reconstruct the chain rule of calculus in the context of backpropagation. (15)	BTL-5	Evaluate

	UNIT - III: CONVOLUTIONAL NETWORKS		
The Convolution Operation – Motivation – Pooling – Variants of the Basic Convolution Function – Structured Outputs – Data types – Efficient Convolution Algorithm – Random or Unsupervised Features.
Q.No	Questions	BT Level	Competence
PART – A
1	What is the purpose of zero-padding in convolutional networks?	BTL-1	Remember
2	Why is the output layer of a convolutional network considered computationally inexpensive?	BTL-1	Remember
3	Show how convolutional networks function and contribute to deep learning applications.	BTL-2	Understand
4	Mention how the stride value influences the size of the feature map in a convolution operation	BTL-2	Understand
5	Show how pooling layers help handle varying input sizes in convolutional neural networks.	BTL-2	Understand
6	Define convolution in the context of deep learning.	BTL-1	Remember
7	List three important practices that enhance machine learning performance.	BTL-1	Remember
8	What is meant by unshared convolution in CNNs?	BTL-1	Remember
9	Define the primary visual cortex and its relevance.	BTL-1	Remember
10	Mention strategies used to minimize training cost in convolutional networks.	BTL-2	Understand
11	Simulate how reverse correlation works in a neural network.	BTL-2	Understand
12	List out the benefits of parameter sharing in convolutional layers and explain why it is efficient.	BTL-2	Understand
13	Show three properties of V1 that CNNs aim to replicate.	BTL-1	Remember
14	What is a feature map in convolutional neural networks?	BTL-1	Remember
15	Define equivariance to translation in convolutional layers.	BTL-1	Remember
16	List the three main stages of a convolutional neural network.	BTL-1	Remember
17	Give the different data formats compatible with convolutional networks.	BTL-1	Remember
18	List out different types of pooling layers used in CNNs and show how they reduce spatial dimensions.	BTL-2	Understand
19	Differentiate between simple and complex layers in convolutional networks.	BTL-2	Understand
20	List three basic approaches for obtaining convolution kernels without supervision.	BTL-1	Remember
21	Give an example that demonstrates convolution operation.	BTL-1	Remember

22	Show the process of reverse correlation and explain why it is used in analyzing neural network behavior.	BTL-2	Understand
23	What is complex layer terminology in convolutional networks?	BTL-1	Remember
24	Show how convolutional layers demonstrate translation equivariance	BTL-2	Understand

PART – B

1	Construct an example function that performs convolution and analyze each step-in detail. (13)	BTL-5	Evaluate
2	i. Describe sparse interactions with diagram. (6) ii. Describe parameter sharing with illustration. (7)	BTL-5	Evaluate
3	Illustrate pooling using a practical example and apply it in a CNN setting. (13)	BTL-4	Apply
4	Develop the mathematical expression for unshared convolution and illustrate tiled convolution. (13)	BTL-5	Evaluate
5	Evaluate various types of basic convolution functions and their usefulness.	BTL-5	Evaluate
6	Construct a CNN architecture to differentiate between simple and complex layer terminologies. (13)	BTL-6	Create
7	Analyze local connections, convolutional layers, and fully connected layers using appropriate diagrams. (13)	BTL-3	Analyze
8	Create a tabular representation of diverse input data formats used in CNNs with examples. (13)	BTL-4	Apply
9	i. Analyze parameter sharing. (7) ii. Analyze equivariant representations in CNNs. (6)	BTL-3	Analyze
10	Assess the differences among locally connected layers, tiled convolution, and standard convolution with examples and diagrams. (13)	BTL-6	Create
11	i. Describe Max Pooling with concise explanation. (6) ii. Describe down-sampling using pooling. (7)	BTL-5	Evaluate
12	Evaluate the role of random or unsupervised feature extraction in convolutional networks. (13)	BTL-6	Create
13	Apply the concept of unshared convolution using a real-time example.	BTL-4	Apply
14	i. Describe three biological properties of V1 modeled by CNN layers. (6) ii. Describe how invariances are learned with diagram. (7)	BTL-4	Apply
15	Evaluate the impact of parameter sharing on performance and efficiency in convolutional networks. (13)	BTL-6	Create
16	Illustrate equivariant representation in convolutional neural networks. (13)	BTL-4	Apply
17	Assess how convolutional networks learn invariances using a detailed diagram and relevant example. (13)	BTL-6	Create

PART – C

1	Evaluate the role of sparse connectivity in convolutional networks by constructing a detailed graphical demonstration. (15)	BTL-5	Evaluate
2	Construct a visual representation of parameter sharing in CNNs and assess	BTL-5	Evaluate

	its impact on learning efficiency. (15)		
3	Assess the effectiveness of different variants of the basic convolution function in deep learning tasks. (15)	BTL-6	Create
4	i. Create a convolutional network that demonstrates the effect of zero padding on output size. (8) ii. Evaluate the neuroscientific inspiration behind the design of convolutional networks. (7)	BTL-6	Create
5	Construct a comparative table of various data formats compatible with convolutional networks, and describe their applications. (15)	BTL-5	Evaluate

UNIT - IV: SEQUENCE MODELING: RECURRENT AND RECURSIVE NETS

Unfolding Computational Graphs – Recurrent Neural Networks – Bidirectional RNNs – Encoder Decoder Sequence to Sequence Architectures – Deep Recurrent Networks – Recursive Neural Networks – The Challenge of Long- Term Dependencies – Echo State Networks – The Long-term memory and other Gated RNNs – Optimization for Long Term Dependencies – Explicit Memory.

PART – A			
Q.No	Questions	BT Level	Competence
1	Define Recurrent Neural Networks.	BTL-1	Remember
2	What is the role of an Encoder in sequence models?	BTL-1	Remember
3	Give the basic computational blocks used in most recurrent neural networks.	BTL-2	Understand
4	What do you mean by Bidirectional Recurrent Neural Networks?	BTL-1	Remember
5	Give one key advantage of recursive neural networks over recurrent neural networks.	BTL-2	Understand
6	What is the purpose of a Decoder in sequence-to-sequence models?	BTL-1	Remember
7	how Recursive Neural Networks process structured input data such as trees.	BTL-1	Remember
8	Mention how Gated RNNs like GRUs and LSTMs help solve the vanishing gradient problem.	BTL-2	Understand
9	Compare Echo State Networks and Liquid State Machines.	BTL-2	Understand
10	Distinguish between content-based and location-based addressing in memory networks.	BTL-2	Understand
11	Classify the strategies used for handling multiple time scales in RNNs.	BTL-1	Remember
12	What is LSTM?	BTL-1	Remember
13	Give two important design patterns used in Recurrent Neural Networks.	BTL-2	Understand
14	Summarize the functioning of Echo State Networks.	BTL-1	Remember
15	Point out the benefit of adding depth in Deep RNN architectures.	BTL-1	Remember

16	Compare gradient descent with and without gradient clipping using a simple diagram.	BTL-2	Understand
17	Mention why the unfolding process is essential in the computational graph of an RNN.	BTL-2	Understand
18	**Show the structure and function of an LSTM cell using a neat labeled diagram.**	BTL-2	Understand
19	List out the functions of leaky units in recurrent neural networks	BTL-2	Understand
20	Mention how a neural network can be designed to include an explicit memory component.	BTL-2	Understand
21	Give a diagram and explain the architecture of a Long Short-Term Memory (LSTM) unit.	BTL-2	Understand
22	Show how Echo State Networks work and mention their potential applications.	BTL-2	Understand
23	why translation equivariance is not typically present in standard RNNs.	BTL-2	Understand
24	What is meant by explicit memory in memory-augmented neural networks, and how is it used?	BTL-2	Understand
PART – B			
1	i. Explain Bidirectional RNNs. (6) ii. Explain Unfolding Computational Graphs. (7)	BTL-5	Evaluate
2	i. Discuss Teacher Forcing in Recurrent Neural Networks. (6) ii. Discuss Networks with Output Recurrence. (7)	BTL-5	Evaluate
3	i. Describe Echo State Networks. (7) ii. Explain the Challenge of Long-Term Dependencies. (6)	BTL-5	Evaluate
4	Discuss Recurrent Neural Networks in detail. (13)	BTL-3	Analyze
5	Describe Deep Recurrent Networks in detail. (13)	BTL-3	Analyze
6	Illustrate Encoder-Decoder Sequence-to-Sequence Architecture. (13)	BTL-3	Analyze
7	Explain Leaky Units and Other Strategies for Multiple Time Scales. (13)	BTL-6	Create
8	Point out various features of Echo State Networks. (13)	BTL-5	Evaluate
9	Explain Optimization for Long-Term Dependencies. (13)	BTL-6	Create
10	Compute the gradient in a Recurrent Neural Network. (13)	BTL-3	Analyze
11	i. Illustrate Clipping Gradients. (7) ii. Illustrate Regularizing to Encourage Information Flow. (6)	BTL-4	Apply
12	i. Describe Long Short-Term Memory. (7) ii. Describe Other Gated RNNs. (6)	BTL-5	Evaluate
13	i. Explain Adding Skip Connections Through Time. (7) ii. Explain Leaky Units and a Spectrum of Different Time Scales. (6)	BTL-5	Evaluate
14	Describe Explicit Memory. (13)	BTL-5	Evaluate

15	Discuss Echo State Networks. (13)	BTL-6	Create
16	Illustrate Bidirectional RNNs. (13)	BTL-4	Analyze
17	Explain Challenge of Long-Term Dependencies. (13)	BTL-6	Create

PART – C			
1	Explain the process of Unfolding Computational Graphs and evaluate its major advantages using an example. (15)	BTL-5	Evaluate
2	Create a step-by-step method to compute the gradient in a Recurrent Neural Network. (15)	BTL-6	Create
3	Create a model that demonstrates sequence modeling conditioned on context using RNNs. (15)	BTL-6	Create
4	Explain the working of Encoder-Decoder (Sequence-to-Sequence) RNN architecture with a detailed example. (15)	BTL-5	Evaluate
5	Create a comparative study on various Gated RNNs such as LSTM, GRU, and others, highlighting key differences. (15)	BTL-6	Create

UNIT - V: DEEP LEARNING RESEARCH and ITS APPLICATIONS

Linear Factor Models – Auto Encoders - Representation Learning – Structured Probabilistic Models for Deep Learning - Monte Carlo Methods. Applications of deep learning in various technologies like Big Data, Medical Imaging, Neural network, vision, natural language processing, arbitrary object recognition, driverless cars, semantic image segmentation, deep visual residual abstraction and brain–computer interfaces

PART – A			
Q.No	Question	BT Level	Competence
1	Mention the concepts behind Probabilistic Principal Component Analysis (PPCA) and Factor Analysis.	BTL-2	Understand
2	Show the structure of a Linear Factor Model and mention its key components.	BTL-2	Understand
3	List the various generalizations of Independent Component Analysis (ICA).	BTL-1	Remember
4	List out the main ideas of Independent Component Analysis (ICA) and show how it separates mixed signals.	BTL-2	Understand
5	State one major advantage of using Slow Feature Analysis.	BTL-1	Remember
6	Identify the different tasks that can be performed using probabilistic models and explain their significance.	BTL-2	Understand
7	What is Denoising Auto encoder?	BTL-1	Remember
8	Distinguish between one-shot learning and zero-shot learning.	BTL-2	Understand
9	Classify the different Graphical models.	BTL-1	Remember
10	Which are undirected models?	BTL-1	Remember

11	Summarize Distributed representations.	BTL-1	Remember
12	Point out the reason for why Greedy layer-wise pre-training called Greedy.	BTL-2	Understand
13	Compare directed models and undirected models.	BTL-2	Understand
14	How many tasks does the learner must perform in transfer learning?	BTL-2	Understand
15	List the two different ideas combined by Unsupervised pre-training.	BTL-1	Remember
16	show an example of a distribution equation that represents a Boltzmann distribution.	BTL-2	Understand
17	What is GPU powered Neural Network?	BTL-1	Remember
18	List the major steps of a typical object recognition pipeline.	BTL-1	Remember
19	Differentiate compartmental architecture and end-to-end architectures in the basic application of deep learning in driverless vehicles.	BTL-2	Understand
20	What is n-gram in natural language processing	BTL-1	Remember
21	What are the ways of acquiring data from the brain?	BTL-2	Understand
22	List the categories of the wave patterns of brain.	BTL-1	Remember
23	Define semantic image segmentation.	BTL-1	Remember
24	Draw the overall BCI system.	BTL-2	Understand

PART – B

1	Describe Sparse Coding. (13)	BTL-4	Analyze
2	Briefly explain Greedy Layer-Wise Unsupervised Pretraining.	BTL-4	Analyze
3	Describe the following i. Probabilistic PCA and. (6) ii. Factor Analysis. (7)	BTL-3	Apply
4	Describe the following. i. Independent Component Analysis, (5) ii. Slow Feature Analysis. (8)	BTL-4	Analyze
5	Discuss Manifold interpretation of PCA. (13)	BTL-4	Analyze
6	Discuss Auto encoders. (13)	BTL-3	Apply
7	Write in detail about Under Complete Auto encoders. (13)	BTL-3	Apply
8	Explain Regularized Auto encoders. (13)	BTL-4	Analyze
9	Evaluate Structured Probabilistic Models versus Unstructured Modeling with suitable comparisons. (13)	BTL-5	Evaluate
10	Discuss in detail about Transfer Learning and Domain Adaptation. (13)	BTL-3	Apply

11	Discuss Distributed Representations and their role in deep learning. (13)	BTL-3	Apply
12	Create a summary using various types of graphs to describe model structure and flow. (13)	BTL-6	Create
13	Analyze sampling and explain how sample values are used to form a Monte Carlo estimate of a given quantity. (13)	BTL-4	Analyze
14	Evaluate the impact and role of deep learning technologies in enabling driverless vehicle systems. (13)	BTL-5	Evaluate
15	Explain the applications of deep learning in Natural Language Processing. (13)	BTL-3	Apply
16	Evaluate the different components of a Brain-Computer Interface and their functions. (13)	BTL-5	Evaluate
17	Explain the applications of deep learning in Medical Imaging. (13)	BTL-4	Analyze
PART – C			
1	Develop a short notes on Separation and D-Separation.(15)	BTL-6	Create
2	Explain Monte Carlo methods.(15)	BTL-5	Evaluate
3	Design and propose deep learning-based solutions to address key challenges in autonomous (driverless) vehicles. (15)	BTL-6	Create
4	Critically evaluate various graphical representations used to describe the structure of a deep learning model. (15)	BTL-5	Evaluate
5	Describe Deep Neural Networks for Brain Computer Interfaces. (15)	BTL-5	Evaluate