**19CSE456 Neural Networks and Deep Learning**

*List of Lab Exercises*

|  |  |
| --- | --- |
| **Lab #** | **Exercise** |
| **Unit 1: Perceptrons and Basic Neural Networks** | |
| 1 | Perceptron Implementation   * Implement a simple perceptron for binary classification. * Experiment with different learning rates and observe the effect on convergence. |
| 2 | Multi-Layer Perceptron (MLP)   * Implement an MLP from scratch. * Train the MLP on a simple dataset (e.g., XOR problem) and visualize the decision boundary. |
| 3 | Activation Functions   * Implement and compare different activation functions (linear, softmax, tanh, ReLU). * Plot and analyse their properties. |
| 4 | Backpropagation and Gradient Descent   * Implement the backpropagation algorithm for training an MLP. * Experiment with different loss functions and learning rates. |
| 5 | Optimization Techniques   * Implement and compare different optimization techniques (momentum, RMSProp). * Observe the effect on training speed and convergence. |
| 6 | Regularization Techniques   * Implement L2 regularization and dropout in your neural network. * Analyze the effect on overfitting and generalization. |
| **Unit 2: Probabilistic Neural Networks and Advanced Models** | |
| 7 | Boltzmann Machines and RBMs   * Implement a Restricted Boltzmann Machine (RBM). * Train the RBM on a simple dataset and visualize the learned features. |
| 8 | Autoencoders   * Implement an autoencoder for dimensionality reduction. * Compare the performance with Principal Component Analysis (PCA). |
| 9 | Hidden Markov Models (HMMs)   * Implement an HMM for sequence modeling. * Train the HMM on a simple sequence dataset and visualize the state transitions. |
| **Unit 3: Deep Learning and Advanced Networks** | |
| 10 | Convolutional Neural Networks (CNNs)   * Implement a CNN for image classification. * Train the CNN on a dataset like CIFAR-10 or MNIST and visualize the filters. |
| 11 | Recurrent Neural Networks (RNNs)   * Implement a simple RNN for sequence prediction. * Train the RNN on a time series dataset and evaluate its performance. |
| 12 | Long Short-Term Memory (LSTM) Networks   * Implement an LSTM network for sequence prediction. * Compare the performance with a simple RNN on the same dataset. |
| 13 | Unsupervised Learning with Autoencoders   * Implement a deep autoencoder for image compression. * Compare the reconstruction quality with shallow autoencoders. |

.