Unit I: Introduction to Machine Learning

- Scope and limitations
- Regression
- Probability
- Statistics
- Linear algebra for machine learning
- Convex optimization
- Data visualization
- Hypothesis function and testing
- Data distributions
- Data preprocessing
- Data augmentation
- Normalizing datasets
- Machine learning models
- Supervised and unsupervised learning

Unit II: Fundamentals of Neural Networks

- Linearity vs non-linearity
- Activation functions (e.g., sigmoid, ReLU)
- Weights and bias
- Loss function
- Gradient descent
- Multilayer networks
- Backpropagation
- Weight initialization

- Training and testing
- Unstable gradient problem
- Autoencoders
- Batch normalization
- Dropout
- L1 and L2 regularization
- Momentum
- Hyperparameter tuning

Unit III: Convolutional Neural Networks (CNNs)

- Flattening
- Subsampling
- Padding
- Stride
- Convolutional layer
- Pooling layer
- Loss layer
- 1×1 convolution
- Inception network
- Input channels
- Transfer learning
- One-shot learning
- Dimension reduction
- Implementation using frameworks like TensorFlow, Keras, etc.

Unit IV: Recurrent Neural Networks (RNNs) and Reinforcement Learning

- Long Short-Term Memory (LSTM)
- Gated Recurrent Unit (GRU)
- Translation
- Beam search and width
- BLEU score
- Attention model
- Reinforcement learning (RL) framework
- Markov Decision Processes (MDP)
- Bellman equations
- Value Iteration and Policy Iteration
- Actor-critic model
- Q-learning
- SARSA

Unit V: Advanced Topics and Applications

- Support Vector Machines (SVMs)
- Bayesian learning
- Application of machine learning in computer vision, speech processing, natural language processing, etc.
- Case Study: ImageNet Competition

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