DSE – 04 (a): Deep Learning

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Deep Learning	4	2	0	2	Class XII pass	DSC-03 DSC-13

Learning Objectives:

To introduce students to deep learning algorithms and their applications in order to solve real problems.

Learning Outcomes:

1. *Describe the feed-forward and deep networks.*
2. *Design single and multi-layer feed-forward deep networks and tune various hyper parameters.*
3. *Implement deep neural networks to solve a problem*
4. *Analyze performance of deep networks.*
5. *Use pre-trained models to solve a problem*

UNIT-I **(6 hours)**

Introduction to neural networks: Artificial neurons, perceptron, computational models of neurons, Structure of neural networks, Multilayer feed-forward neural networks (MLFFNN), Back-propagation learning, Empirical risk minimization, bias-variance tradeoff, Regularization, output units: linear, softmax , hidden units:tanh, RELU

UNIT-II **(6 hours)**

Deep neural networks: Difficulty of training DNNs, Greedy layerwise training, Optimization for training DNN's, Newer optimization methods for neural networks (AdaGrad, RMSProp, Adam), Regularization methods (dropout, drop connect, batch normalization).

UNIT-III **(6 hours)**

Convolution neural networks (CNNs): Introduction to CNN - convolution, pooling, Deep CNNs - LeNet, AlexNet. Training CNNs, weights initialization, batch normalization, hyper parameter optimization, Understanding and visualizing CNNs, Using a pre trained convnet

UNIT-IV **(6 hours)**

Recurrent neural networks (RNNs): Sequence modeling using RNNs, Back propagation through time, Longshot Term Memory (LSTM), Bidirectional RNN, Bidirectional LSTM

UNIT-V **(6 hours)**

Unsupervised deep learning: Auto-encoders, Generative Adversarial Networks. Applications of Deep learning - Computer vision, Speech recognition and NLP.

References:

1. *Ian Goodfellow, Yodhua Bengio and Aaron Courville, Deep Learning, MITPress Book*
2. *Francois Chollet, Deep Learning with python second edition, Meaning Publications Co.*
3. *Bunduma, N. (2017). Fundamentals of Deep Learning. O'reilly Books.*
4. *Heaton, J. (2015). Deep Learning and Neural Networks, Heaton Research Inc.*

***List of Practicals*: (60 Hours)**

1. Implement a feed-forward neural networks for classifying movie reviews as positive or negative(using IMDB dataset)
2. Implement a deep-neural feed-forward network for estimating the price of house, given real-estate data(Boston Housing Price)
3. Implement a deep-neural network for classifying news wires by topic (Reuter's dataset).
4. Implement CNN for classifying MNIST dataset
5. Create a model for time-series forecasting using RNN/LSTM
6. Implement an auto-encoder