DISCIPLINE SPECIFIC ELECTIVE COURSE: 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
		Lecture	Tutorial	Practical/ Practice		
Deep Learning	**4**	**3**	**0**	**1**	Pass in Class XII	DSC03 Mathematics for Computing - I, DSC17 Machine Learning

Learning Objectives

The objective of this course is to introduce students to deep learning algorithms and their applications in order to solve real problems.

Learning outcomes

On successful completion of this course, the student will be able to:

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

SYLLABUS OF DSE

Unit 1 (8 Hours)
Introduction to neural networks: Artificial neurons, perceptron, computational models of neurons, Structure of neural networks, Multilayer feedforward neural networks (MLFFNN), Backpropagation learning, Empirical risk minimization, bias-variance tradeoff, Regularization, output units: linear, softmax , hidden units:tanh, RELU

Unit 2 (8 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 3 (8 Hours)
Convolution neural networks(CNNs): Introduction to CNN - convolution, pooling, Deep CNNs - LeNet, AlexNet. Training CNNs, weights initialization, batch normalization, hyperparameter optimization, Understanding and visualizing CNNs, Using a pre trained convnet

Unit 4 (8 Hours)
Recurrent neural networks (RNNs): Sequence modeling using RNNs, Backpropagation through time, LongShort Term Memory (LSTM), Bidirectional RNN, Bidirectional LSTM
Unit 5 (8 Hours)
Unsupervised deep learning: Autoencoders, Generative Adversarial Networks.

Unit 6 (5 Hours)
Applications: Computer vision, Speech recognition and NLP.

Essential/recommended readings

1. Ian Goodfellow, Yodhua Bengio and Aaron Courville, *Deep Learning,* MIT Press Book**,** 2016.
2. Francois Chollet, *Deep Learning with python***,** *2nd edition*, Meaning Publications Co, 2021.

Additional References

1. Bunduma, N., *Fundamentals of Deep Learning*, 1st edition, O'reilly Books, 2017.
2. Heaton, J., *Deep Learning and Neural Networks*, 1st edition, Heaton Research Inc., 2015.

Suggested Practical List :

Practical exercises such as

The following practicals are to be conducted using Python.

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 (Reuters dataset).
4. Implement CNN for classifying MNIST dataset
5. Create a model for time-series forecasting using RNN/LSTM
6. Implement an auto-encoder