DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY PATNA

Ashok Raj Path, PATNA 800 005 (Bihar), India

Phone No.: 0612 – 2372715, 2370419, 2370843, 2371929, 2371930, 2371715

Fax – 0612- 2670631 Website: www.nitp.ac.in

-

CSXX2829: Deep Learning Algorithms

L-T-P-Cr: 2-0-2-3

Pre-requisites:

1. Basic knowledge of machine learning.

Course Objectives:

1. Students will be able to understand the architecture of neural network.
2. Students will be able to learn different optimization techniques.
3. Student will be able to know working of deep architectures like convolutional neural network and variants of recurrent neural network.

Course Outcome: Upon successful completion of this course, students should be able to:

Sl. No.	Course Outcome (CO)	Program Outcome (PO)
1	Explain the fundamental concepts of neural networks, including error functions, activation functions, and optimization algorithms like gradient descent.	PO1
2	Implement and analyze feedback networks like Hopfield networks and Radial Basis Function Networks (RBFNs) for tasks like pattern association and reconstruction.	PO1, PO2, PO3, PO5
3	Apply clustering algorithms using Self-Organizing Feature Maps (SOMs) and understand advanced techniques like Adaptive Resonance Theory (ART) networks.	PO1, PO2, PO3, PO5
4	Design and utilize Convolutional Neural Networks (CNNs) for image processing tasks, including understanding convolutional operations, pooling, and advanced architectures like Dilated CNNs.	PO1, PO2, PO3, PO5, PO6 (Optional)
5	Implement Deep Recurrent Neural Networks (RNNs) with a focus on Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU) architectures, and explore the concept of attention mechanisms.	PO1, PO2, PO3, PO5
6	Develop and train deep unsupervised learning models like Autoencoders and Generative Adversarial Networks (GANs) to understand data representation and generation.	PO1, PO2, PO3, PO5
7	Apply deep learning techniques to solve real-world problems in a chosen domain (e.g., computer vision, natural language processing) through project work or	PO1, PO2, PO3, PO9, PO10, PO12

	case studies.	

UNIT I: Introduction to Neural NetworkLectures: 10

Brief introduction to neural network. Error Cost Function, Mean-Square Error, Cross-Entropy.Linear vs Non-linear functions:Activation Function – Linear, Sigmoid, Softmax, Relu.

Optimization: Gradient Descent Algorithm, Momentum Based Gradient Descent Algorithm and Nesterov Accelerated Gradient Descent Algorithm.

UNIT II: Feedback Networks Lectures: 12

Algorithm for Pattern Association/Reconstruction: Associative memory networks, Hetero Associative Memory neural networks, Auto Associative Memory Networks, Bi-directional Associative memory networks.

Feedback Networks: Discrete Hopfield Net, Continuous Hopfield Net, Radial Basis Function Networks (RBFN): Training algorithm for an RBFN with fixed Centres.

UNITIII: Lectures: 10

Cluster Network: Self-Organizing Feature Map,Plasticity/Stability Problem,Adaptive Resonant Theory (ARTI and ARTII) - Architecture, ARTMAP.

Dense Embeddings: word2vec – Skip-gram model, Continuous Bag Of Words (CBOW) Model.

UNIT IV: Lectures: 16

Convolutional Neural Network:Architecture, Convolution Operation, Filters, Pooling Operation – Max pooling, Average pooling, Global pooling. Dilated CNN.

Deep RecurrentNeural Network: Long Short Term Memory (LSTM) – Architecture. Gated Recurrent Unit (GRU). Attention Mechanism.Recursive Neural Network.

Deep Unsupervised Learning: Autoencoders, Variational Autoencoders, Adversarial Generative Networks**.**

Reference Book:

1) *Neural Network* by Simon Haykin, Pearson Education/PHI
2) *Deep Learning, Part II*. Goodfellow, I., Bengio, Y., Courville, A., MIT Press, 2016.

References:

1) *Learning deep architectures for AI.* Bengio, Yoshua. Foundations and trends in Machine Learning 2.1 (2009): 1127.