

Elective-III
Neural Networks

Subject Code:
45

Credits: 03

Total Hours:

L-T-P: 3-0-2

Prerequisite: Knowledge on Machine learning techniques and Linear Algebra

Course Objective:

- To understand the importance of neural network system and its components.
- To understand the neural network learning and adaptation in data science.
- To understand the mechanism of single layer perceptron in neural network models.
- To understand the advantage of multilayer perceptron over single layer perceptron.
- To understand the concepts of associative memory in retrieving information from data.
- To understand the concepts of self-organizing feature maps and its application.
- To understand broad application of neural networks in different field of businesses.

PART – A

**Unit I: Introduction to Neural Network System
(5 hours)**

Introduction to biological neurons and their artificial models, history of artificial neural systems development, Simple Memory and Restoration of Patterns, basic concepts related to neural networks: three layers of neural network systems, units, connections, site, mode, perceptron, single layer and multiple layer perceptron, McCulloch-Pitts Neuron Model, Neuron Modelling for Artificial Neural System, Models of neural networks: feedforward and feedback networks, neural processing.

**Unit II: Neural Network Learning and Adaptation
(5 hours)**

Introduction to neural network learning and adaptation, Learning as approximation or Equilibria Encoding, concepts of supervised and unsupervised learning, neural network learning rules : Hebbian learning rule, perceptron learning rule, delta learning rule, Widrow-Hoff Learning Rule, correlation learning rule, Winner- Take-All learning rule, Outstar learning rule, summary and comparison of artificial neural network learning rules.

**Unit III: Single Layer Perceptron Classifiers
(6 hours)**

Introduction to single layer perceptron, classification model, features and decision tree, discriminant functions, linear machine and minimum distance classification, non parametric training concepts, training and classification using the discrete perceptron, single layer continuous perceptron neural networks for linearly separable classification, multi category single layer perceptron neural networks.

**Unit IV: Multilayer Feedforward Neural Networks
(6 hours)**

Introduction to multilayer perceptron neural networks, linearly non separable pattern classification, delta learning rule for multilayer perceptron networks, generalized delta learning rule, Feedforward recall and error Back-Propagation training, training errors, Multilayer Feedforward Networks as Universal Approximators, Learning Factors: Initial Weights, cumulative weight adjustments vs incremental updating, learning constant and

momentum method, classifying and expert layered networks, Character Recognition Application, expert systems applications, learning time sequences.

PART – B

Unit V: Single-Layer Feedback Neural Networks (5 Hours)

Introduction to single layer feedback neural networks, basic concepts of dynamic systems, Mathematical Foundations of Discrete-Time and gradient type Hopfield Networks, Transient Response of Continuous-Time Networks, Relaxation Modelling in Single-Layer Feedback Networks, Summing Network with Digital Outputs, Minimization of the Traveling Salesman Tour Length.

Unit VI: Associative Memories (6 hours)

Introduction to associative memories, basic concepts, linear associators, Basic Concepts of Recurrent Auto associative Memory: retrieval algorithm and storage algorithm, performance considerations, Performance Analysis of Recurrent Auto associative Memory: Energy function reduction, capacity of autoassociative recurrent memory, memory conversion vs. corruption, fixed point concepts, Bidirectional Associative Memory, advantages and limitations.

Unit VII: Matching and Self-Organizing Networks (6 hours)

Introduction to unsupervised learning of clusters in organizing networks, similarity measures in clustering techniques, Winner-Take-All learning, recall mode, initialization of weights and separability limitations, counter propagation networks, feature mapping, self-organizing feature maps, concepts on cluster discovery networks.

Unit VIII: Applications of Neural Algorithms and Systems (6 hours)

Introduction to neural network algorithms and its appropriate uses, linear programming modelling network, Multilayer Feedforward Network for Printed Character Classification, Handwritten Digit Recognition, Recognition Based on Handwritten Character Skeletonization, Recognition of Handwritten Characters Based on Error Back-propagation Training, Neural Networks Control Applications, Networks for Robot Kinematics, Connectionist Expert Systems for Medical Diagnosis.

Course Outcome:

At the end of this course students able to

- Know the basic concepts of neural networks and its components.
- Know neural network learning and adaption techniques.
- Know the detailed concepts of single layer perceptron neural networks.
- Know the detailed concepts of multilayer perceptron neural networks.
- Know the different associative memory concepts in retrieving information in data.
- Explain the different field of application on neural network models.

Text Books

1. Introduction to Artificial Neural Systems – Jacek M Zurada, West Publishing Company.

Reference Books

1. An introduction to neural networks - Kevin Gurney, UCL Press.
2. PRINCIPLES OF ARTIFICIAL NEURAL NETWORKS, 2nd Edition - Daniel Graupe, World Scientific Publishing Co. Pte. Ltd.