Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2021-22

Course Handout

20-08-2021

Course No. : *BITS F312*
Course Title : Neural Network and Fuzzy Logic
Instructor-in-Charge : Dr. Rajesh Kumar Tripathy

1. **Scope and Objective of the Course:**

This course introduces several fundamental concepts of artificial neural network and fuzzy logic. The objective is to familiarize the students with some basic learning algorithms and techniques and their applications, as well as general questions related to analyzing and handling large data sets. Several software libraries and datasets publicly available will be used to illustrate the application of these algorithms. In this course, the various supervised learning algorithms such as logistic regression, multiclass logistic regression, multilayer perceptron, radial basis function neural network, extreme learning machine and the deep neural network will be discussed. By the end of this course, students will have a strong understanding of artificial neural network based techniques for various real-time applications.

2. Textbooks:

T1. Simon Haykin, "*Neural Networks – A comprehensive Foundation*", Pearson Education, 1999.
T2. H. J. Zimmermann, "*Fuzzy Set Theory and its Applications*",*3rd* Edition, Kluwer Academic, 1996.

3. Reference books/Materials

R1: CS229 Lecture notes: Stanford University
R2: CS231 Convolutional neural networks for visual recognition: Stanford University
R3: http://gyan.iitg.ernet.in/handle/123456789/833
R4: https://www.sciencedirect.com/science/article/pii/S0925231206000385
R5: https://www.springer.com/cda/content/document/cda_downloaddocument/9783319284354-c2.pdf?SGWID=0-0-45-1545215-p177863021

4. Course Plan:

Lecture No.	Learning Objectives	Topics to be covered	Chapter in the Text Book
1	Pattern recognition and Machine learning introduction	Introduction to Pattern recognition, machine learning, Supervised, unsupervised and semi-supervised learning,	T1 (ch 2)
2-4	To understand classification and regression problems and linear regression	Classification and regression problems, Linear regression, gradient descent (Batch gradient descent, mini-batch gradient descent, and stochastic gradient descent)	R1
5-8	To understand Binary and Multiclass	Logistic regression, multiclass extension of logistic regression (One Vs One and One Vs All Multiclass coding schemes)	R1

	classifications		
9	To understand measures for classifiers	Performance Measures for Classifiers (binary class and multiclass), Probabilistic classifiers	R3 (2.9.5)
10-11	To understand neural network	What is a Neural Network?, Human Brain and Biological Neuron, Model of an Artificial Neuron, Activation functions, Neural Network Architectures.	T1 (ch 1)
12-13	To understand mathematical model of a single neuron	Single Layer Perceptron, Linear Separability, XOR Problem, Perceptron Learning rules	T1 (ch 3)
14-16	To understand multilayer perceptron	Multilayer Perceptron, Back-propagation Algorithm and parameters selection and tuning	T1 (ch 4)
17-19	To understand kernel machines in machine learning	Radial-Basis Function Networks, various kernel functions used in RBFN, Support Vector Machine (SVM), kernel functions in SVM	T1 (ch 5) and R3
20-24	To understand Autoencoder and deep neural network	Autoencoder, Sparse autoencoder, Denoising autoencoder, Deep neural network based on stacking of autoencoders	R1
25-27	To understand ELM and its kernel extension	Extreme learning machine (ELM), Kernel ELM	R4
28-31	To understand CNN for solving classification problems	Convolutional neural network (CNN), Convolutional Layer**,** Pooling Layer, and Fully-Connected Layers, Convolutional Autoencoder	R2
32-34	To introduce the fuzzy world for decision making	Crisp Sets and Crisp relations, Fuzzy sets and Fuzzy relations, Crisp Logic and Fuzzy Logic	T2 (ch 1)
35-37	To understand fuzzy inference	Membership function, Fuzzification, Fuzzy Inference, Defuzzification Methods	T2 (ch4, ch5, ch9)
38-42	To understand hybrid neuro-fuzzy networks	Neuro-Fuzzy System, Takagi-Sugeno's Approach (ANFIS), Fuzzy Backpropagation Networks	R5

5. Evaluation Scheme:

Component	Duration	Weightage (%)	Marks	Date & Time	Nature of Component
Mid-Sem Exam	90 min	30%	90	To be announced	Closed Book
Programming Assignments using Python and Google Colab	--------	30%	90	To be announced	Open Book
Comprehensive Exam	120 min	40%	120	To be announced	Closed Book

6. Chamber Consultation Hour: Through google meet

7. Notices: Notices concerning this course will be on CMS.

8. Make–up Examination: Make-up will be given on genuine grounds only. Prior application should be made for seeking the make- up examination.

9. Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Rajesh Kumar Tripathy
INSTRUCTOR-IN-CHARGE