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**FIRST SEMESTER 2019-20**

# Course Handout

01-08-2019

*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:**

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| **Lecture No.** | **Topics to be covered** | **Chapter in the Text Book** |
| 1 | Introduction to machine learning, Supervised, unsupervised and semi-supervised learning, | T1 (ch 2) |
| 2-4 | Classification and regression problems, Linear regression, gradient descent (Batch gradient descent and stochastic gradient descent) | R1 |
| 5-8 | Logistic regression, multiclass extension of logistic regression (One Vs One and One Vs All Multiclass coding schemes) | R1 |
| 9 | Performance Measures for Classifiers (binary class and multiclass), Probabilistic classifiers | R3 (2.9.5) |
| 10-11 | What is Neural Network?, Human Brain and Biological Neuron, Model of an Artificial Neuron, Activation functions, Neural Network Architectures. | T1 (ch 1) |
| 12-13 | Single Layer Perceptron, Linear Separability, XOR Problem, Perceptron Learning rules | T1 (ch 3) |
| 14-16 | Multilayer Perceptron, Back-propagation Algorithm and parameters selection and tuning | T1 (ch 4) |
| 17-19 | Radial-Basis Function Networks, various kernel functions used in RBFN | T1 (ch 5) |
| 20-24 | Autoencoder, Sparse autoencoder, Denoising autoencoder, Deep neural network based on stacking of autoencoders | R1 |
| 25-27 | Extreme learning machines, Kernel Extreme learning machine | R4 |
| 28-31 | Convolutional neural network, **Convolutional Layer, Pooling Layer**, and **Fully-Connected Layer** | R2 |
| 32-34 | Crisp Sets and Crisp relations, Fuzzy sets and Fuzzy relations, Crisp Logic and Fuzzy Logic | T2 (ch 1) |
| 35-37 | Membership function, Fuzzification, Fuzzy Inference, Defuzzification Methods, Applications of Fuzzy Logic | T2 (ch4, ch5, ch9) |
| 38-42 | Neuro-Fuzzy System, Takagi-Sugeno’s Approach (ANFIS), Fuzzy Backpropagation Networks, Advantages and Applications of hybrid Neuro-Fuzzy Systems | R5 |

**5. Evaluation Scheme:**

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| **Component** | **Duration** | **Weightage (%)** | **Marks** | **Date & Time** | **Nature of Component** |
| Mid-Sem Exam | 90 min | 25 % | 75 | 4/10, 9.00 -- 10.30 AM | Closed Book |
| Assignments and Programming Exercise | -------- | 30% | 90 | -- | Open Book |
| Comprehensive Exam | 3 Hrs | 45% | 135 | 11/12 FN | Closed Book |

**6. Chamber Consultation Hour:** 3.30PM-4.30PM (Friday)

**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**