TCG-CREST

Sector V, Salt Lake, Kolkata 700091| INDIA

SEMSTER-II

(1) NAME OF THE COURSE: Advanced Machine Learning

(2) OBJECTIVE OF THE COURSE:

Basic objectives of the course are the following:

- **Overview of Machine Learning (ML) and Deep learning**
- **Relations of Artificial Intelligence (AI), ML & DL**

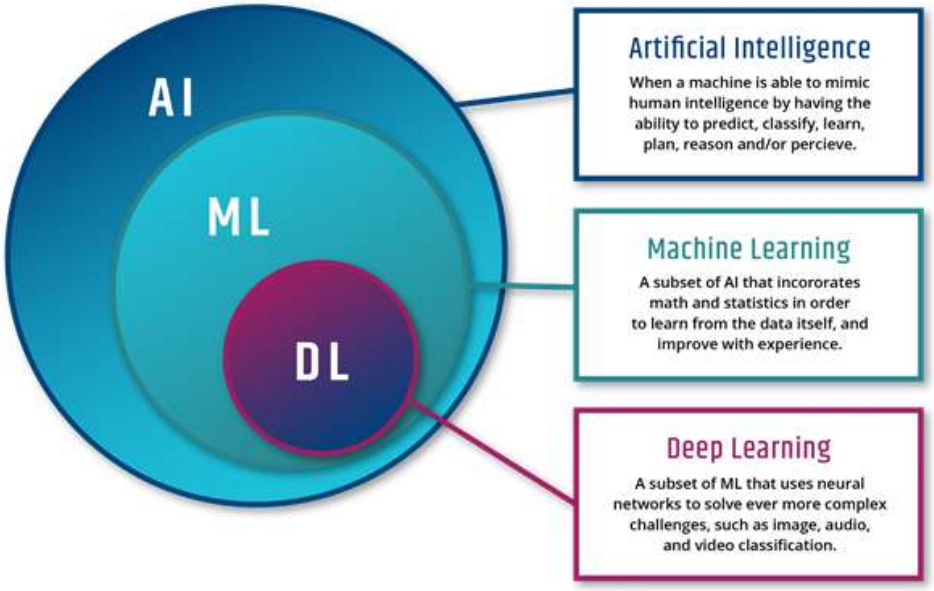

***Figure 1: Artificial Intelligence, Machine Learning and Deep Learning*.**

- **Principles of Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN)**
- **Introduction to Genetic algorithm**

- **ML applications of wireless communication and Networking**

(3) LEARNING OUTCOMES:

After successfully completing the course, students are expected to:

- **Learn and understand underlying relations of AI, ML and DL**
- **Understand training and backpropagation**
- **Have a hands-on application of DL**
- **Understand Optimization with Genetic Algorithm**
- **Have the technical know-how to apply DL in Wireless Communications & Networking**

(4) DETAILED SYLLABUS:

Semester-II: Advanced Machine Learning

Section 1: Neural Networks & Deep Learning

- Introduction to Neural Networks
  - The Perceptron
  - Backpropagation Algorithm
  - Training Procedures
  - Convolutional Neural Networks
  - Recurrent Neural Networks
  - Long short-term memory (LSTM)
  - Introduction to Pytorch
  - Introduction to Genetic Algorithm

Section 2: ML Application for Wireless Communication & Networking (most probably this part will be omitted later)

- Introduction to Adaptive Signal Processing
  - Discrete random processes
  - Digital Wiener filtering
  - Least mean squares adaptive filter

- Method of Least Squares
- Kalman Filters and its Applications
- Adaptive Equalization

Books & References:

1. M. Bishop: Pattern Recognition and Machine Learning, Springer (2006)
2. Goodfellow, Y. Bengio and A. Courville: Deep Learning, MIT Press (2016)
3. Haykin: Neural Networks and Learning Machines, Pearson (2009)
4. Haykin: Adaptive Filter Theory, Prentice Hall (2013)
5. Ali H. Sayed: Fundamentals of Adaptive Filtering, Wiley (2003)
6. R. S. Sutton and A. G. Barto: Reinforcement Learning: An Introduction, MIT Press (2nd ed) (2018)
7. F. Chollet: Deep Learning with Python, Manning Publications (2017)
8. S. J. Russell and P. Norvig: Arti cial Intelligence: A Modern Approach, Pearson (3rd ed) (2015)
9. D. Koller and N. Friedman: Probabilistic Graphical Models Principles and Techniques, MIT Press (2009)

(5) EVALUATION METHODOLOGY:

- **Mid-Term paper & presentation: 30%**
- **Final-Term paper & presentation: 30%**
- **Assignments: 30%**
- **Internal Assessment: 10%**