Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2022-2023
Course Handout Part II

Date: 29.08.2022

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. *: CS F425*

Course Title *: Deep Learning*

Instructor-in-Charge *: Dr. Paresh Saxena*

1. Scope

The objective of this course is to study deep learning so that competitive learning models can be built. This course will provide an understanding of feedforward deep neural networks, overfitting related issues and their resolution, various optimization algorithms which are used for training deep neural networks. The intent of the course is to learn convolutional neural networks, recurrent neural networks, generative deep learning models and deep reinforcement learning models. The course is divided in five parts: (i) Introduction to Deep Learning, (ii) Deep Sequence Modeling, (iii) Deep Convolutional Networks, (iv) Deep Generative Models and (v) Deep Reinforcement Learning.

2. Objectives

This course aims to achieve the following goals:

- To provide an understanding of the deep learning models
- To introduce the overfitting related issues in deep learning and different techniques for their resolution
- To provide an understanding of various optimization algorithms that are used in training deep neural networks
- To provide an understanding of CNN, R-CNN and Faster CNN and their applications
- To provide an understanding of RNN, LSTM, attention mechanism, transformers and their applications
- To provide an understanding of Generative Deep Learning and Deep Reinforcement Learning Models.

3.a. Text Book

T1: Ian Goodfellow and Yoshua Bengio and Aaron Courville: Deep Learning, First Edition, MIT Press, 2016.

3.b. Reference Books

R1. Charu C Aggarwal: Neural Networks and Deep Learning, First Edition, Springer, 2018.

4. Course Plan

Lecture No	Learning Objectives	Topics to be covered	Chapter in the Text Book
Part I: Introduction to Deep Learning			
1-7	To understand basic framework of Deep Learning including Feedforward and Backward Propagation algorithms	Deep Learning Evolution, Perceptron, multi-layer perceptron, loss functions, Hidden and Output Unit Functions, Gradient Descent, Feedforward and Backward Propagation.	T1: Ch6
8 – 12	To understand the methods for regularization for deep learning	L1 & L2 Regularization, Early Stopping, Parameter Sharing, Dropout.	T1: Ch.7
13 - 15	To understand the various optimization algorithms that are used in training deep neural networks	Challenges in Neural Network Optimization, Stochastic Gradient Descent, Momentum Based GD, Parameter Initialization Strategies.	T1: Ch.8
Part II: Deep Sequence Modeling			
15 – 25	To understand sequence modeling and the issues related to long-term dependencies, and models like LSTM, Gated RNNs, attention mechanism and transformers	Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, Vanishing and exploding gradient problems, LSTM, Gated RNNs, attention mechanism, transformers.	T1:Ch.10, R1: Ch 7
Part III: Deep Convolution Neural Networks			
26 – 30	To understand the basic functioning of convolution neural networks, study various case studies and investigate several applications.	Convolution Operation, Basic Structure of a convolutional network, Variants (locally connected Networks, Tiled CNNs, Dilated Convolutions), Introduction to case studies of convolutional architecture including LeNet-5, AlexNet, ImageNet, VGGNet, Google LeNet, Visualization and Applications.	T1: Ch.9, R1: Ch 8
Part IV: Deep Generative Models			
31– 35	To provide an understanding of Generative Deep Learning models.	Boltzmann Machine, Restricted Boltzmann Machine, Deep Belief Machines, Generative Adversarial Networks (GANs).	T1: Ch.20
Part V: Deep Reinforcement Learning			
35-40	To understand basic framework of deep reinforcement learning and to study various applications of DRL methods.	Basic framework of Reinforcement Learning, Q-value, Q-learning, Deep Q-Network, Double Q-learning, and policy gradient methods.	R1: Ch9/ Class Notes

5. Evaluation Scheme

5.a Major Components

Component	Duration	Weightage	Date&Time	Nature of Component
Mid-Term exam	90 mins	**35%**	04/11 3.30 - 5.00PM	Closed Book
Course Project (with final presentation/viva)	-	**20% (5% will be evaluated before the mid-sem)**	Details will be announced during the lecture sessions.	Open Book
Comprehensive	3 hours	**45%**	28/12 AN	Closed Book

Note: minimum 40% of the evaluation to be completed by midsem grading.

6. CHAMBER CONSULTATION HOUR: To be announced.

7. Make-up: The make-up policy will be in accordance with the AUGSD guidelines.

8. NOTICES: All notices pertaining to this course will be displayed on the CMS.

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.

Instructor-in-charge
CS425