Short Syllabus

BCSE332L Deep Learning (3-0-0-3)

Neural Networks Basics - Deep Neural Networks – Forward and Back Propagation; Deep Convolutional Models – ResNet, AlexNet, InceptionNet ; Mini-batch Gradient Descent – Exponential Weighted Averages - Hyperparameter tuning – Batch Normalization ; Recurrent Neural Networks - Bidirectional RNN - BERT ; Recursive Neural Networks - Echo State Networks - Long Short-Term Memory; Transfer Learning – Generative Adversarial Network– Region based CNN – Fast RCNN - You Only Look Once – Single shot detector ; Deep Reinforcement Learning - Deep Q-Learning - Model based Reinforcement Learning.

Course code	Course Title	L	T	P	C
BCSE332L	Deep Learning	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. Introduce major deep neural network frameworks and issues in basic neural networks
2. To solve real world applications using Deep learning

Course Outcomes

At the end of this course, student will be able to:

1. Understand the methods and terminologies involved in deep neural network, differentiate the learning methods used in Deep-nets.
2. Identify and apply suitable deep learning approaches for given application.
3. Design and develop custom Deep-nets for human intuitive applications
4. Design of test procedures to assess the efficiency of the developed model.
5. To understand the need for Reinforcement learning in real – time problems.

Module:1	Introduction to neural networks and deep neural networks	7 hours

Neural Networks Basics - Functions in Neural networks – Activation function, Loss function - Function approximation - Classification and Clustering problems - Deep networks basics - Shallow neural networks – Activation Functions – Gradient Descent – Back Propagation – Deep Neural Networks – Forward and Back Propagation – Parameters - Hyperparameters

Module:2	Convolution neural networks	6 hours

Foundations of Convolutional Neural Networks – CNN operations – Architecture – Simple Convolution Network – Deep Convolutional Models – ResNet, AlexNet, InceptionNet and others

Module:3	Improving deep neural networks	8 hours

Mini-batch Gradient Descent – Exponential Weighted Averages – Gradient Descent with Momentum – RMSProp and Adam Optimization – Hyperparameter tuning – Batch Normalization – Softmax Regression – Softmax classifier – Deep Learning Frameworks – Data Augmentation - Under-fitting Vs Over-fitting

Module:4	Recurrent networks	6 hours

Recurrent Neural Networks - Bidirectional RNNs, Encoder, Decoder, Sequence-to-Sequence Architectures, Deep Recurrent Networks, Auto encoders - Bidirectional Encoder Representations from Transformers (BERT)

Module:5	Recursive neural networks	6 hours

Long-Term Dependencies - Echo State Networks - Long Short-Term Memory and Other Gated RNNs - Optimization for Long-Term Dependencies - Explicit Memory

Module:6	Advanced Neural networks	6 hours

Transfer Learning – Transfer Learning Models – Generative Adversarial Network and their variants – Region based CNN – Fast RCNN - You Only Look Once – Single shot detector

Module:7	Deep reinforcement learning	5 hours

Deep Reinforcement Learning – Q-Learning – Deep Q-Learning – Policy Gradients - Advantage Actor Critic (A2C) and Asynchronous Advantage Actor Critic (A3C) – Model based Reinforcement Learning - Challenges

Module:8	Contemporary issues	1 hours

	Total Lecture hours:	45 Hours

Text Book(s)			
1.	Deep Learning, Ian Goodfellow Yoshua Bengio Aaron Courville, MIT Press, 2017		
2	Neural Networks and Deep Learning, Michael Nielsen,, Determination Press		
Reference Books			
1.	Deep Learning Step by Step with Python, N D Lewis, 2016		
2.	Deep Learning: A Practitioner's Approach, Josh Patterson, Adam Gibson, O'Reilly Media, 2017		
3	Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks, Umberto Michelucci, Apress, 2018.		
4	Deep Learning with TensorFlow: Explore neural networks with Python, Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy, Packt Publisher, 2017.		
Mode of Evaluation: CAT / Written Assignment / Quiz / FAT			
Recommended by Board of Studies	09-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022