Course Binder

Department of Computer Science

Deep Learning

Course Syllabus (ABET -2000 Format):

Course Description	Artificial Intelligence, Machine Learning, Data Mining and many other fields have made many promises to the world — including over-hyped automation of almost everything, driverless cars, medical consultation, and mechanical tasks through robots etc. Deep and Reinforcement Learnings are probably the most important advancements in machine learning that enabled AI experts to make such huge promises. This course on Deep Learning is divided in two part: first would be applied part where deep learning would be practiced in Pytorch API of Python. Most of the lectures before mid-exam would be based on loads of Python-Pytorch deep learning programming for image, text and computer vision applications. Postmid, the course would be focusing on theoretical and mathematical aspects of Deep Learning and introduction to the concepts of Reinforcement Learning.
Prerequisite	Basic Calculus, Probability & Statistics Programming Skills, especially in Python are huge plus
Textbook & Learning Material	1. Deep Learning with Python by Francois Chollet 2. Advanced Deep Learning with Keras by Rowel Atienza 3. Reinforcement Learning with TensorFlow by Sayon Dutta 4. Natural Language Processing with TensorFlow by Thushan Ganegedara
Course Learning Objectives (C.L.O.)	1. Learning the basic concepts of Deep Learning and its applications in text, image and computer vision fields 2. Applying deep learning to solve real world problems 3. Understanding the working mechanism of Reinforcement Learning

Course Relationship to Program Outcomes	Program Outcomes										
	Highest attainable level of Learning	a	b	c	d	e	f	g	h	i	j	k
		1	2	3	-	-	-	-	-	6	5	-
Class/ Lab Schedule												
Instructional Methods	Lectures, Lab work, Research Papers of the field, Project, Assignment, Presentations, and classroom discussion											
Instructor	Syed Muzamil Hussain Shah											

Deep Learning

Course Learning Objectives (C.L.O.)	**Program Outcomes**										
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**

1. Learning the basic concepts of Deep Learning and its applications in text, image, and computer vision fields	**L**								**M**		
2. Applying deep learning to solve real-world problems	**M**	**M**							**M**		

H=3= High = Synthesis & Evaluation levels
M=2= Medium = Application & Analysis Levels
L=1= Low = knowledge & Comprehension Levels

Program Outcomes

(a) Knowledge of core computing, mathematics, and science fitting to the discipline.
(b) Ability to apply acquired knowledge in developing solutions using state-of-theart methods, techniques, skills, and tools.
(c) An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
(d) An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
(e) An ability to function effectively on teams to accomplish a common goal
(f) An understanding of professional, ethical, legal, security and social issues and responsibilities
(g) An ability to communicate effectively with a range of audiences
(h) An ability to analyze the local and global impact of computing on individuals, organizations, and society
(i) Recognition of the need for and an ability to engage in continuing professional development
(j) An ability to use current techniques, skills, and tools necessary for computing practice.
(k)Skills to construct software programs using latest programming languages.

S. No.	Topic	No. of Weeks	Recommended Text Book/ Research Papers
1	• AI, Machine Learning and Deep Learning — Concepts and Promises • Neural Network: the building block for deep learning • Mathematics of Neural Network • Data Representation of neural networks • Tensor Operations • Gradient Base Optimization	01	Chapter 1 and 2 of [1]
2	• Getting Started with neural network • Anatomy of Neural Network • Introduction to Pytorch • Setting-up deep learning workstation • Practical: Classifying movie reviews: A binary classification example • Practical: Classifying newswires: a multiclass classification example • Practical: Predicting house prices: a regression example	01	Chapter 3 of [1]
3	• Fundamentals of Machine Learning • Four branches of Machine Learning • Evaluating machine learning models • Data pre-processing, feature engineering, and feature learning • Over fitting and under fitting • Universal workflow of machine learning	01	Chapter 4 of [1]
4	• Deep Learning in practice • Deep learning for computer vision • Introduction to convonets • Training convonet on small datasets • Using pre-trained convonets • Visualizing convonet learning	01	Chapter 05 of [1]
5	• Deep learning for text and sequences • Working with text data • Understanding RNN • Advanced use of RNN	01	Chapter 06 of [1]
Mid - I Exam			
6	• Generative Deep Learning • Text Generation with LSTM • Generating images with variational autoencoders • Introduction to generative adversarial networks	01	Chapter 07 of [1]
7	• Concluding Pytorch and project brief, ideas brainstorming	01	Chapter 08 of [1]

8	• Implementing MLP, CNN and RNN • See the difference on MNIST	01	Chapter 01 of [2]
9	Project Idea Presentation		
10	• Deep Neural Networks • Pytorch API • ResNet • ResNet V2 • DenseNet	01	Chapter 02 of [2]
11	• Autoencoders • Denoising Autoencoders DAE	01	Chapter 03 of [2]
Mid - II Exam			
12	• Generative Adversarial Networks • Overview • Pytorch Implementation • Image and Text Generation using GANs	01	Chapter 04 of [2]
14	• Introduction to Transformers • Attention All you need • Attention Mechanism • Position embeddings		
15	• Deep Reinforcement Learning • Introduction to DRL • Value Learning and Policy Learning	01	Chapter 09 of [2]
16	• DQN • Policy gradient Method	01	Chapter 01 and 2 of [3] and Chapter 02 of [4]
17	• Markov Decision Process • Partially observable MDP • Training FrozenLake-v0 Environment using MDP • Q-Learning and Deep Q-Networks	01	Chapter 03 and 05 of [3]
18	Project Presentations		
19	Final Exam		

Grading:

Mid Exams: 30%
Final Exam: 40%
Semester Project: 20%
Class Participation and Assignments: 10%