GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Artificial Intelligence and Data Science

Subject Code: ME02095031

Course/Subject Name: Deep Learning & Applications

WEF Academic Year	2024-25
Semester	2
Category of the Course	Professional Elective Course

Prerequisite:	Basic concepts of statistics
Rationale:	This course helps the learners to explore deep learning from scratch or broaden their understanding of deep learning. It covers the conceptual and practical, hands-on exploration of topics in deep learning. The learners will be able to build practical intuition about the core ideas of machine learning and deep learning. After learning this course, the learners will have a solid understanding of what deep learning is, when it's applicable, and what its limitations are. They will be also become familiar with the standard workflow for approaching and solving machine-learning problems, and how to address commonly encountered issues.

Course Outcome:

After completion of the Course, Students will be able to:

No	Course Outcomes	RBT Level*
01	Understand the working methodology of deep neural networks.	UN
02	Apply the concepts of deep learning with parameter tuning in real world applications.	AP
03	Apply the available practical libraries that are most suitable to the real world applications.	AP
04	Analyze the performance of different deep learning approaches in varying conditions of the application.	AN
05	Evaluate the available variety of deep learning methods & their parameters and choose the most relevant to the application.	EV

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Teaching and Examination Scheme:

Teaching Scheme (in hours)			Total Credits (L+T+PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial/Practical		
L	T	PR	C	ESE (E)	PA/CA (M)	PA/CA (I)	ESE (V)	
03	00	02	04	70	30	20	30	150

Course Content:

Unit	Course Content	No of Hours	% of Weightage
1	**Fundamentals of Machine Learning** Four branches of machine learning, Evaluating machine-learning models, Data preprocessing, feature engineering, and feature learning, Overfitting and underfitting, The universal workflow of machine learning	9	15%
2	**Artificial Neural Networks and Deep Neural Networks** A first look at a neural network, Data representations for neural networks, The gears of neural networks: tensor operations, The engine of neural networks: gradient-based optimization, Anatomy of a neural network, Introduction to Keras, Setting up a deep-learning workstation, Classifying movie reviews: a binary classification example, Classifying newswires: a multiclass classification example, Predicting house prices: a regression example	10	25%
3	**Deep Learning for Computer Vision** Introduction to convenets, The convolution operation, The max-pooling operation, Training a convnet from scratch on a small dataset, The relevance of deep learning for small-data problems, Downloading the data, Building your network, Data preprocessing, Using data augmentation, Using a pretrained convnet, Feature extraction, Fine-tuning, Visualizing what convnets learn, Visualizing intermediate	10	25%

	activations, Visualizing convnet filters, Visualizing heatmaps of class activation		
4	**Deep Learning for Text and Sequences** Working with text data, One-hot encoding of words and characters, Using word embeddings, Putting it all together: from raw text to word embeddings, Understanding recurrent neural networks, A recurrent layer in Keras, Understanding the LSTM and GRU layers, A concrete LSTM example in Keras, Advanced use of recurrent neural networks, A temperature-forecasting problem, Preparing the data, A common-sense, non-machine-learning baseline, A basic machine-learning approach, A first recurrent baseline, Using recurrent dropout to fight overfitting, Stacking recurrent layers, Using bidirectional RNNs	10	25%
5	**Recent Trends in the methodological and application areas of Deep Learning**	6	10%
	TOTAL	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**20**	**20**	**20**	**20**	**10**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

Reference/Suggested Learning Resources:

(a) Books:

1. DEEP LEARNING with Python by Francois Chollet, Manning Publications Co., 2018
2. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron An MIT Press book
3. Neural Networks and Deep Learning by Michael Nielsen http://neuralnetworksanddeeplearning.com
4. Pattern Classification by Richard O. Duda, Peter E. Hart, David G. Stork John Wiley & Sons Inc

(b) Open source software and website

- Course-related online MOOCs on NPTEL/SWAYAM platform.
- Recently Published papers/articles in reputed journals.

Suggested Course Practical List:

- The practical work will be carried out based on the content covered during the academic sessions**.**

List of Laboratory/Learning Resources Required: Programming development environment (open source is encouraged) related to the course content.

Suggested Project List: The subject teacher has to assign the relevant outcome based project work to the students in individual/team.

Suggested Activities for Students: The subject teacher has to assign the outcome based activities to the students in individual/team.

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