AIL 411	DEEP LEARNING LAB	CATEGORY	L	T	P	CREDIT
		LAB	0	0	3	2

Preamble: This course aims to offer students hands-on experience on deep learning algorithms. Students will be able to familiarize basic python packages for deep learning, computer vision concepts for deep learning, sequence modelling, recurrent neural network also. This course helps the learners to enhance the capability to design and implement a deep learning architecture for a real time application.

Prerequisite: A sound knowledge in python programming, machine learning concepts, deep learning algorithms.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Implement advanced machine learning concepts using python.**(Cognitive Knowledge Level: Apply)**
CO 2	Applybasic data pre-processing and tuning techniques. **(Cognitive Knowledge Level: Apply)**
CO 3	Implement basic neural network and CNN on standard datasets. **(Cognitive Knowledge Level: Apply)**
CO 4	Design and Implement sequence modelling schemes.**(Cognitive Knowledge Level: Apply)**
CO 5	Implement auto encoders on standard datasets and analyse the performance. **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	✓	✓	✓	✓	✓			✓		✓		✓
CO 2	✓	✓	✓	✓	✓			✓		✓		✓
CO 3	✓	✓	✓	✓	✓	✓		✓		✓		✓
CO 4	✓	✓	✓	✓	✓	✓		✓		✓		✓
CO 5	✓	✓	✓	✓	✓	✓		✓		✓		✓

Assessment Pattern

Bloom's Category	Continuous Assessment Test %	End Semester Examination %
Remember	20	20
Understand	20	20
Apply	60	60
Analyze		
Evaluate		
Create		

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Evaluation in Lab : 30 marks

Continuous Assessment Test : 15 marks

Viva-voce : 15 marks

Internal Examination Pattern: The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

End Semester Examination Pattern: The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks will be converted out of 75 for End Semester Examination.

Operating System to Use in Lab **:**Linux/Windows

Programming Language/Software to Use in Lab **:**matlab or python

Fair Lab Record:

All Students attending the Deep Learning Lab should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record the right hand page should contain Experiment Heading, Experiment Number, Date of Experiment, Aim of Experiment, Details of Experiment including algorithm and Result of Experiment. The left hand page should contain a print out of the code used for the experiment and sample output obtained for a set of input.

SYLLABUS

Familiarize python frameworks for deep learning, Data Preprocessing, Supervised Unsupervised Learning, Design and Implementation of Simple Neural Networks, Back Propagation, Regularization, Dropout, Build and analyze deep learning architectures like CNN, RNN, LSTM, GRU, Autoencoders.

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Reference Books

1. Deep Learning with Python, by François Chollet, Manning, 2021
2. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.
3. Neural Networks and Deep Learning, Aggarwal, Charu C., c Springer International Publishing AG, part of Springer Nature 2018

LIST OF PRACTICE QUESTIONS

1. Basic python programs in machine learning.
2. Implement Simple Linear Regression with Synthetic Data.**
3. Implement basic image enhancement operations such as histogram equalization, morphological operations. **
4. Data pre-processing operations such as duplicate or missing value management.
5. Implement Feed forward neural network with three hidden layers for classification on CIFAR-10 dataset. Design and train a neural network that achieves high accuracy in classifying the images into their respective classes. Test different hyper-parameters
6. Implement a feed forward neural network with three hidden layers for the CIFAR-10 dataset.Train the network using a baseline optimization algorithm, such as stochastic gradient descent (SGD) or Adam, without any specific weight initialization technique or regularization technique. Record the accuracy and loss during training. (a) Repeat

the training process with Xavier initialization for weight initialization. Compare the convergence speed and accuracy of the network with the baseline results. Analyze the impact of Xavier initialization on the network's performance. (b) Repeat the training process with Kaiming initialization for weight initialization. Compare the convergence speed and accuracy of the network with the baseline results. Analyze the impact of Kaiming initialization on the network's performance. (c) Implement dropout regularization by applying dropout to the hidden layers of the network. Train the network with dropout regularization and compare its performance with the baseline results. Analyze the impact of dropout on the network's performance in terms of accuracy and overfitting (d) Implement L1 or L2 regularization techniques by adding a regularization term to the loss function during training. Train the network with regularization and compare its performance with the baseline results. Analyze the impact of regularization on the network's performance in terms of accuracy and prevention of overfitting.**

7. Implement a Convolutional Neural Network (CNN) architecture for digit classification on the MNIST dataset. Design and train a CNN model that achieves high accuracy in recognizing handwritten digits.**
8. Digit classification using pre-trained networks like VGGnet-19 for MNIST dataset and analyse and visualize performance improvement. Explore transfer learning using Convolutional Neural Networks (ConvNets) as fixed feature extractors and fine-tuning for image classification. Analyze their performance on a new image classification task while comparing the fixed feature extractor approach with fine-tuning.**
9. Implement a Recurrent Neural Network (RNN) for review classification on the IMDB dataset. Design and train an RNN model to classify movie reviews as positive or negative based on their sentiment.**
10. Analyze and visualize the performance change while using LSTM (Long Short-Term Memory) and GRU (Gated Recurrent Unit) instead of a standard RNN (Recurrent Neural Network) for sentiment analysis on the IMDB dataset. Compare the performance of different RNN architectures and understand their impact on sentiment classification.**
11. Implement time series forecasting for the NIFTY-50 dataset. Design and train a model to predict future values of the NIFTY-50 stock market index based on historical data.**
12. Implement a shallow autoencoder and decoder network for machine translation using the Kaggle English to Hindi Neural Translation Dataset. Design and train a model to translate English sentences to Hindi by leveraging the power of autoencoders and decoders.**

13. Building meaningful machine learning models for Breast Cancer Wisconsin (Diagnostic) Dataset**.**
14. Visualize deep learning models and parameters using visual keras, sklearn/dTreeViz, ANN visualizer, Netron, NN-SVG or any similar tools.
15. Familiarize GUI deep learning frameworks such as deeplearning studio.

Note: Any suitable dataset and deep learning specific packages can be used. Number of epochs can be reduced to complete the training in the prescribed 3 hour lab sessions

** Mandatory Exercises