Savitribai Phule Pune University
Third Year of Artificial Intelligence and Data Science (2019 Course)
317533: Software Laboratory II

Teaching Scheme:	Credit	Examination Scheme:
PR: 04 Hours/Week	02	Term Work (TW): 25 Marks Practical(PR): 25 Marks

Prerequisite Courses, if any: **Software Laboratory I (317526),Elective I Laboratory (317525)**

Companion Course, if any: **Artificial Neural Network (317534)**

Course Objectives:

- To understand basic techniques and strategies of learning algorithms
- To understand various artificial neural network models
- To make use of tools to solve the practical problems in real field using Pattern Recognition, Classification and Optimization

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Model artificial Neural Network, and to analyze ANN learning, and its applications
CO2: Perform Pattern Recognition, Linear classification.
CO3: Develop different single layer/multiple layer Perception learning algorithms
CO4: Design and develop applications using neural networks.

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of course, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up**of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm,flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable),conclusion/analysis. **Program codes with sample output of all performed assignments are to besubmitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Laboratory / Term Work Assessment

Continuous assessment of laboratory work should be done based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment should be assigned grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Set of suggested assignment list is provided in groups- A, B, and C. Each student must perform at least

10 assignments and one mini project (at least 6 from group A, 2 from group B and 2 from group C)

Group A and B assignments should be implemented in Python without using built-in methods for major functionality of assignment. Operating System recommended:- 64-bit Open source Linux or its derivative Programming tools recommended: - Open Source Python, Programming tool like Jupyter Notebook, Pycharm, Spyder, Tensorflow.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Virtual Laboratory:

https://cse22-iiith.vlabs.ac.in/

http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/index.php

Suggested List of Laboratory Experiments/Assignments

Group A (Any 6)

1. Write a Python program to plot a few activation functions that are being used in neural networks.
2. Generate ANDNOT function using McCulloch-Pitts neural net by a python program.
3. Write a Python Program using Perceptron Neural Network to recognise even and odd numbers. Given numbers are in ASCII form 0 to 9
4. With a suitable example demonstrate the perceptron learning law with its decision regions using python. Give the output in graphical form.
5. Write a python Program for Bidirectional Associative Memory with two pairs of vectors.
6. Write a python program to recognize the number 0, 1, 2, 39. A 5 * 3 matrix forms the numbers. For any valid point it is taken as 1 and invalid point it is taken as 0. The net has to be trained to recognize all the numbers and when the test data is given, the network has to recognize the particular numbers
7. Implement Artificial Neural Network training process in Python by using Forward Propagation, Back Propagation.
8. Create a Neural network architecture from scratch in Python and use it to do multi-class classification on any data.

   Parameters to be considered while creating the neural network from scratch are specified as:

   (1) No of hidden layers : 1 or more

   (2) No. of neurons in hidden layer: 100

   (3) Non-linearity in the layer : Relu

   (4) Use more than 1 neuron in the output layer. Use a suitable threshold value

   Use appropriate Optimisation algorithm

Group B (Any 4)

1. Write a python program to show Back Propagation Network for XOR function with Binary Input and Output
2. Write a python program to illustrate ART neural network.
3. Write a python program in python program for creating a Back Propagation Feed-forward neural network
4. Write a python program to design a Hopfield Network which stores 4 vectors
5. Write Python program to implement CNN object detection. Discuss numerous performance evaluation metrics for evaluating the object detecting algorithms' performance.

Group C (Any 3)

1. How to Train a Neural Network with TensorFlow/Pytorch and evaluation of logistic regression using tensorflow

2. TensorFlow/Pytorch implementation of CNN
3. For an image classification challenge, create and train a ConvNet in Python using TensorFlow. Also try to improve the performance of the model by applying various hyper parameter tuning to reduce the overfitting or under fitting problem that might occur. Maintain graphs of comparisons.
4. MNIST Handwritten Character Detection using PyTorch, Keras and Tensorflow

Mini Project

Car Object Detection using (ConvNet/CNN) Neural Network
Car Object Data: Data Source – https://www.kaggle.com/datasets/sshikamaru/car-object-detection
The dataset contains images of cars in all views.
Training Images – Set of 1000 files
Use Tensorflow, Keras & Residual Network resNet50
Constructs comparative outputs for various Optimisation algorithms and finds out good accuracy.

OR

Mini Project to implement CNN object detection on any data. Discuss numerous performance evaluation metrics for evaluating the object detecting algorithms' performance, Take outputs as a comparative results of algorithms.

Learning Resources

Text Books:

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.
2. Laurene Fausett:Fundamentals of Neural Networks: Architectures, Algorithms & Apps, Pearson, 2004.
3. Learn TensorFlow 2.0: Implement Machine Learning and Deep Learning Models with Python 1st ed. Edition, Apress publication

Reference Books:

1. Getting Started with TensorFlow, by Giancarlo Zaccone
2. AI and Machine learning for coders by Laurence Moroney, O'Reilly Media, Inc.

e-Books:

1. https://www.inf.ed.ac.uk/teaching/courses/nlu/assets/reading/Gurney_et_al.pdf
2. http://neuralnetworksanddeeplearning.com/

MOOC Courses:

1. **http://neuralnetworksanddeeplearning.com/**
2. **https://www.coursera.org/learn/convolutional-neural-networks-tensorflow**
3. **https://nptel.ac.in/courses/106106213**

@The CO-PO mapping table

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2		2								2
CO2	1	2		2								2
CO3	2	2	2									2
CO4	2	2	2	2								2