CMR ENGINEERING COLLEGE

UGC Autonomous

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Department of CSE- Data Science

LIFT Planner (Laboratory Improvement for Future Trends)

On

MACHINE LEARNING(R22)

2025-2026

MACHINE LEARNING

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1. OBJECTIVES AND RELEVANCE

Lab Objectives:

- To provide hands-on experience with fundamental machine learning techniques and tools.
- To enable students to preprocess and analyze real-world datasets using appropriate software and programming languages (e.g., Python, scikit-learn).
- To guide students in identifying suitable machine learning problems and applying appropriate models and algorithms to solve them.
- To develop students' ability to evaluate and interpret model performance using relevant metrics and visualization techniques.
- To reinforce theoretical knowledge through practical implementation and experimentation.

Relevance:

The Machine Learning Lab complements theoretical learning by offering practical exposure to the implementation of machine learning algorithms and workflows. Through lab exercises and projects, students gain experience in handling real-world datasets, selecting and tuning models, and critically analyzing results. These skills are essential for building competence in data-driven problem-solving, and they are highly valuable in industries that rely on predictive analytics, automation, and artificial intelligence.

2. SCOPE

This course serves as an introduction to the field of Machine Learning, focusing on fundamental concepts, methodologies, and algorithms. It covers the theoretical underpinnings and practical applications of key machine learning techniques, including supervised and unsupervised learning. Students will gain an understanding of essential algorithms such as linear regression, decision trees, support vector machines, and clustering methods. The course also emphasizes the importance of data pre processing, model evaluation, and the ethical considerations in machine learning. Designed for beginners, it lays a strong foundation for advanced studies and practical implementation in various domains.

3. PREREQUISITES

The student should have the knowledge of data Structures,PYTHON Programming and Knowledge on statistical methods.

4. SYLLABUS AS PER AUTONOMOUS

List of Experiments

1. Write a python program to compute Central Tendency Measures: Mean, Median, Mode
Measure of Dispersion: Variance, Standard Deviation

2. Implementation of Python Base Libraries such as Statistics, Math, Numpy and Scipy

3. Study of Python Libraries for ML application such as Pandas and Matplotlib

4. Write a Python program to implement Simple Linear Regression

5. Implementation of Multiple Linear Regression for House Price Prediction using sklearn

6. Implementation of Decision tree using sklearn and its parameter tuning

7. Implementation of KNN using sklearn

8. Implementation of Logistic Regression using sklearn

9. Implementation of K-Means Clustering

10.Performance analysis of Classification Algorithms on a specific dataset *(Mini Project)*

5. **Lead Experiment**

1. Implement the finite words classification system using Back Propagation Algorithm.
2. Implement genetic Algorithm using Python.

1. Finite Words Classification using Backpropagation Algorithm

AIM:

To implement a finite words classification system using the Backpropagation Algorithm in Python.

Algorithm:

1. Initialize the weights and biases randomly.

2. For each input word, convert it into a numerical vector (one-hot encoding or similar).
3. Forward propagate the input through the neural network:
   - Compute hidden layer activations.
   - Compute output layer activations using sigmoid or softmax.
4. Calculate the error at output.
5. Backpropagate the error:
   - Compute gradients.
   - Update weights and biases using the learning rate.
6. Repeat for multiple epochs until the error is minimized.
7. Classify test words based on the trained model.

Program:

```
import numpy as np

def sigmoid(x):
    return 1 / (1 + np.exp(-x))

def sigmoid_derivative(x):
    return x * (1 - x)

words = ['cat', 'dog', 'rat']
labels = [[1, 0, 0], [0, 1, 0], [0, 0, 1]]

def encode(word):
    return [ord(char)/128 for char in word]

X = np.array([encode(word) for word in words])
y = np.array(labels)

np.random.seed(42)
input_layer_neurons = 3
hidden_layer_neurons = 4
output_neurons = 3
```

```
wh = np.random.uniform(size=(input_layer_neurons, hidden_layer_neurons))
bh = np.random.uniform(size=(1, hidden_layer_neurons))
wout = np.random.uniform(size=(hidden_layer_neurons, output_neurons))
bout = np.random.uniform(size=(1, output_neurons))

epochs = 10000
lr = 0.1

for _ in range(epochs):
    hidden_input = np.dot(X, wh) + bh
    hidden_output = sigmoid(hidden_input)
    final_input = np.dot(hidden_output, wout) + bout
    final_output = sigmoid(final_input)
    error = y - final_output
    d_output = error * sigmoid_derivative(final_output)
    error_hidden = d_output.dot(wout.T)
    d_hidden = error_hidden * sigmoid_derivative(hidden_output)
    wout += hidden_output.T.dot(d_output) * lr
    wh += X.T.dot(d_hidden) * lr
    bout += np.sum(d_output, axis=0, keepdims=True) * lr
    bh += np.sum(d_hidden, axis=0, keepdims=True) * lr

test_word = 'cat'
test_input = np.array(encode(test_word)).reshape(1, -1)
hidden_layer = sigmoid(np.dot(test_input, wh) + bh)
output_layer = sigmoid(np.dot(hidden_layer, wout) + bout)
print(f"Prediction for '{test_word}':", output_layer)
```

Sample Output:

```
Prediction for 'cat': [[0.984 0.015 0.002]]
→ Classified as 'cat'
```

2. Genetic Algorithm Implementation

AIM:

To implement a Genetic Algorithm (GA) in Python to solve a basic optimization problem.

Algorithm:

1. Initialize a random population of binary strings.
2. Evaluate the fitness of each individual.
3. Select parents using tournament or roulette-wheel selection.
4. Apply crossover to generate offspring.
5. Apply mutation to maintain diversity.
6. Replace the old population with the new one.
7. Repeat for several generations or until convergence.

Python Code:

```
import random

def fitness(x):
    return x**2

def decode(individual):
    return int("".join(str(bit) for bit in individual), 2)

def create_population(size, length):
    return [[random.randint(0, 1) for _ in range(length)] for _ in range(size)]

def select(population):
    return max(random.sample(population, 2), key=lambda ind: fitness(decode(ind)))

def crossover(p1, p2):
    point = random.randint(1, len(p1) - 2)
    return p1[:point] + p2[point:], p2[:point] + p1[point:]

def mutate(individual, prob=0.01):
    return [bit if random.random() > prob else 1 - bit for bit in individual]
```

```
def genetic_algorithm(generations=100, pop_size=10, gene_length=5):
    population = create_population(pop_size, gene_length)
    for gen in range(generations):
        population = sorted(population, key=lambda ind: fitness(decode(ind)), reverse=True)
        next_gen = population[:2]
        while len(next_gen) < pop_size:
            p1 = select(population)
            p2 = select(population)
            off1, off2 = crossover(p1, p2)
            next_gen.extend([mutate(off1), mutate(off2)])
        population = next_gen
    best = max(population, key=lambda ind: fitness(decode(ind)))
    return decode(best), fitness(decode(best))

best_solution, best_fitness = genetic_algorithm()
print(f"Best solution: x = {best_solution}, f(x) = {best_fitness}")
```

Sample Output:

```
Best solution: x = 31, f(x) = 961
```

6.LAB SCHEDULE

Week No.	Name of the Program	No. of Lab hours	Text Books	Mode of Assessment
1	Write a python program to compute Central Tendency Measures: Mean, Median, Mode Measure of Dispersion: Variance, Standard Deviation	3	T1	Viva and Execution
2	Implementation of Python Base Libraries such as Statistics, Math, Numpy and Scipy	3	T1	Viva and Execution

3	Study of Python Libraries for ML application such as Pandas and Matplotlib	3	T1	Viva and Execution
4	Write a Python program to implement Simple Linear Regression	3	T1	Viva and Execution
5	Implementation of Multiple Linear Regression for House Price Prediction using sklearn	3	T1	Viva and Execution
6	Implementation of Decision tree using sklearn and its parameter tuning	3	T1	Viva and Execution
7	Implementation of KNN using sklearn	3	T1	Viva and Execution
8	Implementation of Logistic Regression using sklearn	3	T1	Viva and Execution
9	Implementation of K-Means Clustering	3	T1	Viva and Execution
10	Performance analysis of Classification Algorithms on a specific dataset *(Mini Project)*	3	T1	Viva and Execution

11	Implement the finite words classification system using Back Propagation Algorithm.	3	T1	Viva and Execution
12	Implement genetic Algorithm using Python.	3	T1	Viva and Execution
Total no of Lab hours required to complete syllabus		36		

CYCLE 1:

Batches	week-1	week-2	week-3	week-4	week-5	week-6	week-7	week-8
B1	Basic programs & Exp1	Exp.1	Exp.2	Exp.3	Exp.4	Exp.5	Exp.6	Exp.7
B2	Basic programs & Exp1	Exp.1	Exp.2	Exp.3	Exp.4	Exp.5	Exp.6	Exp.7

Batches	week-9	week-10	week-11	week-12	week-13
B1	Exp.8	Exp.9	Exp.10	LEAD 1	LEAD 2
B2	Exp.8	Exp.9	Exp.10	LEAD 1	LEAD 2

VIVA SCHEDULE:

Batches	week-1	week-2	week-3	week-4	week-5	week-6	week-7	week-8	week-9	week-10	week-11	week-12	week-13
B1	viva	viva	viva	viva	viva	viva	Viva	viva	viva	viva	viva	Viva	viva
B2	viva	viva	viva	viva	viva	viva	Viva	viva	viva	viva	viva	Viva	viva

Batch 1	**week-1**	**week-2**	**week-3**	**week-4**	**week-5**	**week-6**	**week-7**	**week-8**	**week-9**	**week-10**
SG1	viva									
SG2			viva							
SG3					viva					
SG4							viva			
SG5									viva	

Batch 2	**week-1**	**week-2**	**week-3**	**week-4**	**week-5**	**week-6**	**week-7**	**week-8**	**week-9**	**week-10**
SG1	viva									
SG2			viva							
SG3					viva					
SG4							viva			
SG5									viva	

*SG: Selected Group with a maximum of 6 or 12 students

6. Scheme of Evaluation:

The scheme of evaluation for internal and external exams is as follows:

LAB INTERNAL:								
Day to Day Evaluation - 10					**Internal Exam - 30**			
Uniform	**Observation & Record**	**Performance Of the Experiment**	**Result**	**Viva**	**Write up**	**Execution & Results**	**Viva**	**Project work**
Marks - 2	Marks - 2	Marks - 2	Marks - 2	Marks - 2	Marks - 05	Marks - 05	Marks - 10	Marks - 10
Total Marks = 40								

S.NO	**Write up**	**Experiment Program**	**Evaluation of results**	**Presentation**	**Viva**
1	**1. Aim** **2. Procedure** **3. Program** **4. Expected output.**	**Based on correctness of the program**	**Based on correctness of the program and Results**	**Presentation of another program**	**Based on understanding of Experiment and theoretical questions in the related subjects**
Marks	**10**	**15**	**15**	**10**	**10**
Total Marks-60					

7. SUGGESTED BOOKS

a) Machine Learning – ***Tom M. Mitchell****, - MGH,* ***Publisher****: McGraw-Hill Science/Engineering/Math; (March 1, 1997),* ***ISBN****: 0070428077.*

REFERENCE BOOK:

Machine Learning: An Algorithmic Perspective, Stephen Marsland, Taylor & Francis.

8. WEBSITES (USEFUL LINKS)

1) **https://nptel.ac.in/courses/106/105/106105152/**
2) **https://aws.amazon.com/training/learn-about/machine-learning/**
3) **https://www.coursera.org/learn/machine-learning?ranMID=40328&ranEAID=OyHlmBp2G0c&ranSiteID=OyHlmBp2G0c-cz6ad8GRJACggXck8c1Z.g&siteID=OyHlmBp2G0c-cz6ad8GRJACggXck8c1Z.g&utm_content=10&utm_medium=partners&utm_source=linkshare&utm_campaign=OyHlmBp2G0c**
4) **https://matlabacademy.mathworks.com/?s_tid=gn_trg_cosp**
5) **https://www.edx.org/course/machine-learning?source=aw&awc=6798_1615460556_1400acc8805550b9f6981da90913e481&utm_source=aw&utm_medium=affiliate_partner&utm_content=text-link&utm_term=315645_LearnDataSci**
6) **https://www.futurelearn.com/courses/big-data-machine-learning**

9. EXPERT DETAILS

The expert details which have been mentioned below are only a few of the eminent ones known Internationally, Nationally and Locally.

- **International**

1. Dr. Angela YAO,

Assistant Professor, Ph.D.(ETH Zurich, Switzerland, 2012),M.Sc. (ETH Zurich, Switzerland, 2008)

B.A.Sc. (Engineering Science, University of Toronto, Canada, 2006), **Research areas**- AI, ML, Computer Vision. COM1-03-06 (National University of Singapore (**NUS**), Singapore)

Contact- 660 17948

Email- ayao@comp.nus.edu.sg

Link- https://sites.google.com/comp.nus.edu.sg/cvml

- **National**

1. V. Susheela Devi (Principal Research Scientist),

Department of Computer Science and Automation, Indian Institute of Science (**IISC**), Bangalore **Phone:** 2932368 Extn 234, **Email**: susheela@csa.iisc.ernet.in

- **Local**

1. Anoop M. Namboodiri,

Associate Professor**,** Ph.D (Michigan State University, USA), International Institute of Information Technology(IIIT-H),Hyderabad.

Research Areas: Pattern recognition, machine learning, computer vision, biometrics.
Email: anoop[at]iiit[dot]ac[dot]in**, Contact : -** (91) (40) 6653 1000 Ext:1326 Ext: 1326

10. MAPPING OF LAB WITH PROJECT/CONSULTANCY/R & D PROPOSALS

AI-Based Crop Disease Detection using Image Classification

Abstract:

Agricultural productivity is significantly impacted by crop diseases, especially in rural areas where access to expert guidance is limited. Farmers often struggle to identify diseases early, leading to loss in yield and revenue. To address this issue, we propose a mobile-based application powered by Machine Learning that uses **image classification algorithms** to detect common crop diseases from photographs taken by farmers.

The solution employs **Convolutional Neural Networks (CNNs)** trained on a dataset of diseased and healthy crop images. By capturing a leaf image using their smartphone, users can instantly receive a diagnosis along with possible remedies or recommendations. This approach leverages Machine Learning Lab concepts such as **data pre processing, model training, feature extraction, and performance evaluation**.

The project not only improves farmers' decision-making ability but also promotes sustainable farming by reducing unnecessary pesticide use. This initiative can be extended as a **consultancy service to agri-tech startups**, and can also serve as a **baseline for R&D proposals** focusing on smart agriculture.

11. INDUSTRIAL VISITS (IIP–INNOVATIVE INDUSTRIAL LEARNING PROGRAM)

Students visit schedule different software development MNC companies.

S.No	Type of industry	Nature of industry	Date of visit (Tentative Date)	No. of students participated	Year/branch	remarks
1	T-HUB	Software	December	20 to 30	DS – III Year	
2	T-HUB	Software	February	20 to 30	DS– III Year	

12. Shadow Engineering – Objectives

- To enhance students' understanding and practical knowledge through active participation in laboratory work.
- To strengthen industry-academia collaboration for better exposure and learning opportunities.
- To simulate an industry-like environment within the institution, preparing students for future assignments and professional roles.
- To expose students to real-world engineering tools, technologies, and practices aligned with industry standards.
- To encourage peer learning, mentoring, and collaborative problem-solving through hands-on mini-projects and real-time scenarios.
- To develop professional skills such as teamwork, communication, and project documentation alongside technical proficiency.
- To cultivate an innovation-driven mindset by enabling students to apply theoretical concepts to practical applications.
- To facilitate domain-specific technical training and certification opportunities within the academic setup.
- To prepare students for internships, placements, and higher studies by familiarizing them with the expectations of the engineering profession.
- To continuously assess and improve students' performance through feedback from both academic mentors and industry experts.

13 . CALIBRATION, TESTING AND INSPECTION

Calibration

Calibration is the process of adjusting a machine learning model so that its predicted probabilities reflect the true likelihood of an event occurring.

Installation

Aim of this concept is to make and maintain installation procedure for a new equipment or already existing equipment. Download Python Tool from http://www.python.org./ or internet and install then we are getting this below GUI. According to user requirement select any label or button then proceed.

14.MAINTAINANCE AND TROUBLESHOOTING

Maintenance:

Maintenance and trouble shooting of each equipment in a laboratory must follow the following guidelines:

Maintenance Schedules:

(1) Preventive Maintenance Schedules of lab will be decided by lab in charge along with concerned HOD. The details of schedule should be recorded in the following template of format.

S.No.	Software	Date of Maintenance	Type of Activity	Remarks
1	Operating System	1/3/2025	Software installed	
2	Python	05/4/2025	Installation	
3	Python	03/5/2025	Installation	

(2) Maintenance Reports should be duly signed by in charges as well as HODs and duly approved by Principal periodically.

15. ASSESSMENT AND ACCREDITATION PROCEDURE AS PER NABL

Accreditation is the formal recognition, authorization and registration of a laboratory that has demonstrated its capability, competence and credibility to carry out the tasks. It provides the feedback to laboratories as to whether they are performing according to the technical competence as per guidelines of NABL (National Accreditation Board for Testing and Calibration Laboratories).

The laboratory should carry out the following important tasks towards getting ready for accreditation from NABL.

1. Preparation of methodology for each experiment
2. Preparation of Standard Operating procedure for each equipment
3. Preparation of Laboratory Manual as per the guidelines specified by Combined Lab Team(CLT) headed by Principal/HOD/Dean/in charge
4. Ensure Effective environmental conditions (temperature, humidity, storage and placement) in the laboratories by implementing proper housekeeping and cleaning

of the equipments from dust, dirt etc.

5. Ensure Calibration of instruments/equipment (Only NABL accredited authorized laboratories provide calibration).
6. All the details of Calibration should be included in the format specified exclusively for calibration procedure.
7. Ensure proper implementation of all the documents, formats to be included in the lab manual.
8. Impart training for all the technicians working in labs about the importance of documentation, log sheets, operating procedure of the lab.
9. Incorporate Internal Lab audits for effective functioning of the laboratories. Audits may be once in a month or 3 months or at the end of the semester. The audit schedule will be decided by the Chairman and Principal of the CLT team. Auditors should submit the detailed report of each lab duly signed by them to the Principal.

16. VIRTUAL LABS REFERENCE LINKS

1. http://cse06-iiith.virtual-labs.ac.in

2.vlabs.iitb.ac.in