Laboratory Manual

(Problem Solving Using Python MCA17101)

Table of Contents

33	Implementation of Long Short-Term Memory (LSTM) Network	
34	Optimization Techniques: SGD, Adam, and RMSprop	
35	Regularization Techniques: Dropout and Batch Normalization	
36	Overfitting Analysis and Early Stopping Techniques	
37	Transfer Learning using Pre-trained CNN Models	
38	Development of CNN-Based Application on a Dataset	
39	Case Study on Linear Regression-Based Prediction System	
40	Case Study on Logistic Regression for Classification	
41	Case Study on Support Vector Machine Application	
42	Case Study on KNN-Based Classification System	
43	Case Study on Decision Tree Model	
44	Case Study on Random Forest Model	
45	Case Study on Gradient Boosting Model	
46	Case Study on Supervised Learning Model Comparison	
47	Case Study on K-Means Clustering Application	
48	Case Study on Hierarchical Clustering	
49	Case Study on DBSCAN for Density-Based Clustering	
50	Case Study on Gaussian Mixture Models	
51	Case Study on PCA for Dimensionality Reduction	
52	Case Study on t-SNE for Data Visualization	
53	Case Study on Autoencoder-Based Feature Learning	
54	Case Study on Perceptron-Based Classification	
55	Case Study on Multi-Layer Neural Network	
56	Case Study on CNN-Based Image Classification	
57	Case Study on RNN-Based Sequence Modeling	
58	Case Study on LSTM-Based Time Series Prediction	
59	Case Study on Transfer Learning Application	
60	Case Study on Generative Adversarial Networks (GANs)	

Aim/Purpose of the Assignments

Assignment 1:

Aim: To implement Linear Regression using Python.

Purpose: To understand the relationship between independent and dependent variables in supervised learning.

Assignment 2:

Aim: To implement Logistic Regression for binary classification.

Purpose: To model probabilistic outcomes for classification problems.

Assignment 3:

Aim: To implement K-Means clustering on unlabeled data.

Purpose: To understand basic unsupervised learning and data grouping.

Assignment 4:
Aim: To implement Gradient Descent optimization algorithm.
Purpose: To learn how model parameters are optimized by minimizing loss.
Assignment 5:
Aim: To compare different loss functions used in machine learning.
Purpose: To analyze how loss functions affect model training and convergence.
Assignment 6:
Aim: To develop an end-to-end classification-based application.
Purpose: To integrate preprocessing, training, and evaluation in a single ML pipeline.
Assignment 7:
Aim: To implement Support Vector Machine (SVM) for classification.
Purpose: To understand margin-based classification techniques.
Assignment 8:
Aim: To implement K-Nearest Neighbors (KNN) classifier.
Purpose: To study instance-based and distance-driven learning.
Assignment 9:
Aim: To implement Decision Tree classifier.
Purpose: To understand rule-based classification and decision making.
Assignment 10:
Aim: To implement Random Forest classifier.
Purpose: To explore ensemble learning for improved accuracy.
Assignment 11:
Aim: To implement Gradient Boosting classifier.
Purpose: To learn boosting techniques that improve weak learners.
Assignment 12:
Aim: To evaluate models using accuracy, precision, recall, and F1-score.
Purpose: To assess classification model performance comprehensively.
Assignment 13:
Aim: To evaluate models using ROC curve and AUC.
Purpose: To analyze classifier discrimination capability.
Assignment 14:
Aim: To perform model selection using cross-validation and grid search.
Purpose: To select optimal hyperparameters and improve generalization.
Assignment 15:
Aim: To implement K-Means clustering algorithm.
Purpose: To cluster data based on similarity measures.
Assignment 16:
Aim: To determine optimal number of clusters using elbow and silhouette methods.
Purpose: To improve clustering quality and interpretation.

Assignment 17:
Aim: To implement hierarchical clustering and dendrogram visualization.
Purpose: To analyze hierarchical relationships in data.
Assignment 18:
Aim: To implement DBSCAN clustering algorithm.
Purpose: To identify clusters of arbitrary shape and detect noise.
Assignment 19:
Aim: To implement Gaussian Mixture Model (GMM).
Purpose: To perform probabilistic clustering using soft assignments.
Assignment 20:
Aim: To perform comparative analysis of clustering algorithms.
Purpose: To understand strengths and limitations of different clustering methods.
Assignment 21:
Aim: To apply Principal Component Analysis (PCA).
Purpose: To reduce dimensionality while preserving variance.
Assignment 22:
Aim: To visualize high-dimensional data using t-SNE.
Purpose: To project complex data into lower dimensions for visualization.
Assignment 23:
Aim: To implement autoencoders for dimensionality reduction.
Purpose: To learn compressed feature representations.
Assignment 24:
Aim: To perform feature compression and reconstruction using PCA.
Purpose: To analyze information loss during dimensionality reduction.
Assignment 25:
Aim: To visualize reduced-dimensional data effectively.
Purpose: To interpret transformed feature spaces.
Assignment 26:
Aim: To develop an unsupervised learning model on a dataset.
Purpose: To discover hidden patterns in unlabeled data.
Assignment 27:
Aim: To implement a perceptron for binary classification.
Purpose: To understand the foundation of neural networks.
Assignment 28:
Aim: To implement multi-layer neural network using backpropagation.
Purpose: To understand learning in deep architectures.
Assignment 29:
Aim: To study and compare activation functions.
Purpose: To analyze non-linearity effects in neural networks.

Assignment 30:
Aim: To implement Convolutional Neural Network (CNN).
Purpose: To extract spatial features from image data.
Assignment 31:
Aim: To visualize feature maps in CNN.
Purpose: To interpret convolutional layers.
Assignment 32:
Aim: To implement Recurrent Neural Network (RNN).
Purpose: To model sequential and temporal data.
Assignment 33:
Aim: To implement Long Short-Term Memory (LSTM) network.
Purpose: To handle long-term dependencies in sequences.
Assignment 34:
Aim: To compare optimizers such as SGD, Adam, and RMSprop.
Purpose: To study convergence behavior of optimization algorithms.
Assignment 35:
Aim: To apply dropout and batch normalization.
Purpose: To reduce overfitting and stabilize training.
Assignment 36:
Aim: To analyze overfitting and apply early stopping.
Purpose: To improve model generalization.
Assignment 37:
Aim: To apply transfer learning using pre-trained CNN models.
Purpose: To leverage existing knowledge for faster training.
Assignment 38:
Aim: To develop a CNN-based application on a dataset.
Purpose: To build a practical deep learning solution.
Assignment 39:
Aim: To study a case of linear regression-based prediction system.
Purpose: To apply regression concepts to real-world data.
Assignment 40:
Aim: To study a case of logistic regression classification.
Purpose: To analyze binary decision-making systems.
Assignment 41:
Aim: To study SVM-based application.
Purpose: To apply margin-based learning to practical problems.
Assignment 42:
Aim: To study KNN-based classification system.
Purpose: To understand lazy learning in practice.

Assignment 43:
Aim: To study decision tree-based models.
Purpose: To interpret model decisions.
Assignment 44:
Aim: To study Random Forest-based models.
Purpose: To explore ensemble robustness.
Assignment 45:
Aim: To study gradient boosting-based models.
Purpose: To analyze sequential ensemble learning.
Assignment 46:
Aim: To compare supervised learning models using a case study.
Purpose: To select best-performing algorithms.
Assignment 47:
Aim: To study K-Means clustering case study.
Purpose: To analyze grouping behavior in real data.
Assignment 48:
Aim: To study hierarchical clustering case study.
Purpose: To interpret nested cluster structures.
Assignment 49:
Aim: To study DBSCAN clustering case study.
Purpose: To identify density-based clusters.
Assignment 50:
Aim: To study Gaussian Mixture Model case study.
Purpose: To analyze probabilistic clustering.
Assignment 51:
Aim: To study PCA-based dimensionality reduction case study.
Purpose: To simplify complex datasets.
Assignment 52:
Aim: To study t-SNE visualization case study.
Purpose: To visualize high-dimensional data.
Assignment 53:
Aim: To study autoencoder-based feature learning.
Purpose: To learn efficient data representations.
Assignment 54:
Aim: To study perceptron-based classification.
Purpose: To reinforce neural learning fundamentals.
Assignment 55:
Aim: To study multi-layer neural network application.
Purpose: To analyze deep learning behavior.

Assignment 56:
Aim: To study CNN-based image classification case study.
Purpose: To apply deep learning to vision tasks.
Assignment 57:
Aim: To study RNN-based sequence modeling.
Purpose: To understand temporal data learning.
Assignment 58:
Aim: To study LSTM-based time series prediction.
Purpose: To forecast sequential data effectively.
Assignment 59:
Aim: To study transfer learning application.
Purpose: To reduce training time and improve accuracy.
Assignment 60:
Aim: To study Generative Adversarial Networks (GANs).
Purpose: To understand adversarial learning and data generation.

Learning Outcomes

Upon successful completion of the assignments, students will be able to:

Module 1: Foundations of Machine Learning (Assignments 1–6)

Learning Outcomes:

1. Understand the basic concepts and workflow of machine learning.
2. Implement foundational supervised and unsupervised learning algorithms.
3. Apply optimization techniques such as gradient descent for model training.
4. Analyze the role of loss functions in learning performance.
5. Develop simple classification-based machine learning applications.

Module 2: Supervised Learning Techniques (Assignments 7–14)

Learning Outcomes:

1. Implement major supervised learning algorithms including regression and classification models.
2. Understand distance-based, margin-based, and tree-based learning techniques.
3. Evaluate supervised learning models using standard performance metrics.
4. Apply cross-validation and hyperparameter tuning techniques.
5. Build classification applications using real-world datasets.

Module 3: Unsupervised Learning and Dimensionality Reduction (Assignments 15–26)

Learning Outcomes:

1. Understand clustering techniques for learning from unlabeled data.
2. Implement partition-based, hierarchical, density-based, and probabilistic clustering algorithms.
3. Apply dimensionality reduction techniques to high-dimensional datasets.
4. Visualize reduced feature spaces for interpretation.
5. Develop unsupervised learning models for pattern discovery.

Module 4: Deep Learning and Neural Networks (Assignments 27–38)

Learning Outcomes:

1. Understand the fundamentals of neural networks and deep learning.
2. Implement perceptrons and multi-layer neural networks using backpropagation.
3. Apply convolutional and recurrent neural network architectures.
4. Use optimization and regularization techniques to improve deep learning models.
5. Develop CNN-based applications using real datasets.

Module 5: Advanced Topics and Applications (Assignments 39–60)

Learning Outcomes:

1. Analyze real-world case studies using supervised and unsupervised learning techniques.
2. Apply ensemble learning methods such as bagging, boosting, and stacking.
3. Compare ensemble models with base learners.
4. Understand the working of advanced models including GANs.
5. Design and evaluate complete machine learning solutions for practical problems.

2. Prerequisites

- Basic knowledge of Python programming
- Understanding of fundamental mathematics and statistics
- Ability to interpret, execute, and debug Python programs

3. Requirements

- Python Interpreter
- IDLE / Jupyter Notebook / Google Colab
- Required Python libraries: NumPy, Pandas, Matplotlib, Seaborn, Scikit-learn, TensorFlow / PyTorch

4. Introduction and Theory

Machine Learning is a branch of Artificial Intelligence that enables systems to learn patterns from data and make predictions or decisions without being explicitly programmed. This laboratory course provides hands-on experience with fundamental, supervised, unsupervised, and deep learning algorithms. Students will explore optimization techniques, model evaluation methods, and real-world applications through structured experiments.

The experiments are designed to progressively build understanding—from basic machine learning concepts to advanced neural network architectures and ensemble methods—while emphasizing practical implementation using Python.

5. Operating Procedure

Standard operating procedure for using Python and machine learning libraries as per the instructions of the faculty member.
Students must:

- Execute programs in the prescribed environment
- Verify outputs and plots
- Maintain proper documentation in the lab record

6. Precautions and / or Troubleshooting

- Ensure correct installation of required Python libraries
- Carefully handle dataset preprocessing steps
- Debug syntax and logical errors during execution
- Validate model inputs and outputs to avoid incorrect results

7. Observations

- Execute programs with different datasets and parameter values
- Observe variations in model performance and output
- Analyze the effect of hyperparameters on learning behavior

8. Calculations & Analysis

- **Assignments 1–15:** Compilation time and runtime execution
- Performance analysis using appropriate evaluation metrics
- Comparative analysis where applicable

9. Result & Interpretation

The results or outputs obtained from each experiment must be displayed on the computer system and documented in the assignment record. Interpretation should clearly explain the observed behavior, model performance, and learning outcomes.

Machine Learning Laboratory
Algorithm and Pseudocode (Individual Experiments)

Assignment 1: Linear Regression using Python

Algorithm:
1. Load dataset
2. Preprocess data

3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 2: Logistic Regression for Binary Classification

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 3: K-Means Clustering

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 4: Gradient Descent Optimization

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 5: Loss Function Comparison

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 6: Classification-Based Application

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 7: Support Vector Machine

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data

Train model
Evaluate
End

Assignment 8: K-Nearest Neighbors

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 9: Decision Tree Classifier

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 10: Random Forest Classifier

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 11: Gradient Boosting

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 12: Evaluation Metrics

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 13: ROC Curve and AUC

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 14: Cross-Validation and Grid Search

Algorithm:
1. Load dataset

2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 15: K-Means Clustering Analysis

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 16: Elbow and Silhouette Methods

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 17: Hierarchical Clustering

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 18: DBSCAN

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 19: Gaussian Mixture Model

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 20: Clustering Comparison

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data

Train model
Evaluate
End

Assignment 21: PCA

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 22: t-SNE

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 23: Autoencoders

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 24: PCA Reconstruction

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 25: Dimensionality Reduction Visualization

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 26: Unsupervised Model

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 27: Perceptron

Algorithm:
1. Load dataset

2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 28: Multi-layer Neural Network

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 29: Activation Functions

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 30: CNN

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 31: CNN Feature Maps

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 32: RNN

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 33: LSTM

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data

Train model
Evaluate
End

Assignment 34: Optimizers

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 35: Regularization

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 36: Early Stopping

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 37: Transfer Learning

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 38: CNN Application

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 39: Regression Case Study

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 40: Classification Case Study

Algorithm:
1. Load dataset

2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 41: SVM Case Study

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 42: KNN Case Study

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 43: Decision Tree Case

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 44: Random Forest Case

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 45: Gradient Boosting Case

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 46: Model Comparison

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data

Train model
Evaluate
End

Assignment 47: K-Means Case

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 48: Hierarchical Case

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 49: DBSCAN Case

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 50: GMM Case

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 51: PCA Case

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 52: t-SNE Case

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 53: Autoencoder Case

Algorithm:
1. Load dataset

2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 54: Perceptron Case

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 55: MLP Case

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 56: CNN Case

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 57: RNN Case

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 58: LSTM Case

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Assignment 59: Transfer Learning Case

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data

Train model
Evaluate
End

Assignment 60: GAN Case

Algorithm:
1. Load dataset
2. Preprocess data
3. Train model
4. Evaluate output

Pseudocode:
Begin
Load data
Train model
Evaluate
End

Machine Learning Lab – Viva Voce Questions (All 60 Assignments)

Module 1: Foundations of Machine Learning (Assignments 1–10)

Assignment 1: Line, Bar, and Scatter Plots

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Assignment 2: Customizing Charts

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Assignment 3: Histograms and KDE Plots

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 4: Boxplot, Violin Plot, Countplot

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 5: Pairplot and Heatmap

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 6: Pandas DataFrame Visualization

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 7: Pie and Donut Charts

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 8: EDA on Titanic Dataset

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 9: Interactive Charts using Plotly

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 10: Dashboard with Subplots

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Module 2: Supervised Learning Techniques (Assignments 11–25)

Assignment 11: Data Cleaning

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 12: Encoding Categorical Variables

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 13: Feature Scaling

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Assignment 14: Train-Test Split

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Assignment 15: Linear Regression

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Assignment 16: Regression Evaluation Metrics

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Assignment 17: Logistic Regression

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 18: Confusion Matrix & Classification Report

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Assignment 19: KNN Classifier

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Assignment 20: Hyperparameter Tuning in KNN

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Assignment 21: Decision Tree Classifier

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Assignment 22: Random Forest Classifier

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 23: Cross-Validation

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 24: PCA

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 25: End-to-End ML Pipeline

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Module 3: Unsupervised Learning & Training Algorithms (Assignments 26–35)

Assignment 26: Gradient Descent

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 27: Batch vs Stochastic vs Mini-batch GD

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 28: Learning Curve Visualization

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 29: Logistic Regression with GD

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 30: Simple Neural Network

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 31: Optimizers

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 32: Learning Rate Scheduling & Early Stopping

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Assignment 33: Loss Functions

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Assignment 34: Regularization

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Assignment 35: Epochs & Learning Rate Effects

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Module 4: Deep Learning & Prediction Systems (Assignments 36–45)

Assignment 36: Data Splitting Strategies

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 37: Regression Prediction

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 38: Tree & Forest Regression

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 39: KNN Regression

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 40: Softmax & Multiclass Classification

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 41: Model Saving & Loading

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 42: Real-Time Prediction

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 43: ROC & AUC

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 44: Regression Visualization

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 45: Complete ML Project

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Module 5: Advanced Topics & Applications (Assignments 46–60)

Assignment 46: Introduction to Ensemble Methods

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Assignment 47: Random Forest Feature Importance

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Assignment 48: AdaBoost

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Assignment 49: XGBoost

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?
4. What are the key parameters involved?
5. What are real-world applications of this experiment?

Assignment 50: Voting Classifier

1. What is the main objective of this experiment?
2. Which algorithm or technique is implemented?
3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 51: Stacking Ensemble

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 52: CNN Architecture

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 53: CNN Training

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 54: Transfer Learning

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 55: GAN Introduction

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 56: GAN Architecture

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 57: GAN Applications

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 58: Case Study: Supervised Learning

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 59: Case Study: Unsupervised Learning

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

Assignment 60: Case Study: Neural Networks

1. What is the main objective of this experiment?

2. Which algorithm or technique is implemented?

3. Why is this method preferred over others?

4. What are the key parameters involved?

5. What are real-world applications of this experiment?

1. **Assessments**
   As per the assessment and evaluation policy of university

2. **Suggested readings**
   1. Introduction to Machine Learning Second Edition, The MIT Press Cambridge, Massachusetts, London, England, EthemAlpaydın.
3. **Assignment copy format:**
   1. Write in A4 page; No channel file will be accepted.
   2. Front page and Index page format will be provided by department
   3. Following points must be included while writing assignment copy
      a) Problem definition
      b) Algorithm
      c) Program in corresponding language
      d) Output