Cummins College of Engineering for Women

(An autonomous institute affiliated to Savitribai Phule pune university)
Karve Nagar, Pune - 411 052.

Vision

To be globally renowned engineering institute for imparting holistic education and developing professional women leaders in engineering and technology

B. Tech.(Hons.) Computer Engineering

with Specialization in

Artificial Intelligence and Machine Learning

2023 Pattern [R0]

List of Abbreviations

Abbreviation	Title
PCC	Programme Core Course
BSC	Basic Science Course
ESC	Engineering Science Course
PE	Programme Elective Course
OE	Open Elective
VSEC	Vocational and Skill Enhancement Course
CC	Co-curricular Courses / Liberal Learning Course
IKS	Indian Knowledge System
VEC	Value Education Course
RM	Research Methodology
INTR	Internship
PROJ	Project
CEP	Community Engagement Project
RM	Research Methodology
Mm	Multidisciplinary Minor
AEC	Ability Enhancement Course

Autonomous Program Structure
B.Tech in Computer Engineering
with Honors Degree Programme in
Artificial Intelligence and Machine Learning
Academic Year: 2025-2026 Onwards

Course Code	Course Title	Teaching Scheme (hours/week)			Cr	Examination Scheme			Total Marks
		L	T	P		ISE	ESE	Pr/Or	
23HAIML501	Mathematics for Artificial Intelligence and Machine Learning	3	0	0	3	50	50	0	100
23HAIML502	Intelligent Systems and Soft Computing	3	0	0	3	50	50	0	100
23HAIML503L	Computational Intelligence Laboratory	0	0	2	1	25	0	25	50
23HAIML601	Advanced Machine Learning	3	0	0	3	50	50	0	100
23HAIML602	Deep Neural Networks	3	0	0	3	50	50	0	100
23HAIML603L	Advanced Machine Learning and Deep Neural Networks Laboratory	0	0	2	1	25	0	25	50
23HAIML801	Generative Artificial Intelligence	3	0	0	3	50	50	0	100
23HAIML801L	Generative Artificial Intelligence Laboratory	0	0	2	1	25	0	25	50
	Total	15	0	6	18	325	250	75	650

L=Lecture, T=Tutorial, P= Practical, Cr= Credits, ISE =In Semester Evaluation, ESE =End Semester Examination, Pr/Or = Practical/Oral

Department of Computer Engineering

23HAIML501 MATHEMATICS FOR ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Course Objectives
To facilitate the learner

1. To be able to analyze univariate, bivariate and multivariate data using linear algebraic operations
2. To be able to apply feature selection, dimensionality reduction, analysis of variance, time series analysis and multivariate analysis on multidimensional data
3. To be able to apply numerical methods to approximate data
4. To be able to apply statistical inference techniques and statistical decision theory to draw conclusion

Course Outcomes
After completion of the course, students will be able to
1. Make use of linear algebra on the given data for problem solving
2. Utilize time series, multivariate analysis and feature selection techniques for given multidimensional data
3. Apply statistical inference techniques for given data
4. Solve mathematical problems involving data approximation using numerical methods

Section I: Linear Algebra

Vectors, Matrices, and Tensors, Matrix Operations (Addition, Multiplication, Transpose, Inverse, Determinant, rank), Eigenvalues and Eigenvectors, Singular Value Decomposition (SVD), Principal Component Analysis (PCA), Case studies on SVD and PCA.

Section II: Statistical Analysis

Univariate and Bivariate analysis, Multivariate analysis: Partial regression, Partial correlation, Multiple correlation, Multivariate regression Feature selection : Feature selection and dimensionality reduction, supervised and unsupervised feature selection techniques, Filter method, Embedded method, Wrapper method Time series analysis: Introduction to Time Series, Definition and types of time series data, Components: Trend, Seasonality, Cyclicity, Irregular variations, Stationarity: Concept and importance, Time series visualization and decomposition, Forecasting Models**:** Moving Average(MA), Autoregressive(AR), Autoregressive Moving Average(ARMA), Autoregressive Integrated Moving Average (ARIMA) Applications and Case studies of multivariate analysis.

Section III: Statistical Inference

Hypothesis Testing and Confidence Intervals, p value and Significance level, one tailed, two tailed test, Type I and Type II error, parametric and non-parametric test such as One-sample and Two-sample Tests (Z-test, t-test), Chi-Square Test, Mann-Whitney U Test
Analysis of Variance (ANOVA), F- test for variance comparison, Applications and case studies of statistical inferential techniques.

Section IV: Numerical Methods and Approximation

Root Finding Methods (Newton-Raphson), Interpolation and Extrapolation, Types of Interpolation: Linear interpolation, Polynomial interpolation (Lagrange, Newton's divided difference), Spline interpolation (cubic spline), Hidden Markov Model (HMM), HMM parameters, Forward algorithm, Viterbi algorithm, Finite Differences and Numerical Differentiation Forward, Backward, and Central Difference Formulas,Applications and Case studies of numerical methods and approximation.

Text Books
1. "Statistical Methods", S.P. Gupta, 41st Edition, 2011, ISBN :978-81-8054-862-8, Sultan Chand and Sons publication.
2. "Basic statistics", B.L. Agarwal, 9th Edition, 2011, ISBN:978-81-224-2472-0, New Age publication.
3. "Numerical Methods with Applications", J. S. R. Chawla, S. K. Gupta, and M. K. Gupta, 5th Edition, 2003, New Age International, ISBN 81-224-0651-3.

Reference Books
1. "Statistical Data analytic" by Piegorsch W.W., Wiley publication, 2017
2. "Applied multivariate statistical analysis", Richard A. Johnson, Dean W. Wichern, 6th edition, 2012, ISBN : 1-978-81-203-4587-4, PHI Learning

Online/Web/Other References

1. Nptel/coursera courses on Statistics and probability

23HAIML502 INTELLIGENT SYSTEMS AND SOFT COMPUTING

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

Course Objectives
To facilitate the learner to

1. To be familiar with Intelligent systems
2. To gain knowledge of fuzzy systems and its hybrid variants
3. To get acquainted with genetic algorithms and operations involved
4. To understand Swarm Intelligent Algorithms and its applications in engineering

Course Outcomes
After completion of the course, students will be able

1. Make use of intelligent systems concepts, knowledge and reasoning for problem solving
2. Apply the concepts of fuzzy logic to build intelligent systems
3. Select genetic operations for optimization and search problems
4. Solve an optimization problem using swarm intelligence

Section I: Intelligent Systems

Intelligent Systems, Intelligent Agent: Percept, Agent Function, Architecture, Multi-agent Systems, Representation, Knowledge and Reasoning, Uncertain Knowledge, Uncertainty and Methods, Expert Systems, Applications of Intelligent Systems.

Section II: Fuzzy Systems

From Crisp to Fuzzy Systems, Fuzzy Operations, Properties, Inferences, Relations, Arithmetic Operations of Fuzzy Numbers, Linguistic Descriptions and their Analytical Forms, Defuzzification, Fuzzy Decision Making, Fuzzy Logic Control Systems, Case Study and applications Neuro Fuzzy, Genetic Neuro Hybrid Systems.

Section III: Genetic Algorithms

Biological Inspiration, Basic terminologies, Structure of GAs, Traditional Optimization and Search Techniques, GAs and search space, GA vs. traditional algorithms, Simple GA, operations in genetic algorithm: encoding- binary, octal, selection- Roulette wheel selection, random selection, crossover- single point cross over, two point crossover, mutation- flipping, interchanging, stopping condition for genetic algorithm flow, constraints in genetic algorithm, Fitness function and Iteration, Case Study - Genetic Algorithm-Based Internet Search Technique.

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Section IV: Swarm Intelligent Systems

Biological background, Swarm Intelligent Algorithms, Particle Swarm Optimization (PSO), Concept of particles in a search space, Position and velocity updates, Personal and global best solutions, Variants of PSO (adaptive PSO, hybrid PSO), Applications in function optimization and neural network training

Ant Colony Optimization (ACO), Artificial ants and pheromone updates, Probabilistic decision-making in pathfinding, Evaporation and reinforcement mechanisms, Variants of ACO (MAX-MIN ACO, Rank-based ACO), Applications in routing, scheduling, and logistics

Artificial Bee Colony (ABC) Algorithm, Role of employed, onlooker, and scout bees,Food source exploitation and exploration, Applications in engineering and clustering problems

Other Swarm-Based Algorithms - Bat Algorithm, Cuckoo Search Algorithm , Glowworm Swarm Optimization, Grey Wolf Optimizer (GWO).

Text Books
1. "Artificial Intelligence and Intelligent Systems". N P Padhy, Oxford University Press, 1st edition, (2011), ISBN-13: 978-0195671544
2. "Artificial Intelligence - Building Intelligent Systems", Parag Kulkarni and Prachi Joshi, PHI Learning, 1st edition, (2015), ISBN 13 - 978-8120350465
3. "Soft Computing: Advances and Applications", B.K. Tripathi, J Anuradha, CENGAGE Learning, (2015), ISBN 13 - 978-8131526194
4. "Principles of Soft Computing", S.N. Sivanandam, S.N. Deepa, Wiley, 3rd edition, (2018), ISBN 13- 978-8126577132

Reference Books
1. "Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Pearson, 4th edition, (2022), ISBN 13 - 978-9356063570
2. "Artificial Intelligence", Elain Rich, Kevin Knight and Shivshankar Nair, Tata McGraw Hill, 3rd Edition, (2017), ISBN 13- 978-0070087705
3. "Artificial Intelligence", Saroj Kaushik, CENGAGE LEARNING INDIA PVT. LTD, ISBN : 9789355730428
4. "Fuzzy Logic with Engineering Application", Timothy Ross, John Wiley and Sons, 3rd Edition, (2011), ISBN 13 - 978-8126531264
5. "Introduction to Soft Computing" Prof. Debasis Samanta, IIT Kharagpur, 106105173.pdf

Online/Web/Other References
1. AI:Constraint Satisfaction, Deepak Khemani, IIT Madras https://nptel.ac.in/courses/106106158
2. Artificial Intelligence: Knowledge Representation and Reasoning, Deepak Khemani, IIT Madras, https://nptel.ac.in/courses/106106140
3. Introduction to Soft Computing, Prof. Debasis Samanta, IIT Kharagpur, https://archive.nptel.ac.in/courses/106/105/106105173/

4. Soft Computing Techniques, By Dr.T Subha, National Institute of Technical Teachers Training and Research (NITTTR), Taramani, Chennai, https://onlinecourses.swayam2.ac.in/ntr25_ed63/

23HAIML503L COMPUTATIONAL INTELLIGENCE LABORATORY

Teaching Scheme
Practical: 4 Hours / Week

Examination Scheme
In Semester: 25 Marks
End Semester: 25 Marks
Credits: 2

Course Objectives
To facilitate the learner to

1. Implement and analyze the basic and descriptive statistical operations univariate, bivariate and multivariate data
2. Build intelligent solutions using fuzzy logic, genetics algorithms and swarm optimization techniques
3. Perform analysis of time series dataset
4. Make use of statistical inference techniques such as t-test, rank sum test for the given dataset

Course Outcomes
After completion of the course, students will be able to

1. Apply exploratory, descriptive, multivariate and inferential statistical analysis on a given dataset
2. Utilize time series analysis on a given time series dataset
3. Make use of fuzzy logic to handle uncertain reasoning
4. Build optimized solution using genetic algorithms and swarm intelligence

Preamble
The large part of Statistics for Machine learning laboratory course conduction is to develop small case studies, mini projects using built in free datasets from Kaggle, data.gov.in, ncbi.nlm.nih.gov, imagenet, etc, analyse and represent the results and data using different tools and technologies. Data will be used i.e. data cleaning/transformation/integration/reduction will be done and that data will be subsequently used to perform advanced statistical operations. Students will be encouraged to publish their findings in the form of research papers. Students will be motivated to explore the existing data set, build the code for/using statistical methods. Assignments could be performed in any language, however at least 2 assignments should be performed in R language.
Faculty members are encouraged to expand problems with variations. Assignments can be framed and expanded in such a way that it explores concepts, logic of solution and real-life applications. Students will be encouraged to solve open problems in different domains. Faculty will appropriately adopt assignments on similar lines as the examples shown here.

Explore and download free data sets (from Indian datasets or from kaggle or other
Sources such as:
1. https://data.gov.in/, https://www.ncbi.nlm.nih.gov/,
2. https://dbie.rbi.org.in/, https://data.uidai.gov.in/, http://mospi.nic.in/,
3. https://bhuvan-app3.nrsc.gov.in/,
4. https://www.india.gov.in/, ttps://surveyofindia.gov.in/,
5. https://www.meteoblue.com/en/weather/archive/export/india_el-salvador_3585481,
6. https://www.icegate.gov.in/,
7. https://www.gbif.org/dataset/9e7ea106-0bf8-4087-bb61-dfe4f29e0f17)
and perform the relevant assignments on the cleaned and integrated dataset.

Suggestive List of Assignments:

1. Descriptive data analysis for univariate data such as medical data.
2. Data analysis of two-dimensional data / multidimensional using correlation and regression etc and predict data value. Data set can be of nutrition, medical, real estate data etc.
3. Choose an application of your interest—such as Natural Language Processing, Face Recognition, or Medical Diagnostics—and apply fuzzy logic techniques along with an appropriate inference method. Perform an analysis of the obtained results..
4. Perform time series analysis on given time series data such as sales, daily temperature, stock data set.
5. Apply data Feature selection, Dimensionality reduction techniques on multivariate data using PCA, Genetic Algorithm. Analyze the results obtained.
6. Apply statistical inference techniques such as t-test, z-test, F-test test on given data such as cars dataset.
7. Select an application of your interest like data clustering, image processing, search engines, social media, etc. Apply statistical analysis along with a suitable intelligent method from swarm intelligence or genetic algorithms. Analyze and interpret the results.

23HAIML601 ADVANCED MACHINE LEARNING

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

Prerequisite: Artificial Intelligence and Machine Learning

Course Objectives
To facilitate the learner to

1. To be familiar with advanced machine learning algorithms
2. To gain advanced knowledge of support vector machines, naive bayes, decision tree algorithms
3. To get exposure to apply reinforcement learning for relevant applications
4. To apply methods of ensemble learning

Course Outcomes
After completion of the course, students will be able to

1. Make use of kernel methods and design support vector machines for given data
2. Solve the given problem using the probabilistic method
3. Experiment with methods of ensemble learning for given data
4. Apply reinforcement learning concepts and algorithms for problem solving

Section I: Kernel Methods

Introduction to Support Vector Machines(SVM), Optimal Hyperplane for Linearly Separable and Nonseparable Patterns, Maximizing margin, Non linear pattern classification, Kernel trick, Design of Support Vector Machines.

Section II: Probabilistic Methods

Introduction to Naive Bayes, Bayes theorem and concept learning, ML for predicting probabilities, Naive Bayes classifier, Types of bayesian classifier, Bayesian belief networks, Expectation Maximization (EM) algorithm, Decision Tree, Entropy, Information gain, Gini Index for information gain.

Section III: Ensemble Learning

Different types of ensemble learning methods, bagging, boosting, stacking, Random Forests, case studies in python.

Section IV: Reinforcement Learning

Introduction, Agents, Environments, States, Actions, Rewards, Policies, Value functions, Q-learning algorithm, Bandit algorithm, Deep Q networks; Value based, Policy based and Model based methods; Reinforcement learning frameworks.

Text Books
1. Peter Flach, "Machine learning",cambridge university press, 6th edition, ISBN 978-1-316-50611-0, 2018
2. Pradhan, U. Dinesh Kumar, "Machine learning using python", Wiley publication, 1st edition, ISBN 978-81-265-7990-7, 2019
3. S. Sridhar, M.Vijayalakshmi, "Machine learning", 1st Edition, Oxford university press, 2021, ISBN 978-0-19-012727-5
4. R. S. Sutton and A. G. Barto,"Reinforcement Learning: An Introduction", MIT press, 2008

Reference Books
1. Ethem Alpaydın,"Introduction to machine learning", MIT press, 3rd edition, ISBN 978-81-203-5078-6, 2014
2. Michael Bowlers, "Machine learning in python", Wiley publication, 1st edition, ISBN 978-81-265-5592-5, 2015
3. Dipanjan Sarkar, Raghav Bali, Tushar Sharma,"Practical Machine Learning with Python": A Problem-Solver's Guide to Building Real-World Intelligent Systems", Apress publication, ISBN: 978-1-4842-3206-4, 2018
4. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", O'Reilly Media, 2nd edition, ISBN 9781492032649, 2019
5. Ivan Gridin, "Practical Deep Reinforcement Learning with Python", bpb Publication, ISBN: 978-93-55512-055, 2022

23HAIML602 DEEP NEURAL NETWORKS

Teaching Scheme	**Examination Scheme**
Lectures: 3 Hours / week	In Semester: 50 Marks
	End Semester: 50 Marks
	Credits: 3

Prerequisite: Machine Learning

Course Objectives
To facilitate the learner to

1. Explain Artificial Neural Networks and Deep Learning Neural Network concepts for problem-solving
2. Illustrate the design and implementation of Artificial Neural Networks and Convolutional Neural Networks for various applications
3. To explore Deep Learning techniques for sequential data using Recurrent Neural Networks (RNNs)
4. Outline the concepts of Generative Adversarial Networks, Autoencoders, and Transformers for real-time applications

Course Outcomes
After completion of the course, students will be able to

1. Make use of Artificial Neural Networks and Deep Neural Networks concepts for problem-solving
2. Model Artificial Neural Networks and Convolutional Neural Networks for varied applications
3. Construct Recurrent Neural Networks for sequential data
4. Utilize Generative Adversarial Networks, Autoencoders, and Transformers concepts for real time applications

Section I: Artificial Neural Network

The Biological Neuron, Artificial Neuron model, Activation Functions, The Perceptron, linear and nonlinear data, MultiClass and Multilayer Feed-Forward Networks, Unsupervised Neural Network: Hopfield Network, Backpropagation Learning, Loss Functions, Confusion Matrix for Categorical Data, Hyperparameters: Learning Rate, Regularization, Momentum, Sparsity, Bias-Variance Trade-Off, Case study: Classification, Regression.

Section II: Convolutional Neural Networks

Deep Learning fundamentals, Deep Learning applications, Convolutional Network Architecture, Data Augmentation, Pretrained Models: LeNet-5 AlexNet, ZFNet, VGG, GoogLeNet, ResNet, Applications of Convolutional Networks: Object Localization, Object Detection, Segmentation, Case study: Classification, Object Detection.

Section III: Sequential data and Recurrent Neural Networks

Word Embeddings and Word2Vec, Recurrent Neural Network (RNN) Architecture, Backpropagation Through Time, The Challenges of Training Recurrent Networks, Long Short-Term Memory (LSTM) Networks, Gated Recurrent Units (GRUs), Attention Mechanisms in RNNs, Applications of Recurrent Neural Networks: Sentence-Level Classification, Sentiment Analysis Case study: Movie Review Sentiment Analysis

Section IV: Advances in Deep Learning

Autoencoders: Basic Principles, Applications of Autoencoder, De-noising Autoencoders, Variational Autoencoders, Transformer Architecture, Deep Reinforcement Learning, Generative Adversarial Networks (GANs), applications of Transformers and GANs

Text Books

1. Charu C. Aggarwal, "Neural Networks and Deep Learning",Springer International Publishing, Second Edition, (2023), ISBN 978-3-319-94462-3 ISBN 978-3-319-94463-0
2. Nikhil Baduma, Nicholas Locascio, "Fundamentals of Deep Learning: Designing Next Generation intelligence Algorithms", O'Reilly Publication, (2017), ISBN 10: 9352135601, ISBN 13: 978- 9352135608,
3. Christopher M. Bishop, Hugh Bishop, "Deep Learning: Foundations and Concepts", Springer, (2024), e-book (free) Deep Learning - Foundations and Concepts

Reference Books

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press Ltd., (2017), ISBN: 9780262035613
2. Shekhar Khandelwal, "Deep Learning for Data Architects", BPB Publication, (2023), ISBN: 9789355515391 eISBN: 9789355515292
3. Josh Patterson and Adam Gibson, "Deep Learning – A Practitioner's Approach", O'Reilly Publication, 1st edition, (2017), ISBN : 9789352136049
4. Valentino Zocca, Gianmario Spacagna, Daniel Slater, Peter Roelants, "Python Deep Learning", Packt Publishing, (2017), ISBN 9781786460660

Online/Web/Other References

1. Dive into Deep Learning Authors: Aston Zhang, Zachary C. Lipton, Mu Li, Alexandr Smola URL: https://d2l.ai
2. Deep Learning (MIT Press) Authors: Ian Goodfellow, Yoshua Bengio, Aaron Courville URL: https://www.deeplearningbook.org
3. The Illustrated Transformer Author: Jay Alammar URL: https://jalammar.github.io/illustrated-transformer/

23HAIML603L ADVANCED MACHINE LEARNING AND DEEP NEURAL NETWORKS LABORATORY

Teaching Scheme
Practical: 2 Hours / week

Examination Scheme
In semester: 25 Marks
End Semester: 25 Marks
Credit: 1

Course Objectives
To facilitate the learner to

1. Illustrate the use of Support vector machine, Naive bayes algorithms on the dataset
2. Demonstrate and implement decision tree algorithm, random forest algorithm of machine learning
3. Apply Ensemble techniques such as bagging, boosting on the given dataset
4. Implement artificial neural networks back propagation algorithm for XOR
5. Implement a small machine learning application and evaluate the performance of the designed machine learning model

Course Outcomes
After completion of the course, students will be able to

1. Apply the Support vector machine, Naive bayes algorithms of supervised machine learning on the dataset
2. Utilize various Ensemble techniques such as bagging, boosting, stacking and random forest on the given dataset
3. Make use of the Neural network based algorithms to learn from linear or non linear data
4. Develop a machine learning and deep learning application using different techniques

Preamble

The large part of Advanced Machine Learning and Deep Learning laboratory course conduction is to develop small case studies, mini projects using built in free datasets from kaggle, data.gov.in, ncbi.nlm.nih.gov, imagenet, etc, analyze and represent the results and data using different tools and technologies. Data will be used in a progressive way i.e. data cleaning/transformation/integration/reduction done in earlier laboratory work of statistics for machine learning will be subsequently used to build ML and DL Model and model comparison/evaluation will also be done. Build models can be utilized in the decision making process through business intelligence. Students will be encouraged to publish their findings in the form of research papers. The large part of the laboratory component will be devoted to implement the advanced concepts of Machine learning and Deep learning along with the real world applications.
Faculty members are encouraged to expand problems with variations and increased complexities.

Department of Computer Engineering

Assignments can be framed and expanded in such a way that it explores concepts, logic of solution and real life applications. Students will be encouraged to solve open problems in different domains. Faculty will appropriately adopt assignments on similar lines as the examples shown here.

Implementation of the following Machine Learning and Deep learning algorithms using Tensorflow and Keras/R/python library on previously cleaned and integrated dataset and also evaluate the performance of the implemented ML Model.

Reference Data sets which can be used are (from Indian datasets or from kaggle or other sources

1. https://data.gov.in/, https://www.ncbi.nlm.nih.gov/, https://dbie.rbi.org.in/
2. https://data.uidai.gov.in/
3. http://mospi.nic.in/
4. https://bhuvan-app3.nrsc.gov.in/
5. https://www.india.gov.in/
6. https://surveyofindia.gov.in/
7. https://www.meteoblue.com/en/weather/archive/export/india_el-salvador_3585481
8. https://www.icegate.gov.in/
9. https://www.gbif.org/dataset/9e7ea106-0bf8-4087-bb61-dfe4f29e0f17)
10. https://ai.stanford.edu/~amaas/data/sentiment/
11. Amazon Reviews for Sentiment Analysis

Suggestive List of Assignments

1. Support vector machine for data classification using IRIS or breast cancer dataset as example.
2. Naive Bayes algorithm such as gaussian naive bayes, bernoulli naive bayes, multinomial naive bayes etc using Purchase/shopping data set as example.
3. Random Forest algorithm using IRIS data set as example.
4. Ensemble techniques such as bagging, boosting and stacking on breast cancer dataset as example.
5. Apply backpropagation in a single perceptron and multi-layer perceptron for binary linearly separable and non-linearly separable datasets (e.g., logic gates, Iris dataset). Compare the accuracy using the Confusion matrix.
6. Develop a Convolutional Neural Network (CNN) for image classification using MNIST, CIFAR-10, or Fashion-MNIST, and compare its performance with a pretrained CNN.
7. Construct a simple RNN for sentiment analysis and analyze its performance in comparison to LSTM/GRU models. (e.g. IMDb Reviews Dataset/Sentiment140 on Kaggle)
8. Design Auto Encoder model for applications like Image Denoising: (e.g. MNIST/image reconstruction/ anomaly detection)
9. Develop a mini project using advanced Machine learning and deep learning techniques for readily available dataset. Evaluate and compare results of your ML and DL models.