KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY

Deemed to be University
BHUBANESWAR-751024

School of Computer Engineering

LESSON PLAN

Course Title: Machine Learning (CS 31002)
6th Semester B. Tech.
Session: Spring 2025: December 2024 to May 2025

L	T	P	Total	Credit
3	1	0	4	4

Faculty

Dr. Satyananda Champati Rai
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Available Time: 8:00 AM – 10:00 AM (Tuesday and Saturday)

Course Objectives

1. To provide a broad survey of different machine-learning approaches and techniques
2. To understand the principles and concepts of machine learning
3. To learn regression and classification models
4. To learn different clustering models
5. To understand artificial neural networks (ANN) and Convolutional Neural Networks (CNN) concepts
6. To develop programming skills that help to build real-world applications based on machine learning

Course Outcomes

Upon completion of the course, the students will be able to:

CO1: Solve typical machine learning problems

CO2: Compare and contrast different data representations to

facilitate learning

CO3: Apply the concept of regression methods, classification methods, and clustering methods.

CO4: Suggest supervised /unsupervised machine learning approaches for any application

CO5: Implement algorithms using machine learning tools

CO6: Design and implement various machine learning algorithms in a range of real-world applications.

Detailed Lesson Plan

Total No. of Lectures ≈ 48

No. of classes before Mid-semester ≈ 24

No. of Classes after Mid-semester ≈ 24

Module 1

Lecture	Topics
1	Introduction to Machine Learning, definition, and real-world applications.
2	Type of machine learning - Supervised, Unsupervised, Semi-supervised learning, Definitions and examples.
3	Regression - Linear Regression, Intuition, Cost Function
4	Linear Regression - Gradient Descent
5	Multiple Linear regression
6	Closed-form Equation, Type of Gradient Descent (Batch, Stochastic, Mini-batch) - Definition, properties.
7	Normalization and Standardization (definition and why), Overfitting and Underfitting
8	Bias, Variance, Bias and Variance tradeoff

9	Regularization - LASSO Regularization, Ridge Regularization
10	**Activity – 1**

Module 2

Lecture	**Topics**
11	Classification, Logistic Regression - 1 (binary)
12	Logistic Regression - 2 (binary)
13	Nearest neighbor and K Nearest Neighbor
14	Error Analysis - Train/Test Split, validation set, Accuracy, Precision, Recall, F-measure, ROC curve, Confusion Matrix
15	Naive Bayes Classifier - 1
16	Naïve Bayes Classifier - 2
17	Decision Tree Introduction, Id3 Algorithm - 1
18	Decision Tree - Id3 Algorithm - 2
19	Decision Tree - Problem of Overfitting, Pre-pruning/post-pruning Decision Tree, Examples.
20	Support Vector Machine - Terminologies, Intuition, Learning, Derivation - 1
21	Support Vector Machine - Terminologies, Intuition, Learning, Derivation - 2
22	Support Vector Machine - KKT Condition
23	Support Vector Machine - Kernel, Nonlinear Classification, and multi-class (Basic concept)
24	**Activity-2**

Mid Semester

25	Principal Component Analysis - Steps, merits, demerits, Intuition - 1
26	Principal Component Analysis - Steps, merits, demerits, Intuition – 2
27	Understanding and Implementing PCA using SVD for dimensionality reduction.

Module 3

Lecture	**Topics**
28	Clustering: Introduction, K-means Clustering - 1
29	K-median Clustering-2
30	K-means Clustering – 3 (Problem-solving)
31	DBSCAN Clustering - Why we use?, parameters, characterization of points, steps, determining parameters, time/space complexities
32	Mean Shift Clustering
33	Hierarchical Clustering - Agglomerative Clustering, Single/Complete/Average/Centroid Linkage
34	Hierarchical Clustering - Divisive hierarchical clustering
35	**ACTIVITY - 3**

Module 4

Lecture	**Topics**
36	Introduction Neural networks, McCulloch-Pitts Neuron
37	Least Mean Square (LMS) Algorithm
38	Perceptron Model
39	Multilayer Perceptron (MLP) and Hidden layer representation
40	Non-linear problem solving, Activation Functions

41	Backpropagation Algorithm - 1
42	Backpropagation Algorithm - 2
43	Exploding Gradient Problem and Vanishing Gradient Problem, why and how to avoid.
44	Introduction to Convolutional Neural Network (CNN)
45	Basic idea about their working and structure
46	Data Augmentation, Batch Normalization, Dropout
47	**ACTIVITY - 4**

Module 5

Lecture	Topics
48	Introduce machine learning tools like Scikit Learn, PyTorch, TensorFlow, Kaggle competitions, etc.
	Case Study (Any Two)
Case Study – 1: Classification using Iris Dataset **Case Study – 2: Feature Extraction using PCA for Wine Dataset** **Case Study – 3: Implement linear regression to predict house prices based on features like size, location, and number of rooms.** **Case Study – 4: Clustering using Iris Dataset** **Case Study – 5: Classification of MNIST Dataset using CNN Model**	

Activities

Task	Marks
Before Mid-semester	
Quiz	5
Assignment / Coding Assignment	10
After Mid-semester	
Quiz	5
Assignment / Coding Assignment	10

Textbooks:

1. Madan Gopal, “Applied Machine Learning”, TMH Publication
2. Kevin P. Murphy, “Probabilistic Machine Learning”, MIT Press, 2023.
3. Ethem Alpaydin, “Introduction to Machine Learning”, Fourth Edition, MIT Press, 2010.

Reference Books:

1. Laurene Fausett, “Fundamentals of Neural Networks, Architectures, Algorithms and Applications”, PearsonEducation, 2008.
2. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2007.
3. Simon Haykin, “Neural Networks and Learning Machines”, Pearson 2008.
4. An Introduction to Statistical Learning with Applications in Python – Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, Springer.