Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-7 (B.Tech)

Subject: Machine Learning - BETCE17335

Type of course: Professional Core

Prerequisite: Mathematics: Strong foundation in Linear Algebra, Calculus, and Probability/Statistics. Programming: Proficiency in Python, particularly libraries like NumPy and Pandas. Data Handling: Prior knowledge of database management concepts.

Rationale:
Machine Learning is a transformative field that enables computers to learn from data and make predictions or decisions without explicit programming. This course provides a comprehensive introduction to both classical and modern machine learning techniques. Students will gain the theoretical understanding and practical skills necessary to design, implement, and evaluate models for diverse applications such as image recognition, natural language processing, and predictive analytics.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
CI	T	P	C	Theory Marks		Practical Marks		CA	
				ESE	MSE	V	P	ALA	
4	0	2	5	60	30	10	20	30	150

Legends: CI-ClassRoom Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

Course Content:

Sr. No	Course Content	Hrs.	% Weightage
1	**Introduction to Machine Learning** What is Machine Learning, Types of Learning - Supervised Learning, Unsupervised Learning, Reinforcement Learning, Applications of ML (Healthcare, Finance, IoT, etc.), ML vs Traditional Programming, Data preprocessing: Cleaning, Handling missing values, Normalization.	06	10%

2	**Probability and Statistics Foundation in ML** Overview of Probability: Statistical tools in Machine Learning, Concepts of probability, Random variables, Discrete distributions, Continuous distributions, Multiple random variables, Central limit theorem, Sampling distributions, Hypothesis space and inductive bias, Evaluation and Cross Validation, Hypothesis testing, Monte Carlo Approximation.	15	25%
3	**Supervised Learning and Unsupervised Learning** Regression: Linear Regression, Multiple Regression, Classification: SVM, Decision Trees, K-Nearest Neighbors (KNN), Naive Bayes, Model evaluation: Accuracy, Precision, Recall, F1-score Overfitting and Underfitting, Clustering: K-Means Clustering, Hierarchical Clustering Dimensionality Reduction: PCA (Principal Component Analysis) Association Rule Learning: Apriori Algorithm.	15	25%
4	**Neural Networks & Deep Learning** Basics of Neural Networks, Perceptron Model, Activation Functions (ReLU, Sigmoid, Tanh) Introduction to Deep Learning, Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Introduction to LSTM.	15	25%
5	**Practical Machine Learning ML** Tools & libraries: Python, NumPy, Pandas, Scikit-learn, Model building steps: Data collection, Training, Testing Case studies.	09	15%

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	**Algorithm Comparison Study:** Students will compare the performance of three different classifiers (e.g., SVM, Decision Tree, Random Forest) on a standard dataset (like Iris or Titanic) and submit a comparative analysis report on the GMIU Web Portal.	10
2	**End-to-End ML Pipeline Project:** Students will select a real-world dataset, perform data cleaning, feature engineering, model training, and evaluation. The documented notebook and final report must be uploaded to the portal.	10
3	**Real-world Case Study:** Students will analyze a case study where ML is applied in industry (e.g., Netflix recommendation or fraud detection) and present the architectural challenges and solutions.	10
	Total	30

Suggested Specification table with Marks (Theory): 60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	**Remembrance (R)**	**Understanding (U)**	**Application (A)**	**Analyze (N)**	**Evaluate (E)**	**Create (C)**
Weightage %	30%	30%	10%	10%	10%	10%

Course Outcome:

After learning the course, the students should be able to:	
CO1	Differentiate learning paradigms and choose suitable algorithms for data problems.
CO2	Implement and optimize linear and logistic regression models using gradient descent.
CO3	Apply ensemble methods and tree-based models to improve prediction accuracy.
CO4	Execute unsupervised learning techniques for data clustering and feature reduction
CO5	Design and train basic neural network architectures for classification tasks.

List of Practical

Sr. No	Description	Unit No	Hrs.
1	Introduction to Python libraries for ML: NumPy, Pandas, Matplotlib, and Scikit-Learn.	01	04
2	Data cleaning and preprocessing include handling of missing values, duplicates, outliers, normalization, and standardization of datasets.	01	02
3	Implement Simple Linear Regression to predict housing prices using a given dataset.	02	02
4	Applying statistical methods including hypothesis testing, ANOVA, and regression (linear and logistic) for data-driven insights.	02	02
5	Perform Data Preprocessing: Handling missing values, encoding categorical data, and feature scaling.	02	02
6	Implement Multiple/Logistic Regression for binary classification and visualize the decision boundary. (e.g. Stock Market, Banking, Voting)	02	04
7	Build a Decision Tree classifier and visualize the resulting tree structure.	03	02
8	Compare the accuracy of Naive Bayes and K-Nearest Neighbors (KNN) on a text classification task.	03	02
9	Apply K-Means Clustering to group customers based on purchasing behavior. Implement Principal Component Analysis (PCA) for dimensionality reduction on a high-dimensional dataset.	04	04
10	Develop a basic CNN, RNN for digit recognition using the MNIST dataset.	04	04
11	Develop a complete predictive model for a chosen domain healthcare using ensemble techniques.	05	02
12	Develop a complete predictive model for a chosen domain finance using ensemble techniques.	05	02
		Total	30

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Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory.

The internal evaluation will be done on the basis of Active Learning Assignment.

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Reference Books:

[1] Aurélien Géron – Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow – O'Reilly Media.
[2] Tom Mitchell – Machine Learning – McGraw Hill.
[3] Christopher Bishop – Pattern Recognition and Machine Learning – Springer.
[4] Jason Brownlee – Machine Learning Mastery with Python – Machine Learning Mastery.