|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | | | **Name of the Subject** | | | | | | | | **L** | **T** | **P** | **C** |  |
| **BPCCS4020** | | | **Introduction to Machine Learning** | | | | | | | | **4** | **0** | **1** | **4** |  |
| **Course Educational Objectives** | | | | | | | | | | | | | | | |
| **CEO1** | To introduce students to the fundamental concepts and methodologies of machine learning, enabling them to identify and differentiate between various learning paradigms and their applications. | | | | | | | | | | | | | | |
| **CEO2** | To develop students’ ability to design and implement supervised learning algorithms, focusing on regression, classification, and regularization techniques for real-world datasets. | | | | | | | | | | | | | | |
| **CEO3** | To explore unsupervised learning techniques and dimensionality reduction methods for handling large-scale data, focusing on clustering algorithms, principal component analysis (PCA), and kernel-based approaches. | | | | | | | | | | | | | | |
| **CEO4** | To enhance students’ understanding of decision-making algorithms and optimization techniques, including Decision Trees and Support Vector Machines (SVM). | | | | | | | | | | | | | | |
| **CEO5** | To build expertise in ensemble learning techniques like bagging, boosting, and Random Forests, ensuring robust and scalable machine learning model development. | | | | | | | | | | | | | | |
| **CEO6** | To equip students with the knowledge and practical skills needed to evaluate and optimize machine learning models using advanced performance metrics, cross-validation techniques, and visualization tools. | | | | | | | | | | | | | | |
| **Course Outcomes: : *Upon successful completion of this course, students should be able to:*** | | | | | | | | | | | | | | | |
| **CO1** | Comprehend the importance of types of learnings in model development | | | | | | | | | | | | | | |
| **CO2** | Apply machine learning libraries and frameworks to build and implement regression and classification models. | | | | | | | | | | | | | | |
| **CO3** | Design and optimize advanced machine learning models, such as Decision Trees and Support Vector Machines, for diverse problem domains. | | | | | | | | | | | | | | |
| **CO4** | Analyze and apply unsupervised learning methods, such as clustering algorithms and dimensionality reduction techniques, to organize and interpret data. | | | | | | | | | | | | | | |
| **CO5** | Develop robust machine learning solutions using ensemble techniques, such as bagging, boosting, and Random Forests, for complex applications. | | | | | | | | | | | | | | |
| **CO6** | Integrate machine learning techniques into end-to-end workflows for addressing domain-specific challenges with practical, scalable solutions. | | | | | | | | | | | | | | |
| **CO-PO & PSO Mapping** | | | | | | | | | | | | | | | |
| **COs** | **PROGRAMME OUTCOMES** | | | | | | | | | | | | **PSOs** | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **CO1** | 3 | 3 |  |  |  |  |  |  |  |  |  |  | 3 | 3 |  |
| **CO2** | 3 |  | 3 | 2 | 3 |  |  |  |  |  |  |  | 3 | 3 |  |
| **CO3** | 3 | 3 |  | 3 | 3 |  |  |  |  |  |  |  | 3 | 3 |  |
| **CO4** | 2 |  | 3 |  | 3 |  |  |  |  |  |  |  | 3 | 3 |  |
| **CO5** |  |  |  | 3 |  |  |  |  |  |  |  |  | 3 | 3 |  |
| **CO6** |  | 3 |  |  |  |  |  |  |  |  |  |  | 3 | 3 |  |
| **SYLLABUS** | | | | | | | | | | | | | | | |
| **UNIT:1 (10 Hours)**  **Introduction:** Overview of machine Learning, Related Areas and applications,Foundations of Learning: Components of learning, learning vs design, Types of learning Models: supervised, unsupervised, reinforcement, Semi-supervised. Steps of ML , Training vs Testing.  **Theory of generalization**: generalization bound, overfitting, underfitting, bias and variance, learning curve. | | | | | | | | | | | | | | | |
| **UNIT:2 (12 Hours)**  **Supervised Learning**:Introduction to Regression: Regression Vs Classification, Linear regression,Regularization(L1,L2,Elastic-Net),single and multivariate regression; Metrics for assessing regression (Mean Squared Error, Root Mean Squared Error, Mean Absolute Error,R -Squared,Adjusted R-Squared), Logistic Regression, K-Nearest Neighbors,Multi-Colinearity, Naïve Bayes Classifiers.  **Classification Performance Measures**: Confusion Matrix, Accuracy Metrics,Precision,Recall,F1-score,Receiver Operator Characteristic (ROC) Curve, Case study on various classification applications | | | | | | | | | | | | | | | |
| **UNIT:3** . **(12 Hours)**  **Decision Trees**: Introduction to Decision Trees, Algorithm for Decision Tree Construction: ID3, C4.5, CART, Truncation and Pruning  **Support Vector Machine**: Linear SVM Classification, Nonlinear SVM Classification,SVM Regression,Cross Validation | | | | | | | | | | | | | | | |
| **UNIT:4 (11 Hours)**  **Unsupervised Learning** : Introduction to clustering, K-means clustering, Clustering around medoids,Hierarchical Clustering, Silhouettes, K-d Trees, Case study on various clustering applications.  **Dimensionality Reduction**: The Curse of Dimensionality, Main Approaches forDimensionality Reduction, PCA, Using Scikit-Learn, Randomized PCA, Kernel PCA. | | | | | | | | | | | | | | | |
| **UNIT: 5** **(9 Hours)**  **Ensemble Methods** :Introduction to Ensemble methods, Bagging, Committee Machines and Stacking,Boosting - Gradient Boosting, Adaptive Boosting, Random Forests-Multi-class Classification. | | | | | | | | | | | | | | | |
| **Teaching Methods: Chalk& Board/ PPT/Video Lectures** | | | | | | | | | | | | | | | |
| **Text Books:**  *1.Stephen Marsland, “Machine Learning - An Algorithmic Perspective” 2nd Edition, CRC Press, 2015*  *2. EthemAlpaydin, "Introduction to Machine Learning", 3rd Edition, MIT Press, 2014* | | | | | | | | | | | | | | | |
| **Reference Books:**  *1. Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, “Learning from Data”, AMLBook Publishers, 2012.*  *2.P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge University Press, 2012* | | | | | | | | | | | | | | | |