Department of Electronics and Communication Engineering

Details of Lesson Plan

S. No.	Particulars	Details
1.	Course Name	Introduction to AI with Machine Learning
2.	Course Code	ECE-702A
3.	Academic Year	2024-25
4.	Semester	7th
5.	Number of Lesson plans	44
6.	Faculty Assigned	Gurpreet Kour

Faculty Signature

Lesson Plan No. 1	Course Name: Introduction to AI with Machine Learning Topic: Introduction to AI	Course No.: ECE-702A

Objectives	At the end of the lesson the student shall be able to: a. Get a brief view of the topics to be covered in the course. b. articulate the concept of AI c. recognize the key milestones in AI.
Teaching Aids (if any)	a. Power point presentation b. Video on historical AI milestone
Teaching Development	1. **Introduction** (5 minutes) Ask questions - What do you know about AI? - What is the influence of AI on our daily life? - What are the ethics associated with AI? **Introduction of the curriculum:** - Talk about the structure of the syllabus. - Rubrics of the course - Guidelines to be followed. 2. **Development** (30 minutes) a. Early History - Discuss Alan Turing's contributions, including the Turing Test. - Explain the Dartmouth Conference and its significance as the birth of AI. b. The First AI Winter - Describe the period of reduced funding and interest in AI research in the 1970s. - Discuss the reasons behind this decline. c. Expert Systems and Revival - Explain the development of expert systems in the 1980s. - Discuss how these systems led to renewed interest and funding in AI. d. The Second AI Winter - Describe the decline in AI interest in the late 1980s and early 1990s. - Discuss the limitations of expert systems that led to this second decline. e. Modern AI and Machine Learning - Highlight the resurgence of AI in the late 1990s and 2000s with

	the advent of machine learning. - Discuss recent advancements such as deep learning and AI applications in various fields **3. Exercise (5 minutes)** Activity: Summarization.
Closure	1. Summarize the key milestones discussed. 2. Suggested reading: "AI: A Very Short Introduction" by Margaret A. Boden. Homework. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions: What are the key milestones in AI history? 2. Allow students to answer and discuss. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 2	**Course Name: Introduction to AI with Machine Learning** **Topic: Introduction to AI**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. articulate the concept of AI b. identify different types of AI.
Teaching Aids (if any)	a. Power point presentation b. Examples of AI applications
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What is AI? Can you name any AI applications? - What are the ethics associated with AI? Brief overview of AI basics: - Structure - Types **2. Development** (30 minutes) a. Definitions and Types of AI - Define AI and its goals. - Differentiate between Narrow AI, General AI, and Superintelligent AI. b. Narrow AI Applications (5 minutes) - Discuss real-world applications of Narrow AI such as virtual assistants (e.g., Siri, Alexa), recommendation

	systems (e.g., Netflix, Amazon), and image recognition (e.g., Google Photos). c. General AI and Its Challenges (5 minutes) - Explain the concept of General AI and its goal to perform any intellectual task that a human can do. - Discuss the current state of research and the challenges in achieving General AI. d. Superintelligent AI (5 minutes) - Introduce the concept of Superintelligent AI and its potential implications. - Discuss ethical considerations and the importance of ensuring safe AI development. **3. Exercise (5 minutes)** AI Impact on Society Give different numerical problems on the covered content. - Discuss the potential benefits of AI, such as increased efficiency and new capabilities. - Address the potential risks and challenges, including job displacement and ethical concerns.
Closure	1. Summarize the types of AI and their applications. 2. Suggested reading: "Artificial Intelligence: A Guide for Thinking Humans" by Melanie Mitchell. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: What are the different types of AI? • Encourage students to share examples of AI they encounter daily. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 3	Course Name: Introduction to AI with Machine Learning Topic: Introduction to AI	Course No.: ECE-702A

Objectives	At the end of the lesson the student shall be able to: a. articulate the terminology of artificial neural network (ANN)
Teaching Aids (if any)	a. Power point presentation b. Visual aids showing neural network components
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What is a neural network? Have you heard of ANN? Brief overview of ANN terminology: - Structure - Topologies **2. Development** (30 minutes) a. Basic Terms - Define neuron, synapse, weight, bias, and activation function. - Use visual aids to show the structure of a neuron and how these components interact. b. Information Flow - Explain how information flows through a neural network. - Discuss the concept of forward propagation. c. Activation Functions - Introduce common activation functions such as sigmoid, tanh, and ReLU. - Explain their roles in introducing non-linearity to the network. d. Network Architectures - Discuss different types of neural network architectures (e.g., feedforward, recurrent, convolutional). - Provide examples of where each type of network might be used. e. Training Neural Networks - Briefly introduce the concept of training neural networks using backpropagation and gradient descent. - Discuss the importance of weights and biases in learning. **3. Exercise (5 minutes)** Practice questions using activation functions
Closure	1. Summarize the key terms and their roles in ANN.

	2. Suggested reading: "Neural Networks and Deep Learning" by Michael Nielsen. Mitchell. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: What are the key components of an ANN? • Allow students to identify and describe ANN components. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 4	**Course Name: Introduction to AI with Machine Learning** **Topic: Model of a neuron**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. explain the model of a neuron.
Teaching Aids (if any)	a. Power point presentation b. Diagrams of neuron models
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What do you know about biological neurons? Brief overview of neuron models: - Structure **2.Development** (30 minutes) b. Biological Inspiration - Describe the structure and function of biological neurons. - Explain how biological neurons communicate through synapses. c. Artificial Neuron Model - Introduce the mathematical model of an artificial neuron. - Discuss the components: inputs, weights, bias, and activation function. d. Activation Functions - Explain the role of activation functions in artificial neurons. - Compare different activation functions and their use cases. e. Comparison with Biological Neurons - Highlight the similarities and differences between biological and artificial neurons. - Discuss the advantages and limitations of using artificial

	neurons in AI. **3. Exercise (5 minutes)** Practice questions using neuron model
Closure	1. Summarize the model of a neuron. 2. Suggested Reading: "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How does an artificial neuron model work? • Encourage students to compare biological and artificial neurons. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 5	**Course Name: Introduction to AI with Machine Learning** **Topic: Perceptron model**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. outline the perceptron model.
Teaching Aids (if any)	a. Power point presentation b. Examples of Perceptron models
Teaching Development	**1. Introduction** (5 minutes) Ask questions - Have you heard of the Perceptron model? Brief overview of Perceptron model: - Structure **2. Development** (30 minutes) a. Perceptron Structure - Explain the structure of a single-layer Perceptron. - Describe the components: input features, weights, bias, and activation function. b. Mathematical Formulation - Present the mathematical equation for the Perceptron. - Discuss how the weighted sum of inputs and bias is passed through the activation function to produce an output. c. Learning Algorithm - Explain the Perceptron learning algorithm. - Discuss how the weights and bias are updated based on the

	error. d. Applications and Limitations - Provide examples of problems that can be solved using the Perceptron. - Discuss the limitations of the Perceptron, such as its inability to solve non-linearly separable problems. **3. Exercise (5 minutes)** Practice questions using neuron model
Closure	a. Summarize the Perceptron model and its importance. b. Suggested Reading: "Pattern Recognition and Machine Learning" by Christopher M. Bishop. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: What is the Perceptron model used for? • Allow students to describe the Perceptron model in their own words. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 6	**Course Name: Introduction to AI with Machine Learning** **Topic: Feature Set (AI)**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. explains the concept of feature set.
Teaching Aids (if any)	a. Power point presentation b. Examples of feature sets.
Teaching Development	**1. Introduction** (5 minutes) Ask questions - Have you heard of the Perceptron model? Brief overview of Perceptron model: - Structure **2. Development** (30 minutes) a. Definition and Importance - Define what a feature set is in machine learning. - Discuss the role of features in building predictive models. b. Types of Features - Explain different types of features: categorical, numerical, and derived. - Provide examples of each type of feature. c. Feature Engineering

	- Discuss the process of feature engineering. - Explain techniques such as normalization, encoding categorical variables, and creating new features from existing ones. d. Feature Selection - Introduce methods for feature selection, such as filter, wrapper, and embedded methods. - Discuss the importance of selecting relevant features to improve model performance. **3. Exercise (5 minutes)** Activity: Visible Quiz
Closure	a. Summarize the importance of feature sets in machine learning. b. Suggested Reading: "Feature Engineering for Machine Learning" by Alice Zheng and Amanda Casari. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: Why are feature sets important? • Encourage students to create their own feature sets for a given problem. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 7	**Course Name: Introduction to AI with Machine Learning** **Topic: Data division (AI)**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Explains the concept of dataset division.
Teaching Aids (if any)	a. Power point presentation b. Examples of dataset division strategies.
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What is a dataset? How would you divide it? Brief overview of dataset division **2. Development** (30 minutes) a. Importance of Dataset Division - Explain why it is crucial to divide datasets into training, validation, and test sets. - Discuss the role of each subset in the model development process. b. Common Division Strategies

	- Introduce common strategies for dataset division, such as random split, stratified split, and k-fold cross-validation. - Provide examples of when to use each strategy. c. Practical Exercises - Present a sample dataset and guide students through the process of dividing it using different strategies. - Discuss the potential issues that can arise from improper dataset division. d. Best Practices - Highlight best practices for dataset division to ensure model generalizability. - Discuss the importance of maintaining a separate test set for unbiased evaluation. **3. Exercise (5 minutes)** Activity: Summarization (2 students)
Closure	a. Summarize the importance of proper dataset division. b. Suggested Reading: "Data Science for Business" by Foster Provost and Tom Fawcett. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How would you divide a dataset for a given problem? • Allow students to practice dividing datasets. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 8	**Course Name: Introduction to AI with Machine Learning** **Topic: Introduction to Machine Learning**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. acquaints to machine learning techniques and their applications.
Teaching Aids (if any)	a. Power point presentation b. Examples of machine learning applications
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What do you know about machine learning? Brief overview of machine learning techniques using PPT.

	2. Development (30 minutes) a. Supervised Learning - Define supervised learning and its goals. - Discuss common algorithms like linear regression, decision trees, and support vector machines. - Provide examples of applications, such as spam detection and image classification. b. Unsupervised Learning - Define unsupervised learning and its goals. - Discuss common algorithms like k-means clustering, hierarchical clustering, and principal component analysis. - Provide examples of applications, such as customer segmentation and anomaly detection. c. Reinforcement Learning - Define reinforcement learning and its goals. - Discuss the concept of agents, rewards, and environments. - Provide examples of applications, such as game playing (e.g., AlphaGo) and robotics. d. Strengths and Limitations - Discuss the strengths and limitations of each machine learning technique. - Highlight the importance of choosing the right technique for the problem at hand. **3. Exercise (5 minutes)** Activity: Summarization (2 students)
Closure	a. Summarize the machine learning techniques and their applications. b. Suggested Reading: "Machine Learning Yearning" by Andrew Ng. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: Can you provide examples of each type of machine learning? • Encourage students to identify real-world applications of machine learning techniques. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 9	Course Name: Introduction to AI with Machine Learning Topic: Bias- variance trade-off	Course No.: ECE-702A

Objectives	At the end of the lesson the student shall be able to: a. Outline the bias-variance trade-off.
Teaching Aids (if any)	a. Power point presentation b. Visual aids explaining the trade-off
Teaching Development	**1. Introduction** (5 minutes) Ask questions - Have you heard of bias and variance in the context of models? Brief overview of the bias-variance trade-off using PPT. **2. Development** (30 minutes) a. Definition of Bias and Variance - Define bias and variance in the context of machine learning models. - Explain how high bias leads to underfitting and high variance leads to overfitting. b. Impact on Model Performance - Discuss the impact of bias and variance on model performance. - Use visual aids to show examples of high bias and high variance models. c. Trade-off Concept - Explain the bias-variance trade-off and the need to balance both for optimal model performance. - Discuss how the trade-off affects the choice of model complexity. d. Strategies to Manage Trade-off - Introduce strategies to manage the bias-variance trade-off, such as cross-validation and regularization. - Provide practical tips for balancing bias and variance in model development. **3. Exercise (5 minutes)** Activity: Summarization (2 students)
Closure	a. Summarize the bias-variance trade-off. b. Suggested Reading: "The Elements of Statistical Learning" by Trevor Hastie, Robert Tibshirani, and Jerome Friedman. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: What is the bias-variance trade-off? • Allow students to explain the trade-off in their own words. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 10	Course Name: Introduction to AI with Machine Learning Topic: Overfitting and Underfitting	Course No.: ECE-702A

Objectives	At the end of the lesson the student shall be able to: a. justify the concepts of overfitting and underfitting.
Teaching Aids (if any)	a. Power point presentation b. Examples of overfitting and underfitting
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What do you think overfitting and underfitting mean? Brief overview of overfitting and underfitting using PPT. **2. Development** (30 minutes) a. Definition of Bias and Variance - Define bias and variance in the context of machine learning models. - Explain how high bias leads to underfitting and high variance leads to overfitting. b. Definition of Overfitting and Underfitting (10 minutes) - Define overfitting and underfitting in the context of machine learning models. - Use visual aids to show examples of overfitted and underfitted models. c. Causes and Consequences (10 minutes) - Discuss the causes of overfitting, such as too much model complexity or noise in the data. - Explain the consequences of overfitting, including poor generalization to new data. - Discuss the causes of underfitting, such as too simple models or insufficient data. - Explain the consequences of underfitting, including poor performance on training data. d. Detection and Prevention (10 minutes) - Introduce methods for detecting overfitting and underfitting, such as using learning curves and validation performance. - Discuss strategies to prevent overfitting, such as using more data, simplifying the model, and regularization techniques. - Discuss strategies to prevent underfitting, such as

	increasing model complexity or feature engineering. **3. Exercise (5 minutes)** Activity: Quiz
Closure	a. Summarize the concepts of overfitting and underfitting. b. Suggested Reading: "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How can you prevent overfitting and underfitting? • Encourage students to identify examples of overfitting and underfitting in their own work. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 11	**Course Name: Introduction to AI with Machine Learning** **Topic: Supervised Learning: Classification and Regression**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Explain the concepts of classification and regression in supervised learning. b. Differentiate between classification and regression tasks.
Teaching Aids (if any)	a. Power point presentation b. Examples of classification and regression tasks
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What do you know about supervised learning? Brief overview of supervised learning, classification, and regression using PPT. **2. Development** (30 minutes) a. Definitions and Goals - Define supervised learning and its goal of predicting outcomes based on input data. - Differentiate between classification (predicting categorical outcomes) and regression (predicting continuous outcomes). b. Examples of Classification Tasks - Discuss examples of classification tasks, such as email

	spam detection, image recognition, and disease diagnosis. - Explain how classification models assign class labels to new data points. c. Examples of Regression Tasks - Discuss examples of regression tasks, such as predicting house prices, stock market trends, and weather forecasts. - Explain how regression models predict continuous values for new data points. **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the key differences between classification and regression tasks. b. Suggested Reading: "Pattern Recognition and Machine Learning" by Christopher M. Bishop. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: Can you provide an example of a classification and a regression task? • Encourage students to identify tasks in their field that could be classified as either classification or regression. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 12	**Course Name: Introduction to AI with Machine Learning** **Topic: K-Nearest Neighbors (KNN)**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Construct the K-Nearest Neighbours (KNN) algorithm. b. Apply KNN for classification and regression tasks.
Teaching Aids (if any)	a. Power point presentation b. Visual aids for KNN c. Examples of KNN applications
Teaching Development	**1. Introduction** (5 minutes) Ask questions - Have you heard of the K-Nearest Neighbors algorithm? Brief overview of KNN **2. Development** (30 minutes) a. Definition and Intuition - Explain the KNN algorithm and how it classifies or predicts

	the outcome based on the K nearest neighbors in the training data. - Use visual aids to illustrate the concept of neighbors in a feature space. b. Algorithm Steps - Describe the steps involved in the KNN algorithm: calculating the distance between points, selecting the K nearest neighbors, and making a prediction based on majority vote (for classification) or average (for regression). - Discuss different distance metrics such as Euclidean, Manhattan, and Minkowski distances. c. Choosing K - Explain the impact of the value of K on the performance of the KNN algorithm. - Discuss strategies for choosing an optimal K value using techniques like cross-validation. d. Applications and Limitations - Provide examples of KNN applications in fields such as finance, healthcare, and image recognition. - Discuss the limitations of KNN, including computational inefficiency with large datasets and sensitivity to irrelevant features. **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the KNN algorithm and its applications. b. Suggested Reading: "Introduction to Machine Learning with Python" by Andreas C. Müller and Sarah Guido. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How does the KNN algorithm work? • Encourage students to apply KNN to a sample dataset. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 13	Course Name: Introduction to AI with Machine Learning Topic: **Linear Regression**	Course No.: ECE-702A

Objectives	At the end of the lesson the student shall be able to: a. Explain the linear regression algorithm. b. Apply linear regression to predict continuous outcomes
Teaching Aids (if any)	a. Power point presentation b. Examples of linear regression applications
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What do you know about linear regression? Brief overview of linear regression using PPT. **2. Development** (30 minutes) a. Definition and Intuition - Explain linear regression as a method to model the relationship between a dependent variable and one or more independent variables. - Use a scatter plot to illustrate the concept of fitting a line to data points. b. Mathematical Formulation - Present the mathematical equation of linear regression: - Explain the meaning of the coefficients c. Least Squares Method - Introduce the least squares method to estimate the coefficients by minimizing the sum of squared errors. - Discuss how this method finds the best-fitting line for the data. d. Applications and Limitations - Provide examples of linear regression applications, such as predicting house prices, sales forecasting, and economic trends. - Discuss the limitations of linear regression, including its sensitivity to outliers and the assumption of a linear relationship. **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the linear regression algorithm and its applications. b. Suggested Reading: "An Introduction to Statistical Learning" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani. Spend 5 minutes to wrap up and consolidate the learnings

Evaluation	• Reflective Questions: How does linear regression model the relationship between variables? • Encourage students to apply linear regression to a sample dataset. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 14	**Course Name: Introduction to AI with Machine Learning** **Topic: Logistic Regression**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Justify the logistic regression algorithm. b. Apply logistic regression for binary classification tasks.
Teaching Aids (if any)	a. Power point presentation b. Examples of logistic regression applications
Teaching Development	**1. Introduction** (5 minutes) Ask questions - Have you heard of logistic regression? Brief overview of logistic regression using PPT. **2. Development** (30 minutes) a. Definition and Intuition - Explain logistic regression as a method for binary classification. - Use a graph to illustrate the logistic function (sigmoid curve) that maps input features to a probability. b. Mathematical Formulation - Present the logistic regression equation - Explain the meaning of the coefficients and the logistic function. c. Maximum Likelihood Estimation - Introduce the concept of maximum likelihood estimation to estimate the coefficients. - Discuss how this method finds the parameters that maximize the likelihood of the observed data. d. Applications and Limitations - Provide examples of logistic regression applications, such as disease diagnosis, credit scoring, and marketing response prediction. - Discuss the limitations of logistic regression, including its inability to handle non-linear relationships without feature

	engineering. 3. **Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the logistic regression algorithm and its applications. b. Suggested Reading: "The Elements of Statistical Learning" by Trevor Hastie, Robert Tibshirani, and Jerome Friedman. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How does logistic regression differ from linear regression? • Encourage students to apply logistic regression to a sample binary classification problem. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 15	**Course Name: Introduction to AI with Machine Learning** **Topic: Gradient Descent Algorithm**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Explain the gradient descent algorithm. b. Apply gradient descent to optimize machine learning models.
Teaching Aids (if any)	a. Power point presentation b. Visual aids for gradient descent c. Examples of gradient descent
Teaching Development	1. **Introduction** (5 minutes) Ask questions - Have you heard of the gradient descent algorithm? Brief overview of gradient descent 2. **Development** (30 minutes) a. Definition and Intuition - Explain the gradient descent algorithm as an optimization method to minimize the cost function. - Use a visual aid to illustrate the concept of moving downhill on a cost function surface to find the minimum. b. Algorithm Steps - Describe the steps involved in gradient descent: initializing parameters, computing the gradient of the cost function,

	updating parameters using the gradient, and iterating until convergence. - Present the gradient descent update rule c. Learning Rate and Convergence - Discuss the importance of the learning rate (α\alphaα) and its impact on convergence. - Explain the trade-off between too high and too low learning rates and strategies to adjust the learning rate dynamically. d. Applications and Variants - Provide examples of gradient descent applications, such as training neural networks, linear regression, and logistic regression. - Introduce variants of gradient descent, such as stochastic gradient descent (SGD) and mini-batch gradient descent. **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the gradient descent algorithm and its applications. b. Suggested Reading: "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How does the gradient descent algorithm optimize model parameters? • Encourage students to implement gradient descent for a simple linear regression problem. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 16	**Course Name: Introduction to AI with Machine Learning** **Topic: Support Vector Machine (SVM)**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Explain the Support Vector Machine (SVM) algorithm. b. Apply SVM for classification tasks.
Teaching Aids (if any)	a. Power point presentation b. Visual aids for SVM c. Examples of SVM applications
Teaching Development	**1. Introduction** (5 minutes) Ask questions

	- Have you heard of the Support Vector Machine algorithm? Brief overview of SVM **2. Development** (30 minutes) a. Definition and Intuition - Explain SVM as a powerful classification algorithm that finds the optimal hyperplane to separate data points of different classes. - Use visual aids to illustrate the concept of a hyperplane and support vectors. b. Mathematical Formulation - Present the mathematical formulation of SVM: maximizing the margin between classes while minimizing classification error. - Explain the role of support vectors in defining the optimal hyperplane. c. Kernel Trick - Introduce the kernel trick to handle non-linearly separable data by transforming the feature space. - Discuss common kernels such as linear, polynomial, and radial basis function (RBF) kernels. d. Applications and Limitations - Provide examples of SVM applications, such as image classification, text categorization, and bioinformatics. - Discuss the limitations of SVM, including its sensitivity to the choice of kernel and computational inefficiency with large datasets. **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the SVM algorithm and its applications. b. Suggested Reading: "Pattern Recognition and Machine Learning" by Christopher M. Bishop. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How does SVM classify data points? • Encourage students to apply SVM to a sample classification problem. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 17	Course Name: Introduction to AI with Machine Learning Topic: Evaluation Measures: Sum of Squared Errors (SSE)	Course No.: ECE-702A

Objectives	At the end of the lesson the student shall be able to: a. Model the Sum of Squared Errors (SSE) evaluation measure. b. Apply SSE to evaluate regression models.
Teaching Aids (if any)	a. Power point presentation b. Examples of SSE calculations
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What do you know about evaluation measures for regression models? Brief overview of SSE **2. Development** (30 minutes) a. Definition and Formula - Define the Sum of Squared Errors (SSE) as a measure of the total deviation of predicted values from the actual values. - Present the SSE formula for actual and predicted values. b. Calculation Example - Walk through a step-by-step example of calculating SSE for a simple regression model. - Discuss how to interpret the SSE value in terms of model accuracy. c. Importance of SSE - Explain the importance of minimizing SSE to improve model performance. - Discuss how SSE is used in the context of fitting regression models and comparing different models. d. Limitations of SSE - Discuss the limitations of SSE, including its sensitivity to outliers and the scale of the dependent variable. - Introduce alternative evaluation measures that address these limitations. **3. Exercise (5 minutes)** Activity: Practice Questions
Closure	a. Summarize the SSE evaluation measure and its applications. b. Suggested Reading: "Introduction to Statistical Learning" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani. Spend 5 minutes to wrap up and consolidate the learnings

Evaluation	• Reflective Questions: How do you calculate SSE for a regression model? • Encourage students to calculate SSE for a given regression problem. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 18	**Course Name: Introduction to AI with Machine Learning** **Topic: Evaluation Measures: Mean Squared Error (MSE)**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Outline the Mean Squared Error (MSE) evaluation measure. b. Apply MSE to evaluate regression models.
Teaching Aids (if any)	a. Power point presentation b. Examples of MSE calculations
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What is the difference between SSE and MSE? - Brief overview of MSE **2. Development** (30 minutes). a. Definition and Formula - Define the Mean Squared Error (MSE) as the average of the squared differences between predicted and actual values. - Present the MSE formula. b. Calculation Example - Walk through a step-by-step example of calculating MSE for a simple regression model. - Discuss how to interpret the MSE value in terms of model accuracy. c. Importance of MSE - Explain the importance of minimizing MSE to improve model performance. - Discuss how MSE is used in the context of fitting regression models and comparing different models. d. Limitations of MSE - Discuss the limitations of MSE, including its sensitivity to outliers. - Introduce alternative evaluation measures that address these limitations. **3. Exercise (5 minutes)**

	Activity: Summarization (2 random students)
Closure	a. Summarize the MSE evaluation measure and its applications. b. Suggested Reading: "Introduction to Statistical Learning" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How do you calculate MSE for a regression model? • Encourage students to calculate MSE for a given regression problem. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 19	**Course Name: Introduction to AI with Machine Learning** **Topic: Evaluation Measures: R-squared (R2)**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Outline the R-squared (R2) evaluation measure. b. Apply R2 to evaluate regression models.
Teaching Aids (if any)	a. Power point presentation b. Examples of R2 calculations
Teaching Development	1. **Introduction** (5 minutes) Ask questions - What do you know about R-squared? Brief overview of R2 2. **Development** (30 minutes) a. Definition and Formula - Define R-squared (R2) as the proportion of the variance in the dependent variable that is predictable from the independent variable(s). - Present the R2 formula for the sum of squared residuals and the total sum of squares. b. Calculation Example - Walk through a step-by-step example of calculating R2 for a simple regression model. - Discuss how to interpret the R2 value in terms of model accuracy and goodness of fit. c. Importance of R2 - Explain the importance of maximizing R2 to improve

	model performance. - Discuss how R2 is used in the context of fitting regression models and comparing different models. d. Limitations of R2 - Discuss the limitations of R2, including its sensitivity to outliers and its inability to indicate whether a model is appropriate. - Introduce adjusted R2 and other evaluation measures that address these limitations. **3. Exercise (5 minutes)** Activity: Quiz
Closure	a. Summarize the R2 evaluation measure and its applications. b. Suggested Reading: "Introduction to Statistical Learning" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How do you calculate R2 for a regression model? • Encourage students to calculate R2 for a given regression problem. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 20	**Course Name: Introduction to AI with Machine Learning** **Topic: Evaluation Measures: Confusion Matrix**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Outline the confusion matrix evaluation measure. b. Apply the confusion matrix to evaluate classification models.
Teaching Aids (if any)	a. Power point presentation b. Examples of confusion matrix calculations
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What do you know about the confusion matrix? Brief overview of the confusion matrix using PPT. **2. Development** (30 minutes) a. Definition and Structure - Define the confusion matrix as a table used to evaluate the performance of a classification model.

	- Present the structure of the confusion matrix with four elements: true positives (TP), false positives (FP), true negatives (TN), and false negatives (FN). b. Calculation Example - Walk through a step-by-step example of calculating a confusion matrix for a sample classification problem. - Discuss how to interpret the values in the confusion matrix to assess model performance. c. Derived Metrics - Explain how the confusion matrix can be used to derive other evaluation metrics such as accuracy, precision, recall, and F-score. - Discuss the importance of these metrics in evaluating classification models. d. Applications and Limitations - Provide examples of confusion matrix applications in fields such as healthcare, finance, and marketing. - Discuss the limitations of the confusion matrix, including its sensitivity to class imbalance. **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the confusion matrix and its applications. b. Suggested Reading: "Pattern Recognition and Machine Learning" by Christopher M. Bishop. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How do you interpret a confusion matrix for a classification model? • Encourage students to calculate a confusion matrix for a given classification problem. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 21	**Course Name: Introduction to AI with Machine Learning** **Topic: Evaluation Measures: Precision, Recall, F-Score**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. list the evaluation measures of precision, recall, and F-score. b. Apply these measures to evaluate classification models.

Teaching Aids (if any)	a. Power point presentation b. Examples of precision, recall, and F-score calculations
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What do you know about precision, recall, and F-score? Brief overview of these evaluation measures **2. Development** (30 minutes) a. Definitions and Formulas - Define precision as the ratio of true positives to the sum of true positives and false positives: - Define recall as the ratio of true positives to the sum of true positives and false negatives: - Define F-score as the harmonic mean of precision and recall. b. Calculation Example - Walk through a step-by-step example of calculating precision, recall, and F-score for a sample classification problem. - Discuss how to interpret these values to assess model performance. c. Importance of Precision, Recall, and F-Score - Explain the importance of these metrics in evaluating classification models, especially in the context of imbalanced datasets. - Discuss scenarios where precision or recall might be more important and the role of F-score as a balanced measure. d. Applications and Limitations - Provide examples of applications where precision, recall, and F-score are used, such as fraud detection, medical diagnosis, and information retrieval. - Discuss the limitations of these metrics, including their sensitivity to class imbalance. **3. Exercise (5 minutes)** Activity: One minute paper
Closure	a. Summarize the evaluation measures of precision, recall, and F-score and their applications. b. Suggested Reading: "Pattern Recognition and Machine Learning" by Christopher M. Bishop. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How do you calculate precision, recall, and F-score for a classification model? • Encourage students to calculate these metrics for a given classification

	problem. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 22	**Course Name: Introduction to AI with Machine Learning** **Topic: Evaluation Measures: ROC-Curve**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Outline the Receiver Operating Characteristic (ROC) curve evaluation measure. b. Apply the ROC curve to evaluate classification models.
Teaching Aids (if any)	a. Power point presentation b. Examples of ROC curve calculations
Teaching Development	1. **Introduction** (5 minutes) Ask questions - What do you know about the ROC curve? Brief overview of the ROC curve using PPT. 2. **Development** (30 minutes) a. Definition and Intuition - Define the ROC curve as a graphical representation of a classifier's performance across different threshold values. - Use a graph to illustrate the ROC curve, plotting the true positive rate (TPR) against the false positive rate (FPR). b. Calculation Example - Walk through a step-by-step example of plotting an ROC curve for a sample classification problem. - Discuss how to interpret the ROC curve and the significance of the area under the curve (AUC). c. Importance of ROC Curve and AUC - Explain the importance of the ROC curve in evaluating classification models, especially in the context of imbalanced datasets. - Discuss how the AUC provides a single metric to compare the performance of different classifiers. d. Applications and Limitations (5 minutes) - Provide examples of ROC curve applications in fields such as medical diagnosis, credit scoring, and marketing. - Discuss the limitations of the ROC curve, including its inability to handle multi-class classification problems directly.

	3. **Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the ROC curve and its applications. b. Suggested Reading: "Pattern Recognition and Machine Learning" by Christopher M. Bishop. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How do you interpret an ROC curve for a classification model? • Encourage students to plot an ROC curve for a given classification problem. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 23	**Course Name: Introduction to AI with Machine Learning** **Topic: Introduction to Clustering**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Explain the concept of clustering in unsupervised learning. b. Identify different types of clustering techniques.
Teaching Aids (if any)	a. Power point presentation b. Visual aids for clustering c. Examples of clustering applications
Teaching Development	1. **Introduction** (5 minutes) Ask questions - What do you know about clustering? Brief overview of clustering. 2. **Development** (30 minutes) a. Definition and Intuition - Explain clustering as the task of grouping a set of objects such that objects in the same group are more similar to each other than to those in other groups. - Use visual aids to illustrate the concept of clustering. b. Types of Clustering - Discuss different types of clustering techniques: hierarchical, partitioning, density-based, and model-based clustering. - Provide examples of each type of clustering technique.

	c. Applications of Clustering - Provide real-world applications of clustering, such as customer segmentation, image segmentation, and anomaly detection. - Discuss how clustering can be used to gain insights from data. **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the concept of clustering and its applications. b. Suggested Reading: "Data Mining: Concepts and Techniques" by Jiawei Han, Micheline Kamber, and Jian Pei. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How can clustering be applied to real-world problems? • Encourage students to identify potential clustering applications in different fields. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 24	**Course Name: Introduction to AI with Machine Learning** **Topic: Hierarchical Clustering**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Model the hierarchical clustering technique. b. Apply hierarchical clustering to group data.
Teaching Aids (if any)	a. Power point presentation b. Visual aids for hierarchical clustering c. Examples of hierarchical clustering applications
Teaching Development	**1. Introduction** (5 minutes) Ask questions - Have you heard of hierarchical clustering? Brief overview of hierarchical clustering. **2. Development** (30 minutes) a. Definition and Intuition - Explain hierarchical clustering as a method of cluster

	analysis which seeks to build a hierarchy of clusters. - Use visual aids to illustrate the concept of hierarchical clustering and dendrograms. b. Types of Hierarchical Clustering - Discuss agglomerative (bottom-up) and divisive (top-down) approaches to hierarchical clustering. - Provide examples of each approach. c. Applications and Limitations - Provide real-world applications of hierarchical clustering, such as gene expression data analysis and document clustering. - Discuss the limitations of hierarchical clustering, including its computational complexity and sensitivity to noise. **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the hierarchical clustering technique and its applications. b. Suggested Reading: "Pattern Recognition and Machine Learning" by Christopher M. Bishop. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How does hierarchical clustering differ from other clustering techniques? • Encourage students to apply hierarchical clustering to a sample dataset. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 25	**Course Name: Introduction to AI with Machine Learning** **Topic: K-Means Clustering**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Model the K-means clustering technique. b. Apply K-means clustering to group data.
Teaching Aids (if any)	a. Power point presentation b. Visual aids for K-means clustering c. Examples of K-means clustering applications
Teaching Development	**1. Introduction** (5 minutes) Ask questions

	- What do you know about K-means clustering? Brief overview of K-means clustering using PPT. **2. Development** (30 minutes) a. Definition and Intuition - Explain K-means clustering as a partitioning method that divides a dataset into K clusters. - Use visual aids to illustrate the concept of centroids and cluster assignments. b. Algorithm Steps - Describe the steps of the K-means algorithm: initializing centroids, assigning data points to the nearest centroid, and updating centroids. - Provide a detailed example to demonstrate the iterative process of K-means clustering. c. Applications and Limitations - Provide real-world applications of K-means clustering, such as customer segmentation, market basket analysis, and image compression. - Discuss the limitations of K-means clustering, including its sensitivity to the choice of K and initial centroids, as well as its tendency to form spherical clusters. **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the K-means clustering technique and its applications. b. Suggested Reading: "Data Mining: Concepts and Techniques" by Jiawei Han, Micheline Kamber, and Jian Pei. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How does K-means clustering work, and what are its limitations? • Encourage students to apply K-means clustering to a sample dataset. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 26	**Course Name: Introduction to AI with Machine Learning** **Topic: Density-Based Clustering**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Model the density-based clustering technique. b. Apply density-based clustering to group data.

Teaching Aids (if any)	a. Power point presentation b. Visual aids for density-based clustering c. Examples of density-based clustering applications
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What do you know about density-based clustering? Brief overview of density-based clustering using PPT. **2. Development** (30 minutes) a. Definition and Intuition - Explain density-based clustering as a method that identifies clusters as areas of high density separated by areas of low density. - Use visual aids to illustrate the concept of core points, border points, and noise points. b. Algorithm Steps - Describe the steps of the DBSCAN algorithm: identifying core points, expanding clusters, and handling noise. - Provide a detailed example to demonstrate the process of density-based clustering. c. Applications and Limitations - Provide real-world applications of density-based clustering, such as anomaly detection, spatial data analysis, and pattern recognition. - Discuss the limitations of density-based clustering, including its sensitivity to parameter selection (e.g., epsilon and minPts) and computational complexity with high-dimensional data. **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the density-based clustering technique and its applications. b. Suggested Reading: "Data Mining: Concepts and Techniques" by Jiawei Han, Micheline Kamber, and Jian Pei. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How does density-based clustering work, and what are its limitations? • Encourage students to apply density-based clustering to a sample dataset. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 27	Course Name: Introduction to AI with Machine Learning Topic: Association Rules	Course No.: ECE-702A

Objectives	At the end of the lesson the student shall be able to: a. Explain the concept of association rules in unsupervised learning. b. Identify key metrics used to evaluate association rules.
Teaching Aids (if any)	a. Power point presentation b. Examples of association rules.
Teaching Development	**1. Introduction** (5 minutes) Ask questions - Have you heard of association rules in data mining? Brief overview of association rules. **2. Development** (30 minutes) a. Definition and Intuition - Explain association rules as a method for discovering interesting relations between variables in large datasets. - Use examples to illustrate the concept of association rules (e.g., market basket analysis). b. Key Metrics - Discuss key metrics used to evaluate association rules, including support, confidence, and lift. - Provide formulas and examples to demonstrate the calculation of these metrics. c. Applications and Limitations - Provide real-world applications of association rules, such as cross-selling, recommendation systems, and inventory management. - Discuss the limitations of association rules, including the generation of a large number of rules and the challenge of finding meaningful rules. **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the concept of association rules and their applications. b. Suggested Reading: "Data Mining: Concepts and Techniques" by Jiawei Han, Micheline Kamber, and Jian Pei. Spend 5 minutes to wrap up and consolidate the learnings

Evaluation	• Reflective Questions: How are association rules used in data mining, and what are their limitations? • Encourage students to identify potential applications of association rules in different fields. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 28	**Course Name: Introduction to AI with Machine Learning** **Topic: Applications of Association Rule Learning**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Outline the practical applications of association rule learning. b. Apply association rule learning to solve real-world problems.
Teaching Aids (if any)	a. Power point presentation b. Examples of applications of association rule learning
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What are some real-world applications of association rule learning? Brief overview of the applications of association rule learning using PPT. **2. Development** (30 minutes) a. Retail and Market Basket Analysis - Explain how association rule learning is used in retail to identify frequently co-occurring items in transactions. - Provide examples of market basket analysis and its impact on inventory management and sales strategies. b. Recommendation Systems - Discuss how association rule learning is used to build recommendation systems for e-commerce and streaming services. - Provide examples of recommendation systems and their benefits to users and businesses. c. Other Applications - Highlight other applications of association rule learning, such as fraud detection, healthcare (e.g., finding patterns in patient data), and network security (e.g., identifying

	suspicious activity). - Discuss the importance of interpreting and validating the rules generated in these applications. **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the applications of association rule learning and their impact on various industries. b. Suggested Reading: "Data Mining: Concepts and Techniques" by Jiawei Han, Micheline Kamber, and Jian Pei. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: What are some key applications of association rule learning in different fields? • Encourage students to explore and present case studies on the use of association rule learning in real-world scenarios. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 29	**Course Name: Introduction to AI with Machine Learning** **Topic: Reinforcement Learning Through Feedback Network**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Explain the concept of reinforcement learning. b. Learn how feedback networks are used in reinforcement learning.
Teaching Aids (if any)	a. Power point presentation b. Visual aids for reinforcement learning c. Examples of feedback networks
Teaching Development	**1. Introduction** (5 minutes) Ask questions

	- What do you know about reinforcement learning? Brief overview of reinforcement learning using PPT. **2. Development** (30 minutes) a. Definition and Intuition - Explain reinforcement learning as a type of machine learning where an agent learns to make decisions by taking actions in an environment to maximize cumulative reward. - Use visual aids to illustrate the agent-environment interaction and feedback loop. b. Feedback Networks - Describe how feedback networks are used in reinforcement learning to provide feedback on the actions taken by the agent. - Provide examples of feedback networks, such as Q-learning and deep Q-networks (DQNs). c. Applications and Limitations - Provide real-world applications of reinforcement learning, such as robotics, game playing (e.g., AlphaGo), and autonomous vehicles. - Discuss the limitations of reinforcement learning, including the exploration-exploitation trade-off and the challenge of designing reward functions. **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the concept of reinforcement learning and the role of feedback networks. b. Suggested Reading: "Reinforcement Learning: An Introduction" by Richard S. Sutton and Andrew G. Barto. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How does K-means clustering work, and what are its limitations? • Encourage students to apply K-means clustering to a sample dataset. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 30	Course Name: Introduction to AI with Machine Learning Topic: Function Approximation in Reinforcement Learning	Course No.: ECE-702A

Objectives	At the end of the lesson the student shall be able to: a. Explain the concept of function approximation in reinforcement learning. b. Learn how function approximation is used to estimate value functions.
Teaching Aids (if any)	a. Power point presentation b. Visual aids for function approximation c. Examples of function approximation methods
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What do you know about function approximation? Brief overview of function approximation using PPT. **2. Development** (30 minutes) a. Definition and Intuition - Explain function approximation as a method used to estimate value functions in reinforcement learning when the state or action spaces are large or continuous. - Use visual aids to illustrate the concept of value function approximation. b. Types of Function Approximators - Discuss different types of function approximators, including linear function approximators, neural networks, and decision trees. - Provide examples of how each type of function approximator can be used in reinforcement learning. c. Applications and Limitations - Provides real-world applications of function approximation in reinforcement learning, such as deep reinforcement learning for game playing and robot control. - Discuss the limitations of function approximation, including the potential for overfitting and the challenge of selecting appropriate function approximators **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the concept of function approximation and its applications in reinforcement learning. b. Suggested Reading: "Deep Reinforcement Learning Hands-On" by Maxim Lapan.

	Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How is function approximation used in reinforcement learning, and what are its challenges? • Encourage students to apply function approximation to a sample reinforcement learning problem. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 31	**Course Name: Introduction to AI with Machine Learning** **Topic: Bagging (Bootstrap Aggregating)**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Outline the concept of bagging in ensemble methods. b. Learn how bagging is used to improve model performance.
Teaching Aids (if any)	a. Power point presentation b. Visual aids for bagging c. Examples of bagging applications
Teaching Development	1. **Introduction** (5 minutes) Ask questions - What do you know about bagging in machine learning? Brief overview of bagging. 2. **Development** (30 minutes) a. Definition and Intuition - Explain bagging (bootstrap aggregating) as an ensemble method that improves the stability and accuracy of machine learning algorithms by combining the predictions of multiple models. - Use visual aids to illustrate the concept of bootstrapping and aggregating. b. Algorithm Steps - Describe the steps of the bagging algorithm: generating bootstrap samples, training models on each sample, and aggregating predictions. - Provide a detailed example to demonstrate the process of bagging.

	c. Applications and Limitations - Provide real-world applications of bagging, such as random forests and bagged decision trees. - Discuss the limitations of bagging, including its computational complexity and the challenge of selecting base models. **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the concept of bagging and its applications. b. Suggested Reading: " The Elements of Statistical Learning" by Trevor Hastie, Robert Tibshirani, and Jerome Friedman. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How does bagging work, and what are its benefits and limitations? • Encourage students to apply bagging to a sample dataset. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 32	**Course Name: Introduction to AI with Machine Learning** **Topic: Boosting**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Outline the concept of boosting in ensemble methods. b. Learn how boosting is used to improve model performance
Teaching Aids (if any)	a. Power point presentation b. Visual aids for boosting c. Examples of boosting application.
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What do you know about boosting machine learning? Brief overview of boosting. **2. Development** (30 minutes) a. Definition and Intuition - Explain boosting as an ensemble method that combines the predictions of multiple weak learners to create a strong

	learner. - Use visual aids to illustrate the concept of boosting and the iterative training process. b. Algorithm Steps - Describe the steps of the boosting algorithm: training weak learners sequentially, adjusting weights of misclassified samples, and combining predictions. - Provide a detailed example to demonstrate the process of boosting. c. Applications and Limitations - Provide real-world applications of boosting, such as AdaBoost, Gradient Boosting, and XGBoost. - Discuss the limitations of boosting, including its sensitivity to noisy data and the challenge of selecting appropriate weak learners. **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the concept of boosting and its applications. b. Suggested Reading: "The Elements of Statistical Learning" by Trevor Hastie, Robert Tibshirani, and Jerome Friedman. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions How does boosting work, and what are its benefits and limitations? • Encourage students to apply boosting to a sample dataset. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 33	**Course Name: Introduction to AI with Machine Learning** **Topic: Stacking and Learning with Ensembles**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Explain the concept of stacking in ensemble learning. b. Learn how to implement and evaluate stacking models.
Teaching Aids (if any)	a. Power point presentation b. Visual aids for ensemble methods

	c. Code examples for stacking
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What do you know about ensemble methods? Brief overview of ensemble learning and its importance using PPT. **2. Development** (30 minutes) a. Concept of Stacking - Define stacking (stacked generalization) as an ensemble technique where multiple models are trained to solve the same problem, and their predictions are combined by a meta-model. - Use visual aids to show how base models and meta-models interact. b. Implementation of Stacking - Explain how to implement stacking using popular libraries (e.g., scikit-learn). - Demonstrate with a simple example and discuss considerations such as model selection and meta-model choice. c. Evaluation and Use Cases - Discuss evaluation metrics and strategies for stacking models. - Provide examples of real-world applications where stacking has proven effective. **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the key points about stacking and its advantages in ensemble learning. b. Suggested Reading: "Ensemble Methods: Foundations and Algorithms" by Zhi-Hua Zhou. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How does stacking improve model performance compared to individual models? • Encourage students to explore potential use cases for stacking in their projects. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 34	Course Name: Introduction to AI with Machine Learning Topic: **Random Forest**	Course No.: ECE-702A

Objectives	At the end of the lesson the student shall be able to: a. Model the concept of Random Forest as an ensemble learning method. b. Learn how to implement and evaluate Random Forest models.
Teaching Aids (if any)	a. Power point presentation b. Visual aids for Random Forest c. Code examples for Random Forest
Teaching Development	**1. Introduction** (5 minutes) Ask questions - Have you used decision trees before? How might combining trees be beneficial? Brief overview of Random Forest. **2. Development** (30 minutes) a. Concept of Random Forest (10 minutes) - Define Random Forest as an ensemble method that builds multiple decision trees and merges their results for improved accuracy and robustness. - Use visual aids to illustrate how Random Forest aggregates predictions from multiple trees. b. Implementation of Random Forest (10 minutes) - Explain the key parameters of Random Forest and how to tune them (e.g., number of trees, maximum depth). - Demonstrate with a practical example using a popular library (e.g., scikit-learn). c. Evaluation and Applications (10 minutes) - Discuss evaluation metrics and how to interpret Random Forest results. - Provide examples of real-world applications such as classification problems in finance or healthcare. **3. Exercise (5 minutes)** Activity: Summarization (2 random students)
Closure	a. Summarize the benefits of Random Forest and its role in ensemble learning. b. Suggested Reading: " The Elements of Statistical Learning: Data Mining, Inference, and Prediction" by Trevor Hastie, Robert Tibshirani, and Jerome Friedman. Spend 5 minutes to wrap up and consolidate the learnings

Evaluation	• Reflective Questions What are the advantages of using Random Forest over a single decision tree? • Encourage students to apply Random Forest to different datasets and compare its performance to other models. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 35	**Course Name: Introduction to AI with Machine Learning** **Topic: Advanced Random Forest Techniques**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Explore advanced techniques and parameter tuning for Random Forest. b. Justify how to handle complex datasets with Random Forest.
Teaching Aids (if any)	a. Power point presentation b. Code examples for advanced Random Forest techniques c. Datasets for practice
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What advanced features have you explored in Random Forest so far? Brief overview of advanced techniques and parameter tuning using PPT. **2. Development** (30 minutes) a. Advanced Techniques - Discuss techniques such as feature importance, out-of-bag error estimation, and handling imbalanced datasets. - Use visual aids to explain these concepts and their impact on model performance. b. Parameter Tuning - Explain how to fine-tune Random Forest parameters such as number of trees, tree depth, and minimum samples per leaf. - Demonstrate parameter tuning using cross-validation and grid search with code examples. c. Handling Complex Datasets - Discuss strategies for using Random Forest with large and complex datasets, including feature engineering and dimensionality reduction.

	- Provide examples and practical tips for managing large-scale data. **3. Exercise (5 minutes)** Activity: Quiz
Closure	a. Summarize the advanced techniques and their benefits for improving Random Forest models. b. Suggested Reading: "Introduction to Machine Learning with Python: A Guide for Data Scientists" by Andreas C. Müller and Sarah Guido. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions How can advanced techniques enhance the performance of Random Forest models? • Encourage students to experiment with advanced features and parameter tuning on real datasets. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 36	**Course Name: Introduction to AI with Machine Learning** **Topic: Comparing Ensemble Methods**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Compare different ensemble methods, including Random Forest, boosting, and bagging. b. Outline when to use each ensemble method based on the problem and data characteristics.
Teaching Aids (if any)	a. Power point presentation b. Comparison charts c. Code examples for various ensemble methods
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What are the different ensemble methods you are familiar with? Brief overview of various ensemble methods using PPT. **2. Development** (30 minutes) a. Comparison of Ensemble Methods - Compare Random Forest, boosting (e.g., Gradient Boosting Machines), and bagging (e.g., Bagging Classifier).

	- Discuss the strengths and weaknesses of each method using visual aids and comparison charts. b. Choosing the Right Method - Explain how to select the appropriate ensemble method based on problem type (classification vs. regression), dataset size, and computational resources. - Provide case studies and examples where different methods excel. c. Practical Considerations - Discuss practical considerations such as computational complexity, interpretability, and ease of implementation. **3. Exercise (5 minutes)** Activity: Quiz
Closure	a. Summarize the key points about comparing ensemble methods and choosing the right one for specific problems. b. Suggested Reading: "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How do the different ensemble methods compare in terms of performance and applicability? • Encourage students to implement and compare various ensemble methods on different datasets. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 37	**Course Name: Introduction to AI with Machine Learning** **Topic: Representing Concepts as Decision Trees**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Construct how concepts can be represented using decision trees. b. Learn to create and interpret decision tree diagrams.
Teaching Aids (if any)	a. Power point presentation b. Visual aids for decision trees c. Example datasets
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What are decision trees, and how do they help in machine

	learning? Brief overview of decision trees and their role in concept representation using PPT. **2. Development** (30 minutes) a. Concept Representation - Explain how decision trees represent concepts by breaking down data into smaller, more manageable pieces. - Use visual aids to show how a decision tree splits data at each node to classify or predict outcomes. b. Creating Decision Trees - Demonstrate how to create a decision tree using a simple example dataset. - Discuss how to label nodes and branches to represent different concepts. c. Interpreting Decision Trees - Show how to interpret the results of a decision tree by tracing a path from the root to the leaves. - Provide examples to illustrate different types of decisions and classifications. **3. Exercise (5 minutes)** Activity: Summarize (Random 2 students)
Closure	a. Summarize the importance of decision trees in representing complex concepts. b. Suggested Reading: "Pattern Recognition and Machine Learning" by Christopher M. Bishop. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions How can decision trees be used to represent different types of concepts? • Encourage students to create decision trees for different datasets and explain their structure. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 38	Course Name: Introduction to AI with Machine Learning Topic: Recursive Induction of Decision Trees	Course No.: ECE-702A

Objectives	At the end of the lesson the student shall be able to: a. List the process of recursively inducing decision trees. b. Learn how to implement recursive algorithms for decision tree generation.
Teaching Aids (if any)	a. Power point presentation b. Visual aids for recursive induction c. Code examples
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What do you think happens at each step of creating a decision tree? Brief overview of recursive induction in decision trees using PPT. **2. Development** (30 minutes) a. Recursive Induction Process - Explain the recursive process of inducing decision trees, including how to handle subsets of data at each node. - Use visual aids to illustrate the concept of recursion in tree construction. b. Implementation of Recursive Algorithms - Describe the key steps of recursive algorithms for decision tree induction, such as the ID3 algorithm. - Demonstrate a simple implementation using code examples. c. Examples and Practice - Provide examples and practice problems for students to apply recursive induction techniques. - Discuss how to handle various data scenarios during recursion. **3. Exercise (5 minutes)** Activity: Quiz
Closure	a. Summarize the recursive approach to building decision trees and its importance in machine learning. b. Suggested Reading: "Machine Learning" by Tom M. Mitchell. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How does recursive induction help in creating

	decision trees? • Encourage students to implement recursive decision tree algorithms and evaluate their performance. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 39	**Course Name: Introduction to AI with Machine Learning** **Topic: Best Splitting Attribute: Entropy and Information Gain**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Outline the concepts of entropy and information gain. b. Learn how to select the best splitting attribute in decision trees.
Teaching Aids (if any)	a. Power point presentation b. Visual aids for entropy and information gain c. Calculation examples
Teaching Development	**1. Introduction** (5 minutes) Ask questions - How do we decide where to split a decision tree? Brief overview of entropy and information gain using PPT. **2. Development** (30 minutes) a. Entropy - Define entropy as a measure of uncertainty or impurity in a dataset. - Use visual aids to explain how entropy is calculated and its role in decision trees. b. Information Gain - Explain information gain as the reduction in entropy achieved by splitting a dataset based on an attribute. - Demonstrate the calculation of information gain with examples. c. Selecting the Best Attribute - Show how to use entropy and information gain to choose the best attribute for splitting nodes in a decision tree. - Provide examples and practice problems for students to apply these concepts. **3. Exercise (5 minutes)** Activity: Quiz
Closure	a. Summarize how entropy and information gain are used to determine the

	best splitting attribute in decision trees. b. Suggested Reading: "Data Mining: Practical Machine Learning Tools and Techniques" by Ian H. Witten, Eibe Frank, and Mark A. Hall. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions How do entropy and information gain contribute to decision tree learning? • Encourage students to calculate entropy and information gain for different datasets. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 40	**Course Name: Introduction to AI with Machine Learning** **Topic: Overfitting in Decision Trees**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Outline the concept of overfitting in decision trees. b. Learn strategies to prevent and address overfitting.
Teaching Aids (if any)	a. Power point presentation b. Visual aids for overfitting c. Case studies
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What do you think happens when a model learns too much from the training data? Brief overview of overfitting using PPT. **2. Development** (30 minutes) a. Understanding Overfitting (10 minutes) - Define overfitting and explain how it occurs when a decision tree becomes too complex and captures noise in the data. - Use visual aids to illustrate examples of overfitting in decision trees. b. Strategies to Prevent Overfitting (10 minutes) - Discuss techniques such as pruning, setting maximum

	depth, and using cross-validation. - Provide examples and code snippets to demonstrate these strategies. c. Case Studies (10 minutes) - Present case studies where overfitting was addressed using various techniques. - Encourage students to analyze the effectiveness of different methods in these cases. **3. Exercise (5 minutes)** Activity: Quiz
Closure	a. Summarize the impact of overfitting on decision trees and the importance of using preventive strategies. b. Suggested Reading: "The Elements of Statistical Learning: Data Mining, Inference, and Prediction" by Trevor Hastie, Robert Tibshirani, and Jerome Friedman. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: What are the signs of overfitting, and how can we mitigate it in decision trees? • Encourage students to apply overfitting prevention techniques to their decision tree models. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 41	**Course Name: Introduction to AI with Machine Learning** **Topic: Noisy Data in Decision Trees**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Predict the impact of noisy data on decision trees. b. Learn strategies to handle noisy data effectively.
Teaching Aids (if any)	a. Power point presentation b. Visual aids for noisy data c. Examples and exercises

Teaching Development	**1. Introduction** (5 minutes) Ask questions - How might noisy data affect the performance of a decision tree? Brief overview of noisy data and its impact on decision trees using PPT. **2. Development** (30 minutes) a. Impact of Noisy Data (10 minutes) - Define noisy data and explain how it can lead to inaccurate splits and poor decision tree performance. - Use visual aids to show examples of noisy data and its effects on decision trees. b. Handling Noisy Data (10 minutes) - Discuss techniques for dealing with noisy data, such as data preprocessing, robust algorithms, and noise filtering. - Provide examples and practical exercises for students to practice these techniques. c. Examples and Exercises (10 minutes) - Present examples of datasets with noisy data and ask students to apply handling techniques. - Discuss the results and effectiveness of different strategies. **3. Exercise (5 minutes)** Activity: Summarize (2 students)
Closure	a. Summarize how to handle noisy data in decision trees and the importance of data quality. b. Suggested Reading: "Data Mining: Practical Machine Learning Tools and Techniques" by Ian H. Witten, Eibe Frank, and Mark A. Hall. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How does noisy data affect decision tree learning, and what methods can mitigate these effects? • Encourage students to identify and handle noisy data in their own datasets. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 42	Course Name: Introduction to AI with Machine Learning Topic: **Pruning Decision Trees**	Course No.: ECE-702A

Objectives	At the end of the lesson the student shall be able to: a. Model the concept and purpose of pruning in decision trees. b. Learn different pruning techniques and how to implement them.
Teaching Aids (if any)	a. Power point presentation b. Visual aids for pruning c. Code examples
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What do know about simplifying decision trees? Brief overview of pruning and its importance in improving decision tree performance using PPT. **2. Development** (30 minutes) a. Concept of Pruning - Define pruning and explain its role in reducing tree complexity and improving generalization. - Use visual aids to illustrate how pruning simplifies decision trees. b. Pruning Techniques (10 minutes) - Discuss different pruning techniques such as cost-complexity pruning (also known as weakest link pruning) and reduced-error pruning. - Provide code examples to demonstrate how to implement these techniques. c. Practical Application (10 minutes) - Offer examples and exercises for students to practice pruning techniques on sample datasets. - Discuss how to evaluate the impact of pruning on model performance. **3. Exercise (5 minutes)** Activity: Quiz
Closure	a. Summarize the benefits of pruning and its role in creating more effective decision trees. b. Suggested Reading: "Introduction to Machine Learning" by Ethem Alpaydin. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How does pruning improve decision tree performance, and what are the different techniques available?

	• Encourage students to apply pruning techniques to their decision tree models and assess the results Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 43	**Course Name: Introduction to AI with Machine Learning** **Topic: Evaluating Decision Tree Performance**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Explain methods to evaluate the performance of decision trees. b. Outline how to interpret evaluation metrics and improve model performance.
Teaching Aids (if any)	a. Power point presentation b. Evaluation metrics charts c. Code examples
Teaching Development	**1. Introduction** (5 minutes) Ask questions - What metrics do you use to evaluate a model's performance? Brief overview of evaluation metrics for decision trees using PPT. **2. Development** (30 minutes) a. Evaluation Metrics - Discuss common metrics for evaluating decision trees, such as accuracy, precision, recall, F1-score, and confusion matrix. - Use visual aids to explain how each metric is calculated and interpreted. b. Improving Model Performance - Explain strategies for improving decision tree performance based on evaluation results, including parameter tuning and data preprocessing. - Provide code examples to illustrate these strategies. c. Practical Exercises - Offer exercises for students to evaluate and improve decision tree models using provided datasets. - Discuss the results and effectiveness of different approaches. **3. Exercise (5 minutes)**

	Activity: Quiz
Closure	a. Summarize the importance of evaluation metrics in assessing and improving decision tree performance. b. Suggested Reading: "Pattern Recognition and Machine Learning" by Christopher M. Bishop. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: What metrics are most useful for evaluating decision trees, and how can you use these metrics to improve model performance? • Encourage students to apply evaluation techniques to their decision tree models and interpret the results. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 44	**Course Name: Introduction to AI with Machine Learning** **Topic: Decision Trees Case Studies and Applications**	**Course No.: ECE-702A**

Objectives	At the end of the lesson the student shall be able to: a. Analyse real-world case studies involving decision trees. b. List the practical applications of decision trees in various domains.
Teaching Aids (if any)	a. Power point presentation b. Case studies documents c. Code examples
Teaching Development	1. **Introduction** (5 minutes) Ask questions - Can you think of some real-world applications where decision trees might be useful? Brief overview of decision tree applications using PPT. 2. **Development** (30 minutes) a. Case Studies - Present and analyze case studies where decision trees have been successfully applied, such as in medical diagnosis, financial forecasting, or customer segmentation. - Discuss the challenges faced and how decision trees addressed them. b. Applications and Practical Insights - Explore various domains where decision trees are used,

	including healthcare, finance, and marketing. - Provide practical insights and best practices for applying decision trees in these areas. c. Discussion and Analysis - Encourage students to discuss and analyze the case studies and applications presented. - Ask students to consider how they might apply decision trees to their own projects or fields of interest. **3. Exercise (5 minutes)** Activity: Quiz
Closure	a. Summarize the key takeaways from the case studies and applications of decision trees. b. Suggested Reading: "Machine Learning Yearning" by Andrew Ng. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	• Reflective Questions: How can decision trees be effectively used in real-world applications? • Encourage students to identify and analyze potential use cases for decision trees in their own domains or projects. Spend 5 minutes to evaluate student assimilation of the lesson contents