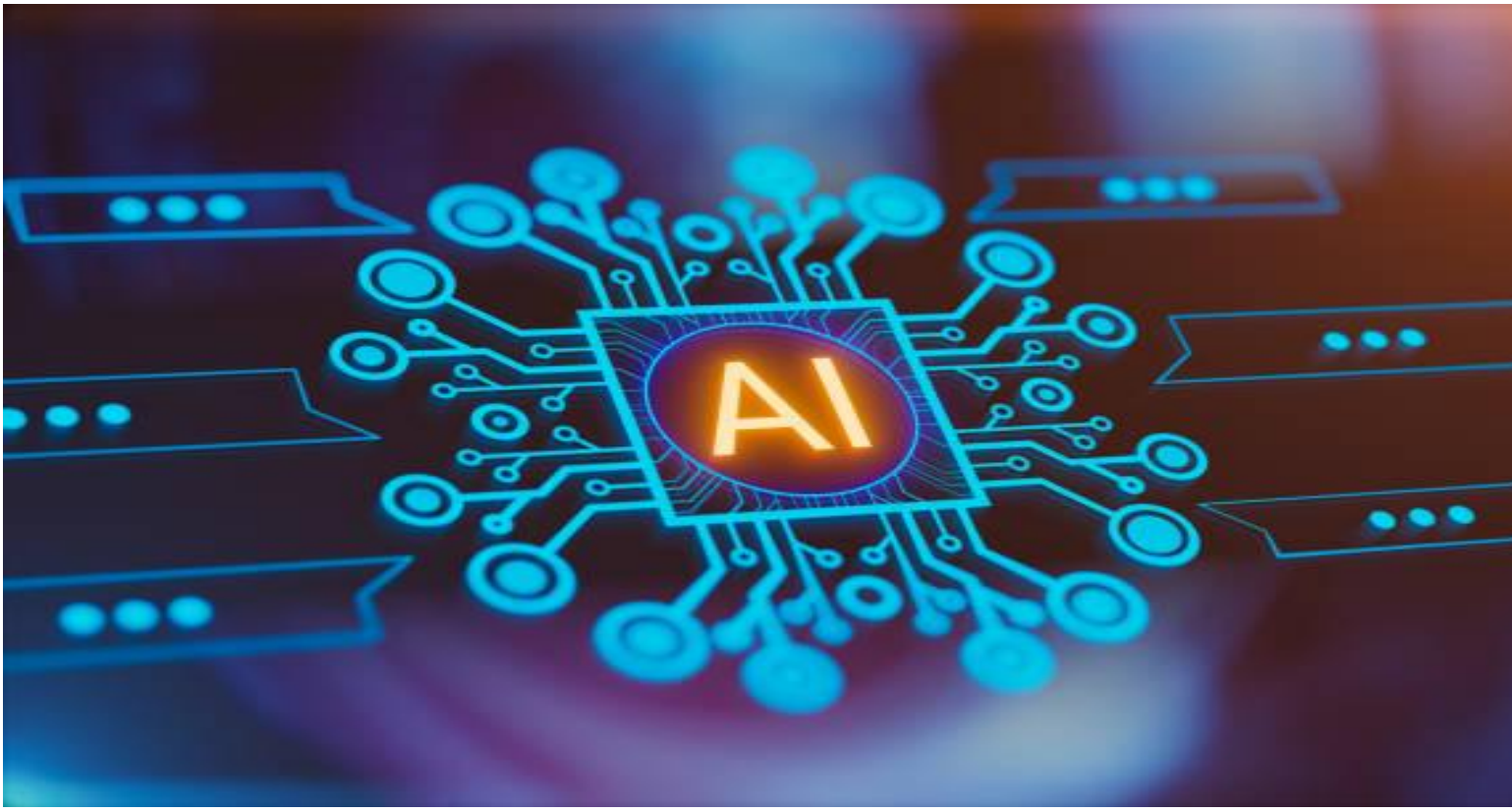

PG Diploma in Artificial Intelligence and Machine Learning

Offered by

Department of Computer Science and Engineering

NATIONAL INSTITUTE OF TECHNICAL TEACHERS TRAINING AND RESEARCH
Institution Deemed to be University under Distinct Category,
A Centrally Funded Technical Institute Ministry of Education, Government of India,
Taramani, Chennai-600113.
www.nitttrc.ac.in

NATIONAL INSTITUTE OF TECHNICAL TEACHERS TRAINING AND RESEARCH
CHENNAI

Deemed to be University under Distinct Category – A Centrally Funded Technical Institute

PG DIPLOMA IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

PROGRAMME DETAILS

The PG Diploma in Artificial Intelligence (AI) and Machine Learning (ML) is to provide a solid foundation in both theoretical concepts and practical applications of AI. The curriculum is carefully designed to introduce learners to key areas such as machine learning, deep learning, natural language processing, and computer vision. Alongside technical modules, the program incorporates hands-on labs, industry case studies, and project-based learning to ensure real-world skill development. This curriculum prepares students for emerging roles in AI and data science, while also serving as a gateway for further specialization or advanced academic pursuits in the field

LEARNING OBJECTIVES

- To provide a solid foundation in core principles of mathematics, programming, and artificial intelligence, enabling learners to build strong analytical and technical capabilities.
- To develop the ability to understand, analyse, and solve problems in AI and Machine Learning, with a focus on applying these solutions to real-world scenarios across various industries.
- To equip students with practical knowledge and skills necessary for designing intelligent systems and developing innovative AI-based solutions for contemporary challenges in the domain.

LEARNING OUTCOMES

On successful completion of the programme, participants will be able to

- Understand the significance of implementing AI-driven solutions to address practical problems and contribute to societal advancement.
- Ability to apply AI and ML techniques independently to investigate, analyse, and develop solutions for real-world challenges.
- Demonstrate sound knowledge and practical expertise in core areas of Artificial Intelligence and Machine Learning.
- Work efficiently both individually and collaboratively in project environments, while adhering to ethical standards and professional conduct.
- Proficiency in preparing well-structured technical documentation and effectively communicating project outcomes.

ELIGIBILITY CRITERIA

- Graduates (10+2+3 or 10+2+4) or Diploma Holders (10+2+3) in computer science related discipline from a recognized university in any stream from any recognized University or Institution (UGC/AICTE/DEC/AIU/State Government) and a desirable work experience* of minimum 1 year as on program start date.
- Fresh Graduates will be considered on case-to-case basis

*Internships and Training Experiences will not be considered as full-time work-experience.

DURATION

Contextually designed One year programme for aspiring entrepreneurs.

ATTENDANCE CRITERIA

A minimum of 75% attendance is a prerequisite for the successful completion of the programme.

CURRICULUM AND SYLLABUS

SEMESTER I

S.No.	Course Code	Course Title	Contact Period	L	T	P	C
Theory							
1.	AM24P11	Advanced Data Structure and Algorithms	3	3	0	0	3
2.	AM24P12	Foundation of Data Science	3	3	0	0	3
3.	AM24P13	Machine Learning	3	3	0	0	3
4.	AM24P14	Artificial Intelligence	3	3	0	0	3
5.	AM24D13	Recommender Systems	3	3	0	0	3
Practical							
6.	AM24P22	Machine Learning Laboratory	4	0	0	4	2
		Total	19	15	0	4	17

SEMESTER II

S.No.	Course Code	Course Title	Contact Period	L	T	P	C
Theory							
1.	AM24A11	Information Retrieval	3	3	0	0	3
2.	AM24A12	Natural Language Processing	3	3	0	0	3
3.	AM24A13	Artificial neural networks	3	3	0	0	3
4.	AM24D12	Image Processing and Computer Vision	3	3	0	0	3
5.	AM24E14	Predictive Analytics	3	3	0	0	3
Practical							
6.	AM24T21	Project Work	16	0	0	16	8
		Total	31	15	0	16	23

AM24P11 ADVANCED DATA STRUCTURE AND ALGORITHMS

Course Description:

This course introduces the fundamental role of algorithms in computing, covering hierarchical data structures like trees and heaps, as well as graph theory and its applications. Students will learn to evaluate problems, choosing appropriate data structures and algorithms to design effective solutions. The course also covers NP-Completeness, helping students understand problem complexity and computational limitations.

AM24P11	ADVANCED DATA STRUCTURE AND ALGORITHMS	L	T	P	C
		3	0	0	3
Unit – 1	Algorithms – Algorithms as a Technology -Time and Space complexity of Algorithms- Asymptotic analysis- Average and worst-case analysis-Asymptotic notation- Importance of efficient algorithms- Program performance measurement - Recurrences: The Substitution Method – The Recursion-Tree Method- Data structures and algorithms	9			
Unit – 2	Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of B -trees – Basic operations on B-Trees – Deleting a key from a B-Tree- Heap – Heap Implementation – Disjoint Sets - Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and deleting a node- Bounding the maximum degree.	9			
Unit – 3	Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single- Source Shortest paths in Directed Acyclic Graphs – Dijkstra‘s Algorithm; Dynamic Programming - All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm	9			
Unit – 4	Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: – Elements of the Greedy Strategy- An Activity-Selection Problem - Huffman Coding.	9			
Unit – 5	Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducibility – NP- Completeness Proofs – NP-Complete Problems.	9			
	Total Periods	45			

Course Outcomes:

At the end of the course, students will be able to

1. Apply data structures and algorithms to solve computing problems.
2. Choose and implement efficient data structures and apply them to solve problems.
3. Apply algorithms using graph structure and various string-matching algorithms to solve real-life problems.
4. Develop one's own algorithm for an unknown problem.
5. Apply suitable design strategy for problem solving

References:

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, ―Data Structures and Algorithms‖, Pearson Education, Reprint 2006.
2. Robert Sedgewick and Kevin Wayne, ―ALGORITHMS‖, Fourth Edition, Pearson Education.
3. S.Sridhar, Design and Analysis of Algorithm, First Edition, Oxford University Press,2014.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, ―Introduction to Algorithms, Third Edition, Prentice-Hall, 2011.

AM24P12 FOUNDATION OF DATA SCIENCE

Course Description:

This course provides a foundation in data science techniques and processes, focusing on the application of descriptive analytics and data visualization for diverse applications. It also covers inferential analytics, enabling students to draw insights and make data-driven decisions.

AM24P12	FOUNDATION OF DATA SCIENCE	L	T	P	C
		3	0	0	3
Unit – 1	Data Science: Benefits and uses – facets of data – Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation – Exploratory Data analysis – build the model– presenting findings and building applications – Data Mining – Data Warehousing – Basic Statistical descriptions of Data	9			
Unit – 2	Types of Data – Types of Variables -Describing Data with Tables and Graphs – Describing Data with Averages – Describing Variability – Normal Distributions and Standard (z) Scores	9			
Unit – 3	Correlation –Scatter plots –correlation coefficient for quantitative data – computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r2 –multiple regression equations –regression towards the mean	9			
Unit – 4	Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – aggregation and grouping – pivot tables	9			
Unit – 5	Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three-dimensional plotting – Geographic Data with Basemap – Visualization with Seaborn.	9			
	Total Periods	45			

Course Outcomes:

At the end of the course, students will be able to

1. Explain the data analytics pipeline.
2. Describe and visualize data.
3. Perform statistical inferences from data.
4. Analyse the variance in the data.
5. Build models for predictive analytics.

References:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017.
3. Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, "Fundamentals of Data Science", CRC Press, 2022.
4. Vineet Raina, Srinath Krishnamurthy, "Building an Effective Data Science Practice: A Framework to Bootstrap and Manage a Successful Data Science Practice", Apress, 2021.
5. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020

AM24P13 MACHINE LEARNING

Course Description:

This course offers an in-depth understanding of machine learning, focusing on its mathematical foundations and various problem types it addresses. Students will explore supervised learning techniques, including ensemble methods, and delve into unsupervised and reinforcement learning. The course also covers the role of probabilistic methods in machine learning, alongside introducing neural networks and deep learning fundamentals.

AM24P13	MACHINE LEARNING	L	T	P	C
		3	0	0	3
Unit – 1	Machine Learning – Basic Concepts in Machine Learning – Types of Machine Learning – Basics of Learning Theory – Concept Learning - Hypothesis space - Heuristics space search - Find - Modelling in Machine learning - Learning Frameworks - PAC Framework	9			
Unit – 2	Introduction-Discriminative and Generative Models -Linear Regression - Least Squares -Under-fitting / Overfitting -Cross-Validation – Lasso Regression- Classification - Logistic Regression- Gradient Linear Models -Support Vector Machines –Kernel Methods -Instance based Methods - K-Nearest Neighbours - Tree based Methods –Decision Trees –ID3 – CART - Ensemble Methods –Random Forest - Evaluation of Classification Algorithms	9			
Unit – 3	Introduction - Clustering Algorithms -K – Means – Hierarchical Clustering - Cluster Validity - Dimensionality Reduction –Principal Component Analysis – Recommendation Systems - EM algorithm. Reinforcement Learning – Elements - Model based Learning – Temporal Difference Learning	9			
Unit – 4	Introduction -Naïve Bayes Algorithm -Maximum Likelihood -Maximum Apriori - Bayesian Belief Networks -Probabilistic Modelling of Problems -Inference in Bayesian Belief Networks – Probability Density Estimation - Sequence Models – Markov Models – Hidden Markov Models.	9			
Unit – 5	Neural Networks – Biological Motivation- Perceptron – Multi-layer Perceptron – Feed Forward Network – Back Propagation-Activation and Loss Functions- Limitations of Machine Learning – Deep Learning–Use cases.	9			
	Total Periods	45			

Course Outcomes:

At the end of the course, students will be able to

1. Understand and outline problems for each type of machine learning.
2. Apply Decision tree and Random Forest algorithm for an application
3. Implement Probabilistic Discriminative and Generative algorithms for an application and analyse the results.
4. Use a tool to implement typical Clustering algorithms for different types of applications.
5. Develop and implement an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification.

References:

1. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Chapman & Hall/CRC, 2nd Edition, 2014.
2. Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
3. Ethem Alpaydin, "Introduction to Machine Learning", Third Edition, Adaptive Computation and Machine Learning Series, MIT Press, 2014
4. Tom M Mitchell, "Machine Learning", McGraw Hill Education, 2013.
5. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press, 2012.
6. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2015
7. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2007
8. Hal Daumé III, "A Course in Machine Learning", 2017 (freely available online)
9. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer, 2009 (freely available online)
10. Aurélien Géron , Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition, o'reilly, (2017)

AM24P14 ARTIFICIAL INTELLIGENCE

Course Description:

This course introduces the foundational principles of Artificial Intelligence (AI), guiding students in designing intelligent agents. Key AI areas covered include problem-solving, knowledge representation, reasoning, and decision-making, equipping students to create systems that can perform complex tasks autonomously.

AM24P14	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3
Unit – 1	Agents and Environments – Good Behaviour: The concepts of Rationality – The Nature of Environments – The Structure of Agents, Problem solving - Solving problems by searching - Search in Complex Environments - Adversarial Search and games - Constraint Satisfaction Problem	9			
Unit – 2	Logical Agents - Propositional Logic - Theorem proving, First Order Logic: Syntax and Semantics - Knowledge Engineering in First Order Logic, Inference in First Order Logic: Forward Chaining - Backward Chaining - Resolution, Knowledge Representation: - Ontological Engineering - Categories and Objects	9			
Unit – 3	Directed Graphical Models – Bayesian Networks – Exploiting Independence Properties – From Distributions to Graphs – Inference in Graphical Models - Bayes model - Generative and Discriminative model - Maximum-likelihood parameter learning: Continuous models - Bayesian parameter learning - Bayesian linear regression	9			
Unit – 4	Decision Process formulation, utility theory, utility functions, decision networks, value of information, Making Complex Decisions: Sequential Decision Problems - Algorithms for MDPs - Bandit Problems - partially observable MDPs - Algorithms for Solving POMDPs - Reinforcement learning	9			
Unit – 5	Learning AI model deployment - Containers - Dockers - Discussion of AI Applications - Natural Language Processing - Chatbots - Dialog Flow - Image Classification - Robotics - Model deployment with containers such as Docker.	9			
	Total Periods	45			

Course Outcomes:

At the end of the course, students will be able to

1. Relate the type of agents and environments in the real-world scenarios
2. Analyse different search techniques with computational complexity
3. Understand the working of Bayesian techniques to solve AI problems
4. Use the decision-making process to solve simple and complex problems
5. Explain the different learning techniques and its applications.

References:

1. Stuart J. Russell, Peter Norvig, Artificial Intelligence – A Modern Approach, Pearson Education, 4th Edition, 2021
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, Artificial Intelligence, Third Edition, Tata McGraw-Hill, 2008.
3. Dheepak Khemani, "A First Course in Artificial Intelligence", McGraw-Hill, 2013.
4. NPTEL Artificial Intelligence Course by Prof. Dasgupta –http://nptel.ac.in/courses/106105079/2
5. https://cloud.google.com/dialogflow
6. https://cloud.google.com/community/tutorials/kubernetes-ml-ops
7. https://www.tensorflow.org/tutorials/images/cnn

AM24D13 RECOMMENDER SYSTEMS

Course Description:

This course provides a thorough examination of Recommender Systems, starting with foundational concepts such as taxonomy, data mining methods, and the various functions and applications of these systems. It addresses collaborative filtering techniques, including user-based and item-based approaches, their comparisons, and the challenges, including attacks on collaborative systems. The course then explores content-based recommendation, focusing on system architecture, item profiles, feature extraction, and user profile learning. It continues with knowledge-based recommendation, covering constraint-based and case-based recommenders, and different hybridization approaches. Finally, the course covers methods for evaluating recommender systems, including evaluation designs, use of historical datasets, and community-based search, social tagging, and trust in recommendations.

AM24D13	RECOMMENDER SYSTEMS	L	T	P	C
		3	0	0	3
Unit – 1	Basic taxonomy of recommender systems - Data mining methods for recommender systems - Recommender system functions - Understanding ratings - Applications of recommendation systems - Issues with recommender system.	9			
Unit – 2	Nearest-neighbor collaborative filtering (CF). User-based and item-based CF, comparison, Components of neighborhood methods Hybrid recommender systems. Attacks on collaborative recommender systems.	9			
Unit – 3	High-level architecture of content-based systems - Advantages and drawbacks of content-based filtering, Item profiles - Discovering features of documents - Obtaining item features from tags - Representing item profiles - Methods for learning user profiles - Similarity based retrieval - Classification algorithms.	9			
Unit – 4	Knowledge representation and reasoning – Constraint-based recommenders – Case-based recommenders - Hybrid approaches: Opportunities for hybridization - Monolithic hybridization design - Parallelized hybridization design - Pipelined hybridization design.	9			
Unit – 5	Introduction - Evaluation designs - Evaluation on historical datasets - Community-Based Web Search - Social Tagging Recommenders Systems - Trust and Recommendations.	9			
	Total Periods	45			

Course Outcomes:

At the end of the course, students will be able to

1. Develop an understanding of recommender systems and data mining techniques used.
2. Apply collaborative filtering techniques and addressing attacks on collaborative recommender systems.
3. Develop content-based recommender systems using similarity retrieval or classification algorithms. CO4: Employ knowledge representation and reasoning in recommender systems and opportunities for hybridization.
4. Apply recommender systems for real-time application.
5. Develop state-of-the-art recommender systems.

References:

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press(2011), 1st ed. 2.
2. C.C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
3. F. Ricci, L Rokach, B. Shapira and P.B. Kantor, Recommender systems handbook, Springer 2010.
4. Schutze, Hinrich, Christopher D. Manning, and Prabhakar Raghavan. Introduction to information retrieval. Cambridge University Press, 2008.
5. Leskovec, Jure, Anand Rajaraman, and Jeffrey David Ullman. Mining of massive data sets. Second Edition, Dreamtech Press, 2016.
6. T.V.Geetha and S.Sendhilkumar, Machine Learning: Concepts,Techniques and Applications, First Edition, CRC Press, Taylor and Franics, 2023

AM24P22 MACHINE LEARNING LABORATORY

Course Description:

This course will explore supervised and unsupervised learning methods including regression, classification and clustering using Python-based libraries. It emphasizes data preprocessing, model training and evaluation, and performance analysis using real-world datasets.

Exp.No.	Name of the Experiments	Duration
1.	Sample UCI dataset or to replace with the variable's mean.	4
2.	Use excel sheet to perform t-hypothesis testing for a given sample data.	4
3.	Download IRIS dataset from UCI repository and generate a box plot, scatter plot and histogram using any tool.	4
4.	Use simple python matplotblib functions to generate various types of plots.	4
5.	Work with simple python numpy package functions.	4
6.	Work with simple python pandas package functions.	4
7.	Use python program to train a decision tree classification model and generate a decision tree for Car Evaluation Dataset from UCI repository.	4
8.	Develop a Linear regression model using Algerian Forest Fire Dataset using python.	4
9.	Write a python program to generate the confusion matrix for classification using decision tree for car evaluation dataset. Also derive various metrics like accuracy, precision, recall, sensitivity and F-measure and give your inferences about the model's performance.	4
10.	Implement K-NN classification algorithm with different datasets and check with evaluation metrics.	4
11.	Implement Logistic Regression classification algorithm with different datasets and check with evaluation metrics.	4
12.	Implement Random Forest classification algorithm with different datasets and check with evaluation metrics	4
13.	Implement Naïve Bayes classification algorithm with different datasets and check with evaluation metrics	4
14.	Implement clustering algorithms with different datasets and check with	4

	evaluation metrics.	
15.	Implement Single layer perceptron	4

Course Outcomes:

At the end of the course, students will be able to

1. Understand and outline problems for each type of machine learning.
2. Design a Decision tree and Random Forest for an application
3. Implement Probabilistic Discriminative and Generative algorithms for an application and analyze the results.
4. Use a tool to implement typical Clustering algorithms for different types of applications.
5. Design and implement an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification.

AM24A11 INFORMATION RETRIVAL

Course Description:

This course offers an in-depth exploration of Information Retrieval (IR), starting with its goals, history, and the influence of the web. It covers key retrieval models like Boolean and Vector Space, along with TF-IDF weighting and cosine similarity for ranking and analysing text. Core concepts include text preprocessing and indexing through inverted indices and sparse vectors. Further topics address text representation, query languages, relevance feedback, and query expansion, as well as classification methods.

AM24A11	INFORMATION RETRIVAL	L	T	P	C
		3	0	0	3
Unit – 1	Goals and History of IR – The Impact of the Web on IR – Basic IR Models Boolean and Vector Space Retrieval Models – Ranked Retrieval – Text Metrics – TF-IDF (term frequency/inverse document frequency) Weighting – Cosine Similarity - Pre-processing: Simple tokenizing, Stop-word removal, and stemming, Basic Searching and Indexing: inverted indices and files, efficient processing with sparse vectors.	9			
Unit – 2	Porter stemmer; Zipf's law; morphology; index term selection; using thesauri; Metadata and markup languages (SGML, HTML, XML, DTD) and schema Web linking technologies – Query Operations and Languages – Relevance Feedback – Query Expansion – Query Languages.	9			
Unit – 3	Text classification - Naive Bayes – Decision Trees and Nearest Neighbor- Vector space classification - Support vector machines, Expectation Maximization (EM) - Flat clustering, Hierarchical clustering, Matrix decompositions and latent semantic indexing - Applications to Information Filtering – Organization and Relevance Feedback.	9			
Unit – 4	Search Engines, Spidering, Web Crawling, Meta-crawlers, Directed spidering, link analysis, Static ranking: Page Rank HITS, shopping agents, Query log analysis, Adversarial IR; Extracting data from text, XML, Ontologies, Thesauri, Semantic Web, collecting and integrating specialized information on the web.	9			
Unit – 5	Recommender Systems – Collaborative Filtering – Content Based Recommendation of Documents and Products – Information Extraction and Integration – Extracting Data from Text – XML – Semantic Web – Collecting and Integrating Specialized Information on the Web. Experimental Evaluation of IR Performance Metrics -	9			

	Recall, Precision and F Measure – Evaluations on Benchmark Text Collections.	
	Total Periods	45

Course Outcomes:

At the end of the course, students will be able to

1. Build an Information Retrieval system using the available tools.
2. Identify and design the various components of an Information Retrieval system.
3. Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.
4. Analyse the Web content structure.
5. Analyse the approaches used for recommendation systems.
6. Design an efficient search engine

References:

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, "Introduction to Information Retrieval", Cambridge University Press, 2008.
2. F. Ricci, L. Rokach, B. Shapira, P. B. Kantor, "Recommender Systems Handbook",Springer, 2011.
3. Peter Brusilovsky, "The Adaptive Web Methods and Strategies of Web Personalization", Springer 2007.
4. Manu Konchady, "Building Search Applications: Lucene, LingPipe, and Gate",Mustru Publishing

AM24A12 NATURAL LANGUAGE PROCESSING

Course Description:

This course provides a comprehensive study of Natural Language Processing (NLP), starting with its foundational components, including linguistics, probability, and morphology, along with techniques like tokenization and finite state automata. It explores statistical NLP and sequence labelling, covering N- grams, language models, Naive Bayes classification, and modern methods like Word2Vec and part-of- speech tagging. The course delves into contextual embedding, focusing on parsing techniques such as Context-Free Grammars, CKY Parsing, and dependency parsing. Advanced topics include computational semantics, with a focus on Word Sense Disambiguation, Semantic Role Labelling, and information extraction. The course concludes with discourse analysis and speech processing, exploring discourse structure, question answering systems, chatbots, and dialogue systems using frame-based and dialogue-state architectures.

AM24A12	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3
Unit – 1	Natural Language Processing – Components - Basics of Linguistics and Probability and Statistics – Words-Tokenization-Morphology-Finite State Automata.	9			
Unit – 2	N-grams and Language models –Smoothing -Text classification- Naïve Bayes classifier – Evaluation - Vector Semantics – TF-IDF - Word2Vec- Evaluating Vector Models -Sequence Labeling – Part of Speech – Part of Speech Tagging -Named Entities –Named Entity Tagging.	9			
Unit – 3	Constituency –Context Free Grammar –Lexicalized Grammars- CKY Parsing – Earley's algorithm Evaluating Parsers -Partial Parsing – Dependency Relations- Dependency Parsing -Transition Based - Graph Based.	9			
Unit – 4	Word Senses and WordNet – Word Sense Disambiguation – Semantic Role Labelling – Proposition Bank- FrameNet- Selection Restrictions - Information Extraction - Template Filling.	9			
Unit – 5	Discourse Coherence – Discourse Structure Parsing – Centering and Entity Based Coherence – Question Answering –Factoid Question Answering – Classical QA Models – Chatbots and Dialogue systems – Frame-based Dialogue Systems – Dialogue - State Architecture.	9			
	Total Periods	45			

Course Outcomes:

At the end of the course, students will be able to

1. Understand basics of linguistics, probability and statistics associated with NLP.
2. Implement a Part-of-Speech Tagger.
3. Design and implement a sequence labeling problem for a given domain.
4. Implement semantic processing tasks and simple document indexing and searching system using the concepts of NLP.
5. Implement a simple chatbot using dialogue system concepts.

References:

1. Daniel Jurafsky and James H.Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition" (Prentice Hall Series in Artificial Intelligence), 2020
2. Jacob Eisenstein. "Natural Language Processing ", MIT Press, 2019
3. Samuel Burns "Natural Language Processing: A Quick Introduction to NLP with Python and NLTK, 2019
4. Christopher Manning, "Foundations of Statistical Natural Language Processing", MIT Press, 2009.
5. Nitin Indurkhya,Fred J. Damerau, "Handbook of Natural Language Processing", Second edition, Chapman & Hall/CRC: Machine Learning & Pattern Recognition, Hardcover,2010
6. Deepti Chopra, Nisheeth Joshi, "Mastering Natural Language Processing with Python", Packt Publishing Limited, 2016
7. Mohamed Zakaria Kurdi "Natural Language Processing and Computational Linguistics: Speech, Morphology and Syntax (Cognitive Science)", ISTE Ltd., 2016
8. Atefeh Farzindar,Diana Inkpen, "Natural Language Processing for Social Media (Synthesis Lectures on Human Language Technologies)", Morgan and Claypool Life Sciences, 2015

AM24A13 ARTIFICIAL NEURAL NETWORKS

Course Description:

This course covers the basics of Artificial Neural Networks (ANNs), including neural computation, biological and artificial neuron models, and learning rules. It explores multilayer feedforward networks, Hopfield networks, and associative memories. Applications include character recognition, robot kinematics, medical diagnosis, and self-organizing maps.

AM24A13	ARTIFICIAL NEURAL NETWORKS	L	T	P	C
		3	0	0	3
Unit – 1	Neural computation-History of Neural Systems Development – Fundamental Concepts and Models of Artificial Neural Systems: Biological Neurons and Their Artificial Models – Models of Artificial Neural Networks – Neural Processing – Learning and Adaptation – Neural Network Learning Rules – Single Layer Perception Classifiers	9			
Unit – 2	Linearly Non-separable Pattern Classification - Delta Learning Rule for Multi-perceptron Layer - Generalized Delta Learning Rule - Feedforward Recall and Error Back-Propagation Training - Learning Factors - Classifying and Expert Layered Networks - Functional Link Networks.	9			
Unit – 3	Basic Concepts of Dynamical Systems - Mathematical Foundations of Discrete-Time Hopfield Networks - Mathematical Foundations of Gradient-Type Hopfield Networks - Transient Response of Continuous- Time Networks - Relaxation Modelling in Single-Layer Feedback Networks	9			
Unit – 4	Basic Concepts - Linear Associator - Basic Concepts of Recurrent Auto associative Memory - Performance Analysis of Recurrent Auto associative Memory - Bidirectional Associative Memory - Associative Memory of Spatio-temporal Patterns	9			
Unit – 5	Linear Programming Modelling Network - Character Recognition Networks - Neural Networks Control Applications - Networks for Robot Kinematics - Connectionist Expert Systems for Medical Diagnosis - Self-organizing Semantic Maps– Interactive Calendars –Selecting one from many- Animation Design for Simulation.	9			
	Total Periods	45			

Course Outcomes:

At the end of the course, students will be able to

1. Understand the fundamental concept behind neural network
2. Implement the feed forward network
3. Understand the working of feedback neural network
4. Explore the memory architecture using neural networks.
5. Design and develop applications using neural networks
6. Explore the recent advances in neural networks

References:

1. Jacek M.Zuarda, “Introduction to Artificial Neural Networks”, West Publishing Company.1994
2. Simon Haykin, Neural Networks & Learning Machines, Third Edition, Pearson, 2009

AM24D12 IMAGE PROCESSING AND COMPUTER VISION

Course Description:

This course covers the fundamentals of image processing, including human vision, digital imaging systems, and color models. It explores image enhancement techniques such as Fourier and wavelet transforms, grey level transformations, and spatial filtering. The course also focuses on image restoration, noise modelling, and boundary detection using morphological operations and edge detection. Image segmentation and feature extraction methods, including SIFT, SURF, and PCA, are covered. Finally, students will learn about image classifiers, supervised learning methods (like SVM), unsupervised learning (like K-means clustering), and deep learning-based image classification.

AM24D12	IMAGE PROCESSING AND COMPUTER VISION	L	T	P	C
		3	0	0	3
Unit – 1	Introduction – Applications of Image Processing – Steps in Image Processing Applications – Human vision and color perception- Digital Imaging System – Imaging sensors-Sampling and Quantization – Pixel Connectivity – Distance Measures – Colour Fundamentals and Models – File Formats – Image Operations.	9			
Unit – 2	Image Transforms: Discrete Fourier Transform – Fast Fourier Transform – – Wavelet Transforms -Image Enhancement in Spatial and Frequency Domain – Grey Level Transformations – Histogram Processing – Spatial Filtering – Smoothing and Sharpening – Frequency Domain: Filtering in Frequency Domain.	9			
Unit – 3	Image Restoration – Image Degradation Model – Noise Modeling – Blur – Order Statistic Filters – Image Restoration - Morphological Operations- Dilation-Erosion-Opening-Closing- Edge Detection-Corner Detection - Detection of Discontinuities Edge Linking and Boundary Detection.	9			
Unit – 4	Image Segmentation — Thresholding – Region based Segmentation – Image Features and Extraction – Image Features – Types of Features – Feature extraction – SIFT, SURF– Feature reduction algorithms- PCA.	9			
Unit – 5	Image Classifiers – Supervised Learning – Maximum Likely Hood-Minimum Distance – Parallopiped- Support Vector Machines, Image Clustering – Unsupervised Learning – K-means Hierarchical and Partition Based Clustering Algorithms –ANN – Deep Learning Image Classifier.	9			
	Total Periods	45			

Course Outcomes:

At the end of the course, students will be able to

1. Implement basic image processing operations.
2. Apply and develop new techniques in the areas of image enhancement and frequency transforms.
3. To restore images from noise and to extract edges and boundaries.
4. Understand the image segmentation algorithms and Extract features from images.
5. Apply classifiers and clustering algorithms for image classification and clustering.
6. Design and develop an image processing application that uses different concepts of image processing.

References:

1. Rafael Gonzalez, Richard E. Woods, "Digital Image Processing", Fourth Edition, Pearson Education, 2018
2. S. Sridhar, "Digital Image Processing", Second Edition, Oxford University Press, 2016.
3. Forsyth and Ponce, "Computer Vision – A Modern Approach", Second Edition, Prentice Hall, 2011.
4. Anil K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall Information , 2011 5. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing Analysis and Machine Vision", Fourth Edition, Cengage India, 2017.

AM24E14 PREDICTIVE ANALYTICS

Course Description:

This course delves into the methodologies and tools used for predictive modeling and forecasting. It emphasizes practical applications and the use of various algorithms to analyze historical data and predict future outcomes.

AM24E14	PREDICTIVE ANALYTICS	L	T	P	C
		3	0	0	3
Unit – 1	Introduction to Predictive Analytics - Overview of predictive analytics and its importance - Types of predictive models: classification vs. regression - Data types and structures - Data Preprocessing and Exploration - Data cleaning and preparation techniques - Exploratory Data Analysis (EDA) methods - Feature engineering and selection.	9			
Unit – 2	Regression Analysis - Simple and multiple linear regression - Assumptions and diagnostics of regression models - Time Series Forecasting - Components of time series data - Techniques for forecasting: ARIMA, Exponential Smoothing - Seasonality and trend analysis.	9			
Unit – 3	Classification Techniques - Overview of classification algorithms - Logistic Regression- Decision Trees – SVM - Performance metrics: accuracy, precision, recall, F1-score - Model tuning and validation techniques - Advanced Machine Learning Algorithms - Ensemble methods: Random Forests, Gradient Boosting.	9			
Unit – 4	Model Evaluation and Selection - Cross-validation techniques - Bias-variance trade-off - ROC curves and AUC for model assessment.	9			
Unit – 5	Predictive Analytics in Business - Case studies in marketing, finance, and operations- Implementing predictive analytics projects - Ethical considerations in predictive modelling - Tools and Software for Predictive Analytics - Overview of tools: Python libraries -Scikit-learn -TensorFlow.	9			
	Total Periods	45			

Course Outcomes:

At the end of the course, students will be able to

1. Understand the fundamental concepts of predictive analytics.
2. Learn statistical and machine learning techniques for prediction.
3. Develop skills in data preprocessing, feature selection, and model evaluation.
4. Apply predictive models to real-world scenarios across different industries.

References:

1. "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die" by Eric Siegel
2. "Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst" by Dean Abbott