JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

COURSE STRUCTURE & SYLLABUS M.Tech CSE
NEURAL NETWORKS PROGRAMME

(Applicable for batches admitted from 2019-2020)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

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I-SEMESTER

S.No	Course Code	Courses	Category	L	T	P	C
1	MTNN1101	**Program Core-1** Artificial Neural Networks	PC	3	0	0	3
2	MTNN1102	**Program Core-2** Advanced Data Structures	PC	3	0	0	3
3	MTNN1103	**Program Elective-1** 1. Machine Learning 2. Intelligent Systems 3. Expert Systems	PE	3	0	0	3
4	MTNN1104	**Program Elective-2** 1. Data Warehouse and Data Mining 2. Recommender Systems 3. Pattern Recognition	PE	3	0	0	3
5	MTNN1105	**Research Methodology and IPR**	CC			0	2
6	MTNN1106	**Laboratory-1** Advanced Data Structures Lab	LB	0	0	4	2
7	MTNN1107	**Laboartory-2** Neural Networks Lab	LB	0	0	4	2
8	MTNN1108	**Audit Course-1***	AC	2	0	0	0
Total Credits							18

**Student has to choose any one audit course listed below.*

II-SEMESTER

M. Tech. (NN) II SEMESTER							
S.No	**Course Code**	**Courses**	**Category**	**L**	**T**	**P**	**C**
1	MTNN1201	**Program Core-3** Soft Computing	PC	3	0	0	3
2	MTNN1202	**Program Core-4** Deep Learning	PC	3	0	0	3
3	MTNN1203	**Program Elective-3** 1. Computer Vision 2. Big Data Analytics 3. Remote Sensing	PE	3	0	0	3
4	MTNN1204	**Program Elective-4** 1. Cognitive Systems 2. Knowledge Discovery 3. Natural Language Processing	PE	3	0	0	3
5	MTNN1205	**Laboratory-3** Soft Computing Lab	LB	0	0	4	2
6	MTNN1206	**Laboartory-4** Deep Learning lab	LB	0	0	4	2
7	MTNN1207	**Mini Project with Seminar**	MP	2	0	0	2
8	MTNN1208	**Audit Course-2***	AC	2	0	0	0
Total Credits							18

**Student has to choose any one audit course listed below.*

Audit Course 1 & 2:

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills

III SEMESTER

S.No	Course Code	Courses	Category	L	T	P	C
1	MTNN2101	**Program Elective-5** 1. Reinforcement Learning 2. Bio-Informatics 3. Speech Processing 4. MOOCS-I(NPTEL/SWAYAM-12 Week Program related to the programme which is not listed in the course structure	PE	3	0	0	3
2	MTNN2102	**Open Elective** 1. MOOCS-II(NPTEL/SWAYAM-Any 12WeeksProgram-Interdisciplinary Course but not from the Parent Department) 2. Courses offered by other departments in the college	OE	3	0	0	3
3	MTNN2103	**Dissertation-I/Industrial Project#**	PJ	0	0	20	10
Total Credits							16

#Students going for Industrial Project/Thesis will complete these courses through MOOCs

IV SEMESTER

S.No	Course Code	Courses	Category	L	T	P	C
1	MTNN2201	**Dissertation-II**	PJ	0	0	32	16
Total Credits							16

Open Electives offered to Other Departments

1. Python Programming
2. Artificial Intelligence
3. Machine Learning
4. Deep Learning

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I Year - I Semester		L	T	P	C
		3	0	0	3

Artificial Neural Networks (MTNN1101)

Course Objective:

- The main objective of this course is to provide the student with the basic understanding of neural networks fundamentals,
- Program the related algorithms and Design the required and related systems

Course Outcomes:

- Demonstrate ANN structure and activation Functions
- Define foundations and learning mechanisms and state-space concepts
- Identify structure and learning of perceptions
- Explain Feed forward, multi-layer feed forward networks and Back propagation algorithms
- Analyze Radial Basis Function Networks, Theor Regularization and RBF networks

UNIT-I: Introduction and ANN Structure, Biological neurons and artificial neurons. Model of an ANN. Activation functions used in ANNs. Typical classes of network architectures.

UNIT-II: Mathematical Foundations and Learning mechanisms.Re-visiting vector and matrix algebra, State-space concepts, Concepts of optimization, Error-correction learning. Memory-based learning, Hebbian learning. Competitive learning.

UNIT-III: Single layer perceptrons, Structure and learning of perceptrons, Pattern classifier, introduction and Bayes' classifiers, Perceptron as a pattern classifier, Perceptron convergence. Limitations of a perceptrons.

UNIT-IV: Feed forward ANN, Structures of Multi-layer feed forward networks. Back propagation algorithm, Back propagation - training and convergence, Functional approximation with back propagation. Practical and design issues of back propagation learning.

UNIT-V: Radial Basis Function Networks, Pattern separability and interpolation, Regularization Theor Regularization and RBF networks.RBF network design and training. Approximation properties of RBF.

Text Books:

1. Simon Haykin, "Neural Networks: A comprehensive foundation", Second Edition, Pearson Education Asia.
2. Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill, 2004.

Reference Books:

1. Robert J. Schalkoff, "Artificial Neural Networks", McGraw-Hill International Editions, 1997.

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		3	0	0	3

Advanced Data Structures (MTNN1102)

Course Objectives:

- The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
- Students should be able to understand the necessary mathematical abstraction to solve problems.
- To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.
- Student should be able to come up with analysis of efficiency and proofs of correctness.

Course Outcomes:

- After completion of course, students would be able to:
- Understand the implementation of symbol table using hashing techniques.
- Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
- Develop algorithms for text processing applications.
- Identifysuitabledatastructuresanddevelopalgorithmsforcomputationalgeometry problems.

UNIT-I: Dictionaries: Definition, Dictionary Abstract Data Type, and Implementation of Dictionaries. **Hashing:** Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

UNIT-II: Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists.

UNIT-III: Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees**.**

UNIT–IV: Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

UNIT-V: Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad trees, k-D Trees. Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem.

Text Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson,2004
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley,2

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Machine Learning (MTNN11XX)

Course Objectives:

- Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem.
- Formalize a given problem in the language/framework of different AI methods (e.g., as a search problem, as a constraint satisfaction problem, as a planning problem, as a Markov decision process, etc).
- Implement basic AI algorithms (e.g., standard search algorithms or dynamic programming).
- Design and carry out an empirical evaluation of different algorithms on problem formalization, and state the conclusions that the evaluation supports.

Course Outcomes:

After the completion of the course, student will be able to

- Explain the definition and usage of the term 'the internet of things' in different contexts.
- Demonstrate on various network protocols used in IoT.
- Analyze on various key wireless technologies used in IoT systems, such as WiFi, 6LoWPAN, Bluetooth and ZigBee.
- Illustrate on the role of big data, cloud computing and data analytics in IoT system.
- Design a simple IoT system made up of sensors, wireless network connection, data analytics and display/actuators, and write the necessary control software.

UNIT-I: Introduction-Towards Intelligent Machines, Well posed Problems, Example of Applications in diverse fields, Data Representation, Domain Knowledge for Productive use of Machine Learning, Diversity of Data: Structured Unstructured, Forms of Learning, Machine Learning and Data Mining, Basic Linear Algebra in Machine Learning Techniques.

UNIT-II: Supervised Learning- Rationale and Basics: Learning from Observations, Bias and Why Learning Works: Computational Learning Theory, Occam's Razor Principle and Over fitting Avoidance Heuristic Search in inductive Learning, Estimating Generalization Errors, Metrics for assessing regression, Metris for assessing classification.

UNIT-III: Statistical Learning- Machine Learning and Inferential Statistical Analysis, Descriptive Statistics in learning techniques, Bayesian Reasoning a probabilistic approach to inference, K-Nearest Neighbor Classifier. Discriminant functions and regression functions, Linear Regression with Least Square Error Criterion, Logistic Regression for Classification Tasks, Fisher's Linear Discriminant and Thresholding for Classification, Minimum Description Length Principle.

UNIT-IV: Support Vector Machines (SVM)- Introduction, Linear Discriminant Functions for Binary Classification, Perceptron Algorithm, Large Margin Classifier for linearly separable data, Linear Soft Margin Classifier for Overlapping Classes, Kernel Induced Feature Spaces, Nonlinear Classifier, Regression by Support vector Machines. **Learning with Neural**

Networks: Towards Cognitive Machine, Neuron Models, Network Architectures, Perceptrons, Linear neuron and the Widrow-Hoff Learning Rule, The error correction delta rule.

UNIT-V: Decision Tree Learning: Introduction, Example of classification decision tree, measures of impurity for evaluating splits in decision trees, ID3, C4.5, and CART decision trees, pruning the tree, strengths and weakness of decision tree approach.

Textbooks:

1. Applied Machine Learning, M.Gopal, Mc Graw Hill Education
2. Machine Learning, Tom Mitchell, c Graw Hill

References

1. Introduction to Machine Learning with Python: A Guide for Data Scientists, Andreas C. Müller and Sarah Guido, O'Reilly
2. Machine Learning, The Art and Science of Algorithms that Make Sense of Data, Peter Flach, Cambridge press

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		3	0	0	3

Intelligent Systems (MTNN11XX)

Course Objectives:

- Understand the fine structure or deeper origin of knowledge
- Generate intelligent behavior on the basis of statistical evidence.

Course Outcomes:

After completion of course, students would be:

- Demonstrate Data representation and Logical operations.
- Analyze backward reasoning and solving problems by reduction.
- Identify Tools for representation of Lisp programming.
- Explain the architecture of real time expert systems.
- Define Quantitative simulation and Petri Nets.

UNIT I: Knowledge Representation:

Data and knowledge: Data representation and data items in traditional databases, Data representation and data items in relational databases. Rules: Logical operations, Syntax and semantics of rules, Data log rule sets ,The dependence graph of data log rule sets, Objects, Solving problems by reasoning: The structure of the knowledge base, The reasoning algorithm, Conflict resolution, Explanation of the reasoning.

Unit II: Rule Based Systems:

Forward reasoning: The method of forward reasoning, A simple case study of forward reasoning, Backward reasoning: Solving problems by reduction, The method of backward reasoning, A simple case study of backward reasoning, Bidirectional reasoning. Contradiction freeness: The notion of contradiction freeness, Testing contradiction freeness, The search problem of contradiction freeness .Completeness: The notion of completeness, Testing Completeness, The search problem of completeness .Decomposition of knowledge bases: Strict decomposition, Heuristic decomposition

UNIT III: Tools for Representation and Reasoning:

The Lisp programming language: The fundamental data types in Lisp, Expressions and their evaluation, some useful Lisp primitives, some simple examples in Lisp, The Prolog programming language: The elements of Prolog programs, The execution of Prolog programs, Built-in predicates, and Some simple examples in Prolog. Expert system shells: Components of an expert system shell, Basic functions and services in an expert system shell

UNIT IV: Real-Time Expert Systems:

The architecture of real-time expert systems: The real-time subsystem, The intelligent subsystem Synchronization and communication between real-time and intelligent subsystems: Synchronization and communication primitives, Priority handling and time-out. Data exchange between the real-time and the intelligent subsystems: Loose data exchange, the blackboard architecture. Software engineering of real-time expert systems: The software lifecycle of real time expert systems, Special steps and tool, An Example of A Real-Time expert System.

UNIT V: Qualitative Reasoning and Petri Nets:

Sign and interval calculus, Qualitative simulation: Constraint type qualitative differential equations, The solution of QDEs: the qualitative simulation algorithm: Initial data for the simulation, Steps of the simulation algorithm, Simulation results. Qualitative physics, Signed directed graph (SDG) models, The Notion of Petri nets, The firing of transitions, Special cases and extensions, The state-space of Petri nets The use of Petri nets for intelligent control, The analysis of Petri nets: Analysis Problems for Petri Nets, Analysis techniques.

Text Books:

1. Intelligent Control Systems-An Introduction with Examples by Katalin M. Hangos, Rozália Lakner , Miklós Gerzson, Kluwer Academic Publishers.
2. Intelligent Systems and Control: Principles and Applications Paperback – 12 Nov 2009 by Laxmidhar Behera, Indrani Kar by OXFORD.

References Books:

1. Intelligent Systems and Technologies Methods and Applications by Springer publications.
2. Intelligent Systems - Modeling, Optimization and Control, by Yung C. Shin and Chengying Xu, CRC Press, Taylor & Francis Group, 2009.

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		3	0	0	3

Expert Systems (MTNN11XX)

Corse Objectives:

- In this course the student will learn the methodology used to transfer the knowledge of a human expert into an intelligent program that can be used to solve problems.

Course Outcomes:

After completing this course, the student should be able to:

- Apply the methodology to transfer human knowledge into an expert system
- Apply knowledge representation
- Design a knowledge base and Implement a rule-based expert system
- Evaluate Expert System tools
- Apply CLIPS for the implementation of an expert system

UNIT-I: Introduction what is AI? The Foundations of AI, What is an AI Technique?-Tic-Tac-Toe. Problems, Problem Spaces and Search Defining the problem as a state space search, Production systems, Problem characteristics, production system characteristics, Issues in the design of search programs.

UNIT-II: Heuristic Search Techniques Generate-and-test, Hill climbing, Simulated Annealing, Best-First search, A* algorithm, AO* algorithm, Constraint satisfaction, Means-Ends Analysis.

UNIT-III: First-Order Logic Syntax and Semantics, Extensions and Notational Variations, Using First-Order Logic, Representing Change in the world, deducing hidden properties of the world. Interface in First-Order Logic Inference rules involving Quantifiers, An Example proof, Generalized Modus Ponens, Forward and Backward Chaining, Completeness, Resolution, Completeness of Resolution.

UNIT-IV: Slot-and-Filler Structures Semantic Nets, Frames, And Conceptual Dependency. Game Playing Overview, The Mini-max Search Procedure, Adding Alpha-Beta Cutoffs, Additional Refinements, Iterative Deepening.

UNIT-V: Natural Language Processing Introduction, Syntactic processing, Semantic analysis. Expert Systems Representing and Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition.

Text Books:

1. Rich, Elaine and Knight, Kevin, Artificial Intelligence, Tata McGraw-Hill publications, 2nd Edition, 2006
2. Russell, Stuart and Norvig, Peter, Artificial Intelligence A Modern Approach, Pearson Education

Reference Books:

1. Eugene Charniak and Drew McDermott, Introduction to Artificial Intelligence, Addison Wesley, Pearson Education, 2005
2. George F Luger, Artificial Intelligence Structures and Strategies for Complex Problem Solving, Pearson Education Ltd., 2nd Edition, 2002.
3. Dan W Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice-Hall of India, 2001.

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		3	0	0	3

Data Warehousing and Data Mining (MTNN11XX)

Course Objectives:

- This course will introduce the concepts of data ware house and data mining, which gives a complete description about the principles
- Student able to understand architectures, applications, design and implementation of data mining and data ware housing concepts.

Course Outcomes:

- Understand the functionality of the various data mining and data warehousing component
- Appreciate the strengths and limitations of various data mining and data warehousing models
- Explain the analyzing techniques of various data
- Describe different methodologies used in data mining and data ware housing
- Compare different approaches of data ware housing and data mining with various technologies

UNIT-I: Data Warehousing-Data warehousing Components –Building a Data warehouse –- Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata.

UNIT-II: Business Analysis-Reporting and Query tools and Applications – Tool Categories – The Need for Applications – Cognos Impromptu – Online Analytical Processing (OLAP) – Need – Multidimensional Data Model – OLAP Guidelines – Multidimensional versus Multirelational OLAP – Categories of Tools – OLAP Tools and the Internet.

UNIT-III: Data Mining-Introduction – Data – Types of Data – Data Mining Functionalities – Interestingness of Patterns – Classification of Data Mining Systems – Data Mining Task Primitives – Integration of a Data Mining System with a Data Warehouse – Issues –Data Preprocessing.

UNIT-IV: Association Rule Mining And Classification -Mining Frequent Patterns, Associations and Correlations – Mining Methods – Mining various Kinds of Association Rules – Correlation Analysis – Constraint Based Association Mining – Classification and Prediction – Basic Concepts – Decision Tree Induction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines
Associative Classification – Lazy Learners – Other Classification Methods – Prediction.

UNIT-V: Clustering And Trends In Data Mining-Cluster Analysis – Types of Data – Categorization of Major Clustering Methods – K-means– Partitioning Methods – Hierarchical Methods – Density-Based Methods –Grid Based Methods – Model-Based Clustering Methods – Clustering High Dimensional Data Constraint-Based Cluster Analysis – Outlier Analysis – Data Mining Applications.

Text Books:

1. Alex Berson and Stephen J.Smith, "Data Warehousing, Data Mining and OLAP", Tata McGraw – Hill Edition, Thirteenth Reprint 2008.
2. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2012.

Reference Books:

1. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to DataMining", PersonEducation,2007.
2. K.P. Soman, Shyam Diwakar and V. Aja, "Insight into Data Mining Theory and Practice", Eastern Economy Edition, Prentice Hall of India, 2006.
3. G. K. Gupta, "Introduction to Data Mining with Case Studies", Eastern Economy Edition, Prentice Hall of India, 2006.
4. Daniel T.Larose, "Data Mining Methods and Models", Wiley-Interscience, 2006.

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I Year - I Semester		L	T	P	C
		3	0	0	3

Recommender Systems (MTNN110XX)

Course Objectives:

- To learn techniques for making recommendations, including non-personalized, content-based, and collaborative filtering
- To automate a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations

Course Outcomes:

- Design recommendation system for a particular application domain.
- Evaluate recommender systems on the basis of metrics such as accuracy, rank accuracy, diversity, product coverage, and serendipity
- Explain User-based recommendation, knowledge-based recommender system
- Define Opportunities for hybridization, Monolithic hybridization
- Identify hybridization design, Weighted, Switching, Mixed, Pipelined hybridization

UNIT-I: Introduction: Overview of Information Retrieval, Retrieval Models, Search and Filtering Techniques: Relevance Feedback, User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

UNIT-II: Content-based Filtering: High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, pre-processing and feature extraction, Obtaining item features from tags, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.

UNIT-III: Collaborative Filtering: User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems. **Types of Recommender Systems:** Recommender systems in personalized web search, knowledge-based recommender system, Social tagging recommender systems, Trust-centric recommendations, Group recommender systems

UNIT-IV: Hybrid Approaches: opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade, Meta-level, Limitations of hybridization strategies

UNIT-V: Evaluating Recommender System: Introduction, General properties of evaluation research, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations.

Text Books:

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
2. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer (2016), 1st ed.

Reference Books:

1. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st ed.
2. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1st ed.

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		3	0	0	3

Pattern Recognition (MTNN11XX)

Course Objectives:

- To implement pattern recognition and machine learning theories
- To design and implement certain important pattern recognition techniques
- To apply the pattern recognition theories to applications of interest
- To implement the entropy minimization, clustering transformation and feature ordering

Course Outcomes:

- Design systems and algorithms for pattern recognition (signal classification), with focus on sequences of patterns that are analyzed using, e.g., hidden Markov models (HMM)
- Analyze classification problems probabilistically and estimate classifier performance,
- Understand and analyze methods for automatic training of classification systems,
- Apply Maximum-likelihood parameter estimation in relatively complex probabilistic models, such as mixture density models and hidden Markov models
- Understand the principles of Bayesian parameter estimation and apply them in relatively simple probabilistic models

UNIT- I: Introduction - Basic concepts, Applications, Fundamental problems in pattern Recognition system design, Design concepts and methodologies, Examples of Automatic Pattern recognition systems, Simple pattern recognition model, Decision and Distance Functions - Linear and generalized decision functions, Pattern space and weight space, Geometrical properties, implementations of decision functions, Minimum-distance pattern classifications.

UNIT-II: Probability-Probability of events, Random variables, Joint distributions and densities, Movements of random variables, Estimation of parameter from samples, Statistical Decision Making - Introduction, Baye's theorem, Multiple features, Conditionally independent features, Decision boundaries, Unequal cost of error, estimation of error rates, the leaving-one-out-techniques, characteristic curves, estimating the composition of populations. Baye's classifier for normal patterns.

UNIT-III: Non Parametric Decision Making - Introduction, histogram, kernel and window estimation, nearest neighbor classification techniques. Adaptive decision boundaries, adaptive discriminate functions, Minimum squared error
Discriminate functions, choosing a decision making techniques. Clustering and Partitioning - Hierarchical Clustering: Introduction, agglomerative clustering algorithm, the single-linkage, complete-linkage and average-linkage algorithm. Ward's method Partition clustering-Forg's algorithm, K-means's algorithm, Isodata algorithm.

UNIT-IV: Pattern Preprocessing and Feature Selection: Introduction, distance measures, clustering transformation and feature ordering, clustering in feature selection through entropy minimization, features selection through orthogonal expansion, binary feature selection.

UNIT-V: Syntactic Pattern Recognition & Application Of Pattern Recognition: Introduction, concepts from formal language theory, formulation of syntactic pattern recognition problem, syntactic pattern description, recognition grammars, automata as pattern recognizers, Application of pattern recognition techniques in bio-metric, facial recognition, IRIS scan, Finger prints, etc.,

Text Books:

1. Gose. Johnsonbaugh. Jost. " Pattern recognition and Image Analysis",PHI.
Tou. Rafael. Gonzalez. "Pattern Recognition Principle", PearsonEducation

Reference Book:

1. Richard duda, Hart., David Strok, "Pattern Classification", John Wiley.

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		2	0	0	2

Research Methodology and IPR

UNIT 1:
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT 2:
Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT 3:
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT 4:
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT 5:
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCES:

(1) Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
(2) Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
(3) Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
(4) Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
(5) Mayall, "Industrial Design", McGraw Hill, 1992.
(6) Niebel, "Product Design", McGraw Hill, 1974.
(7) Asimov, "Introduction to Design", Prentice Hall, 1962.
(8) (8) Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
(9) T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

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I Year - I Semester		L	T	P	C
		0	0	4	2

Advanced Data Structures Lab (MTNN1106)

Course Objectives:
From the course the student will learn

- Knowing about oops concepts for a specific problem.
- Various advanced data structures concepts like arrays, stacks, queues, linked lists, graphs and trees.

Course Outcomes:

- Identify classes, objects, members of a class and relationships among them needed for a specific problem.
- Examine algorithms performance using Prior analysis and asymptotic notations.
- Organize and apply to solve the complex problems using advanced data structures (like arrays, stacks, queues, linked lists, graphs and trees.)
- Apply and analyze functions of Dictionary

List of Experiments

Experiment 1:
Implement Multi stacks.
Experiment 2:
Implement Double Ended Queue (Dequeues) & Circular Queues.
Experiment 3:
Implement various Recursive operations on Binary Search Tree.
Experiment 4:
Implement various Non-Recursive operations on Binary Search Tree.
Experiment 5:
Implement BFS for a Graph
Experiment 6:
Implement DFS for a Graph.
Experiment 7:
Implement Merge & Heap Sort of given elements.
Experiment 8:
Implement Quick Sort of given elements.
Experiment 9:
Implement various operations on AVL trees.
Experiment 10:
Implement B Tree operations.
Experiment 11:
Implementation of Binary trees Traversals Techniques.
Experiment 12:
Implement Krushkal's algorithm to generate a min-cost spanning tree.
Experiment 13:
Implement Prim's algorithm to generate a min-cost spanning tree.
Experiment 14:
Implement functions of Dictionary using Hashing.

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I Year - I Semester		L	T	P	C
		0	0	4	2

Neural Networks Lab (MTNN1107)

Course Objectives:

- This course will serve as a comprehensive introduction to various topics in machine learning. At the end of the course
- The students should be able to design and implement machine learning solutions to classification, regression, and clustering problems; and be able to evaluate and interpret the results of the algorithms.

Course Outcomes:

- Create a custom feed-forward network.
- Design Constructing Layers
- Setting Transfer Functions, Each layer has its own transfer function
- Define which is set through the net. Layers{i}.transferFcn property
- Discriminative Learning models: Logistic Regression, Perceptrons, Artificial Neural Networks, Support Vector Machines.

Note: The experiments need to be implemented using MATLAB.

List of Experiments

Sample Problem Statement: Create a custom feed-forward network .It consists of the following sections:

1. Network Layers
   - Constructing Layers
   - Connecting Layers
   - Setting Transfer Functions
2. Weights and Biases
3. Training Functions & Parameters
   - The difference between train and adapt
   - Performance Functions
   - Train Parameters
4. Conclusion

1. Network Layers

- **Constructing Layers**

  assume you have an empty network object named `net' in your workspace
  >> net = network

  Define properties of input layer
  >> net.numInputs = 1

  Define the number of neurons in the input layer. This should of course be equal to the dimensionality of data set. The appropriate property to set is net.

inputs{i}.size, where i is the index of the input layers.
So to make a network which has 2 dimensional points as inputs, type:
>> net.inputs{1}.size = 2;

net.numLayers represents the total number of layers in the network, and net.layers{i}.size, which sets the number of neurons in the i^{th} layer. To build our example network, we define 2 extra layers (a hidden layer with 3 neurons and an output layer with 1 neuron),using:
>> net.numLayers = 2;
>> net.layers{1}.size = 3;
>> net.layers{2}.size = 1;

- **Connecting Layers**
  >> net.inputConnect(1) = 1;
  >> net.layerConnect(2, 1) = 1;
  >> net.outputConnect(2) = 1;
  >> net.targetConnect(2) = 1;

- **Setting Transfer Functions**
  Each layer has its own transfer function which is set through the net.layers{i}.transferFcn property. So to make the first layer use sigmoid transfer functions, and the second layer use linear transfer functions,
  >> net.targetConnect(2) = 1;
  >> net.layers{2}.transferFcn = 'purel

2. Weights and Biases

Define which layers have biases by setting the elements of net.bias Connect to either 0 or 1, where net.biasConnect(i) = 1 means layer i has biases attached to it.

To attach biases to each layer in network use
>> net.biasConnect = [1 ; 1];

- Iinitialisation procedure for the weights
  reset all weights and biases by using
  >> net = init(net);

- Each layer of weights and biases use their own initialisation routine to initialise.
  >> net.initFcn = 'initlay';

- The initialisation for each set of weights and biases separately.
  >> net.layers{i}.initFcn = 'initnw';
  >> net.layers{i}.initFcn = 'initwb';

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- Define the initialisation for the input weights,
  >> net.inputWeights{1,1}.initFcn = 'rands';

- Define the initialisation for each set of biases
  >> net.biases{i}.initFcn = 'rands';

- Define the initialisation for weight matrices
  >> net.layerWeights{i,j}.initFcn = 'rands';

where net.layerWeights{i,j} denotes the weights from layer j to layer i.

2. Training Functions & Parameters

- The difference between train and adapt
  When using adapt, both incremental and batch training can be used. Which one is actually used depends on the format of your training set. If it consists of two matrices of input and target vectors

  ```
  >> P = [ 0.3 0.2 0.54 0.6 ; 1.2 2.0 1.4 1.5]
  ```

  P is input vector and T is Target vector

  ```
  >> T = [ 0 1 1 0 ]
  ```

- Performance Functions
  The performance function is set with means quare error

  ```
  >> net.performFcn = 'mse';
  ```

- Train Parameters
  Train network using a Gradient Descent w/ Momentum algorithm

  ```
  >> net.trainFcn = 'traingdm';
  ```

- set the parameters

  ```
  >> net.trainParam.lr = 0.1;
  >> net.trainParam.mc = 0.9;
  ```

  lr is the learning rate, and mcis the the momentum term
  Two other useful parameters are net.trainParam.epochs, which is the maximum number of times the complete data set may be used for training, and net.trainParam.show, which is the time between status reports of the training function.

  ```
  >> net.trainParam.epochs = 1000;
  >>net.trainParam.show=100;
  ```