(w.e.f 2015-2016)

Jawaharlal Nehru Technological University Anantapur
College Of Engineering Anantapur (Autonomous)
Course Structure for Master of Technology (Artificial Intelligence)
(w.e.f 2015-16)

I Year I Semester

Code	Subject	L	T/P/D	C
15D53101	Advances in Artificial Intelligence	4	0	4
15D53102	Problem Solving Methods	4	0	4
15D53103	Knowledge Representation and Reasoning	4	0	4
15D53104	Machine Learning	4	0	4
	Elective- I	4	0	4
15D53105	1. Digital Image Processing			
15D53106	2. Pattern Recognition			
15D53107	3. Robotics & Automation			
	Elective –II	4	0	4
15D53108	1. Logic Programming using Prolog & Lisp			
15D53109	2. Expert Systems			
15D53110	3. Intelligent systems			
15D53111	Artificial Intelligence & Functional Programming Lab	0	4	2
	Total	**24**	**4**	**26**

I Year II Semester

Code	Subject	L	T/P/D	C
15D53201	Artificial Neural Networks	4	0	4
15D53202	Speech Processing	4	0	4
15D51202	Natural Language Processing	4	0	4
15D53203	Genetic Algorithms & Applications	4	0	4
	Elective –III	4	0	4
15D53204	1. Advanced Data Mining			
15D51208	2. Big Data Analytics			
15D53205	3. Computational Intelligence			
	Elective –IV	4	0	4
15D53206	1. Text Processing			
15D53207	2. Geographical Information System & Spatial Decision Support System			
15D53208	3. Logic and Engineering			
15D54201	Research Methodology (Audit Course)			
15D53209	Natural Language Processing & Genetic Algorithms Lab	0	4	2
	Total	**24**	**4**	**26**

(w.e.f 2015-2016)

III & IV Semester

Code	Subject	L	P	C
15D53301	**III Semester Seminar - I**	0	4	2
15D53401	**IV Semester Seminar - II**	0	4	2
15D53302	**III & IV Semester Project Work**	--	--	44
	Total	**0**	**8**	**48**

Note: All End Examinations (Theory and Practical) are of three hours duration.

T- Tutorial L- Theory P- Practical/Drawing C - Credits

(w.e.f 2015-2016)

JNTUA College of Engineering (*Autonomous*) :: Ananthapuramu

Department of Computer Science & Engineering

M.Tech. I– I Sem (AI)	**T**	**P**	**C**
	4	**0**	**4**

15D53101: Advances in Artificial Intelligence

Objectives:

- To learn the difference between optimal reasoning Vs human like reasoning
- To understand the notions of state space representation, exhaustive search, heuristic search along with the time and space complexities
- To learn different knowledge representation techniques
- To understand the applications of AI: namely Game Playing, Theorem Proving, Expert Systems, Machine Learning and Natural Language Processing

UNIT-I

Introduction: What is AI? Foundations of AI, History of AI, Agents and environments, The nature of the Environment, Problem solving Agents, Problem Formulation, Search Strategies

UNIT-II

Knowledge and Reasoning: Knowledge-based Agents, Representation, Reasoning and Logic, Prepositional logic, First-order logic, Using First-order logic, Inference in First-order logic, forward and Backward Chaining

UNIT-III

Learning: Learning from observations, Forms of Learning, Inductive Learning, Learning decision trees, why learning works, Learning in Neural and Belief networks

UNIT-IV

Practical Natural Language Processing: Practical applications, Efficient parsing, Scaling up the lexicon, Scaling up the Grammar, Ambiguity, Perception, Image formation, Image processing operations for Early vision, Speech recognition and Speech Synthesis

UNIT-V

Robotics: Introduction, Tasks, parts, effectors, Sensors, Architectures, Configuration spaces, Navigation and motion planning, Introduction to AI based programming Tools

TEXT BOOKS

1. Stuart Russell, Peter Norvig: "Artificial Intelligence: A Modern Approach",2nd Edition, Pearson Education, 2007

REFERENCES

1. Artificial Neural Networks B. Yagna Narayana, PHI

2. Artificial Intelligence , 2nd Edition, E.Rich and K.Knight (TMH).

3. Artificial Intelligence and Expert Systems – Patterson PHI.

4. Expert Systems: Principles and Programming- Fourth Edn, Giarrantana/ Riley, Thomson.

5. PROLOG Programming for Artificial Intelligence. Ivan Bratka- Third Edition – Pearson Education.

6. Neural Networks Simon Haykin PHI

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M.Tech. I– I Sem (AI)	**T**	**P**	**C**
	4	**0**	**4**

15D53102: Problem Solving Methods

Objectives:

- To explain problem solving and reasoning strategies in AI systems
- To enable students to analyze a problem so that appropriate problem solving techniques may be applied
- To recognize the importance of dealing with the cause of a problem, rather than just dealing with the effect of a problem
- To learn how to generate alternative solutions, using creative thinking and brainstorming
- To learn the different stages of the decision making process and understand the importance of each stage in ensuring effective decisions are made
- To enable students to apply problem solving and decision making models to the workplace.

UNIT I

General introduction of AI: What is AI?, The foundations of AI, The history of AI, The state of the art.

Intelligent agents: Agents and environments, Good behavior: The concept of reality, The nature of environments, The structure of agents, AI applications.

UNIT II

Solving problems by searching: Problem-solving agents, Example problems, Searching for solutions, Uninformed search strategies, Avoiding repeated states, Searching with partial information.

Informed search and exploration: Informed search strategies, Heuristic functions, Local search algorithms and optimization problems, Local search in continuous spaces, Online search agents and unknown environments.

UNIT III

Constraint satisfaction problems: Backtracking search for CSPs, Local search for constraint satisfaction problems, The structure of problems.

Adversarial search: Games, Optimal decisions in games, Alpha-beta pruning, Imperfect real-time decisions, Games that include an element of chance, State-of-the-art game programs.

UNIT IV

Formalized symbolic logics: Introduction, Syntax and semantics for propositional logic, Syntax and semantics for first order propositional logic, Properties of WFFS, Connection to clausal

form, Inference rules, The resolution principle, Non-deductive inference methods, Representations using rules.
Resolution refutation systems: Production systems for resolution refutations, Control strategies for resolution methods, Simplification strategies, Extracting answers from resolution refutations.

UNIT V
The Planning problem: Planning with state-space search, Partial-order planning, Planning graphs, Planning with propositional logic, Analysis of planning approaches.
Planning and acting in the real world: Time, schedules, and resources, Hierarchical task network planning, planning and acting in nondeterministic domains, Conditional planning, Execution monitoring and replanning, Continuous planning, Multi-agent planning.
AI system architectures, Knowledge acquisition, Representational formalisms.

Text Books:

1. D. W. Patterson: Introduction to AI & Expert System, PHI.
2. S. Russell and P. Norvig. AI: A Modern Approach, 2nd Edn., McGraw-Hill, 2003.

Reference Books:

1. J. Siekmann, R. Goebel, and W. Wahlster: Problem Solving Methods, Springer, 2000 edition
2. N.J.Nilsson: Principles of Artificial Intelligence, Narosa Publications.

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M.Tech. I– I Sem (AI)	**T**	**P**	**C**
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15D53103: Knowledge Representations and Reasoning

Objectives:

- To investigate the key concepts of knowledge representation (KR) techniques and different notations.
- To integrate the KR view as a knowledge engineering approach to model organizational knowledge.
- To introduce the study of ontologies as a KR paradigm and applications of ontologies.
- To understand various KR techniques.
- To understand process, knowledge acquisition and sharing of ontology.

Course Outcomes:

- Analyze and design knowledge based systems intended for computer implementation.
- Acquire theoretical knowledge about principles for logic-based representation and reasoning.
- Ability to understand *knowledge*-engineering process
- Ability to implement production systems, frames, inheritance systems and approaches to handle uncertain or incomplete knowledge.

UNIT I:

The Key Concepts: Knowledge, Representation, Reasoning, Why knowledge representation and reasoning, Role of logic

Logic: Historical background, Representing knowledge in logic, Varieties of logic, Name, Type, Measures, Unity Amidst diversity

UNIT II:

Ontology: Ontological categories, Philosophical background, Top-level categories, Describing physical entities, Defining abstractions, Sets, Collections, Types and Categories, Space and Time

UNIT III:

Knowledge Representations: Knowledge Engineering, Representing structure in frames, Rules and data, Object-oriented systems, Natural language Semantics, Levels of representation

UNIT IV:

Processes: Times, Events and Situations, Classification of processes, Procedures, Processes and Histories, Concurrent processes, Computation, Constraint satisfaction, Change

Contexts: Syntax of contexts, Semantics of contexts, First-order reasoning in contexts, Modal reasoning in contexts, Encapsulating objects in contexts.

UNIT V:

Knowledge Soup: Vagueness, Uncertainty, Randomness and Ignorance, Limitations of logic, Fuzzy logic, Nonmonotonic Logic, Theories, Models and the world, Semiotics

Knowledge Acquisition and Sharing: Sharing Ontologies, Conceptual schema, Accommodating multiple paradigms, Relating different knowledge representations, Language patterns, Tools for knowledge acquisition

Text Books:

1. Knowledge Representation *logical, Philosophical, and Computational Foundations* by John F. Sowa, Thomson Learning.
2. Knowledge Representation and Reasoning by Ronald J. Brachman, Hector J. Levesque, Elsevier.

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M.Tech. I– I Sem (AI)	**T**	**P**	**C**
	4	**0**	**4**

15D53104: Machine Learning

Objectives:

- To understand the basic theory underlying machine learning.
- To be able to formulate machine learning problems corresponding to different applications.
- To understand a range of machine learning algorithms along with their strengths and weaknesses.
- To be able to apply machine learning algorithms to solve problems of moderate complexity.

Course Outcomes:

- Ability to understand what is learning and why it is essential to the design of intelligent machines.
- Ability to design and implement various machine learning algorithms in a wide range of real-world applications.
- Acquire knowledge deep learning and be able to implement deep learning models for language, vision, speech, decision making, and more

UNIT I INTRODUCTION

Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

UNIT II NEURAL NETWORKS AND GENETIC ALGORITHMS

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evalution and Learning.

UNIT III BAYESIAN AND COMPUTATIONAL LEARNING

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian

Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

UNIT IV INSTANT BASED LEARNING

K- Nearest Neighbour Learning – Locally weighted Regression – Radial Bases Functions – Case Based Learning.

UNIT V ADVANCED LEARNING

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning

TEXT BOOKS:

1. Machine Learning – Tom M. Mitchell, - MGH

REFERENCE BOOKS

1. Machine Learning: An Algorithmic Perspective, Stephen Marsland, Taylor & Francis

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15D53105: DIGITAL IMAGE PROCESSING

Elective-I

Objectives:

- Develop an overview of the field of image processing.
- Understand the Image segmentation, enhancement, compression etc., approaches and how to implement them.
- Prepare to read the current image processing research literature.
- Gain experience in applying image processing algorithms to real problems
- Analyze general terminology of digital image processing.

Unit - I :

Digital Image Fundamentals: What is Digital Image Processing, examples of fields that use digital image processing, fundamental Steps in Digital Image Processing, Components of an Image processing system, Image Sampling and Quantization, Some Basic Relationships between Pixels, Linear and Nonlinear Operations.

Unit – II:

Image Enhancement: Image Enhancement in the spatial domain: some basic gray level transformations, histogram processing, enhancement using arithmetic and logic operations, basics of spatial filters, smoothening and sharpening spatial filters, combining spatial enhancement methods.

Unit – III :

Segmentation: Thresholding, Edge Based Segmentation: Edge Image Thresholding, Region Based Segmentation, Matching, **Representation and Description**: Representation , Boundary Descriptors, Regional Descriptors.

Unit – IV :

Image Compression: Fundamentals, image compression models, elements of information theory, error-free compression, lossy compression,Image Compression Stanadrds.

Unit – V :

Morphological Image Processing: Preliminaries, dilation, erosion, open and closing, hit transformation, basic morphologic algorithms.
Color Image Processing: Color fundamentals, Color Models and basics of full-color image processing

Text Books :

1. "Digital Image Processing", Rafael C.Gonzalez and Richard E. Woods, Third Edition, Pearson Education, 2007
2. Digital Image Processing", S.Sridhar, Oxford University Press

Reference Books :

1. "Fundamentals of Digital Image Processing" , S. Annadurai, Pearson Edun, 2001.
2. "Digital Image Processing and Analysis", B. Chanda and D. Dutta Majumdar, PHI, 2003.
3. "Image Processing" , Analysis and Machine Vision , Milan Sonka, Vaclav Hlavac and Roger Boyle, 2nd Edition, Thomson Learning, 2001.
4. "Digital Image Processing" Vipula Singh, Elsevier

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15D53106: PATTERN RECOGNITION
Elective-I

Objectives:

- Understand the fundamental pattern recognition and machine learning theories
- Able to design and implement certain important pattern recognition techniques
- Capable of applying the pattern recognition theories to applications of interest.

Unit - I :

Introduction to Pattern Recognition: Data Sets for Pattern Recognition, Different Paradigms for Pattern Recognition,

Pattern Representation: Data Structures for Pattern Representation, Representation of Clusters, Proximity Measures, Size of Patterns, Abstractions of the Data Set, Feature, Feature Selection, Evaluation of Classifiers, Evaluation of Clustering

Unit – II:

Nearest Neighbour Based Classifiers: Nearest Neighbour Algorithm, Variants of the NN Algorithm , Use of the Nearest Neighbour Algorithm for Transaction Databases, Efficient Algorithms, Data Reduction, Prototype Selection,

Bayes Classifier: Bayes Theorem, Minimum error rate classifier, Estimation of Probabilities, Comparison with the NNC, Naive Bayes Classifier, Bayesian Belief Network.

Unit – III :

Hidden Markov Models: Markov Models for Classification, Hidden Markov Models, Classification Using HMMs, Classification of Test Patterns.

Decision Trees: Introduction, Decision Trees for Pattern Classification, Construction of Decision Trees, Splitting at the Nodes, Over fitting and Pruning, Example of Decision Tree Induction.

Unit – IV :

Support Vector Machines: Introduction, Linear Discriminant Functions, Learning the Linear Discriminant Function, Neural Networks, SVM for Classification, Linearly Separable Case, Non-linearly Separable Case.

Combination of Classifiers: Introduction, Methods for Constructing Ensembles of Classifiers, Methods for Combining Classifiers, Evaluation of Classifiers, Evaluation of Clustering

Unit – V :

Clustering: Clustering and its Importance, Hierarchical Algorithms, Partitional Clustering, Clustering Large Data Sets, An Application to Handwritten Digit Recognition: Description of the Digit Data, Pre-processing of Data, Classification Algorithms, Selection of Representative Patterns.

Text Books :

1. Pattern Recognition an Introduction, V. Susheela Devi M. Narasimha Murty, University Press.
2. Pattern Recognition, Segrios Theodoridis,Konstantinos Koutroumbas, Fourth Edition, Elsevier

Reference Books :

1. Pattern Recognition and Image Analysis, Earl Gose, Richard John Baugh, Steve Jost, PHI 2004.
2. C. M. Bishop, 'Neural Networks for Pattern Recognition', Oxford University Press, Indian Edition, 2003.
3. Pattern Classification, R.O.Duda, P.E.Hart and D.G.Stork, Johy Wiley, 2002

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M.Tech. I– I Sem (AI)	**T**	**P**	**C**
	4	**0**	**4**

15D53107: Robotics & Automation

(Elective - I)

Course Outcomes:

- Acquire basic Knowledge on Robots
- Ability to process end effectors and robotic controls.
- Analyze Robot Transformations and Sensors
- Able to understand Robot cell design and applications

UNIT I-Introduction

Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems

UNIT II- End Effectors And Robot Controls

Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot controls-Point to point control, Continuous path control, Intelligent robot-Control system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDT-Motion Interpolations-Adaptive control.

UNIT III-Robot Transformations and Sensors

Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile

sensor – Proximity and range sensors – Robotic vision sensor-Force sensor-Light sensors, Pressure sensors.

UNIT IV-Robot Cell Design And Applications

Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, actuation using MATLAB, NXT Software Introductions-Robot applicationsMaterial handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and undersea robot.

UNIT V-Micro/Nano Robotics System

Micro/Nanorobotics system overview-Scaling effect-Top down and bottom up approach-Actuators of Micro/Nano robotics system-Nanorobot communication techniques-Fabrication of micro/nano grippers-Wall climbing micro robot working principles-Biomimetic robot-Swarm robot-Nanorobot in targeted drug delivery system

Textbooks:

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
2. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012.

References:

1. Carl D. Crane and Joseph Duffy, Kinematic Analysis of Robot manipulators, Cambridge University press, 2008.
2. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “Robotics control, sensing, vision and intelligence”, McGraw Hill Book co, 1987
3. Craig. J. J. “Introduction to Robotics mechanics and control”, Addison- Wesley, 1999.
4. Ray Asfahl. C., “Robots and Manufacturing Automation”, John Wiley & Sons Inc.,1985.

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M.Tech. I– I Sem (AI)	T	P	C
	4	0	4

15D53108: Logic Programming using Prolog & Lisp
(Elective -II)

Objectives:
Students will become familiar with:

- the basic syntax of Prolog language.
- giving a declarative and procedural reading of a Prolog program.
- pursuing any course that makes use of predicate calculus or Prolog.
- how to better utilize recursion through functional programming
- how to write common Lisp programs as groups of functions and definitions
- how to use the common Lisp programming environment including the debugger
- what symbolic computing is and some common AI problems and Lisp-based solutions
- Programming concepts like variable binding, memory allocation and deallocation, scope, the run-time stack. etc.

UNIT I
Prolog Representation: Introduction, Logic-Based Representation, Prolog Syntax, Creating, Changing, and Tracing a Prolog Computation, Lists and Recursion in Prolog.
Structured Representation and Inheritance Search: Abstract Data Types and Search, Using cut, Control Search in prolog, Abstract Data Types (ADTs) in Prolog.

UNIT II
Depth-First, Breadth-First and Best-First Search: Production System Search, Designing Alternative Search Strategies.
Meta-Linguistic Abstraction, Types and Meta-Interpreters: Meta-Interpreters, Types, and Unification, Types in prolog, Unification, Variable Binding, and Evaluation.

UNIT III
Machine Learning Algorithms in Prolog: Machine Learning: Version Space Search, Explanation Based Learning in Prolog.
Programming in Lisp: S-Expressions, Syntax of LISP, Lists and Recursive Search, Variables, Datatypes, High Order Functions, Logic Programming in LISP, Lisp-Shell.

UNIT IV
Semantic Networks, Inheritance and Machine Learning: Sematic Nets, Inheritance, Object-

Oriented Lisp, Learning ID3 Algorithm, Implementing ID3 Algorithm.

UNIT V

Java, Representation and Object-Oriented Programming, Problem Spaces and Search, A Logic-Based Reasoning System, An Expert System Shell

TEXT BOOKS

1. George F. Luger, William A. Stubblefield, Pearson Publishers, AI Algorithms, Data Structures, and Idioms in Prolog, Lisp and Java 6th Edition

REFERENCES

1. Logic, Programming and Prolog by Ulf Nilsson, Jan Maluszynski.Wiley; 2 edition (August 1995)
2. The Art of Prolog: Advanced Programming Techniques (Mit Press Series in Logic Programming) by Leon Sterling and Ehud Shapiro (Oct 1986)
3. Prolog Programming for Artificial Intelligence (4th Edition) (International Computer Science Series) by Ivan Bratko (Aug 31, 2011)
4. Paradigms of Artificial Intelligence Programming: Case Studies in Common Lisp by Peter Norvig (Oct 15, 1991)
5. Common LISP: The Language by Guy L. Steele (Mar 16, 1984)
6. Lisp 3rd Edition, Bertbold Klaus Paul Horn, Patrick Henry Winston
7. Artificial Intelligence Common LISP 1st Edition (Hardcover) by Noyes, James S. Noyer, James L. Noyes

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M.Tech. I– I Sem (AI)	T	P	C
	4	0	4

15D53109: Expert Systems

(Elective - II)

Course Outcomes:

- Acquire knowledge on fundamentals of knowledge representation
- Analyze Probabilistic Reasoning for knowledge
- Able to understand expert systems architecture

UNIT I

Overview of Artificial Intelligence: Definition & Importance of AI.

Knowledge: General Concepts: Introduction, Definition and Importance of Knowledge, Knowledge-Based Systems, And Representation of Knowledge, Knowledge Organization, Knowledge Manipulation, And Acquisition of Knowledge.

UNIT II

Knowledge Representation: Introduction, Syntax and Semantics for Propositional logic, Syntax and Semantics for FOPL, Properties of Wffs, Conversion to Clausal Form, Inference Rules, The Resolution Principle, No deductive Inference Methods, Representations Using Rules.

UNIT III

Dealing with Inconsistencies and Uncertainties: Introduction, Truth Maintenance Systems, Default Reasoning and the Closed World Assumption, Predicate Completion and Circumscription, Modal and Temporal Logics.

Probabilistic Reasoning: Introduction, Bayesian Probabilistic Inference, Possible World Representations, Dumpster-Shafer Theory, Ad-Hoc Methods.

UNIT IV

Structured Knowledge: Graphs, Frames and Related Structures: Introduction, Associative Networks, Frame Structures, Conceptual Dependencies and Scripts.

Object-Oriented Representations: Introduction, Overview of Objects, Classes, Messages and Methods, Simulation Example using an OOS Program.

UNIT V

Knowledge Organization and Management: Introduction, Indexing and Retrieval Techniques, Integrating Knowledge in Memory, Memory Organization Systems.

Expert Systems Architectures: Introduction, Rule Based System Architecture, Non-Production System Architecture, Dealing with uncertainty, Knowledge Acquisition and Validation, Knowledge System Building Tools.

Text Book:

1. Dan W. Patterson - Introduction to Artificial Intelligence and Expert Systems, PHI, New Delhi, 2006.

Reference Books:

1. E. Rich & K. Knight - Artificial Intelligence, 2/e, TMH, New Delhi, 2005.

2. P.H. Winston - Artificial Intelligence, 3/e, Pearson Edition, New Delhi, 2006.

3. D.W. Rolston,- Principles of AI & Expert System Development, TMH, New Delhi.

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M.Tech. I– I Sem (AI)	T	P	C
	4	0	4

15D53110: Intelligent Systems
(Elective - II)

Objectives:

- One of the major challenges of Intelligent Systems is to make the computer systems on which we rely so much more "intelligent". There are two ways in which a system can be taken to act intelligently.
- Artificial intelligence covers a whole range of methods, from logical, symbol manipulation methods with attached semantics to statistical and heuristic techniques.
- Knowledge is mainly statistical: the aim is not to understand the fine structure or deeper origin of knowledge, but to generate intelligent behavior on the basis of statistical evidence.

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 ,Frames ,Semantic nets, 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. Search Methods: Depth-first search, Breadth-first search, Hill climbing search, A* search. 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.**

REFERENCES BOOKS:

1. Intelligent Systems and Control: Principles and Applications Paperback **– 12 Nov 2009** by Laxmidhar Behera, Indrani Kar by OXFORD.
2. Intelligent Systems and Technologies Methods and Applications by Springer publications.
3. *Intelligent Systems - Modeling, Optimization and Control,* by Yung C. Shin and Chengying Xu, CRC Press, Taylor & Francis Group, 2009

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M.Tech I Sem. (AI)	T	P	C
	0	3	2

15D53111:Artificial Intelligence and Functional Programming Lab

Course Objective

1. To provide students with a theoretical and practical base in Artificial Intelligence.
2. Students will be able purse their study in advanced functional programming.
3. Students will able to Design, Implement, and Analyze simple problem solving technique.
4. Students will able to identify, formulate, and solve problems.

Course Outcomes:

1. Able to understanding of the major areas and challenges of AI
2. Ability to apply basic AI algorithms to solve problems
3. Able to describe search strategies and solve problems by applying a suitable search method.
4. Able to describe and apply knowledge representation.

List of Experiments:

Week 1

1. Write a program to implementation of DFS
2. Write a program to implementation of BFS

Week 2

1. Write a Program to find the solution for traveling salesman Problem

Week 3

1. Write a program to implement Simulated Annealing Algorithm
2. Write a program to find the solution for wampus world problem

Week 4

1. Write a program to implement 8 puzzle problem

Week 5

1. Write a program to implement Tower of Hanoi problem

Week 6

1. Write a program to implement A* Algorithm

Week 7

1. Write a program to implement Hill Climbing Algorithm

Week 8

1. To Study JESS expert system

Week 9

1. To Study RVD expert system

(w.e.f 2015-2016)

Week 10

1. Write a Program to Perform Fibonacci Series
2. Write a Program to Check Sides of a Triangle

Week 11

1. Write a Program to Perform Length of List
2. Write a Program to Perform Reverse in List.

Week 12

1. Write a Prolog program to perform Arithmetic Mean.
2. Write a Program to Check Vowels or Not.

(w.e.f 2015-2016)

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15D53201: Artificial Neural Networks

Objectives:

- To Survey of attractive applications of Artificial Neural Networks.
- To practical approach for using Artificial Neural Networks in various technical, organizational and economic applications

UNIT I: INTRODUCTION: History Of Neural Networks, Structure And Functions Of Biological And Artificial Neuron, Neural Network Architectures, Characteristics Of ANN, Basic Learning Laws and Methods.

UNIT II: SUPERVISED LEARNING: Single Layer Neural Network and architecture, McCulloch-Pitts Neuron Model, Learning Rules, Perceptron Model, Perceptron Convergence Theorem, Delta learning rule, ADALINE, Multi-Layer Neural Network and architecture, MADALINE, Back Propagation learning, Back Propagation Algorithm.

UNIT III: UNSUPERVISED LEARNING-1: Outstar Learning, Kohenen Self Organization Networks, Hamming Network And MAXNET, Learning Vector Quantization, Mexican hat.

UNIT IV: UNSUPERVISED LEARNING-2: Counter Propagation Network -Full Counter Propagation network, Forward Only Counter Propagation Network, Adaptive Resonance Theory (ART) -Architecture, Algorithms.

UNIT V : ASSOCIATIVE MEMORY NETWORKS : Introduction, Auto Associative Memory ,Hetero Associative Memory, Bidirectional Associative Memory(BAM) -Theory And Architecture, BAM Training Algorithm, Hopfield Network: Introduction, Architecture Of Hopfield Network.

TEXT BOOKS:

1. B.Yegnanarayana" Artificial neural networks" PHI ,NewDelhi.
2. S.N.Sivanandam ,S.N.Deepa, "Introduction to Neural Networks using MATLAB 6.0", TATA MCGraw- Hill publications.
3. J .M. Zurada ,"Introduction to Artificial neural systems" –Jaico publishing.

REFERENCE BOOKS:

1. S.Rajasekaran and G.A.Vijayalakshmi pai “Neural Networks.Fuzzy Logic and genetic Algorithms”.
3. James A Freeman and Davis Skapura” Neural Networks Algorithm, applications and programming Techniques ”, Pearson Education, 2002.
4. Simon Hakins “Neural Networks “ Pearson Education.

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15D53202: Speech Processing

Objectives:

- To analyze a speech signal in terms of its frequency content.
- To understand the basics of human speech production mechanism.
- To understand which speech coding methods are used for what reasons.
- To implement LPC Analysis.

UNIT I

FUNDAMENTALS OF DIGITAL SPEECH PROCESSING: Anatomy & physiology of speech organs, The process of speech production, The acoustic theory of speech production, Digital models for speech signals.

UNIT II

TIME DOMAIN MODELS FOR SPEECH PROCESSING: Introduction- Window considerations, Short time energy and average magnitude short time average zero crossing rate, Speech Vs Silence discrimination using Average energy and zero crossing, Pitch period estimation using parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function.

UNIT III

LINEAR PREDICTIVE CODING (LPC) ANALYSIS: Basic principles of linear predictive analysis: The Autocorrelation method, The covariance method, solution of LPC equations: Cholesky Decomposition, solution for covariance method, Durbin's recursive solution for the Autocorrelation equations, Comparison between the methods of solution of the LPC parameters, Formant analysis using LPC parameters.

HOMOMORPHIC SPEECH PROCESSING: Introduction, Homomorphic systems for convolution: Properties of the complex cepstrum, computational considerations, The complex cepstrum of speech, pitch detection, Formant estimation, The homomorphic vocoder.

SPEECH SYNTHESIS

Formant Speech Synthesis –Concatenative Speech Synthesis – Prosodic Modification of Speech– Source Filter Models For Prosody Modification

UNIT IV

AUTOMATIC SPEECH RECOGNITION: Basic pattern recognition approaches, parametric representation of speech, Evaluating the similarity of speech patterns, isolated digit recognition system, continuous digit recognition system.

HIDDEN MARKOV MODEL (HMM) FOR SPEECH: Hidden markov model (HMM) for speech recognition, Viterbi algorithm, Training and testing using HMMS, Adapting to variability in speech, Language models.

UNIT V

SPEAKER RECOGNITION: Recognition techniques, Features that distinguish speakers, speaker recognition systems: speaker verification system, Speaker identification system.

SPEECH ENHANCEMENT: Nature of interfering sounds, speech enhancement techniques, spectral subtraction, Enhancement by re-synthesis.

TEXT BOOKS:

1. L.R.Rabiner and S.W.Schafer. Digital processing of speech signals,Pearson.
2. Douglas. O. Shaughnessy, speech communication, second edition Oxford university press,2000.
3. Fundamentals of speech recognition- L.R. Rabinar and B.H.Juang

REFERENCES:

1. Discrete Time Speech Signal Processing-Thomas F. Quateri1/e,Pearson.
2. Speech & Audio signal processing- Ben Gold & Nelson Morgan,1/e,Wiley.

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15D51202: Natural Language Processing

Objectives:

- able to explain and apply fundamental algorithms and techniques in the area of natural language processing (NLP)
- Understand approaches to syntax and semantics in NLP.
- Understand current methods for statistical approaches to machine translation.
- Understand language modeling.
- Understand machine learning techniques used in NLP.

UNIT I:

Introduction to Natural language

The Study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different Levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English Syntax.

Unit II: Grammars and Parsing

Grammars and Parsing- Top- Down and Bottom-Up Parsers, Transition Network Grammars, Feature Systems and Augmented Grammars, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.

UNIT III: Grammars for Natural Language

Grammars for Natural Language, Movement Phenomenon in Language, Handling questions in Context Free Grammars, Hold Mechanisms in ATNs, Gap Threading, Human Preferences in Parsing, Shift Reduce Parsers, Deterministic Parsers.

UNIT IV:

Semantic Interpretation

Semantic & Logical form, Word senses & ambiguity, The basic logical form language, Encoding ambiguity in the logical Form, Verbs & States in logical form, Thematic roles, Speech acts & embedded sentences, Defining semantics structure model theory.

Language Modeling

Introduction, n-Gram Models, Language model Evaluation, Parameter Estimation, Language Model Adaption, Types of Language Models, Language-Specific Modeling Problems, Multilingual and Crosslingual Language Modeling.

UNIT V:

Machine Translation

Survey: Introduction, Problems of Machine Translation, Is Machine Translation Possible, Brief History, Possible Approaches, Current Status.

Anusaraka or Language Accessor: Background, Cutting the Gordian Knot, The Problem,

Structure of Anusaraka System, User Interface, Linguistic Area, Giving up Agreement in Anusarsaka Output, Language Bridges.

Multilingual Information Retrieval

Introduction, Document Preprocessing, Monolingual Information Retrieval, CLIR, MLIR, Evaluation in Information Retrieval, Tools, Software and Resources.

Multilingual Automatic Summarization

Introduction, Approaches to Summarization, Evaluation, How to Build a Summarizer, Competitions and Datasets.

TEXT BOOKS:

1. James Allen, Natural Language Understanding, 2nd Edition, 2003, Pearson Education.
2.Multilingual Natural Language Processing Applications : From Theory To Practice-Daniel M.Bikel and Imed Zitouni , Pearson Publications.
3.Natural Language Processing, A paninian perspective, Akshar Bharathi,Vineet chaitanya,Prentice –Hall of India.

REFERENCES BOOKS:

1. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
2. Jurafsky, Dan and Martin, James, Speech and Language Processing, 2nd Edition, Prentice Hall, 2008.
3. Manning, Christopher and Henrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

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15D53203: Genetic Algorithms & Applications

Objectives:

- To understand the search methods in the genetic algorithms
- To implement the reproduction concepts.
- To design the techniques of dominance in genetic algorithms.

Course Outcomes:

- An ability to understand and the fundamental concepts of Genetic algorithms
- Understand the consequence of applying various genetic operators
- Ability to analyze GA operators and implement them to solve different types of GA problems
- Creating and understanding about the way the GA is used and the domain of application

UNIT- I INTRODUCTION TO GENETIC ALGORITHM

Introduction to Genetic Algorithm – Robustness of Traditional Optimization and Search methods – Goals of optimization-GA versus Traditional methods – Simple GA – GA at work – Similarity templates (Schemata) – Learning the lingo - **Mathematical foundations:** The fundamental theorem - Schema processing at work. – The 2-armed & k-armed Bandit problem. – The building Block Hypothesis. – Minimal deceptive problem.

UNIT – II GA OPERATORS

Data structures – Reproduction- Roulette-wheel Selection – Boltzman Selection – Tournament Selection-Rank Selection – Steady –state selection –Crossover mutation – A time to reproduce, a time to cross. – Get with the Main program. – How well does it work. – Mapping objective functions to fitness forum. – Fitness scaling. Coding – A Multi parameter, Mapped, Fixed – point coding – Discretization – constraints

UNIT – III APPLICATIONS OF GA

The rise of GA – GA application of Historical Interaction. – Dejung & Function optimization – Current applications of GA **-Advanced operators & techniques in genetic search :**Dominance, Diploidy & abeyance – Inversion & other reordering operators. – other mine-operators – Niche & Speciation – Multi objective optimization – Knowledge-Based Techniques. – GA & parallel processes – Real life problem

UNIT – IV INTRODUCTION TO GENETICS-BASED MACHINE LEARNING

Genetics – Based Machine learning – Classifier system – Rule & Message system – Apportionment of credit: The bucket brigade – Genetic Algorithm – A simple classifier system in Pascal. – Results using the simple classifier system.

(w.e.f 2015-2016)

UNIT –V APPLICATIONS OF GENETICS-BASED MACHINE LEARNING

The Rise of GBMC – Development of CS-1, the first classifier system. – Smitch's Poker player. – Other Early GBMC efforts. –Current Applications.

TEXT BOOKS

1. David E. Gold Berg, "Genetic Algorithms in Search, Optimization & Machine Learning", Pearson Education, 2001

2. S.Rajasekaran, G.A.Vijayalakshmi Pai, " Neural Networks, Fuzzy Logic and Genetic Algorithms ", PHI , 2003 (Chapters 8 and 9)

REFERENCE BOOK

1. Kalyanmoy Deb, "Optimization for Engineering Design, algorithms and examples", PHI 1995

2. An Introduction to Genetic Algorithm by Melanie Mitchell

3. The Simple Genetic Algorithm Foundation & Theores by Michael P. Vosk

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15D53204: Advanced Data Mining
(Elective-III)

Objectives:

- To develop the abilities of critical analysis to data mining systems and applications.
- To implement practical and theoretical understanding of the technologies for data mining
- To understand the strengths and limitations of various data mining models.

UNIT-I

Introduction about data mining, Need of data mining, Business data mining, data mining tools, Data Mining Process: CRISP Data Mining, Business Understanding, data understanding and data preparation, modeling, evaluation and deployment, SEMMAS Process, Data mining applications, comparison of CRISP & SEMMA.

UNIT-II

Memory-Based Reasoning Methods, Matching ,Weighted Matching, Distance Minimization Data Mining Methods As Tools X Contents, Association Rules in Knowledge Discovery, Market-Basket Analysis, Market Basket Analysis Benefits Demonstration on Small Set of Data, Real Market Basket Data The Counting Method Without Software.

UNIT-III

Fuzzy Sets in Data Mining, Fuzzy Sets and Decision Trees, Fuzzy Sets and Ordinal Classification, Fuzzy Association Rules, Demonstration Model, Computational Results, Testing Inferences.

Rough Sets :Theory of Rough Sets , Information System, Decision Table, Applications of Rough Sets, Rough Sets Software Tools, The Process of Conducting Rough Sets Analysis, Data Pre-Processing, Data Partitioning, Discretization, Reduct Generation, Rule Generation and Rule Filtering, Apply the Discretization Cuts to Test Dataset, Score the Test Dataset on Generated Rule set , Deploying the Rules in a Production System.

UNIT-IV

Support Vector Machines, Formal Explanation of SVM, Primal Form, Dual Form, Soft Margin, Non-linear Classification, Regression, implementation, Kernel Trick.

Use of SVM–A Process-Based Approach, Support Vector Machines versus Artificial Neural Networks, Disadvantages of Support Vector Machines, Genetic Algorithm Support to Data Mining, Demonstration of Genetic Algorithm, Application of Genetic Algorithms in Data Mining

(w.e.f 2015-2016)

UNIT-V

Performance Evaluation for Predictive Modeling, Performance Metrics for Predictive Modeling ,Estimation Methodology for Classification Models, Simple Split, The *k*-Fold Cross Validation Bootstrapping and Jackknifing, Area Under the ROC Curve.

Applications: Applications of Methods Memory-Based Application, Association Rule Application Fuzzy Data Mining, Rough Set Models, Support Vector Machine Application, Genetic Algorithm Applications-Product Quality Testing Design, Customer Targeting .

Text Book:

[1] Advanced Data Mining Techniques Authors: David L. Olson (Author), Dursun Delen.

References :

[1] Advances in data mining and modeling by Wai-Ki ChingMichael Kwok-Po Ng

[2] Advanced Techniques in Knowledge Discovery and Data Mining edited by Nikhil R. Pal, Lakhmi C Jain.

[3] Dynamic and Advanced Data Mining for Progressing Technological Development: Innovations and Systemic ApproachesA B M Shawkat Ali (Central Queensland University, Australia) and Yang Xiang (Central Queensland University, Australia)

(w.e.f 2015-2016)

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15D51208: Big Data Analytics
(Elective III)

Course Objectives:

- To understand Big Data Analytics for different systems like Hadoop.
- To learn the design of Hadoop File System.
- To learn how to analyze Big Data using different tools.
- To understand the importance of Big Data in comparison with traditional databases.

Course Outcomes:

- To gain knowledge about working of Hadoop File System.
- Ability to analyze Big Data using different tools.

UNIT- I

Introduction to Big Data. What is Big Data? Why Big Data is Important. Meet Hadoop Data, Data Storage and Analysis, Comparison with other systems, Grid Computing. A brief history of Hadoop. Apache hadoop and the Hadoop Ecosystem. Linux refresher, VMWare Installation of Hadoop.

UNIT-II

The design of HDFS. HDFS concepts. Command line interface to HDFS.Hadoop File systems. Interfaces. Java Interface to Hadoop. Anatomy of a file read. Anatomy of a file writes. Replica placement and Coherency Model. Parallel copying with distcp, keeping an HDFS cluster balanced.

UNIT-III

Introduction. Analyzing data with unix tools. Analyzing data with hadoop. Java MapReduce classes (new API). Data flow, combiner functions, Running a distributed MapReduce Job. Configuration API. Setting up the development environment. Managing configuration. Writing a unit test with MRUnit. Running a job in local job runner. Running on a cluster, Launching a job. The MapReduce WebUl.

UNIT-IV

Classic Mapreduce. Job submission. Job Initialization. Task Assignment. Task execution .Progress and status updates. Job Completion. Shuffle and sort on Map and reducer side.

Configuration tuning. Map Reduce Types. Input formats. Output cormats. Sorting. Map side and Reduce side joins.

UNIT-V

The Hive Shell. Hive services. Hive clients. The meta store. Comparison with traditional databases. Hive QI. Hbasics. Concepts. Implementation. Java and Map reduce clients. Loading data, web queries.

Text Books:

1. Tom White, Hadoop,"The Definitive Guide", 3rd Edition, O'Reilly Publications, 2012.

2. Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch ,"Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data", 1st Edition, TMH,2012.

References:

1. Big Data and Health Analytics Hardcover Katherine Marconi (Editor), Harold Lehmann (Editor)
2. Analytics in a Big Data World: The Essential Guide to Data Science and its Applications by bart baesens, Wiley publications.

(w.e.f 2015-2016)

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15D53205: Computational Intelligence
(ELECTIVE-III)

Course Objectives:

- Computational Intelligence is the successor to Artificial Intelligence
- Offering special benefits in its applications in certain areas like Classification, Regression, Pattern Matching, Control, Robotics, Data Mining etc.
- To introduce the basic tools and techniques in Computational Intelligence such as Neural Networks and Genetic Algorithms from an application perspective to the students.

UNIT I

Introduction: Background and history of evolutionary computation, Behavioral Motivations for Fuzzy Logic, Myths and Applications areas of Computational Intelligence. Adaption, Self organization and Evolution, Historical Views of Computational Intelligence, Adaption and Self organization for Computational Intelligence, Ability to Generalize, Computational Intelligence and Soft Computing Vs Artificial Intelligence and Hard Computing.

UNIT II

Review of evolutionary computation theory and concepts: History of Evolutionary Computation, Evolution Computation Overview, Genetic algorithms, Evolutionary programming, Evolution strategies, genetic programming, and particle swarm optimization.

UNIT III

Review of basic neural network theory and concepts: Neural Network History, What Neural Networks are and Why they are useful, Neural Networks Components and Terminology, Neural Networks Topology, Neural Network Adaption, Comparing Neural Networks and Other information Processing Methods, Preprocessing and Post Processing.

UNIT IV:

Fuzzy Systems Concepts and Paradigms: Fuzzy sets and Fuzzy Logic, Theory of Fuzzy sets , Approximate Reasoning , Fuzzy Systems Implementations , Fuzzy Rule System Implementation.

UNIT V:

Computational Intelligence Implementations: Implementation Issues, Fuzzy Evolutionary Fuzzy Rule System Implementation, Best tools, Applying Computational Intelligence to Data Mining.

Performance Metrics: General Issues, Percent Correct, Average Sum-squared Error.

(w.e.f 2015-2016)

Textbooks:

1. Computational Intelligence - Concepts to Implementations by Eberhart & Shi

References:

1. Introduction to Genetic Algorithms by Melanie Mitchell
2. Handbook of Genetic Algorithms by Davis
3. Machine Learning by Tom Mitchell

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15D53206: Text Processing
(Elective IV)

OBJECTIVES:
To understand:
- various static methods of the Character wrapper class
- additional methods of the String class
- the difference between a String object and a String Buffer object
- the use of a String Tokenizer object that extracts tokens from a string
- the processing of delimited values read in from a text file

UNIT-I
The Information Environment- Automatic information processing, Types of information. The Automated Office - The Office Environment, Analyzing Office Systems, File Management Systems, Office Display Systems, Office-Information Retrieval. Text Editing and Formatting-Introduction, Approaches to word Processing, Text Editing & Formatting, Typical processing systems, Automatic typesetting systems.

UNIT-II
Text Compression-Statistical language characteristics, rationale for text compression, Text compression methods. Text Encryption- Basic cryptographic concepts, Conventional cryptographic systems, DES. File Accessing Systems- Basic concepts, Sequential search, single key Indexed searches, Tree searching, Balanced Search Trees, Multiway Search Trees, Hash-Table Access, Indexed Searches for Multikey Access, Bitmap Encoding for Multikey Access.

UNIT-III
Conventional Text-Retrieval Systems- Database Management and Information Retrieval, Text Retrieval Using Inverted Indexing Methods, Typical File Organization, Text-scanning systems, Hardware aids to text searching. Automatic Indexing - Indexing Environment, Indexing Aims, Single – term Indexing Theories, Term Relationships in Indexing, Term-phrase Formation, Thesaurus-Group Generation, A blue print for Automatic indexing.

UNIT-IV
Advanced Information-Retrieval Models- The Vector Space Model, Automatic Document Classification, Probabilistic Retrieval Model, Extended Boolean Retrieval Model, Integrated System for Processing Text and Data, Advanced Interface Systems. Language Analysis and Understanding- The Linguistic Approach, Dictionary Operations, Syntactic Analysis, Knowledge-based Processing, Specialized Language Processing.

UNIT-V

Automatic Text Transformations- Text transformations, Automatic writing Aids, Automatic abstracting systems, Automatic Text Generation, Automatic Translation. Paperless Information Systems- Paperless Processing, Processing Complex Documents, Graphics Processing, Speech Processing, Electronic Mail and Messages, Electronic Information Services, Electronic Publications and the Electronic Library.

Text Books:

1. Gerald Salton, "Automatic Text Processing", Addison-Wesley, 1989.

References:

1. Bran Boguraev, Ted Briscoe (Eds), “Computational Lexicography for Natural Language Processing”, Longman, 1989.
2. A V Aho, Ravi Sethi, J D Ullman, "Compilers: Principles, Techniques and Tools", Addison-Wesley.
3. Robert Sedgewick, "Algorithms in C", Addison Wesley, 1990.

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15D53207: Geographical Information Systems & Spatial Decision Support Systems

(Elective-IV)

Course Outcomes:

- Analyse the Fundamental mechanism of GIS
- Process spatial and attribute data to prepare thematic maps
- Identify decision support models, methods, and technologies
- Analyse and prepare the DSS for the remote sensing and GIS applications

UNIT 1

Map – mapping concepts, analysis with paper based maps, limitations, Computer Automated Cartography – History and Developments, GIS- Definition, advantages of digital maps.

UNIT 2

Fundamentals of GIS – Information Systems, Modeling Real World Features Data , Data Formats – Spatial and Non-spatial, Components, Data Collection and Input, Data Conversion, Database Management – Database Structures, Files; Standard Data Formats, Compression Techniques, Hardware – Computing, printing and scanning systems; Software – Standard Packages like Arcview, ArcGIS, Autocad Map, Map Info etc.

UNIT 3

Spatial Analysis and Modeling – Proximity Analysis, Overlay Analysis, Buffer Analysis, Network Analysis, Spatial Auto Correlation, Gravity Modeling, DTM/DEM, Integration with Remote Sensing data

UNIT 4

Introduction: Concepts of decision making, systems and modeling, Need for DSS, Expert Systems.

Decision Analysis and Decision Making: Decision environments, Decision making under certainty, risk and uncertainty, Concepts of multicriteria decision making, Value and utility concepts in decision making, overview of methods of multicriteria decision making.

UNIT 5

Overview of DSS: Characteristics and capabilities of DSS, Components of DSS, Data management, model management and user interface subsystems, Classification of DSS, Development of DSS, Approaches to DSS construction, DSS development tools.

Text Books:

1. Thanappan Subash., Geographical Information System, Lambert Academic Publishing, 2011.
2. Paul Longley., Geographic Information systems and Science, John Wiley & Sons, 2005
3. Efraim Turban and Jay E. Aronson, Decision Support Systems and Intelligent Systems, Prentice Hall College Div; 5 edition.,1997.

References:

1. Marble, D.F & Calkins, H.W., Basic Readings in Geographic Information System, Spad System Ltd, 1990. ArcGIS 10.1 Manuals, 2013.
2. Kang Tsung Chang., Introduction to Geographic Information Systems, Tata Mc Graw Hill Publishing Company Ltd, New Delhi, 2008.
3. Burrough, P.A., Principles of GIS for Land Resource Assessment, Oxford Publications, 2005

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15D53208: Logic and Engineering
(Elective IV)

OBJECTIVES:

- To understand fuzzy logic basics and operations,
- To understand fuzzy arithmetic and representations and classical logic.
- Able to understand automated methods for fuzzy systems.
- Able to apply fuzzy logic for engineering problems.

UNIT-I

Introduction: The Case for Imprecision, A Historical Perspective, The Utility of Fuzzy Systems, Limitations of Fuzzy Systems, The Illusion: Ignoring Uncertainty and Accuracy, Uncertainty and Information, The Unknown, Fuzzy Sets and Membership, Chance Versus Fuzziness, Sets as Points in Hypercubes.

Classical Sets and Fuzzy Sets: Classical Sets, Fuzzy Sets

Classical Relations and Fuzzy Relations: Cartesian Product, Crisp Relations, Fuzzy Relations, Tolerance and Equivalence Relations, Fuzzy Tolerance and Equivalence Relations, Value Assignments, Other Forms of the Composition Operation.

Properties of Membership Functions, Fuzzification, and Defuzzification: Features of the Membership Function, Various Forms, Fuzzification, Defuzzification to Crisp Sets, λ-Cuts for Fuzzy Relations, Defuzzification to Scalars.

UNIT-II:

Logic and Fuzzy Systems: Logic, Fuzzy Systems.

Development of Membership Functions: Membership Value Assignments.

UNIT-III:

Automated Methods for Fuzzy System: Definitions, Batch Least Squares Algorithm, Recursive Least Squares Algorithm, Gradient Method, Clustering Method, Learning From Examples, Modified Learning From Examples,

Decision Making with Fuzzy Information: Fuzzy Synthetic Evaluation, Fuzzy Ordering, Nontransitive Ranking, Preference and Consensus, Multiobjective Decision Making, Fuzzy Bayesian Decision Method, Decision Making Under Fuzzy States and Fuzzy Actions.

UNIT-IV:

Fuzzy Classification: Classification by Equivalence Relations, Cluster Analysis, Cluster Validity, *c*-Means Clustering, Hard *c*-Means (HCM), Fuzzy *c*-Means (FCM), Classification Metric, Hardening the Fuzzy *c*-Partition, Similarity Relations from Clustering.

Fuzzy Pattern Recognition: Feature Analysis, Partitions of the Feature Space, Single-Sample Identification, Multifeature Pattern Recognition, Image Processing.

UNIT-V:

Fuzzy Arithmetic and the Extension Principle: Extension Principle, Fuzzy Arithmetic, Interval Analysis in Arithmetic, Approximate Methods of Extension

Fuzzy Control Systems: Control System Design Problem, Examples of Fuzzy Control System Design, Fuzzy Engineering Process Control, Fuzzy Statistical Process Control, Industrial Applications.

Text Book:

Timothy J. Ross, Fuzzy Logic with Engineering Applications, third edition, Willey, 2010.

Text Books:

2. Gerald Salton, "Automatic Text Processing", Addison-Wesley, 1989.

References:

4. Bran Boguraev, Ted Briscoe (Eds), “Computational Lexicography for Natural Language Processing”, Longman, 1989.
5. A V Aho, Ravi Sethi, J D Ullman, "Compilers: Principles, Techniques and Tools", Addison-Wesley.
6. Robert Sedgewick, "Algorithms in C", Addison Wesley, 1990.

(w.e.f 2015-2016)

JNTUA COLLEGE OF ENGINEERING (*AUTONOMOUS*) : : ANANTAPUR

Department Of Computer Science & Engineering

M.Tech. I – II Sem.(AI)

15D54201: Research Methodology (Audit Course)

(Audit Course For M.Tech. –II Semester Program from 2015 admitted batches onwards)

UNIT I

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

UNIT II

Sampling Design – steps in Sampling Design –Characteristics of a Good Sample Design – Random Sampling Design.
Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation.
Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

UNIT III

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

UNIT IV

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multi-variate Analysis.

UNIT V

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

Text books:

1. **Research Methodology:Methods and Techniques – C.R.Kothari, 2nd Edition,New Age International Publishers.**

2. **Research Methodology: A Step by Step Guide for Beginners- Ranjit Kumar, Sage Publications (Available as pdf on internet)**
3. **Research Methodology and Statistical Tools – P.Narayana Reddy and G.V.R.K.Acharyulu, 1st Edition,Excel Books,New Delhi.**

REFERENCES:

1. **Scientists must Write - Robert Barrass (Available as pdf on internet)**
2. **Crafting Your Research Future –Charles X. Ling and Quiang Yang (Available as pdf on internet)**

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15D53209: Natural Language Processing & Genetic Algorithms Lab

Objectives:

- able to explain and apply fundamental algorithms and techniques in the area of natural language processing (NLP)
- Understand language modeling.
- To implement the reproduction concepts.
- To design the techniques of dominance in genetic algorithms

Part A: Natural Language Processing

1. Write a program given a piece of text, we want to split the text at all spaces (including new line characters and carriage returns) and punctuation marks.

2. Write a program to remove the first and last characters if they are not letters or numbers from a given sentence.

3. Write a program to split a word into pair's at all possible positions. For example, carried will be split into {c, arried, ca ,rried, car, ried, carr, Ied, carri, ed, carri, d}.

4. Write a program to find out the frequencies of distinct words, given a sentence.

5. Write a program to remove digits from a given sentence using Greedy Tokenizer.

Part B: Genetic Algorithms

1. Write a program that generates a pseudorandom integer between some specified lower limit and some specified upper limit. Test the program by generating 1000 numbers between 3 and 12.
2. Create a procedure that receives two binary strings and a crossing site value, performs simple crossover, and returns two offspring strings. Test the program by crossover the following strings of length 10:1011101011, 0000110100. Try crossing site values of -3, 1, 6 and 20.

3. For the function $f(x)=x^2$ on the interval [0,31] coded as a five-bit, unsigned binary integer. Calculate the average fitness values for all 3^5 schemata.
4. Improve the efficiency of the selection procedure by implementing a binary search using cumulative selection probability distribution values.
5. Implement a coding routine to implement a floating-point code with specified mantissa and exponent.
6. Develop a ranking procedure that gives one copy to the population mean, MAX copies to the population best, with linear variation of copies assumed everywhere else (use stochastic remainder selection after ranking and assignment).
7. Develop a multiple-point crossover procedure similar to De Jong's with parameter CP (no. of crossover points).
8. Write a program and test the cycle crossover operator for a permutation string representation
9. Write a program to test the order crossover operator for permutation coding.
10. a) Write a program to demonstrate the genetic operator mutation.
    b) Write a program to demonstrate the crossover genetic operator.
11. Write a program to evolve a word with non-repetitive character (eg 'computer') by taking a population size of say 5 and performing mutation and crossover.

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Course Structure of R21 Academic Regulations for M.Tech (Regular) Programs with effect from AY 2021-2022

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ARTIFICIAL INTELLIGENCE

I SEMESTER

S.No.	Course Code	Subject Name	Cate Gory	Hours Per Week			Credits
				L	T	P	
1	21D53101	Fundamentals of Artificial Intelligence	PC	3	0	0	3
2	21D53102	Soft Computing	PC	3	0	0	3
3	**Professional Elective – I**						
	21D53103	Mathematics for Machine Learning	PE	3	0	0	3
	21D53104	Digital Image Processing					
	21D52105	Advanced Python Programming					
4	**Professional Elective – II**						
	21D52103	Advanced Data Structures and Algorithms	PE	3	0	0	3
	21D53105	Data Science					
	21D53106	Knowledge Representation and Reasoning					
5	21D11109	Research Methodology and IPR	MC	2	0	0	2
6	21D11110	English for Research Paper Writing	AC	2	0	0	0
	21D11111	Value Education					
	21D11112	Pedagogy Studies					
7	21D53107	Artificial Intelligence Lab	PC	0	0	4	2
8	21D53108	Soft Computing Lab	PC	0	0	4	2
Total				**16**	**00**	**08**	**18**

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ARTIFICIAL INTELLIGENCE

II SEMESTER

S.No.	Course Code	Subject Name	Cate Gory	Hours Per Week			Credits
				L	T	P	
1	21D53201	Knowledge Engineering & Intelligent Systems	PC	3	0	0	3
2	21D53202	Deep Learning	PC	3	0	0	3
3	**Professional Elective – III**						
	21D55105	Data Analytics	PE	3	0	0	3
	21D53203	Pattern Recognition					
	21D53204	Bio Inspired Computing					
4	**Professional Elective – IV**						
	21D53205	Intrusion Detection Systems	PE	3	0	0	3
	21D53206	Computer Vision					
	21D53207	Natural Language Processing					
5	21D11209	Technical Seminar	PR	0	0	4	2
6	21D11210	Disaster Management	AC	2	0	0	0
	21D11211	Constitution of India					
	21D11212	Stress Management by Yoga					
7	21D53208	Knowledge Engineering & Intelligent Systems Lab	PC	0	0	4	2
8	21D53209	Deep Learning Lab	PC	0	0	4	2
Total				**14**	**00**	**12**	**18**

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III SEMESTER

S.No.	Course Code	Subject Name	Cate Gory	Hours Per Week			Credits
				L	T	P	
1	**Professional Elective – V**						
	21D53301	Reinforcement Learning	PE	3	0	0	3
	21D53302	Applied Artificial Intelligence					
	21D53303	Speech Processing					
2	**Open Elective**						
	21D50301	Software Development and IT Services	OE	3	0	0	3
3	21D53304	Dissertation Phase – I	PR	0	0	20	10
4	21D00301	Co-Curricular Activities	PR				2
Total				**06**	**00**	**20**	**18**

IV SEMESTER

S.No.	Course Code	Subject Name	Cate Gory	Hours Per Week			Credits
				L	T	P	
1	21D53401	Dissertation Phase – II	PR	0	0	32	16
Total				**00**	**00**	**32**	**16**

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE)

Course Code	21D53101	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE (21D53101)	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- The goal of Artificial Intelligence is to build software systems that behave "intelligently".
- The ability to create representations of the domain of interest and reason with these representations is a key to intelligence.

Course Outcomes (CO): Student will be able to

- Understand the major areas and challenges of AI
- Ability to apply basic AI algorithms to solve problems
- Able to describe search strategies and solve problems by applying a suitable search method.
- Able to describe and apply knowledge representation
- To learn different knowledge representation techniques
- Represent knowledge of a domain formally,
- Design, implement and apply a knowledge-based system.

UNIT - I		Lecture Hrs:9

AI Problems and Search: AI problems, Techniques, Problem Spaces and Search, Heuristic Search Techniques- Generate and Test, Hill Climbing, Best First Search Problem reduction, Constraint Satisfaction and Means End Analysis. Approaches to Knowledge Representation-Using Predicate Logic and Rules.

UNIT - II		Lecture Hrs:9

Artificial Neural Networks: Introduction, Basic models of ANN, important terminologies, Supervised Learning Networks, Perceptron Networks, Adaptive Linear Neuron, Back propagation Network. Associative Memory Networks. Traing Algorithms for pattern association, BAM and Hopfield Networks.

UNIT - III		Lecture Hrs:9

Unsupervised Learning Network- Introduction, Fixed Weight Competitive Nets, Maxnet, Hamming Network, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization, Counter Propagation Networks, Adaptive Resonance Theory Networks. Special Networks-Introduction to various networks.

UNIT - IV		Lecture Hrs:9

Introduction to Classical Sets (crisp Sets)and Fuzzy Sets- operations and Fuzzy sets. Classical Relations -and Fuzzy Relations- Cardinality, Operations, Properties and composition. Tolerance and equivalence relations. Membership functions- Features, Fuzzification, membership value assignments, Defuzzification.

UNIT - V		Lecture Hrs:9

Fuzzy Arithmetic and Fuzzy Measures, Fuzzy Rule Base and Approximate Reasoning Fuzzy

Decision making Fuzzy Logic Control Systems, Genetic Algorithm- Introduction and basic operators and terminology. Applications: Optimization of TSP, Internet Search Technique.

Textbooks:

1. Artificial Intelligence – A Modern Approach. Second Edition, Stuart Russel, Peter Norvig, PHI/ Pearson Education.
2. Artificial Intelligence, Kevin Knight, Elaine Rich, B. Shivashankar Nair, 3rd Edition,2008
3. Artificial Neural Networks B. Yagna Narayana, PHI

Reference Books:

1. Artificial Intelligence, 2nd Edition, E.Rich and K.Knight (TMH).
2. Artificial Intelligence and Expert Systems – Patterson PHI.
3. Expert Systems: Principles and Programming- Fourth Edn, Giarrantana/ Riley, Thomson.
4. PROLOG Programming for Artificial Intelligence. Ivan Bratka- Third Edition – Pearson Education.
5. Neural Networks Simon Haykin PHI
6. Artificial Intelligence, 3rd Edition, Patrick Henry Winston., Pearson Edition

Online Learning Resources:

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE)

Course Code	21D53102	SOFT COMPUTING (21D53102)	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- To give students knowledge of soft computing theories fundamentals, i.e.
- Fundamentals of artificial and neural networks
- To gain knowledge of fuzzy sets and fuzzy logic and genetic algorithms.

Course Outcomes (CO): Student will be able to

- Understand intelligent agents.
- Solve searching problems using A*, Mini-Max algorithms.
- Create operations and Fuzzy sets logic.
- Use Bayesian learning for classification problems.
- Understand Natural Language Processing.

UNIT - I		Lecture Hrs:9

Introduction: WhatisAI? Agents and Environments, The Structure of Agents, Problem-Solving Agents, Searching for Solutions, Measuring problem-solving performance, Uninformed Search Strategies, Avoiding Repeated States, Searching with Partial Information, Sensorless problems, Contingency problems.

UNIT - II		Lecture Hrs:9

Informed Search and Exploration: Informed (Heuristic) Search Strategies, Heuristic Functions, Inventing admissible heuristic functions, Local Search Algorithms and Optimization Problems, Constraint Satisfaction Problems: Backtracking Search for CSPs, Local Search for Constraint Satisfaction Problems.

UNIT - III		Lecture Hrs:9

Knowledge and reasoning : Logical Agents, Reasoning Patterns in Propositional Logic, Effective propositional inference, Agents Based on Propositional Logic. Knowledge Representation: Ontological Engineering, Categories and Objects, Actions, Situations. and Events , Mental Events and Mental Objects, The Internet Shopping World , Reasoning Systems for Categories, Reasoning with Default Information, Truth Maintenance Systems.

UNIT - IV		Lecture Hrs:9

Natural Language Processing: Introduction, syntactic processing, semantic analysis, disclosure and pragmatic processing, statistical natural language processing, spell checking, Connectionist Models: Hopfield Networks, Learning in Neural Networks, Applications of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI and Symbolic AI, Perception and Action Real-time Search, Perception , Robot Architectures.

UNIT - V		Lecture Hrs:9

Fuzzy Logic Systems : Introduction , Crisp Sets , Fuzzy Sets , Some Fuzzy Terminology , Fuzzy Logic Control , Sugeno Style of Fuzzy Inference Processing , Fuzzy Hedges , a Cut Threshold , Nemo Fuzzy Systems. Prolog: —The Natural Language of Artificial

Intelligence , Introduction , Converting English to Prolog Facts and Rules , Goals , Prolog Terminology , Variables , Control Structures ,Arithmetic Operators , Matching in Prolog , Backtracking , Cuts , Recursion , Lists , Dynamic Databases , Input/Output and Streams, Some Aspects Specific to LPA Prolog .
Textbooks:
1. Principles of Soft Computing- S N Sivanandam, S N Deepa, Wiley India, 2007 2. Soft Computing and Intelligent System Design -Fakhreddine O Karray, Clarence D Silva,. Pearson Edition, 2004.
Reference Books:
1. Artificial Intelligence and Soft Computing- Behavioural and Cognitive Modeling of the Human Brain- Amit Konar, CRC press, Taylor and Francis Group. 2. Artificial Intelligence – Elaine Rich and Kevin Knight, TMH, 1991, rp2008. 3. Artificial Intelligence – Patric Henry Winston – Third Edition, Pearson Education. 4. A first course in Fuzzy Logic-Hung T Nguyen and Elbert A Walker, CRC. Press Taylor and Francis Group
Online Learning Resources:

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
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(ARTIFICIAL INTELLIGENCE)

Course Code	21D53103	MATHEMATICS FOR MACHINE LEARNING (21D53103) PE – I	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- To understand the basic theory underlying machine learning.
- To be able to formulate machine learning problems corresponding to different applications
- To understand a range of machine learning algorithms along with their strengths and weaknesses
- To be able to apply machine learning algorithms to solve problems of moderate complexity

Course Outcomes (CO): Student will be able to

- Ability to understand what is learning and why it is essential to the design of intelligent machines
- Apply theoretical foundations of decision trees to identify best split and Bayesian classifier to label data points
- Acquire knowledge in deep learning and be able to implement deep learning models for language, vision, speech and decision making
- Illustrate the working of classifier models like SVM, Neural Networks and identify classifier model for typical machine learning applications
- Illustrate and apply clustering algorithms and identify its applicability in real life problems.

UNIT - I		Lecture Hrs:9

Linear Algebra: Systems of Linear Equations, Matrices, Solving Systems of Linear Equations Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings, Affine Spaces.
Matrix Decompositions: Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation, Matrix Phylogeny.

UNIT - II		Lecture Hrs:9

Probability and Distributions: Construction of a Probability Space, Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem, Summary Statistics and Independence, Gaussian Distribution, Conjugacy and the Exponential Family, Change of Variables/Inverse Transform.

UNIT - III		Lecture Hrs:9

Parameter Estimation, Probabilistic Modeling and Inference, Directed Graphical Models, Model Selection.
Linear Regression: Problem Formulation, Parameter Estimation, Bayesian Linear Regression, Maximum Likelihood as Orthogonal Projection

UNIT - IV		Lecture Hrs:9
Dimensionality Reduction with Principal Component Analysis: Problem Setting, Maximum Variance Perspective, Projection Perspective, Eigenvector Computation and Low-Rank Approximations, PCA in High Dimensions, Key Steps of PCA in Practice, Latent Variable Perspective		
UNIT - V		Lecture Hrs:9
UNIT-V: Density Estimation with Gaussian Mixture Models: Gaussian Mixture Model, Parameter Learning via Maximum Likelihood, EM Algorithm, Latent-Variable Perspective. Classification with Support Vector Machines: Separating Hyper planes, Primal Support Vector Machine, Dual Support Vector Machine, Kernels, Numerical Solution.		
Textbooks:		
1. Mathematics for Machine Learning , Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong 2020 2. Machine Learning, Tom Mitchell, c Graw Hill		
Reference Books:		
1. Machine Learning: An Algorithmic Perspective, Stephen Marsland, Taylor & Francis		
Online Learning Resources:		

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R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE)

Course Code	21D53104	DIGITAL IMAGE PROCESSING (21D53104) PE – I	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- To make the students to understand
- The fundamentals of Computer Graphics and Image Processing
- The concepts related edge detection, segmentation, morphology and image compression methods.

Course Outcomes (CO): Student will be able to

- understanding of digital image processing fundamentals: hardware and software, digitization, enhancement and restoration, encoding, segmentation, feature detection
- ability to apply image processing techniques in both the spatial and frequency (Fourier) domains
- Ability To understand (i.e., be able to describe, analyse and reason about) how digital images are represented, manipulated, encoded and processed, with emphasis on algorithm design, implementation and performance evaluation

UNIT - I		Lecture Hrs:9

Digital Image Fundamentals: What is Digital Image Processing, examples of fields that use digital image processing, fundamental Steps in Digital Image Processing, Components of an Image processing system, Image Sampling and Quantization, Some Basic Relationships between Pixels, Linear and Nonlinear Operations.

UNIT - II		Lecture Hrs:9

Image Enhancement: Image Enhancement in the spatial domain: some basic gray level transformations, histogram processing, enhancement using arithmetic and logic operations, basics of spatial filters, smoothening and sharpening spatial filters, combining spatial enhancement methods.

UNIT - III		Lecture Hrs:9

Unsupervised Learning Network- Introduction, Fixed Weight Competitive Nets, Maxnet, Hamming Network, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization, Counter Propagation Networks, Adaptive Resonance Theory Networks. Special Networks- Introduction to various networks.

UNIT - IV		Lecture Hrs:9

Image Compression: Fundamentals, image compression models, elements of information theory, error-free compression, lossy compression, Image Compression Standards.

UNIT - V		Lecture Hrs:9

Morphological Image Processing: Preliminaries, dilation, erosion, open and closing, hit transformation, basic morphologic algorithms.
Color Image Processing: Color fundamentals, Color Models and basics of full-color image processing

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Textbooks:
1. "Digital Image Processing", Rafael C.Gonzalez and Richard E. Woods, Third Edition, Pearson Education, 2007 2. Digital Image Processing", S.Sridhar, Oxford University Press
Reference Books:
1. "Fundamentals of Digital Image Processing" , S. Annadurai, Pearson Edun, 2001. 2. "Digital Image Processing and Analysis", B. Chanda and D.Dutta Majumdar, PHI, 2003. 3. "Image Processing" , Analysis and Machine Vision , Milan Sonka, Vaclav Hlavac and 4. Roger Boyle, 2nd Edition, Thomson Learning, 2001. 5. "Digital Image Processing" Vipula Singh, Elsevier
Online Learning Resources:

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE)

Course Code	21D53105	ADVANCED PYTHON PROGRAMMING (21D53105) PE – I	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- To be able to introduce core programming basics and program design with functions using Python programming language.
- To understand a range of Object-Oriented Programming, as well as in-depth data and information processing techniques.
- To understand the high-performance programs designed to strengthen the practical expertise.□.

Course Outcomes (CO): Student will be able to

- Understanding of digital image processing fundamentals of python.
- Ability to apply Object oriented concepts.
- Ability To understand lists and methods.
- Illustrate the working of dictionaries and files.
- Illustrate data visualization and graphs.

UNIT - I		Lecture Hrs:9

Introduction: What is a program, Running python, Arithmetic operators, Value and Types. Variables, Assignments and Statements: Assignment statements, Script mode, Order of operations, string operations, comments.
Functions: Function calls, Math functions, Composition, Adding new Functions, Definitions and Uses, Flow of Execution, Parameters and Arguments, Variables and Parameters are local, Stack diagrams, Fruitful Functions and Void Functions, Why Functions.

UNIT - II		Lecture Hrs:9

Case study: The turtle module, Simple Repetition, Encapsulation, Generalization, Interface design, Refactoring, docstring.
Conditionals and Recursion: floor division and modulus, Boolean expressions, Logical operators, Conditional execution, Alternative execution, Chained conditionals, Nested conditionals, Recursion, Infinite Recursion, Keyboard input.
Fruitful Functions: Return values, Incremental development, Composition, Boolean functions, More recursion, Leap of Faith, Checking types.

UNIT - III		Lecture Hrs:9

Iteration: Reassignment, Updating variables, The while statement, Break, Square roots, Algorithms.
Strings: A string is a sequence, len, Traversal with a for loop, String slices, Strings are immutable, Searching, Looping and Counting, String methods, The in operator, String comparison.
Case Study: Reading word lists, Search, Looping with indices.
Lists: List is a sequence, Lists are mutable, Traversing a list, List operations, List slices, List

methods, Map filter and reduce, Deleting elements, Lists and Strings, Objects and values, Aliasing, List arguments.		
UNIT - IV		Lecture Hrs:9
Dictionaries: A dictionary is a mapping, Dictionary as a collection of counters, Looping and dictionaries, Reverse Lookup, Dictionaries and lists, Memos, Global Variables. Tuples: Tuples are immutable, Tuple Assignment, Tuple as Return values, Variable-length argument tuples, Lists and tuples, Dictionaries and tuples, Sequences of sequences. Files: Persistence, Reading and writing, Format operator, Filename and paths, Catching exceptions, Databases, Pickling, Pipes, Writing modules. Classes and Objects: Programmer-defined types, Attributes, Instances as Return values, Objects are mutable, Copying.		
UNIT - V		Lecture Hrs:9
Introduction to NumPy, Pandas, Matplotlib. Exploratory Data Analysis (EDA), Data Science life cycle, Descriptive Statistics, Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA. Data Visualization: Scatter plot, bar chart, histogram, boxplot, heat maps etc.		
Textbooks:		
1. Allen B. Downey, "Think Python", 2nd edition, SPD/O'Reilly, 2016. 2. Cathy O'Neil, Rachel Schutt, Doing Data Science, Straight Talk from the Frontline. O'Reilly, 2013.		
Reference Books:		
1. Martin C.Brown, "The Complete Reference: Python", McGraw-Hill, 2018. 2. Kenneth A. Lambert, B.L. Juneja, "Fundamentals of Python", CENGAGE, 2015. 3. R. Nageswara Rao, "Core Python Programming", 2nd edition, Dreamtech Press, 2019		
Online Learning Resources:		

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Course Code	21D52103	ADVANCED DATA STRUCTURES AND ALGORITHMS (21D52103) PE – II	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- To provide the foundations of the practical implementation and usage of Algorithms and Data Structures.
- To ensure that the student evolves into a competent programmer capable of designing and analyzing implementations of algorithms and data structures for different kinds of problems.
- To expose the student to the algorithm analysis techniques, to the theory of reductions, and to the classification of problems into complexity classes like NP.

Course Outcomes (CO): Student will be able to

- Design and analyze programming problem statements.
- Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.
- Understand the necessary mathematical abstraction to solve problems.
- come up with analysis of efficiency and proofs of correctness
- Comprehend and select algorithm design approaches in a problem specific manner.

UNIT - I		Lecture Hrs:9

Overview of Data Structures - Arrays, Stacks, Queues, linked lists , Linked stacks and Linked queues, Applications

Algorithm Analysis - Efficiency of algorithms, Asymptotic Notations, Time complexity of an algorithm using O notation, Polynomial Vs Exponential Algorithms, Average, Best, and Worst Case Complexities, Analyzing Recursive Programs.

UNIT - II		Lecture Hrs:9

Trees and Graphs – Basics of trees and binary trees, Representation of trees and Binary trees, Binary tree Traversals, Threaded binary trees, Graphs, representation and traversals. Binary Search Trees, AVL Trees and B Trees - Binary Search Trees: Definition, Operations and applications. AVL Trees: Definition, Operations and applications. B Trees: Definition, Operations and applications.

UNIT - III		Lecture Hrs:9

Red – Black Trees, Splay Trees and Hash Tables - Red–Black Trees, Splay Trees and their applications, Hash Tables, Hash Functions and various applications, File Organizations.

UNIT - IV		Lecture Hrs:9

Divide – and – Conquer & Greedy Method - General Method, Binary Search, Finding Maximum and Minimum, Quick Sort, Merge sort, Strassen's Matrix Multiplication, Greedy Method- General Method, Minimum Cost Spanning Trees, Single Source Shortest Path.

Back Tracking and Branch – and – Bound - General Method, 8 – Queen's Problem, Graph

Coloring. Branch – and – Bound: The Method, LC Search, Control Abstraction, Bounding, 0 /1 Knapsack Problem.
Classes and Objects: Programmer-defined types, Attributes, Instances as Return values, Objects are mutable, Copying.

UNIT - V		Lecture Hrs:9

Dynamic Programming - General Method, All Pairs Shortest Path, Single Source Shortest Path, 0 /1 Knapsack problem, Reliability Design, Traveling Sales Person's Problem.

Textbooks:

1. Fundamentals of Computer Algorithms by Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, 2nd edition, University Press.

Reference Books:

1. Data Structures and Algorithms Using C++ by Ananda Rao Akepogu and Radhika Raju Palagiri, Pearson Education, 2010.
2. Classic Data Structures by D. Samanta, 2005, PHI
3. Data Structures and Algorithms by G.A.V. Pai, 2009, TMH.
4. Design and Analysis of Computer Algorithms by Aho, Hopcraft, Ullman 1998, PEA.
5. Introduction to the Design and Analysis of Algorithms by Goodman, Hedetniemi, TMG
6. Design and Analysis of Algorithms by E. Horowitz, S. Sahani, 3rd Edition, Galgotia.
7. Data Structures and Algorithms in C++ by Drozdek 2nd Edition, Thomson.

Online Learning Resources:

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R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE)

Course Code	21D53105	DATA SCIENCE	L	T	P	C
Semester	I	(21D53105) PE – II	3	0	0	3

Course Objectives:

- demonstrate proficiency with statistical analysis of Data.
- execute statistical analyses with professional statistical software.
- demonstrate skill in Data management.
- develop the ability to build and assess Databased models.
- apply data science concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively

Course Outcomes (CO): Student will be able to

- To develop relevant programming abilities.
- To demonstrate proficiency with statistical analysis of data.
- To develop the ability to build and assess data-based models.
- To execute statistical analyses with professional statistical software.
- To demonstrate skill in data management.
- To apply data science concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively

UNIT - I		Lecture Hrs:9

Introduction, What Is Statistical Learning?, Why Estimate f?, How Do We Estimate f?, The Trade-Off Between Prediction Accuracy and Model Interpretability, Supervised Versus Unsupervised Learning, Regression Versus Classification Problems, Assessing Model Accuracy, Measuring the Quality of Fit, The Bias-Variance Trade-of, The Classification Setting, Introduction to R, Basic Commands, Graphics, Indexing Data, Loading Data, Additional Graphical and Numerical Summaries.

UNIT - II		Lecture Hrs:9

Linear Regression, Simple Linear Regression, Multiple Linear Regression, Other Considerations in the Regression Model, Comparison of Linear Regression with K-Nearest Neighbours, Linear Regression.

UNIT - III		Lecture Hrs:9

Classification, Logistic Regression, Linear Discriminant Analysis, A Comparison of Classification Methods, Logistic Regression, LDA, QDA, and KNN.

UNIT - IV		Lecture Hrs:9

Programming for basic computational methods such as Eigen values and Eigen vectors, sparse matrices, QR and SVD, Interpolation by divided differences.
Data Wrangling: Data Acquisition, Data Formats, Imputation, The split-apply-combine paradigm.

UNIT - V		Lecture Hrs:9
Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity. Data Warehouse: Basic Concepts, Data Warehouse Modeling: Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, Data Generalization by Attribute-Oriented Induction.		
Textbooks:		
1. Gareth James Daniela Witten Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, February 11, 2013, web link: www.statlearning.com. 2. Mark Gardener, Beginning R The statistical Programming Language, Wiley, 2015. 3. Han , Kamber, and J Pei, Data Mining Concepts and Techniques, 3rd edition, Morgan Kaufman, 2012.		
Reference Books:		
1. Sinan Ozdemir, Principles of Data Science, Packt Publishing Ltd Dec 2016. 2. Joel Grus, Data Science from Scratch, Oreilly media, 2015.		
Online Learning Resources:		

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R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE)

Course Code	21D53106	KNOWLEDGE REPRESENTATIONS AND REASONING (21D53106) PE – II	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- To investigate the key concepts of knowledge representation (KR) techniques and different notations.
- To integrate the KR view as a knowledge engineering approach to model organizational knowledge.
- To introduce the study of ontologies as a KR paradigm and applications of ontologies.
- To understand various KR techniques.
- To understand process, knowledge acquisition and sharing of ontology.

Course Outcomes (CO): Student will be able to

- Analyze and design knowledge based systems intended for computer implementation.
- Acquire theoretical knowledge about principles for logic-based representation and reasoning.
- Ability to understand knowledge-engineering process
- Ability to implement production systems, frames, inheritance systems and approaches to handle uncertain or incomplete knowledge.
- To design and implement data warehouse.

UNIT - I		Lecture Hrs:9

The Key Concepts: Knowledge, Representation, Reasoning, Why knowledge representation and reasoning, Role of logic
Logic: Historical background, Representing knowledge in logic, Varieties of logic, Name, Type, Measures, Unity Amidst diversity

UNIT - II		Lecture Hrs:9

Ontology: Ontological categories, Philosophical background, Top-level categories, Describing physical entities, Defining abstractions, Sets, Collections, Types and Categories, Space and Time

UNIT - III		Lecture Hrs:9

Knowledge Representations: Knowledge Engineering, Representing structure in frames, Rules and data, Object-oriented systems, Natural language Semantics, Levels of representation

UNIT – IV		Lecture Hrs:9

Processes: Times, Events and Situations, Classification of processes, Procedures, Processes and Histories, Concurrent processes, Computation, Constraint satisfaction, Change
Contexts: Syntax of contexts, Semantics of contexts, First-order reasoning in contexts, Modal reasoning in contexts, Encapsulating objects in contexts.

UNIT - V		Lecture Hrs:9
Knowledge Soup: Vagueness, Uncertainty, Randomness and Ignorance, Limitations of logic, Fuzzy logic, Non-monotonic Logic, Theories, Models and the world, Semiotics Knowledge Acquisition and Sharing: Sharing Ontologies, Conceptual schema, Accommodating multiple paradigms, Relating different knowledge representations, Language patterns, Tools for knowledge acquisition		
Textbooks:		
1. Knowledge Representation logical, Philosophical, and Computational Foundations by John F. Sowa, Thomson Learning. 2. Knowledge Representation and Reasoning by Ronald J. Brachman, Hector J. Levesque, Elsevier.		
Reference Books:		
1. Knowledge Representation and Reasoning 1st Edition - May 19, 2004 Authors: Ronald Brachman, Hector Levesque		
Online Learning Resources:		

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R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
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(ARTIFICIAL INTELLIGENCE)

Course Code	21D53107	ARTIFICIAL INTELLIGENCE LAB (21D53107)	L	T	P	C
Semester	I		0	0	4	2

Course Objectives:

- To understand the various characteristics of Intelligent agents
- To learn the different search strategies in AI
- To learn to represent knowledge in solving AI problems
- To understand the different ways of designing software agents
- To know about the various grammars of NLP.

Course Outcomes (CO):

- Understand different types of agents.
- Solve searching problems using A*, Mini-Max algorithms.
- Create logical agents to do inference using first order logic.
- Use Bayesian learning for classification problems.
- Understand different phases of Natural Language Processing.
- Implement visualization techniques in R.

List of Experiments:

1. Implementation of DFS for water jug problem using LISP/PROLOG
2. Implementation of BFS for tic-tac-toe problem using LISP/PROLOG/Java
3. Implementation of TSP using heuristic approach usingJava/LISP/Prolog
4. Implementation of Simulated Annealing Algorithm using LISP/PROLOG
5. Implementation of Hill-climbing to solve 8- PuzzleProblem
6. Implementation of Towers of Honoi Problem using LISP/PROLOG
7. Implementation of A* Algorithm using LISP/PROLOG
8. Implementation of Hill Climbing Algorithm using LISP/PROLOG
9. Implementation Expert System with forward chaining using JESS/CLIPS
10. Implementation Expert System with backward chaining usingRVD/PROLOG
11. Implement Monkey banana problem using LISP/PROLOG

References:

1. AI ALGORITHMS, DATA STRUCTURES, and Idioms in Prolog, Lisp and Java , George G. Luger, William A. Stubblefield.

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R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE)

Course Code	21D53108	SOFT COMPUTING LAB (21D53108)	L	T	P	C
Semester	I		0	0	4	2

Course Objectives:

- To give students knowledge of soft computing theories fundamentals, i.e.
- Fundamentals of artificial and neural networks
- To gain knowledge of fuzzy sets and fuzzy logic and genetic algorithms.

Course Outcomes (CO):

- Understand Fuzzy concepts
- Learn neural networks with back propagation and without preparation
- Learn the operators of genetic algorithms
- Practice on crisp partitions

List of Experiments:

Week-1: PERCEPTRON
Create a perceptron with appropriate number of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights

Week-2: ARTIFICIAL NEAURAL NETWORKS
Write a program to implement artificial neural network without back propagation.
Write a program to implement artificial neural network with back propagation.

Week-3: FUZZY SETS
Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.

Week-4: GENETIC ALGORITHMS
Implement travelling sales person problem (TSP) using genetic algorithms.

Week-5: COVARIANCE
Plot the correlation plot on dataset and visualize giving an overview of relationships among data on soya bins data. Analysis of covariance: variance (ANOVA), if data have categorical variables on iris data.

Week-6: DATA FITTING BY REGRESSION
Implement linear regression and multi-regression for a set of data points.

Week-7: CRISP MODEL
Implement crisp partitions for real-life iris dataset.

Week-8: PERCEPTRON RULE
Write a program to implement Hebb's rule Write a program to implement Delta rule.

Week-9: LOGIC GATES
Write a program to implement logic gates.

Week-10: CLASSIFICATION
Implement SVM classification by Fuzzy concepts.

Reference Books:

1. D.K Prathikar, ―Soft Computing‖, Narosa Publishing House, New Delhi, 2008.

Web References:

1. https://ldrp.ac.in/images/syllabus/BE-Computer/802- 3%20soft%20computing.pdf
2. http://itmgoi.in/download/ CSE%20&%20IT/Soft%20Computing%20IT%2 0(IT-802).pdf
3. http://mirlab.org/jang/book/

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R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE)

Course Code	21D53201	KNOWLEDGE ENGINEERING & INTELLIGENT SYSTEMS (21D53201)	L	T	P	C
Semester	II		3	0	0	3

Course Objectives:

- To introduce the Fundamentals of Knowledge Engineering and Intelligent Systems.
- To provide Deep understanding of Knowledge Engineering and Intelligent Systems
- To educate about all aspect of advanced models of Knowledge Engineering and Its applications.

Course Outcomes (CO): Student will be able to

CO1: Demonstrate the knowledge of fundamental elements and concepts related to Intelligent Systems.
CO2: Representation of knowledge and different reasoning techniques.
CO3: Demonstrate the fundamental and advanced modules of Knowledge Engineering especially with Searching methods.

UNIT - I Lecture Hrs:8

Approaching an Intelligent System Project: Introducing Intelligent Systems, Knowing When to Use Intelligent Systems, A Brief Refresher on Working with Data, Defining the Intelligent System's Goals.

UNIT - II Lecture Hrs:8

Intelligent Experiences: The Components of Intelligent Experiences, Why Creating Intelligence Experiences Is Hard, Balancing Intelligent Experiences, Modes of Intelligent Interaction, Getting Data from Experience, Verifying Intelligent Experience.

UNIT - III Lecture Hrs:9

Implementing Intelligence: The Components of an Intelligence Implementation, The Intelligence Runtime, Where Intelligence Lives, Intelligence Management, Intelligent Telemetry.

UNIT – IV Lecture Hrs:9

Creating Intelligence: Overview of Intelligence, Representing Intelligence, The Intelligence Creation Process, Evaluating Intelligence, Machine Learning Intelligence, Organizing Intelligence.

UNIT – V Lecture Hrs:9

Orchestrating Intelligent Systems: Overview of Intelligence Orchestration, the Intelligence Orchestration Environment, Dealing with Mistakes, Adversaries and Abuse, Approaching Your Own Intelligent System.

Textbooks:

1. Building Intelligent Systems A Guide to Machine Learning Engineering, Authors: Hulten, Geoff, Apress; 1st ed. edition (2018).

Reference Books:

Online Learning Resources:

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R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE)

Course Code	21D53202	DEEP LEARNING (21D53202)	L	T	P	C
Semester	II		3	0	0	3

Course Objectives:

- To identify Convolutional Neural Networks models to solve Supervised Learning Problems
- To design Auto encoders to solve Unsupervised Learning problems
- To apply Long Shot Term Memory (LSTM) Networks for time series analysis classification problems.
- To apply Classical Supervised Tasks for Image Denoising, Segmentation and Object detection problems.

Course Outcomes (CO): Student will be able to

CO1: Identify Convolutional Neural Networks models to solve Supervised Learning Problems
CO2: Design Autoencoders to solve Unsupervised Learning problems
CO3: Apply Long Shot Term Memory (LSTM) Networks for time series analysis classification problems.
CO4: Apply Classical Supervised Tasks for Image Denoising, Segmentation and Object detection problems.

UNIT - I		Lecture Hrs:9

Introduction to Biological Neurons, Artificial Neural Networks, McCulloch Pitts Neuron, Learning processes, Perceptron, Perceptron convergence theorem, XOR problem, Multilayer perceptron, Back Propagation (BP) Learning.

UNIT - II		Lecture Hrs:9

Activation functions: Sigmoid, Linear, Tanh, ReLU, Leaky ReLU, SoftMax, loss functions, First and Second order optimization methods, Optimizers: Gradient Descent (GD), Batch Optimization, Momentum Based GD, Stochastic GD, AdaGrad, RMSProp, Adam; Introduction to Self Organizing Maps; Sequence to sequence models, RNN, Vanishing and Exploding Gradients, GRU, LSTM for NLP Applications.

UNIT - III		Lecture Hrs:9

Convolutional Neural Network, Building blocks of CNN, Transfer Learning; Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Dropout.

UNIT - IV		Lecture Hrs:9

Autoencoders : Unsupervised Learning with Deep Network, Autoencoders, Stacked, Sparse, Denoising Autoencoders, Variational Autoencoders; Recent Trends in Deep Learning Architectures, Residual Network, Skip Connection Network, GoogleNet, DensenNet, SqueezNet, MobileNet, NasNet Models.

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UNIT - V		Lecture Hrs:9
Classical Supervised Tasks with Deep Learning, Segmentation Unet, FCN models, Object Localization (RCNN), FRCNN with Applications; Transformer, Generative Adversarial Network, Design own neural network models on Image, vision and NLP Applications..		
Textbooks:		
1. Deep Learning- Ian Good felllow, YoshuaBenjio, Aaron Courville, The MIT Press. 2. Christopher Bishop, Pattern Recognition and Machine Learning, Springer,2006.		
Reference Books:		
1. Simon Haykin, "Neural Networks, A Comprehensive Foundation", 2nd Edition, Addison Wesley Longman, 2001. 2. Deep Learning From Scratch: Building with Python from First Principles by Seth Weidman published by O`Reilley 3. Grokking Deep Learning by Andrew W. Trask published by Manning Publications.		
Online Learning Resources:		

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R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE)

Course Code	21D55105	DATA ANALYTICS (21D55105)	L	T	P	C
Semester	II	PE – III	3	0	0	3

Course Objectives:

- To understand statistical approaches to learning and exploratory data analysis.
- To implement basic machine learning tools to solve real world problems.
- To identify basic approaches for feature extraction and feature generation.
- To identify paradigms that constitute recommendation engine.

Course Outcomes (CO): Student will be able to

CO1: Understand the ideas of statistical approaches to learning
CO2: Understand the significance of exploratory data analysis (EDA) in data science and apply basic tools (plots, graphs, summary statistics) to perform EDA.
CO3: Recognize the characteristics of machine learning techniques that are useful to solve real-world problems
CO4: Identify basic approaches used for feature generation and feature selection algorithms (Filters, Wrappers, Decision Trees, and Random Forests) and to apply the techniques in applications
CO5: Identify and explain fundamental mathematical and algorithm paradigms that constitute a recommendation engine. Build their own recommendation system using existing components.

UNIT - I Lecture Hrs:9

Introduction: What is Data Science? Big Data and Data Science hype and getting past the hype, Why now? Datafication, Current landscape of perspectives, Skill sets, Life cycle of Data Science, Different phases.

UNIT - II Lecture Hrs:9

Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Case Study: RealDirect (online real estate firm), Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbors (k-NN), k-means.

UNIT - III Lecture Hrs:10

One More Machine Learning Algorithm and Usage in Applications: Motivating application: Filtering Spam, Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes and why it works for Filtering Spam, Data Wrangling: APIs and other tools for scrapping the Web, Feature Generation and Feature Selection (Extracting Meaning From Data), Motivating application: user (customer) retention, Feature Generation (brainstorming, role of domain expertise, and place for imagination).

UNIT – IV		Lecture Hrs:10
Feature Selection algorithms: Filters; Wrappers; Decision Trees; Random Forests, Recommendation Systems: Building a User-Facing Data Product: Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis, Exercise: build your own recommendation system.		
UNIT – V		Lecture Hrs:9
Data Visualization: Basic principles, ideas and tools for data visualization, Case study on industry projects, Exercise: create your own visualization of a complex dataset, Data Science and Ethical Issues: Discussions on privacy, security, ethics, A look back at Data Science, Next-generation data scientists.		

Textbooks:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly, 2014.
2. Jure Leskovek, AnandRajaraman and Jerey Ullman. Mining of Massive Datasets, Cambridge University Press, 2014.

Reference Books:

1. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. MIT Press, 2013.
2. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. O′Reilly, 2013.
3. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Elements of Statistical Learning, Second Edition. Springer, 2009.
4. Avrim Blum, John Hopcroft and Ravindran Kannan. Foundations of Data Science.2018.
5. Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press, 2014.
6. Jiawei Han, MichelineKamber and Jian Pei. Data Mining: Concepts and Techniques, Third Edition. Morgan Kaufmann, 2011.

Online Learning Resources:

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R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE)

Course Code	21D53203	PATTERN RECOGNITION (21D53203)	L	T	P	C
Semester	II	PE – III	3	0	0	3

Course Objectives:

- To understand the PR importance in various real time applications
- To understand the basic model and fundamental steps of PR system
- To understand the use of different classifiers/algorithms/tech
- To learn the different methods for combining classifiers.
- To provide an introduction to various clustering algorithms

Course Outcomes (CO): Student will be able to

CO1: Explain the paradigms for PR problems
CO2: Classify the patterns using NN, Bayes, HMM, Decision trees and SVM classifiers
CO3: Apply ensemble of classifiers for certain PR problems
CO4: Differentiate between supervised and unsupervised classifiers.
CO5: Design an application : Handwritten Digit Recognition

UNIT - I Lecture Hrs:9

Introduction to Pattern Recognition: Data Sets for Pattern Recognition, Different Paradigms for Pattern Recognition,
Pattern Representation: Data Structures for Pattern Representation, Representation of Clusters, Proximity Measures, Size of Patterns, Abstractions of the Data Set, Feature, Feature Selection, Evaluation of Classifiers, Evaluation of Clustering

UNIT - II Lecture Hrs:8

Nearest Neighbour Based Classifiers: Nearest Neighbour Algorithm, Variants of the NN Algorithm, Use of the Nearest Neighbour Algorithm for Transaction Databases, Efficient Algorithms, Data Reduction, Prototype Selection,
Bayes Classifier: Bayes Theorem, Minimum error rate classifier, Estimation of Probabilities, Comparison with the NNC, Naive Bayes Classifier, Bayesian Belief Network.

UNIT - III Lecture Hrs:9

Hidden Markov Models: Markov Models for Classification, Hidden Markov Models, Classification Using HMMs, Classification of Test Patterns.
Decision Trees: Introduction, Decision Trees for Pattern Classification, Construction of Decision Trees, Splitting at the Nodes, Over fitting and Pruning, Example of Decision Tree Induction.

UNIT - IV Lecture Hrs:8

Support Vector Machines: Introduction, Linear Discriminant Functions, Learning the Linear Discriminant Function, Neural Networks, SVM for Classification, Linearly Separable Case, Non-linearly Separable Case.
Combination of Classifiers: Introduction, Methods for Constructing Ensembles of Classifiers, Methods for Combining Classifiers, Evaluation of Classifiers, Evaluation of Clustering

UNIT - V		Lecture Hrs:8
Clustering: Clustering and its Importance, Hierarchical Algorithms, Partitional Clustering, Clustering Large Data Sets, An Application to Handwritten Digit Recognition: Description of the Digit Data, Pre-processing of Data, Classification Algorithms, Selection of Representative Patterns.		
Textbooks:		
1. Pattern Recognition an Introduction, V. Susheela Devi M. Narasimha Murty, University Press (India) Pvt Ltd, 2011. 2. Pattern Recognition, Segrios Theodoridis, Konstantinos Koutroumbas, Fourth Edition, Academic Press, 2009		
Reference Books:		
1. Pattern Classification, R.O.Duda, P.E.Hart and D.G.Stork, John Wiley, 2002. 2. Andrew Webb, “Statistical Pattern Recognition”, Arnold publishers, London, 1999. 3. C.M.Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006. 4. Menahem Friedman, Abraham Kandel, “Introduction to Pattern Recognition Statistical, Neural and Fuzzy Logic Approaches”, World Scientific Publishing Co. Ltd, 2000. 5. Robert J.Schalkoff “Pattern Recognition Statistical, Structural and Neural Approaches”, John Wiley & Sons Inc., New York, 1992.		
Online Learning Resources:		

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(ARTIFICIAL INTELLIGENCE)

Course Code	21D53204	BIO INSPIRED COMPUTING (21D53204)	L	T	P	C
Semester	II	PE – III	3	0	0	3

Course Objectives:

1. Introduce the basic of bio inspired computing and its application areas particularly to neuromorphic systems.

Course Outcomes (CO): Student will be able to

CO1: Understand and be able to apply brain-inspired neural network techniques for solving real world problems.
CO2: Appreciate and be able to apply nature-inspired evolutionary computation (genetic algorithm) techniques for solving optimization problems.
CO3: Develop an awareness of the emerging area of neuromorphic systems (including their underlying silicon implementation techniques), and the way forward.

UNIT - I Lecture Hrs:9

Evolutionary systems: Artificial Evolution, Genetic Representations, Evolutionary measures. Cellular Systems: Cellular Automata, Modelling with Cellular Systems, Other Cellular systems, Computation, Artificial life, Complex Systems, Analysis and Synthesis of Cellular Systems.

UNIT - II Lecture Hrs:9

Neural Systems: Biological Nervous Systems, Artificial Neural Networks, Neuron Models, Architecture, Signal Encoding, Synaptic Plasticity, Unsupervised Learning, Supervised Learning, Reinforcement Learning.

UNIT – III Lecture Hrs:8

Developmental Systems: Potential Advantages of Developmental Representation, Synthesis of Developmental Systems, Evolution and Development, Defining Artificial Evolutionary Developmental Systems, Evolutionary Rewriting Systems. Evolutionary Developmental Programs and Processes.

UNIT – IV Lecture Hrs:8

Immune Systems: Immune Systems work, Constituents of Biological Immune Systems, Lessons for Artificial Immune Systems, Algorithms and Applications, Shape Space, Negative Selection Algorithm, Clonal Selection Algorithm. Behavioral Systems: Behavior in Cognitive Science, Artificial Intelligence, Behavior Based Robotics, Inspiration for Robots, Robots as Biological Models, Robot Learning, Evolution of Behavioral Systems, Neural Development in Behavioral Systems, Coevolution of Body and Control, Toward Self Reproduction, Simulation and Reality.

UNIT – V Lecture Hrs:9

Collective Systems: Self Organiztion, Ant Colony Optimization, Particle Swarm Optimization, Swarm Robotics, Coevolutionary Dynamics: biological Models, Artificial Evolution of Competing Systems, Artificial Evolution of Cooperation.

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Textbooks:
1. Bio- Inspired Artificial Intelligence theories, methods, and technologies, by Dario Floreano and Claudio Mattiussi, PHI publication, 2010. 2. Flake, Gary William. The Computational Beauty of Nature. MIT Press, 1998.
Reference Books:
Online Learning Resources:

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R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE)

Course Code	21D53205	INTRUSION DETECTION SYSTEMS (21D53205)	L	T	P	C
Semester	II	PE – IV	3	0	0	3

Course Objectives:

- To understand when, where, how, and why to apply Intrusion Detection tools and techniques in order to improve the security posture of an enterprise.
- Apply knowledge of the fundamentals and history of Intrusion Detection in order to avoid common pitfalls in the creation and evaluation of new Intrusion Detection Systems.
- Analyze intrusion detection alerts and logs to distinguish attack types from false alarms.
- To be able to analyze the basic Firewall mechanism.

Course Outcomes (CO): Student will be able to

CO1: Acquire knowledge of Intrusion Detection.
CO2: Ability to improve the security posture of any enterprise by applying the intrusion mechanism.
CO3: Ability to design new Intrusion Detection Systems in the lower level.
CO4: Identify attack types from false alarms.

UNIT - I		Lecture Hrs:9

History of Intrusion Detection: Audit, Concept and definition, Internal and external threats to data, attacks, Need and types of IDS, Information sources Host based information sources, Network based information sources.

UNIT - II		Lecture Hrs:10

Intrusion Prevention System and Snort: Network IDs protocol based IDs, Hybrid IDs, Analysis schemes, thinking about intrusion. A model for intrusion analysis- Incident Responses – Incident Response Process – IDS ad IPS response Phases Forensics –Corporate Issues - Snort Installation Scenarios, Installing Snort, Running Snort on Multiple Network Interfaces, Snort Command Line Options. Step-By-Step Procedure to Compile and Install Snort Location of Snort Files, Snort Modes Snort Alert Modes.

UNIT - III		Lecture Hrs:10

Snort Rules and ACID: Rule Headers, Rule Options, the Snort Configuration File etc. Plugins, Preprocessors and Output Modules, Using Snort with MySQL - Using ACID and Snort Snarf with Snort -Agent development for intrusion detection - Architecture models of IDs and IPs.

UNIT - IV		Lecture Hrs:10

Firewall Introduction and Technologies: Why Internet Firewalls - Internet Services - Security Strategies - Building Firewalls - Packets and Protocols - What Does a Packet Look Like? - IP - Protocols Above IP - Protocols Below IP - Application Layer Protocols - IP Version - Non-IP Protocols - Attacks Based on Low-Level Protocol Details - Firewall Technologies - Some Firewall Definitions - Packet Filtering - Proxy Services - Network Address Translation - Virtual Private Networks.

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UNIT - V		Lecture Hrs:9
Building Firewalls: Firewall Architectures - Firewall Design - Packet Filtering - Proxy Systems - Bastion Hosts - UNIX and Linux Bastion Hosts 176 - Windows NT and Windows 2000 Bastion Hosts.		
Textbooks:		
1. RafeeqRehman , " Intrusion Detection with SNORT, Apache, MySQL, PHP and ACID," 1st Edition, Prentice Hall , 2003. 2. Carl Endorf, Eugene Schultz and Jim Mellander"Intrusion Detection & Prevention", 1st Edition, Tata McGraw-Hill, 2004. 3. Elizabeth D. Zwicky, Simon Cooper & D. Brent Chapman , "Building Internet Firewalls" O'Reilly.		
Reference Books:		
1. Christopher Kruegel,FredrikValeur, Giovanni Vigna: "Intrusion Detection and Correlation Challenges and Solutions", 1st Edition, Springer, 2005. 2. Stephen Northcutt, Judy Novak : "Network Intrusion Detection", 3rd Edition, New Riders Publishing, 2002. 3. T. Fahringer, R. Prodan, "A Text book on Grid Application Development and Computing Environment". 6th Edition,KhannaPublihsers, 2012.		
Online Learning Resources:		

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
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Course Code	21D53206	COMPUTER VISION (21D53206)	L	T	P	C
Semester	II	PE – IV	3	0	0	3

Course Objectives:

- Computer Vision focuses on development of algorithms and techniques to analyze and interpret the visible world around us.
- This requires understanding of the fundamental concepts related to multi-dimensional signal processing, feature extraction, visual geometric modeling, stochastic optimization etc.
- Knowledge of these concepts is necessary in this field, to explore and contribute to research and further developments in the field of computer vision.

Course Outcomes (CO): Student will be able to

CO1: Apply basic tools (plots, graphs, summary statistics) to carry out Computer Vision tasks.
CO2: Describe the Computer Vision Process and how it works.
CO3: Create APIs and other tools to build Computer Vision models.
CO4: Analyze Computer Vision in different case studies.
CO5: Apply basic machine learning algorithms (Linear Regression, k-Nearest Neighbors (k-NN), k-means, Naive Bayes) for Computer Vision tasks.

UNIT - I Lecture Hrs:9

Digital Image Formation and low-level processing: Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing, introduction to computer vision.

UNIT - II Lecture Hrs:10

Feature Extraction: Shape, histogram, color, spectral, texture, Feature analysis, feature vectors, distance /similarity measures, data preprocessing, Edges - Canny, LOG, DOG; Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT; Line detectors (Hough Transform), Orientation Histogram, SIFT, SURF, GLOH, Corners - Harris and Hessian Affine.

UNIT - III Lecture Hrs:9

Depth estimation and Multi-camera views: Perspective, Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Binocular Stereopsis: Camera and Epipolar Geometry; Auto-calibration.
Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

UNIT - IV Lecture Hrs:9

Motion Analysis: Optical Flow, KLT, Spatio-Temporal Analysis, Background Subtraction and Modeling, Dynamic Stereo; Motion parameter estimation.

UNIT - V		Lecture Hrs:9
Shape from X: Light at Surfaces; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges Albedo estimation; Photometric Stereo; Phong Model; Reflectance Map.		
Textbooks:		
1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011. 2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003. 3. 3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.		
Reference Books:		
1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992. 2. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.		
Online Learning Resources:		

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R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE)

Course Code	21D53207	NATURAL LANGUAGE PROCESSING (21D53207)	L	T	P	C
Semester	II	PE – IV	3	0	0	3

Course Objectives:

- To be able to tag a given word with basic language processing features
- To be able to discuss the current and likely future performance of several NLP applications;
- To be able to describe briefly a fundamental technique for processing language for several subtasks, such as morphological processing, parsing, word sense disambiguation etc.
- To understand how these techniques draw on and relate to other areas of Computer Science.

Course Outcomes (CO): Student will be able to

CO1: Describe the current and likely future performance of several NLP applications.
CO2: Explain how these techniques draw on and relate to other areas of Computer Science.
CO3: Describe the processing language for subtasks
CO4: List the language processing features.

UNIT - I Lecture Hrs:9

Introduction to NLP : Knowledge in Speech and Language Processing -–Information Theory- Ambiguity Models and Algorithms, Language : N-gram Language Models - Evaluating Language Models, Thought and Understanding - The State of the Art and the Near term Future

UNIT - II Lecture Hrs:9

Speech Tagging and Transducers: Part of Speech Tagging, Probability Basics: Hidden Markov - Maximum Entropy Models, Word Transducers: Finite State Transducers - Orthographic Rules - Finite-State Transducers Combining FST Lexicon Rules, Lexicon Free FSTs: The Porter Stemmer Human Morphological Processing.

UNIT - III Lecture Hrs:9

Syntax Parsing: Syntax Parsing: Grammar Formalisms - Tree Banks - Parsing with Context Free Grammars - Features and Unification, Statistical parsing: probabilistic CFGs (PCFGs) - Lexicalized PCFG

UNIT - IV Lecture Hrs:9

Semantic Analysis: Representing Meaning – Semantic Analysis - Lexical Semantics – Computational Lexical Semantics - Supervised – Dictionary based and Unsupervised Approaches - Compositional Semantics - Semantic Role Labelling - Semantic Parsing – Discourse Analysis.

R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
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(ARTIFICIAL INTELLIGENCE)

UNIT - V		Lecture Hrs:9
Case Studies and Applications: Machine Translation Language Similarities and Differences - Named Entity Recognition and Relation Extraction- IE using sequence labelling-Machine Translation (MT) - Basic issues in MT-Statistical translation - Word Alignment - Phrase-based Translation – Question Answering		
Textbooks:		
1. Daniel Jurafsky and James H. Martin, Martin Speech and Language Processing, 2008, 2nd Edition, Prentice Hall. 2. Christopher D. Manning and HinrichSchuetze, Foundations of Statistical Natural Language Processing, 1999, MIT Press.		
Reference Books:		
1. James Allen, Natural Language Understanding, 1994, 2nd Edition, Addison Wesley. 2. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, O'Reilly Media, 2009, 1st Edition.		
Online Learning Resources:		

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R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE)

Course Code	21D53208	KNOWLEDGE ENGINEERING & INTELLIGENT SYSTEMS LAB (21D53208)	L	T	P	C
Semester	II		0	0	4	2

Course Objectives:

- Determine which type of intelligent system methodology would be suitable for a given type of application problem.
- Demonstrate, in the form of a major project work, the ability to design and develop an intelligent system for a selected application.

Course Outcomes (CO):

CO1: Apply artificial intelligence techniques to solve different problems
CO2: Use artificial intelligence technique(s) to design and develop intelligent systems.

List of Experiments:

1. Study of PROLOG. Write the following programs using PROLOG
2. Write a program to solve 8 queens problem
3. Solve any problem using depth first search.
4. Solve any problem using best first search.
5. Solve 8-puzzle problem using best first search
6. Solve Robot (traversal) problem using means End Analysis.
7. Solve traveling salesman problem.

References:

1. Artificial Intelligence: A Modern Approach,. Russell & Norvig. 1995, Prentice Hall.
2. Artificial Intelligence, Elain Rich and Kevin Knight, 1991, TMH.
3. Artificial Intelligence-A modern approach, Staurt Russel and peter norvig, 1998, PHI.
4. Artificial intelligence, Patrick Henry Winston:, 1992, Addition Wesley 3 Ed.,
5. Introduction to prolog.

Online learning resources/Virtual labs:

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R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE)

Course Code	21D53209	DEEP LEARNING LAB (21D53209)	L	T	P	C
Semester	II		0	0	4	2

Course Objectives:

- To implement Multilayer Feed Backward Neural network on MNIT digits dataset.
- To construct RNN, LSTM, BiLSTM Networks for time series analysis classification problems.
- To design Autoencoders to solve Unsupervised Learning problems
- To evaluate Classical Supervised Tasks for Image Denoising, Segmentation and Object detection problems.

Course Outcomes (CO):

CO1: Implement Multilayer Feed Backward Neural network on MNIT digits dataset
CO2: Build RNN, LSTM, BiLSTM Networks for time series analysis classification problems.
CO3: Design Autoencoders to solve Unsupervised Learning problems
CO4: Implement Classical Supervised Tasks for Image Denoising, Segmentation and Object detection problems.

LIST OF EXPERIMENTS:

1. Implement perceptron learning algorithm and attempt to solve two input (i) AND gate (ii) OR Gate (iii) EXOR gate problems.
2. Design and implement a perceptron learning algorithm and attempt to solve XOR problem
3. Implement a Multilayer Feed Backward Neural network algorithm on MNIT digits dataset.
4. Build your own Recurrent networks and Long short-term memory networks on IMDB movie reviews classification data.
5. Design and implement a BiLSTM and BERT on given a product review dataset to classify the review rating from 1 to 5 classes
6. Design and implement Autoencoders for credit card fraud detection.
7. Design and implement a Convolutional Neural Network for image classification on the Fashion-MNIST dataset.
8. Implement a VGG19 model for image classification with and without Transfer Learning on Grocery dataset.

9. Implement a U-Net convolutional neural network model on segmentation of electron microscopic (EM) images of the brain dataset.
10. Implement a FRCNN algorithm for object detection on small object dataset.

References:

1. Deep Learning- Ian Goodfelllow, YoshuaBenjio, Aaron Courville, The MIT Press.
2. Christopher Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006.
3. Simon Haykin, "Neural Networks, A Comprehensive Foundation", 2nd Edition, Addison Wesley Longman, 2001.

Online learning resources/Virtual labs:

R21 COURSE STRUCTURE & SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE)

Course Code	21D50301	SOFTWARE DEVELOPMENT AND IT SERVICES-ORDER (OPEN ELECTIVE)	L	T	P	C
Semester	III		3	0	0	3

Course objectives:

- Take user stories and translate them into functioning web applications using HTML, CSS, and JavaScript
- Evaluate alternative approaches to software implementations
- Work through coding issues with analytical debugging techniques

Course Outcomes:

UNIT – I:
The Big Picture: A Snapshot of Devops Culture, The Evolution of Culture, The Value of the Story, Illustrating Devops with Stories, What is Devops? The Devops equation, A History of Devops, Developer as Operator, The Advent of Software Engineering, The Advent of Proprietary Software and Standardization, The Age of the Network, The Beginnings of a Global Community,The Age of Applications and the Web, The Growth of Software Development Methodologies, Open Source Software, Proprietary Services, Agile Infrastructure, The Beginning of devopsdays, The Current State of Devops.
Foundational Terminology and Concepts: Software Development Methodologies, Operations Methodologies, Systems Methodologies, Development, Release, and Deployment Concepts, Infrastructure Concepts, Cultural Concepts
Devops Misconceptions and Anti-Patterns: Common Devops Misconceptions, Devops Anti-Patterns, The Four Pillars of Effective Devops

UNIT – II:
Collaboration: Individuals Working Together, Defining Collaboration, Individual Differences and Backgrounds, Opportunities for Competitive Advantage, Mentorship, Introducing Mindsets, Mindsets and Learning Organizations, the Role of Feedback, Reviews and Rankings, Communication and Conflict Resolution Styles, Communication Context and Power Differentials, Empathy and Trust, Humane Staffing and Resources, Effective Collaboration with Sparkle Corp.
Collaboration: Misconceptions and Troubleshooting: Collaboration Misconceptions, Collaboration Troubleshooting.

UNIT – III:
Affinity: From Individuals to Teams, What Makes a Team, Teams and Organizational Structure,

Finding Common Ground Between Teams, Improving Team Communication, Case Study: United States Patent and Trademark Office, Bene‡ts of Improved Affinity, Requirements for Affinity, Measuring Affinity

Misconceptions and Troubleshooting: Affinity Misconceptions, Affinity Troubleshooting**.**

UNIT – IV:

Overview of Software, Automation, Monitoring, Metrics, Logging, Alerting, Events, Evolution of the Ecosystem.

Tools: Accelerators of Culture, What Are Tools? Irrelevance of Tools, Selection of Tools, Auditing Your Tool Ecosystem, Case Studies, Examining Etsy, Motivations and Decision-Making Challenges.

UNIT – V:

Scaling: Inflection Points, Understanding Scaling, Organizational Structure, Team Flexibility, Organizational Lifecycle, Complexity and Change, Scaling for Teams.

Case Studies: Growing and Scaling Teams, Job Postings and Recruitment Issues, Developing Individuals and Teams, Team Scaling and Growth Strategies, Managing Conflict, Scaling for Organizations.

Misconceptions and Troubleshooting: ScalingMisconceptions, ScalingTroubleshooting.

TEXT BOOKS:

1. Effective DevOps Building a Culture of Collaboration, A□nity, and Tooling at Scale, Jennifer Davis and Ryn Daniels
2. DevOpsfor Developers, Michael Hüttermann