



**VARDHAMAN**  
COLLEGE OF ENGINEERING

## **CURRICULUM**

**For**

**Bachelor of Technology**

**Artificial Intelligence and Machine Learning (Minors)**

**Under**

**Choice Based Credit System (CBCS)**

**B. Tech. - Minors Degree Program**

(For batches admitted from the Academic Year 2025 - 2026)

**August 2025**



**VARDHAMAN COLLEGE OF ENGINEERING**  
(Autonomous)

Affiliated to JNTUH, Approved by AICTE, Accredited by NAAC with A++ Grade  
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| II B.Tech. II Semester |             |                         |          |                              |   |    |         |       |         |                  |     |     |
|------------------------|-------------|-------------------------|----------|------------------------------|---|----|---------|-------|---------|------------------|-----|-----|
| #                      | Course Code | Title of the Course     | Category | Teaching and Learning Scheme |   |    |         | Hours | Credits | Assessment Marks |     |     |
|                        |             |                         |          | CI                           |   | LI | TW + SL |       |         | H                | C   | CIE |
|                        |             |                         |          | L                            | T | P  | SL      |       |         |                  |     |     |
| <b>Theory Courses</b>  |             |                         |          |                              |   |    |         |       |         |                  |     |     |
| 1                      | M2101       | Artificial Intelligence | PC       | 45                           | - | -  | 45      | 90    | 3       | 40               | 60  | 100 |
| 2                      | M2102       | Machine Learning        | PC       | 45                           | - | -  | 45      | 90    | 3       | 40               | 60  | 100 |
| <b>Total</b>           |             |                         |          | 90                           | 0 | 0  | 90      | 180   | 6       | 80               | 120 | 200 |

| III B.Tech. I Semester |             |                              |          |                              |   |    |         |       |         |                  |     |     |
|------------------------|-------------|------------------------------|----------|------------------------------|---|----|---------|-------|---------|------------------|-----|-----|
| #                      | Course Code | Title of the Course          | Category | Teaching and Learning Scheme |   |    |         | Hours | Credits | Assessment Marks |     |     |
|                        |             |                              |          | CI                           |   | LI | TW + SL |       |         | H                | C   | CIE |
|                        |             |                              |          | L                            | T | P  | SL      |       |         |                  |     |     |
| <b>Theory Courses</b>  |             |                              |          |                              |   |    |         |       |         |                  |     |     |
| <b>Elective-I:</b>     |             |                              |          |                              |   |    |         |       |         |                  |     |     |
| 1                      | M2103       | Computational Intelligence   | PC       | 45                           | - | -  | 45      | 90    | 3       | 40               | 60  | 100 |
|                        | M2104       | Computer Vision with open CV |          |                              |   |    |         |       |         |                  |     |     |
| <b>Elective-II:</b>    |             |                              |          |                              |   |    |         |       |         |                  |     |     |
| 2                      | M2105       | Natural Language Processing  | PC       | 45                           | - | -  | 45      | 90    | 3       | 40               | 60  | 100 |
|                        | M2106       | Robotics Process Automation  |          |                              |   |    |         |       |         |                  |     |     |
| <b>Total</b>           |             |                              |          | 90                           | 0 | 0  | 90      | 180   | 6       | 80               | 120 | 200 |

| III B.Tech. II Semester  |             |                             |          |                              |   |    |         |       |         |                  |     |     |
|--------------------------|-------------|-----------------------------|----------|------------------------------|---|----|---------|-------|---------|------------------|-----|-----|
| #                        | Course Code | Title of the Course         | Category | Teaching and Learning Scheme |   |    |         | Hours | Credits | Assessment Marks |     |     |
|                          |             |                             |          | CI                           |   | LI | TW + SL |       |         | H                | C   | CIE |
|                          |             |                             |          | L                            | T | P  | SL      |       |         |                  |     |     |
| <b>Theory Courses</b>    |             |                             |          |                              |   |    |         |       |         |                  |     |     |
| <b>Elective-III:</b>     |             |                             |          |                              |   |    |         |       |         |                  |     |     |
| 1                        | M2107       | Data Mining                 | PC       | 45                           | - | -  | 45      | 90    | 3       | 40               | 60  | 100 |
|                          | M2108       | Data Interpretation         |          |                              |   |    |         |       |         |                  |     |     |
| <b>Practical Courses</b> |             |                             |          |                              |   |    |         |       |         |                  |     |     |
| 2                        | M2109       | Machine Learning Laboratory | PC       | -                            | - | 30 | -       | 30    | 1       | 40               | 60  | 100 |
| <b>Total</b>             |             |                             |          | 45                           | 0 | 30 | 45      | 120   | 4       | 80               | 120 | 200 |

| IV B.Tech. I Semester               |             |                                      |          |                              |   |    |         |       |         |                  |    |     |
|-------------------------------------|-------------|--------------------------------------|----------|------------------------------|---|----|---------|-------|---------|------------------|----|-----|
| #                                   | Course Code | Title of the Course                  | Category | Teaching and Learning Scheme |   |    |         | Hours | Credits | Assessment Marks |    |     |
|                                     |             |                                      |          | CI                           |   | LI | TW + SL |       |         | H                | C  | CIE |
|                                     |             |                                      |          | L                            | T | P  | SL      |       |         |                  |    |     |
| <b>Experiential Learning Course</b> |             |                                      |          |                              |   |    |         |       |         |                  |    |     |
| 1                                   | M2110       | Mini Project in Minor Specialization | PW       | -                            | - | -  | 90      | 90    | 2       | 40               | 60 | 100 |
| <b>Total</b>                        |             |                                      |          | 0                            | 0 | 0  | 90      | 90    | 2       | 40               | 60 | 100 |

**II B.Tech. II Semester**

## M2101 - Artificial Intelligence

| Teaching and Learning Scheme |   |    |       | Hours | Credits | Assessment Marks |     |       |
|------------------------------|---|----|-------|-------|---------|------------------|-----|-------|
| CI                           |   | LI | TW+SL | H     | C       | CIE              | SEE | Total |
| L                            | T | P  | SL    |       |         |                  |     |       |
| 45                           | 0 | 0  | 45    | 90    | 3       | 40               | 60  | 100   |

### Course Description

#### Course Overview

This is an undergraduate course to acquire the ability to design intelligent solutions to problems in a variety of domains and business applications such as natural language Processing, text mining, and robotics, reasoning and problem-solving. AI will focus on problem solving, reasoning, planning and gaming. Through learning problem solving skills can be acquired. The course enables to choose data science domain to implement machine learning and deep learning applications.

#### Course Pre/Co-requisites

A9511-Python Programming Laboratory A9506-Discrete Mathematical Structures

#### Course Outcomes

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

- M2101.1. Apply AI techniques to solve problems of game playing, theorem proving, and machine learning.
- M2101.2. Apply the propositional logic to AI designs.
- M2101.3. Learn different knowledge representation techniques.
- M2101.4. Examine the role of searching strategies in AI environment.
- M2101.5. Analyse the constraint satisfaction problems for problem solving.

### Course Syllabus

#### Unit-I:

##### Introduction:

Introduction to AI - Intelligent Agents, Problem-Solving Agents, Searching for Solutions - Breadth-first search, Depth-first search, Hill-climbing search, simulated annealing search, Local Search in Continuous Spaces.

#### Unit-II:

##### Adversarial Search

Games, Optimal Decisions in Games, The minimax algorithm, Alpha-Beta Pruning, Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Knowledge-Based Agents, The wumpus world.

#### Unit-III:

##### Propositional Logic:

Inference and proofs, Proof by resolution, Horn clauses and definite clauses. First-Order Logic : Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution.

#### Unit-IV:

##### Planning:

Definition of Classical Planning, Algorithms for Planning with State Space Search, Planning ,Graphs, Analysis of Planning approaches, Hierarchical Planning.

**Unit-V:**

**Reinforcement learning:**

Introduction, passive Reinforcement learning, active Reinforcement learning, Generalization in reinforcement learning Robotics: Introduction, Robot Hardware, Robot Perception, planning to move, moving Robotic Software Architectures.

**Books and Materials**

**Text Books:**

1. Stuart J.Russel, Peter Norvig. *Artificial Intelligence – A Modern Approach* , 3<sup>rd</sup> ed., Pearson Education 2009.
2. E.Rich and K.Knight *Artificial Intelligence* , 3<sup>rd</sup> ed., Tata McGraw Hill, 2008.

**Reference Books:**

1. Patrick Henry Winston *Artificial Intelligence*, 3<sup>rd</sup> ed., Pearson Education Private Limited, India, 2001.
2. George F. Luger *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*, 6<sup>th</sup> ed., Pearson, 2008.
3. Shivani Goel *Artificial Intelligence* , 4<sup>th</sup> ed., Pearson Education Private Limited, India, 2009.

## Course Structure

### M2102 – Machine Learning

| Teaching and Learning Scheme |   |    |       | Hours | Credits | Assessment Marks |     |       |
|------------------------------|---|----|-------|-------|---------|------------------|-----|-------|
| CI                           |   | PI | TW+SL | H     | C       | CIE              | SEE | Total |
| L                            | T | P  | SL    |       |         |                  |     |       |
| 45                           | 0 | 0  | 45    | 90    | 3       | 40               | 60  | 100   |

### Course Description

#### Course Overview

This course will introduce the field of Machine Learning, in particular focusing on the core concepts of supervised and unsupervised learning. In supervised learning we will discuss algorithms which are trained on input data labelled with a desired output, for instance an image of a face and the name of the person whose face it is, and learn a function mapping from the input to the output. Unsupervised learning aims to discover latent structure in an input signal where no output labels are available, an example of which is grouping web- pages based on the topics they discuss. Students will learn the algorithms which underpin many popular Machine Learning techniques, as well as developing an understanding of the theoretical relationships between these algorithms.

#### Course Pre/Co-requisites

A9501 - Problem Solving Through C A9511 - Python Programming Laboratory

#### Course Outcomes

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

- M2102.1. Identify the various concepts and challenges in machine Learning.
- M2102.2. Select modelling and evaluation technique for handling real time data.
- M2102.3. Use supervised and unsupervised learning algorithms for a given problem.
- M2102.4. Examine supervised and unsupervised learning algorithms for analysing data..
- M2102.5. Identify the various concepts of neural network to develop AI based applications.

### Course Syllabus

#### Unit-I:

**Introduction to Machine Learning:** Types of Machine Learning, Problems not to be solved using Machine Learning, Applications of Machine Learning, Tools in Machine Learning, Issues in Machine Learning, Machine learning Activities, Basic Types of Data in Machine Learning, Exploring Structure of data, Data Quality & Remediation, Data Pre-Processing.

#### Unit-II:

**Modelling and Evaluation:** Games, Introduction, Selecting a Model, Training a Model, Model Representation and Interpretability, Evaluating Performance of a Model, Improving per- formance of a Model, Feature subset selection, Dimensionality Reduction - PCA, SVD,FA, LDA. Agents,

#### Unit-III:

**Bayesian Concept Learning:** Introduction, Bayes' Theorem, Navie Bayes Classifier, Applications of Navie Bayes Classifier, Supervised Learning: Classification, Example of Supervised Learning, Classification Model Learning Steps, Common Classification Algorithms: KNN, Decision Tree, Random Forest model Support vector machines. Introduction of Regression: Example of Regression, linear Regression, Multiple linear Regression.

**Unit-IV:**

**Unsupervised Learning:** Introduction, Unsupervised vs Supervised Learning, Application of Unsupervised Learning, Clustering K-Means, K-Medoid, DBSCAN.

**Unit-V:**

**Basics of Neural Network:** Introduction, Understanding the Biological Neuron, Exploring the Artificial Neuron, Types of Activation Functions, Early Implementations of ANN, Architectures of Neural Network.

**Books and Materials**

**Text Books:**

1. Das, G. Amit Kumar, Saikat Dutt, and Subramanian Chandramouli. *Machine Learning.* , Pearson India Education Services, 2019.
2. Tom M. Mitchel *Machine Learning* , McGraw Hill Education, 2013.

**Reference Books:**

1. Rudolph Russell. *Machine Learning: Step-by-Step Guide to Implement Machine Learning Algorithms with Python* , Addison-Wesley, 1992.
2. Luger, George F. *Artificial Intelligence: Structures and Strategies for Complex Problem Solving.*, 6<sup>th</sup> ed., Create Space Independent Publishing Platform, 2018.
3. Goel, Shivani. *Express Learning – Artificial Intelligence* , Pearson Education India, 2013.

**III B.Tech. I Semester**

## **ELECTIVES COURSE - I**

## M2103-Computational Intelligence

| Teaching and Learning Scheme |   |    |       | Hours | Credits | Assessment Marks |     |       |
|------------------------------|---|----|-------|-------|---------|------------------|-----|-------|
| CI                           |   | LI | TW+SL | H     | C       | CIE              | SEE | Total |
| L                            | T | P  | SL    |       |         |                  |     |       |
| 45                           | 0 | 0  | 45    | 90    | 3       | 40               | 60  | 100   |

### Course Description

#### Course Overview

This course covers the fundamentals of Computational Intelligence/ Soft computing including Fuzzy Logic Systems, Genetic Algorithm, Artificial Neural networks, and Hybrid Intelligent Systems like Adaptive Neuro-Fuzzy Inference System (ANFIS). It is easy to understand for anyone interested in the field of Computational Intelligence and includes practical examples of the techniques implemented in Python.

#### Course Outcomes

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

- M2103.1. Illustrate various neural network architectures and their applications
- M2103.2. Identify Fuzzy Logic, Various fuzzy systems and their functions.
- M2103.3. Analyze the genetic algorithms and their applications.
- M2103.4. Analyze the Rough Set Theory, Markov model techniques and decision tree model used in different fields .
- M2103.5. Identify Optimization based techniques and use them in different real life applications

### Course Syllabus

#### Unit-I:

##### Introduction to Computational Intelligence:

Types of Computational Intelligence, components of Computational Intelligence. Concept of Learning/Training model. Parametric Models, Non parametric Models. Multilayer Networks: Feed Forward network, Feedback network.

#### Unit-II:

##### Fuzzy Systems:

Fuzzy set theory: Fuzzy sets and operations, Membership Functions, Concept of Fuzzy relations and their composition, Concept of Fuzzy Measures; Fuzzy Logic: Fuzzy Rules, Inferencing; Fuzzy Control - Selection of Membership Functions, Fuzzyfication, Rule Based Design & Inferencing, Defuzzyfication.

#### Unit-III:

##### Genetic Algorithms:

Basic Genetics, Concepts, Working Principle, Creation of Offsprings, Encoding, Fitness Function, Selection Functions, Genetic Operators-Reproduction, Crossover, Mutation; Genetic Modelling, Benefits.

#### Unit-IV:

##### Rough Set Theory:

Introduction, Fundamental Concepts, Set approximation, Rough membership, Attributes, Optimization. Hidden Markov Models, Decision tree model.

**Unit-V:**

**Introduction to Swarm Intelligence:**

Swarm Intelligence Techniques: Ant Colony Optimization, Particle Swarm Optimization, Bee Colony Optimization etc. Applications of Computational Intelligence.

**Books and Materials**

**Text Books:**

1. Russell C. Eberhart and Yuhui Shi *Computational Intelligence: Concepts to Implementations* , Morgan Kaufmann Publishers,2007.
2. Andries P. Engelbrecht *Computational Intelligence: An Introduction* , 2<sup>rd</sup> ed., Wiley Publishing, 2007.

**Reference Books:**

1. Simon Haykin *Neural Networks: A Comprehensive Foundation.* , <sup>rd</sup> , Prentice Hall,1998.
2. David E. Goldberg *Genetic Algorithm in Search Optimization and Machine Learning,* <sup>rd</sup> , Pearson Education.
3. Jagdish Chand Bansal, Pramod Kumar Singh, Nikhil R. Pal *Evolutionary and Swarm Intelligence Algorithms*, Springer Publishing, 2019.

## M2014-Computer Vision with Open CV

| Teaching and Learning Scheme |   |    |       | Hours | Credits | Assessment Marks |     |       |
|------------------------------|---|----|-------|-------|---------|------------------|-----|-------|
| CI                           |   | LI | TW+SL | H     | C       | CIE              | SEE | Total |
| L                            | T | P  | SL    |       |         |                  |     |       |
| 45                           | 0 | 0  | 45    | 90    | 3       | 40               | 60  | 100   |

### Course Description

#### Course Overview

Computer Vision has become ubiquitous in our society, with applications in search, image understanding, apps, mapping, medicine, drones, and self-driving cars. Core to many of these applications are visual recognition tasks such as image classification and object detection. This course is a deep dive into details of neural-network based deep learning methods for computer vision.

#### Course Outcomes

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

- M2014.1. Demonstrate Image formation process, fundamentals of deep learning re- quired for computer vision.
- M2014.2. Examine existing practical computer vision techniques.
- M2014.3. Analyse computer vision Classification and learning algorithms
- M2014.4. Design deep learning applications for Face Detection and Recognition and Pedestrian detection.
- M2014.5. Implement computer vision applications using Open-CV

### Course Syllabus

#### Unit-I:

##### Introduction to Computer Vision:

What is computer vision, Applications of computer vision. The digital camera, Sampling and aliasing. Imaging Geometry: Translation and Scaling, Rotation, Perspective Transform. Image Formation: Pinhole Perspective, Weak Perspective. Model Fitting and Optimization: Scattered data interpolation

#### Unit-II:

##### Image Classification:

Data-driven approach, K-Nearest Neighbor, Hyper parameters, Cross-validation Linear Classifiers: Algebraic / Visual / Geometric viewpoints; Soft- max / SVM classifiers. Application: Interactive colorization, Interactive segmentation

#### Unit-III:

##### Convolutional Neural Networks:

Pooling and un pooling. Application: Digit classifica- tion, Network architectures, Model zoos, Visualizing weights and activations, Adversarial examples, Self-supervised learning.

#### Unit-IV:

##### Recognition:

Instance recognition, Image classification, Feature-based methods, Deep networks.

#### Unit-V:

##### Open CV Applications:

Image fundamentals: Camera Sensors, Image Noise models. Feature detection and object segmentation: Types

of Detectors, Semantic, Instance, and Panoptic Segmentation. Vision and AI: Vision Transformers, Vision Language models, Multi-model and Generative Models for Vision.

## Books and Materials

### Text Books:

1. Shah M. *Fundamentals of Computer Vision* , 1997.
2. Richard Szeliski. *Computer Vision: Algorithms and Applications (CVAA)* , 2<sup>rd</sup> nd., Springer, 2011.
3. Forsyth D. and Ponce J. *Computer Vision - A Modern Approach* , 2<sup>rd</sup> nd.,Prentice Hall, 2002.

### Reference Books:

1. Rafael C. Gonzalez, Richard E. Woods *Digital Image Processing* , 2<sup>rd</sup> nd., Prentice Hall, 2013.
2. R. Jain, R. Kasturi, and B. G. Schunk *Machine Vision, McGraw-Hill*.
3. Milan Sonka,VaclavHlavac, Roger Boyle, *Image Processing, Analysis, and Machine Vision, Thomson Learning*.

## **ELECTIVES COURSE - II**

## M2105-Natural Language Processing

| Teaching and Learning Scheme |   |    |       | Hours | Credits | Assessment Marks |     |       |
|------------------------------|---|----|-------|-------|---------|------------------|-----|-------|
| CI                           |   | LI | TW+SL | H     | C       | CIE              | SEE | Total |
| L                            | T | P  | SL    |       |         |                  |     |       |
| 45                           | 0 | 0  | 45    | 90    | 3       | 40               | 60  | 100   |

### Course Description

#### Course Overview

Natural Language Processing is the art of extracting information from unstructured text. Learn basics of Natural Language Processing, Regular Expressions & text sentiment analysis using machine learning in this course. Natural Language Processing (NLP) is basically how we can teach machines to understand human languages and extract meaning from text. The course covers the phases of NLP processing and uses libraries provided by NLP to analyze the given text document.

#### Course Outcomes

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

- M2105.1. Identify the structure of words and documents for text preprocessing.
- M2105.2. Choose an approach to parse the given text document.
- M2105.3. Make use of semantic parsing to capture real meaning of text.
- M2105.4. Select a language model to predict the probability of a sequence of words.
- M2105.5. Examine the various applications of NLP.

### Course Syllabus

#### Unit-I:

##### Introduction:

What is Natural Language Processing (NLP), Origins of NLP, The Challenges of NLP, Phases of NLP, Language and Grammar. Finding the Structure of Words and Documents: Words and Their Components, Issues and Challenges, Morphological Models. Finding the Structure of Documents: Introduction, Sentence Boundary Detection, Topic Boundary Detection, Methods, Complexity of the Approaches, Performances of the Approaches, Features, Processing Stages.

#### Unit-II:

##### Syntax:

Parsing Natural Language, A Data-Driven Approach to Syntax, Stop words, Correcting Words, Stemming, Lemmatization, Parts of Speech (POS) Tagging, Representation of Syntactic Structure, Parsing Algorithms, Models for Ambiguity Resolution in Parsing.

#### Unit-III:

##### Semantic Parsing:

Introduction, Semantic Interpretation: Structural Ambiguity, Entity and Event Resolution, System Paradigms, Word Sense: Simplified Lesk, Supervised: Rules for selecting syntactic relations as features, unsupervised, and Semisupervised: The Yarowsky algorithm, Predicate-Argument Structure: FrameNet, PropBank, The semantic role labeling (SRL) algorithm, content word, Meaning Representation: ATIS, Communicator, GeoQuery, Robocup: CLang

**Unit-IV:**

**Language modelling:**

Introduction, n-Gram Models, Language Model Evaluation, Parameter Estimation, Types of Language Models: Class-Based Language Models, MaxEnt Language Models, Neural Network Language Models Language-Specific Modeling Problems, Multilingual and Crosslingual Language Modeling.

**Unit-V:**

**Applications:**

Question Answering: History, Architectures, Question Analysis, Search and Candidate Extraction, Automatic Summarization: Approaches to Summarization, Information Retrieval: Document Preprocessing, Monolingual Information Retrieval

**Books and Materials**

**Text Books:**

1. Daniel M. Bikel Imed Zitouni. *Multilingual Natural Language Processing Applications: From Theory to Practice* , IBM Press, 2013.
2. Tanveer Siddiqui, U.S. Tiwary *Natural Language Processing and Information Retrieval* ,<sup>rd</sup> , Oxford University, 2008.

**Reference Books:**

1. Daniel Jurafsky and James H Martin *Speech and Language Processing: An introduction to Natural Language Processing., Computational Linguistics and Speech Recognition* , 2<sup>rd</sup> ed., Prentice Hall, 2008.
2. James Allen. *Natural Language Understanding*, 2<sup>rd</sup> ed., Cummings publishing company,1995.

## M2106 – Robot Modelling and Control

| Teaching and Learning Scheme |   |    |       | Hours | Credits | Assessment Marks |     |       |
|------------------------------|---|----|-------|-------|---------|------------------|-----|-------|
| CI                           |   | LI | TW+SL | H     | C       | CIE              | SEE | Total |
| L                            | T | P  | SL    |       |         |                  |     |       |
| 45                           | 0 | 0  | 45    | 90    | 3       | 40               | 60  | 100   |

### Course Description

#### Course Overview

This course will introduce the field of Machine Learning, in particular focusing on the core concepts of supervised and unsupervised learning. In supervised learning we will discuss algorithms which are trained on input data labelled with a desired output, for instance an image of a face and the name of the person whose face it is, and learn a function mapping from the input to the output. Unsupervised learning aims to discover latent structure in an input signal where no output labels are available, an example of which is grouping web- pages based on the topics they discuss. Students will learn the algorithms which underpin many popular Machine Learning techniques, as well as developing an understanding of the theoretical relationships between these algorithms.

#### Course Outcomes

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

- M2103.1. Illustrate various neural network architectures and their applications.
- M2103.2. Apply the propositional logic to AI designs .
- M2103.3. Learn different knowledge representation techniques.
- M2103.4. Examine the role of searching strategies in AI environment.
- M2103.5. Analyse the constraint satisfaction problems for problem solving.

### Course Syllabus

#### Unit-I:

##### Introduction:

Introduction to AI - Intelligent Agents, Problem-Solving Agents, Searching for Solutions - Breadth-first search, Depth-first search, Hill-climbing search, simulated annealing search, Local Search in Continuous Spaces.

#### Unit-II:

##### Adversarial Search

Games, Optimal Decisions in Games, The minimax algorithm, Alpha–Beta Pruning, Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Knowledge-Based Agents, The wumpus world.

#### Unit-III:

##### Propositional Logic:

Inference and proofs, Proof by resolution, Horn clauses and definite clauses. First-Order Logic : Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution.

#### Unit-IV:

##### Planning:

Definition of Classical Planning, Algorithms for Planning with State Space Search, Planning ,Graphs, Analysis of Planning approaches, Hierarchical Planning.

**Unit-V:**

**Reinforcement learning:**

Introduction, passive Reinforcement learning, active Reinforcement learning, Generalization in reinforcement learning Robotics: Introduction, Robot Hardware, Robot Perception, planning to move, moving Robotic Software Architectures.

**Books and Materials**

**Text Books:**

1. G Amit Kumar Das, Saikat Dutt, Subramanian Chandramouli *Computational Intelligence: Concepts to Implementations* , Morgan Kaufmann Publishers,2007.
2. E.Rich and K.Knight *Artificial Intelligence* , 3<sup>rd</sup> ed., Tata McGraw Hill, 2008.

**Reference Books:**

1. Patrick Henry Winston *Artificial Intelligence*, Pearson India Education Services, 2019.
2. George F. Luger *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*, 6<sup>th</sup> ed., Pearson, 2008.
3. Shivani Goel *Artificial Intelligence* , 4<sup>th</sup> ed., Pearson Education Private Limited, India, 2009.

**III B.Tech. II Semester**

## **ELECTIVES COURSE - III**

## M2107 – Data Mining

| Teaching and Learning Scheme |   |    |       | Hours | Credits | Assessment Marks |     |       |
|------------------------------|---|----|-------|-------|---------|------------------|-----|-------|
| CI                           |   | LI | TW+SL | H     | C       | CIE              | SEE | Total |
| L                            | T | P  | SL    |       |         |                  |     |       |
| 45                           | 0 | 0  | 45    | 90    | 3       | 40               | 60  | 100   |

### Course Description

#### Course Overview

This course provides the concepts and techniques in processing gathered data or information which will be used in various applications. Students will become acquainted with both the strengths and limitations of various data mining techniques like Association, Classification, Cluster and Outlier analysis. Data mining tools predict future trends and behaviours, allowing businesses to make proactive, knowledge-driven decisions.

#### Course Pre/Co-requisites

A9509 - Data Base Management Systems.

#### Course Outcomes

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

- M2107.1 Apply AI techniques to solve problems of game playing, theorem proving, and machine learning.
- M2107.2 Build data warehouse schemas for enterprise applications.
- M2107.3 Perform market basket analysis using association rule mining.
- M2107.4 Utilize classification techniques for analysis and interpretation of data.
- M2107.5. Identify appropriate clustering and outlier detection techniques to handle complex data.

### Course Syllabus

#### Unit-I:

##### Introduction to Data Mining:

Data mining, Knowledge Discovery process, Data Mining Functionalities-Kinds of Patterns, Major Issues in Data Mining. Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Dissimilarity of Numeric Data-Distance measures, Data Pre-processing: Major Tasks in Data Pre-processing, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.

#### Unit-II:

##### Data Warehouse and OLAP:

Data Warehouse basic concepts, Differences between Operational Database Systems and Data Warehouses, Multi-tiered Architecture, Data Warehouse Models, Schemas for Multidimensional Data Models, Typical OLAP Operations, Data Warehouse Design Process, OLAP Servers.

#### Unit-III:

##### Association Analysis:

Basic Concepts, Market Basket Analysis, Apriori Algorithm, FP- growth, From Association Analysis to Correlation Analysis, Pattern Mining in Multilevel Associations and Multidimensional Associations.

#### Unit-IV:

##### Classification:

Basic Concepts, Decision Tree Induction, Bayes Classification Methods, Rule- Based Classification, Metrics for Evaluating Classifier Performance, Ensemble Methods, Multilayer Feed-Forward Neural Network, Support Vector Machines, k-Nearest- Neighbor Classifiers.

**Unit-V:**

**Cluster Analysis:**

Requirements for Cluster Analysis, Overview of Basic Clustering Methods, Partitioning Methods-k-Means, k-Medoids, Hierarchical Methods-AGENES, DIANA, BIRCH, Density-Based Method-DBSCAN, Outlier Analysis: Types of Outliers, Challenges of Outlier Detection, and Overview of Outlier Detection Methods.

**Books and Materials**

**Text Books:**

1. Jiawei Han, Micheline Kamber, Jian Pei. *Data Mining: Concepts and Techniques*, 3<sup>rd</sup> ed Morgan Kaufmann/Elsevier, 2012.

**Reference Books:**

1. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne and Vipin Kumar *Introduction to Data Mining*, 2<sup>nd</sup> ed., Pearson Education India, 2021
2. Margaret H Dunham *Data Mining Introductory and Advanced Topics*, 2<sup>nd</sup> ed., Pearson Education India, 2006.
3. Amitesh Sinha *Data Warehousing*, Thomson Learning, India, 2007.
4. Shivani Goel *Artificial Intelligence*, 4<sup>th</sup> ed., Pearson Education Private Limited, India, 2009.

## M2108 – Pattern Recognition

| Teaching and Learning Scheme |   |    |       | Hours | Credits | Assessment Marks |     |       |
|------------------------------|---|----|-------|-------|---------|------------------|-----|-------|
| CI                           |   | LI | TW+SL | H     | C       | CIE              | SEE | Total |
| L                            | T | P  | SL    |       |         |                  |     |       |
| 45                           | 0 | 0  | 45    | 90    | 3       | 40               | 60  | 100   |

### Course Description

#### Course Overview

Pattern recognition is the process of recognizing patterns by using a machine learning algorithm. Pattern recognition can be defined as the classification of data based on knowledge already gained or on statistical information extracted from patterns and/or their representation. One of the important aspects of pattern recognition is its application potential. The course is designed to introduce students to theoretical concepts and practical issues associated with pattern recognition. The course also enables to Design systems and algorithms for pattern recognition (signal classification), with focus on sequences of patterns that are analyzed using hidden Markov models (HMM).

#### Course Outcomes

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

- M2108.1. Illustrate various neural network architectures and their applications
- M2108.2. Apply the propositional logic to AI designs .
- M2108.3. Learn different knowledge representation techniques
- M2108.4. Examine the role of searching strategies in AI environment.
- M2108.5. Analyse the constraint satisfaction problems for problem solving.

### Course Syllabus

#### Unit-I:

##### Introduction:

Introduction to AI - Intelligent Agents, Problem-Solving Agents, Searching for Solutions - Breadth-first search, Depth-first search, Hill-climbing search, simulated annealing search, Local Search in Continuous Spaces.

##### Course Pre/Co-requisites

A9702 – Machine Learning.

#### Unit-I:

##### Introduction

Machine perception, pattern recognition example, pattern recognition systems, the Design cycle, learning and adaptation Bayesian Decision Theory: Introduction, continuous features – two categories classifications, minimum error-rate classification-zero-one loss function, classifiers, discriminant functions, and decision surfaces.

#### Unit-II:

##### Normal density:

Univariate and multivariate density, discriminant functions for the normal Density different cases, Bayes decision theory – discrete features, compound Bayesian decision theory and context.

#### Unit-III:

##### Maximum likelihood and Bayesian parameter estimation:

Introduction, maximum likelihood Estimation, Bayesian estimation, Bayesian parameter estimation–Gaussian case.

**Unit-IV:**

**Un-supervised learning and clustering:**

Introduction, mixture densities and identifiability, maximum likelihood estimates, application to normal mixtures, K-means clustering.

**Unit-V:**

**Pattern recognition using discrete and Continuous hidden Markov models:**

Discrete time Markov process, Extensions to hidden Markov models, three basic problems of HMMs, types of HMMs. Continuous observation densities, multiple mixtures per state, speech recognition applications.

**Books and Materials**

**Text Books:**

1. Richard O. Duda, Peter E. Hart, David G. Stork. *Pattern Recognition: An Indian Adaption*, 2<sup>nd</sup> ed Wiley student edition, 2021.
1. M Narasimha Murty & V Susheela Devi. *Introduction to pattern recognition and machine learning*, IISc Press, 2015.

**Reference Books:**

1. Richard O. Duda, Peter E. Hart, David G. Stork. *Pattern Classification*, 2<sup>nd</sup> ed., Wiley student edition, 2000.
2. Christopher M. Bishop. *Pattern Recognition and Machine Learning*, Springer, 2006.

## Course Structure

### M2109– Machine Learning Laboratory

| Teaching and Learning Scheme |   |    |       | Hours | Credits | Assessment Marks |     |       |
|------------------------------|---|----|-------|-------|---------|------------------|-----|-------|
| CI                           |   | PI | TW+SL | H     | C       | CIE              | SEE | Total |
| L                            | T | P  | SL    |       |         |                  |     |       |
| 0                            | 0 | 30 | -     | 30    | 1       | 40               | 60  | 100   |

### Course Description

#### Course Overview

Machine Learning is concerned with computer programs that automatically improve their performance through experience. This course covers the practical algorithms for machine learning from a variety of perspectives. We cover topics such as PCA, ID3, Naive Bayesian classifier, SVM classifier, KNN classifier, Bayesian network, linear and Multiple Regression algorithms, K-means and Agglomerative hierarchical Clustering algorithm..

#### Course Pre/Co-requisites

This course has no specific pre-requisites and co-requisites.

### Course Outcomes

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

- M2109.1. Understand the implementation procedures for the machine learning algorithms.
- M2109.2. Design Python programs for various Learning algorithms
- M2109.3. Apply appropriate data sets to the Machine Learning algorithms.
- M2109.4. Identify and apply Machine Learning algorithms to solve real-world problems.
- M2109.5. Apply various pre-processing techniques on data sets.

### Course Syllabus

#### List of Experiments :

1. Demonstrate the Data Pre-Processing techniques by taking real datasets.
2. Demonstrate Feature subset selection and implement dimensionality reduction (PCA) technique.
3. Write a program to demonstrate the working of the decision tree-based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Write a program to demonstrate the working of the decision tree-based CART algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
5. Write a program to demonstrate the working of the decision tree-based C4.5 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
6. Write a program to implement the naive Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering a few test data sets.
7. Write a program to implement the SVM classifier for a sample training data set stored as a .CSV file.
8. Write a program to implement the K-NN classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier.
9. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using the standard Heart Disease Data Set.
10. Implement a linear Regression algorithm in order to t data points. Select the appropriate data set for your experiment and draw graphs.

11. Implement multiple linear Regression algorithms in order to t data points. Select the appropriate data set for your experiment and draw graphs
12. Write a program to implement the K-Means Clustering algorithm and find the SSE of set of cluster
13. Write a program to implement the DBSCAN Clustering algorithm and find the MSE of set of cluster
14. Write a program to implement an agglomerative hierarchal Clustering algorithm.
15. Write a program to illustrate all activation functions for Neural Network

**Laboratory Equipment/Software/Tools Required:**

1. Computer Systems (PCs) installed with Ubuntu OS (Open source/ Freeware)
2. Python (Open Source/ Freeware), Jupyter Notebook, Anaconda (Open Source/ Free- ware)



## Vision

To be a pioneer institute and leader in engineering education to address societal needs through education and practice.

## Mission

- To adopt innovative student centric learning methods.
- To enhance professional and entrepreneurial skills through industry institute interaction.
- To train the students to meet dynamic needs of the society.
- To promote research and continuing education.

## Quality Policy

We at Vardhaman College of Engineering, endeavor to uphold excellence in all spheres by adopting the best practices in effort and effect.



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