



B.Tech (Minor (AI&ML))

Offered by

**Department
of
CSE (AI&ML)**

R21 - COURSE STRUCTURE & SYLLABUS



B.Tech. with Minor Degree Program in AI&ML

Course Structure (2022-23)

COURSE STRUCTURE

Year/Semester		Course code	Theory (Which is not studied in regular B.Tech. course)	Total Credits
III - I Semester		21MAI31T1	Foundations of Artificial Intelligence	3
		21MAI31L1	Artificial Intelligence Laboratory	1.5
III - II Semester		21MAI32T1	AI Applications	3
		21MAI32L2	AI Applications Laboratory	1
IV - I Semester		21MAI41T1 21MAI41T2	(Either online through MOOCS or off-line Class) Machine Learning OR Deep Learning	3
		21MAI41L3 21MAI41L4	Machine Learning Laboratory OR Deep Learning Laboratory	1.5
IV - II Semester		21MAI42T1 21MAI42T2 21MAI42T3 21MAI42T4 21MAI42T5 21MAI42T6	Any one of the following subjects: 1. Robotics Process Automation 2. Natural Language Processing 3. Game theory 4. Computer Vision & Robotics 5. Speech & Video Processing 6. Soft Computing	3
IV-II Semester		21MAI42PW1	Mini Project	2
Total credits				18

III - I Semester

21MAI31T1: FOUNDATIONS OF ARTIFICIAL INTELLIGENCE

B.Tech (AI&ML). III Year I Sem

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Course Objective:

1. To review and strengthen important mathematical concepts required for AI & ML.
2. Introduce the concept of learning patterns from data and develop a strong theoretical foundation for understanding state of the art Machine Learning algorithms.

Course Outcomes:

After completion of course, students would be able to:

1. Design and implement machine learning solutions to classification, regression and clustering problems.
2. Evaluate and interpret the results of the different ML techniques.
3. Design and implement various machine learning algorithms in a range of Real-world applications.

UNIT - I

Defining Artificial Intelligence, Defining AI techniques, Using Predicate Logic and Representing Knowledge as Rules, Representing simple facts in logic, Computable functions and predicates, Procedural vs Declarative knowledge, Logic Programming

UNIT - II

Mathematical foundations: Matrix Theory and Statistics for Machine Learning.

Idea of Machines learning from data, Classification of problem – Regression and Classification, Supervised and Unsupervised learning.

UNIT - III

Linear Regression: Model representation for single variable, Single variable Cost Function, Gradient Decent for Linear Regression, Gradient Decent in practice.

UNIT - IV

Logistic Regression: Classification, Hypothesis Representation, Decision Boundary, Cost function, Advanced Optimization, Multi-classification (One vs All), Problem of Overfitting.

UNIT - V

Discussion on clustering algorithms and use-cases centered around clustering and classification.

TEXT BOOKS:

1. Saroj Kaushik, Artificial Intelligence, Cengage Learning, 1st Edition 2011.
2. Yuxi (Hayden) Liu, "Python Machine Learning by Example", Packet Publishing Limited, 2017.

REFERENCE BOOKS:

1. Anindita Das Bhattacharjee, "Practical Workbook Artificial Intelligence and Soft Computing for beginners, Shroff Publisher-X team Publisher.
2. Tom Mitchell, Machine Learning, McGraw Hill, 2017.
3. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2011.
4. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2011.

Corresponding Online Resources:

1. Artificial Intelligence, https://swayam.gov.in/nd2_cec20_cs10/preview.

21MAI31L1: ARTIFICIAL INTELLIGENCE LABORATORY

B.Tech (AI&ML). III Year I Sem

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1. Basic programs in Python to get familiarize various programming structures.
2. Implementation of logical rules in Python.
3. Using any data apply the concept of:
 - a. Liner regression
 - b. Gradient decent
 - c. Logistic regression
4. Perform and plot over fitting in a data set.
5. Implementation of KNN classification algorithm.
6. Implementation of k-means clustering algorithm.
7. Explore statistical methods for machine learning.

III - II Semester

21MAI32T1: AI APPLICATIONS

B.Tech (AIML). III Year II Sem

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Course Objective: To give deep knowledge of AI and how AI can be applied in various fields to make the life easy.

Course Outcomes: After completion of course, students would:

1. To correlate the AI and solutions to modern problem.
2. To decide when to use which type of AI technique.

UNIT-I

Supervised Learning-Classification: Naive Bayes Classifier-AI Application in Natural Language Processing, k-NN classification-AI Application in Healthcare, Support vector machines-AI application in Food and Animal predictions.

UNIT-II

Ensemble Techniques I-Decision Trees-ID3(Iterative Dichotomiser3),CART(Classification and Regression Tree)-AI applications in Weather Forecasting.

UNIT III

Ensemble Techniques II- C4.5, CHAID(Chi-Square Automatic Interaction Detection),Random Forest–AI applications in Environmental & Banking Predictions

Unsupervised Learning-Clustering: K-Means, Hierarchical Learning- AI applications in sales and Marketing.

UNIT-IV

Adversarial Search-Min-Max Algorithm, Alpha Beta Pruning, Bayes' theorem in AI-Robotic process automation.

UNIT-V

Artificial Neural Networks-Concepts and applications, Self Organizing Maps(SOM),ANN based Clustering, Introduction to Cascade and Haar Classifiers, AI application in Face Recognition.

Text Books:

- [1] Sameer Dhanrajani, AI and Analytics, Accelerating Business Decisions, John Wiley & Sons.
- [2] Artificial Intelligence in Practice: How 50 Successful Companies Used AI and Machine Learning to Solve Problems, Bernard Marr, Matt Ward, Wiley.
- [3] John Fulcher,(2006)“ Advances in Applied Artificial Intelligence “ University of Wollongong, Australia
- [4] B. Yegnanarayana (2010) “ Artificial Neural Networks” PHI

Reference Books:

- [1] Life 3.0: Being Human in the Age of Artificial Intelligence by Max Tegmark, 2018.
- [2]. Homo Deus: A Brief History of Tomorrow by Yuval Noah Harari, 2017

21MAI32L2: AI Applications Laboratory

B.Tech (AI&ML). III Year II Sem

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Course Objective: To give deep knowledge of AI and how AI can be applied in various fields to make the life easy.

Course Outcomes: After completion of course, students would know how:

1. To correlate the AI and solutions to modern problems.
2. To decide when to use which type of AI technique.

List of Experiments

1. AI Applications in Natural Language Processing using Python
2. AI Applications in Health Care using Python
3. AI Applications in Food predictions using Python
4. AI Applications in Animal predictions using Python
5. AI Applications in Weather Fore Casting using Python
6. AI Applications in Environmental using Python
7. AI Applications in Banking using Python
8. AI Applications in Sales and Marketing using Python
9. AI Applications in Robotic Process Automation using Python
10. AI Applications in Face Recognition using Python

IV - I Semester

21MAI41T1: MACHINE LEARNING

B.Tech (AI&ML). IV Year I Sem

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Prerequisites:

1. Data Structures
2. Knowledge on statistical methods

Course Objectives:

- This course explains machine learning techniques such as decision tree learning, Bayesian learning etc.
- To understand computational learning theory.
- To study the pattern comparison techniques.

Course Outcomes:

- Understand the concepts of computational intelligence like machine learning
- Ability to get the skill to apply machine learning techniques to address the real time problems in different areas
- Understand the Neural Networks and its usage in machine learning application.

UNIT - I

Introduction - Well-posed learning problems, designing a learning system, Perspectives and issues in machine learning

Concept learning and the general to specific ordering – introduction, a concept learning task, concept learning as search, find-S: finding a maximally specific hypothesis, version spaces and the candidate elimination algorithm, remarks on version spaces and candidate elimination, inductive bias.

Decision Tree Learning – Introduction, decision tree representation, appropriate problems for decision tree learning, the basic decision tree learning algorithm, hypothesis space search in decision tree learning, inductive bias in decision tree learning, issues in decision tree learning.

UNIT - II

Artificial Neural Networks-1– Introduction, neural network representation, appropriate problems for neural network learning, perceptions, multilayer networks and the back-propagation algorithm.

Artificial Neural Networks-2- Remarks on the Back-Propagation algorithm, An illustrative example: face recognition, advanced topics in artificial neural networks.

Evaluation Hypotheses – Motivation, estimation hypothesis accuracy, basics of sampling theory, a general approach for deriving confidence intervals, difference in error of two hypotheses, comparing learning algorithms.

UNIT - III

Bayesian learning – Introduction, Bayes theorem, Bayes theorem and concept learning, Maximum Likelihood and least squared error hypotheses, maximum likelihood hypotheses for predicting probabilities, minimum description length principle, Bayes optimal classifier, Gibbs algorithm, Naïve Bayes classifier, an example: learning to classify text, Bayesian belief networks, the EM algorithm.

Computational learning theory – Introduction, probably learning an approximately correct hypothesis, sample complexity for finite hypothesis space, sample complexity for infinite hypothesis spaces, the mistake bound model of learning.

Instance-Based Learning- Introduction, k -nearest neighbour algorithm, locally weighted regression, radial basis functions, case-based reasoning, remarks on lazy and eager learning.

UNIT- IV

Genetic Algorithms – Motivation, Genetic algorithms, an illustrative example, hypothesis space search, genetic programming, models of evolution and learning, parallelizing genetic algorithms.

Learning Sets of Rules – Introduction, sequential covering algorithms, learning rule sets: summary, learning First-Order rules, learning sets of First-Order rules: FOIL, Induction as inverted deduction, inverting resolution.

Reinforcement Learning – Introduction, the learning task, Q -learning, non-deterministic, rewards and actions, temporal difference learning, generalizing from examples, relationship to dynamic programming.

UNIT - V

Analytical Learning-1- Introduction, learning with perfect domain theories: PROLOG-EBG, remarks on explanation-based learning, explanation-based learning of search control knowledge.

Analytical Learning-2- Using prior knowledge to alter the search objective, using prior knowledge to augment search operators.

Combining Inductive and Analytical Learning – Motivation, inductive-analytical approaches to learning, using prior knowledge to initialize the hypothesis.

TEXT BOOK:

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

REFERENCE BOOK:

2. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis

Course Objective: The objective of this lab is to get an overview of the various machine learning techniques and can able to demonstrate them using python.

Course Outcomes: After the completion of the course the student can able to:

- understand complexity of Machine Learning algorithms and their limitations;
- understand modern notions in data analysis-oriented computing;
- be capable of confidently applying common Machine Learning algorithms in practice and implementing their own;
- Be capable of performing experiments in Machine Learning using real-world data.

List of Experiments

1. The probability that it is Friday and that a student is absent is 3 %. Since there are 5 school days in a week, the probability that it is Friday is 20 %. What is the probability that a student is absent given that today is Friday? Apply Baye's rule in python to get the result. (Ans: 15%)
2. Extract the data from database using python
3. Implement k-nearest neighbours classification using python
4. Given the following data, which specify classifications for nine combinations of VAR1 and VAR2 predict a classification for a case where VAR1=0.906 and VAR2=0.606, using the result of k- means clustering with 3 means (i.e., 3 centroids)

VAR1	VAR2	CLAS
1		S
1.713	1.586	0
0.180	1.786	1
0.353	1.240	1
0.940	1.566	0
1.486	0.759	1
1.266	1.106	0
1.540	0.419	1
0.459	1.799	1
0.773	0.186	1

5. The following training examples map descriptions of individuals onto high, medium and low credit-worthiness.

medium skiing design single twenties no -> high Risk
 high golf trading married forties yes -> low Risk
 low speedway transport married thirties yes -> med Risk
 medium football banking single thirties yes -> low Risk
 high flying media married fifties yes -> high Risk
 low football security single twenties no -> med Risk
 medium golf media single thirties yes -> med Risk
 medium golf transport married forties yes -> low Risk
 high skiing banking single thirties yes -> high Risk
 low golf unemployed married forties yes -> high Risk

Input attributes are (from left to right) income, recreation, job, status, age-group, home-owner. Find the unconditional probability of 'golf' and the conditional probability of 'single' given 'medRisk' in the dataset?

6. Implement linear regression using python.
7. Implement Naïve Bayes theorem to classify the English text
8. Implement an algorithm to demonstrate the significance of genetic algorithm

9. Implement the finite words classification system using Back-propagation algorithm

21MAI41T2:DEEP LEARNING

B.Tech (AI&ML). IV Year I Sem

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Course Objectives:

- To introduce the foundations of Artificial Neural Networks
- To acquire the knowledge on Deep Learning Concepts
- To learn various types of Artificial Neural Networks
- To gain knowledge to apply optimization strategies

Course Outcomes:

- Ability to understand the concepts of Neural Networks
- Ability to select the Learning Networks in modeling real world systems
- Ability to use an efficient algorithm for Deep Models
- Ability to apply optimization strategies for large scale applications

UNIT-I

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

UNIT-II

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 - III

Introduction to Deep Learning, Historical Trends in Deep learning, Deep Feed - forward networks, Gradient-Based learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms

UNIT - IV

Regularization for Deep Learning: Parameter norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised learning, Multi-task learning, Early Stopping, Parameter Typing and Parameter Sharing, Sparse Representations, Bagging and other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, tangent Prop and Manifold, Tangent Classifier

UNIT - V

Optimization for Train Deep Models: Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second- Order Methods, Optimization Strategies and Meta-Algorithms

Applications: Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural

Language Processing

TEXT BOOKS:

1. Deep Learning: An MIT Press Book By Ian Goodfellow and Yoshua Bengio and Aaron Courville
2. Neural Networks and Learning Machines, Simon Haykin, 3rd Edition, Pearson Prentice Hall.

21MAI41L4: DEEP LEARNING LABORATORY

B.Tech (AI&ML). IV Year I Sem

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Course Objectives:

1. To Build the Foundation of Deep Learning.
2. To Understand How to Build the Neural Network.
3. To enable students to develop successful machine learning concepts.

Course Outcomes:

1. Upon the Successful Completion of the Course, the Students would be able to:
2. Learn the Fundamental Principles of Deep Learning.
3. Identify the Deep Learning Algorithms for Various Types of Learning Tasks in various domains.
4. Implement Deep Learning Algorithms and Solve Real-world problems.

LIST OF EXPERIMENTS:

1. Setting up the Spyder IDE Environment and Executing a Python Program
2. Installing Keras, Tensorflow and Pytorch libraries and making use of them
3. Applying the Convolution Neural Network on computer vision problems
4. Image classification on MNIST dataset (CNN model with Fully connected layer)
5. Applying the Deep Learning Models in the field of Natural Language Processing
6. Train a sentiment analysis model on IMDB dataset, use RNN layers with LSTM/GRU notes
7. Applying the Autoencoder algorithms for encoding the real-world data
8. Applying Generative Adversarial Networks for image generation and unsupervised tasks.

TEXT BOOKS:

1. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press.
2. The Elements of Statistical Learning by T. Hastie, R. Tibshirani, and J. Friedman, Springer.
3. Probabilistic Graphical Models. Koller, and N. Friedman, MIT Press.

REFERENCES:

1. Bishop, C.M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Golub, G.H., and Van Loan, C.F., Matrix Computations, JHU Press, 2013.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw Hill Education, 2004.

EXTENSIVE READING:

1. <http://www.deeplearning.net>
2. <https://www.deeplearningbook.org/>
3. <https://developers.google.com/machine-learning/crash-course/ml-intro>
4. www.cs.toronto.edu/~fritz/absps/imagenet.pdf
5. <http://neuralnetworksanddeeplearning.com/>

IV Year II Semester

Course Objectives: Aim of the course is to make learners familiar with the concepts of Robotic Process Automation.

Course Outcomes:

1. Describe RPA, where it can be applied and how it's implemented.
2. Identify and understand Web Control Room and Client Introduction.
3. Understand how to handle various devices and the workload.
4. Understand Bot creators, Web recorders and task editors.

UNIT-I

Introduction to Robotic Process Automation & Bot Creation Introduction to RPA and Use cases –Automation Anywhere Enterprise Platform–Advanced features and capabilities– Ways to create Bots.

UNIT-II

Web Control Room and Client Introduction-Features Panel-Dashboard(Home,Bots,Devices,Audit,Workload, Insights) - Features Panel – Activity (View Tasks in Progress and Scheduled Tasks) - Bots(View Bots Uploaded and Credentials).

UNIT-III

Devices (View Development and Runtime Clients and Device Pools) - Workload (Queues and SLA Calculator) - Audit Log (View Activities Logged which are associated with Web CR) - Administration(Configure Settings, Users, Roles, License and Migration) - Demo of Exposed API's – Conclusion –Client introduction and Conclusion.

UNIT-IV

Bot Creator Introduction–Recorders–Smart Recorders–Web Recorders–Screen Recorders-Task Editor – Variables - Command Library – Loop Command – Excel Command – Database Command –String Operation Command -XML Command.

UNIT-V

Terminal Emulator Command- PDF Integration Command- FTP Command-PGP Command-Object Cloning Command - Error Handling Command - Manage Windows Control Command – Workflow Designer –Report Designer.

TEXTBOOKS:

1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath: Create Software robots with the leading RPA tool–UiPath Kindle Edition.

REFERENCES:

1. Robotic Process Automation A Complete Guide-2020 Edition Kindle Edition.

21MAI42T2: NATURAL LANGUAGE PROCESSING

B.Tech. IV Year II Sem.

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Prerequisites:

- Data structures, finite automata and probability theory

Course Objectives

- Introduce to some of the problems and solutions of NLP and their relation to linguistics and statistics.

Course Outcomes

- Show sensitivity to linguistic phenomena and an ability to model them with formal grammars.
- Understand and carry out proper experimental methodology for training and evaluating empirical NLP systems
- Able to manipulate probabilities, construct statistical models over strings and trees, and estimate parameters using supervised and unsupervised training methods.
- Able to design, implement, and analyze NLP algorithms
- Able to design different language modeling Techniques.

UNIT – I

Finding the Structure of Words: Words and Their Components, Issues and Challenges, Morphological Models.

Finding the Structure of Documents: Introduction, Methods, Complexity of the Approaches, and Performances of the Approaches.

UNIT - II

Syntax Analysis: Parsing Natural Language, Tree banks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure, Parsing Algorithms, Models for Ambiguity Resolution in Parsing, Multilingual Issues.

UNIT - III

Semantic Parsing: Introduction, Semantic Interpretation, System Paradigms, Word Sense Systems, Software.

UNIT - IV

Predicate- Argument Structure, Meaning Representation Systems, Software.

UNIT - V

Discourse Processing: Cohesion, Reference Resolution, Discourse Cohesion and Structure

Language Modeling: Introduction, N-Gram Models, Language Model Evaluation, Parameter Estimation, Language Model Adaptation, Types of Language Models, Language-Specific Modeling Problems, Multilingual and Cross lingual Language Modeling.

TEXT BOOKS:

1. Multilingual natural Language Processing Applications: From Theory to Practice– Daniel M. Bikel and Imed Zitouni, Pearson Publication.
2. Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S.Tiwary

REFERENCES:

3. Speech and Natural Language Processing - Daniel Jurafsky & James H Martin, Pearson Publications.

21MAI42T3: GAME THEORY

B.Tech. IV Year II Sem.

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Course Objectives: The course will explain in depth the standard equilibrium concepts (such as Nash equilibrium, Subgame-Perfect Nash Equilibrium, and others) in Game Theory.

Course Outcomes:

1. Understand the basic concepts of game theory and solutions
2. Understand different types of equilibrium interpretations
3. Understand and analyze knowledge and solution concepts
4. Analyze extensive games with perfect information

UNIT-I

Introduction-Game Theory, Games and Solutions Game Theory and the Theory of Competitive Equilibrium, Rational Behavior, The Steady State and Deductive Interpretations, Bounded Rationality Terminology and Notation. Nash Equilibrium-Strategic Games, Nash Equilibrium Examples Existence of a Nash Equilibrium, Strictly Competitive Games, Bayesian Games: Strategic Games with Imperfect Information.

UNIT-II

Mixed, Correlated, and Evolutionary Equilibrium - Mixed Strategy Nash Equilibrium, Interpretations of Mixed Strategy Nash Equilibrium, Correlated Equilibrium, Evolutionary Equilibrium, Rationalizability and Iterated Elimination of Dominated Actions - Rationalizability Iterated Elimination of Strictly Dominated Actions, Iterated Elimination of Weakly Dominated Actions.

UNIT-III

Knowledge and Equilibrium -A Model of Knowledge Common Knowledge, Can People Agree to Disagree? Knowledge and Solution Concepts, The Electronic Mail Game

UNIT-IV

Extensive Games with Perfect Information-Extensive Games with Perfect Information Sub game Perfect Equilibrium Two Extensions of the Definition of a Game The Interpretation of a Strategy, Two Notable Finite Horizon Games, Iterated Elimination of Weakly Dominated, Strategies Bargaining Games -Bargaining and Game Theory, A Bargaining Game of Alternating Offers Subgame Perfect Equilibrium Variations and Extensions.

UNIT-V

Repeated Games - The Basic Idea Infinitely Repeated Games vs. Finitely Repeated Games, Infinitely Repeated Games: Definitions Strategies as Machines Trigger Strategies: Nash Folk, Theorems Punishing for a Limited Length of Time: A Perfect Folk Theorem for the Limit of Means Criterion Punishing the Punisher: A Perfect Folk Theorem for the Overtaking Criterion, Rewarding Players Who Punish: A Perfect Folk Theorem for the Discounting Criterion The Structure of Subgame Perfect Equilibria Under the Discounting Criterion Finitely Repeated Game.

TEXTBOOKS:

1. A course in Game Theory, M.J.Osborne and A.Rubinstein, MIT Press

2. Game Theory, Roger Myerson, Harvard University Press
3. Game Theory, D.Fudenberg and J.Tirole, MIT Press

REFERENCEBOOKS:

1. Theory of Games and Economic Behavior, J.vonNeumann and O.Morgenstern, New York: John Wiley and Sons.
2. Games and Decisions, R.D.Luce and H.Raiffa, New York: John Wiley and Sons.
3. Game Theory, G.Owen, 2nd Edition, New York: Academic Press.

21MAI42T4: COMPUTER VISION AND ROBOTICS

B.Tech. IV Year II Sem.

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Pre-Requisites: UG level Course in Linear Algebra and Probability.

Course Objectives:

1. To understand the Fundamental Concepts related To sources, shadows and shading.
2. To understand the Geometry of Multiple Views.

Course Outcomes:

1. Implement fundamental image processing techniques required for computer vision.
2. Implement boundary tracking techniques.
3. Apply chain codes and other region descriptors, Hough Transform for line, circle, and ellipse detections.
4. Apply 3D vision techniques and Implement motion related techniques.
5. Develop applications using computer vision techniques.

UNIT-I

CAMERAS: Pinhole Cameras.

Radiometry–Measuring Light: Light in Space, Light Surfaces, Important Special Cases.

Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Inter reflections: Global Shading Models.

Color: The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.

UNIT-II

Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates.

Edge Detection: Noise, Estimating Derivatives, Detecting Edges.

Texture: Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesis by Sampling Local Models, Shape from Texture.

UNIT-III

The Geometry of Multiple Views: Two Views

Stereopsis: Reconstruction, Human Stereopsis, Binocular Fusion, Using More Cameras

Segmentation by Clustering: What Is Segmentation? Human Vision: Grouping and Gestalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering,

UNIT-IV

Segmentation by Fitting a Model: The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness

Segmentation and Fitting Using Probabilistic Methods: Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice.

Tracking With Linear Dynamic Models: Tracking as an Abstract Inference Problem,

Linear Dynamic Models, Kalman Filtering, Data Association, Applications and Examples

UNIT-V

Geometric Camera Models: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations.

Geometric Camera Calibration: Least-Squares Parameter Estimation, A Linear Approach to Camera Calibration, Taking Radial Distortion into Account, Analytical Photo Grammetry, An Application: Mobile Robot Localization.

Model-Based Vision: Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses by pose Clustering, Obtaining Hypotheses Using Invariants, Verification, Application: Registration In Medical Imaging Systems, Curved Surfaces and Alignment.

TEXTBOOKS:

1. David A. Forsyth and Jean Ponce: Computer Vision—A Modern Approach, PHI Learning (Indian Edition), 2009.

REFERENCEBOOKS:

1. E.R. Davies: Computer and Machine Vision—Theory, Algorithms and Practicalities, Elsevier (Academic Press), 4th edition, 2013.
2. R.C. Gonzalez and R.E. Woods “Digital Image Processing” Addison Wesley 2008.
3. Richard Szeliski “Computer Vision: Algorithms and Applications” Springer-Verlag London Limited 2011.

21MAI42T5: SPEECH AND VIDEO PROCESSING

B.Tech. IV Year II Sem.

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Course Objectives: Knowledge on speech and video processing techniques

Course Outcomes:

1. Describe the mechanisms of human speech production systems and methods for speech feature extraction.
2. Understand basic algorithms of speech analysis and speech recognition.
3. Explain basic techniques in digital video processing, including imaging characteristics and sensors.
4. Apply motion estimation and object tracking algorithms on video sequence.

UNIT-I:

Speech processing concepts: The speech production mechanism, Discrete time speech signals, Pole-Zero modeling of speech, relevant properties of the fast Fourier transform for speech recognition, convolution, linear and nonlinear filter banks, spectral estimation of speech using DFT. Linear Prediction analysis of speech.

UNIT-II:

Speech recognition: Real and Complex Cepstrum, application of cepstral analysis to speech signal, feature extraction for speech, static and dynamic feature for speech recognition, robustness issues, discrimination in the feature space, feature selection, MFCC, LPCC, Distance measures, vector quantization models. Gaussian Mixture model, HMM.

UNIT-III:

Basics of Video Processing: Video formation, perception and representation: Principle of color video, video cameras, video display, pinhole model, CAHV model, Camera motion, Shape model, motion model, Scene model, two-dimensional motion models. Three-Dimensional Rigid Motion, Approximation of projective mapping.

UNIT-IV:

Motion estimation Techniques: Optical flow, motion representation, motion estimation criteria, optimization methods, pixel-based motion estimation, Block matching algorithm, gradient Based, Intensity matching, feature matching, frequency domain motion estimation, Depth from motion. Motion analysis applications: Video Summarization, video surveillance.

UNIT-V:

Object tracking and segmentation: 2D and 3D video tracking, blob tracking, kernel based counter tracking, feature matching, filtering Mosaicing, video segmentation, mean shift based, active shape model, video shot boundary detection. Interframe compression, Motion compensation

TEXTBOOKS:

1. Fundamentals of Speech recognition—L.Rabiner and B.Juang, Prentice Hall signal processing series.
2. Digital Video processing, A Murat Tekalp, Prentice Hall.
3. Discrete-time speech signal processing: principles and practice, Thomas F.Quatieri, Coth.

4. Video Processing and Communications, YaoWang, J.Osternann and QinZhang, Pearson Education.

REFERENCEBOOKS:

1. "Speech and Audio Signal Processing", B.Gold and N.Morgan, Wiley.
2. "Digital image sequence processing, Compression, and analysis", ToddR. Reed, CRC Press
3. "Handbook of Image and Video processing", AlBovik, Academic press, second

21MAI42T6: SOFT COMPUTING

B.Tech. IV Year II Sem.

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Course objectives:

1. To make the student to understand the role of imprecision and uncertainty in real world scenarios.
2. To explain the role of Soft Computing in addressing the imprecision and uncertainty.
3. To explain the principal components of soft computing that include Fuzzy Sets and Fuzzy Logic, Artificial Neural Networks, Genetic Algorithms and Rough Sets.
4. To learn the Design and Implementation of Soft Computing methodologies.
5. To explain the design of hybrid systems which is combination of one or more soft computing methodologies mentioned.

Course outcomes:

1. Ability to represent Uncertainty / imprecision data.
2. Ability to select a suitable method of Soft Computing to solve a particular problem.
3. Ability to build hybrid systems using Soft Computing techniques.

UNIT I

Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.

UNIT II

Back propagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization - Hamming Neural Network - Hopfield Neural Network- Bi-directional Associative Memory - Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.

UNIT III

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations -Membership Functions -Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.

UNIT IV

Basic Concepts- Working Principles -Encoding- Fitness Function - Reproduction - Inheritance Operators - Cross Over - Inversion and Deletion -Mutation Operator - Bit-wise Operators - Convergence of Genetic Algorithm.

UNIT V

Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller

TEXT BOOKS:

1. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 2nd Edition, 2011.
2. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017.

REFERENCES

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, —Neuro-Fuzzy and Soft Computing‡, Prentice-Hall of India, 2002.
2. Kwang H.Lee, —First course on Fuzzy Theory and Applications‡, Springer, 2005.
3. George J. Klir and Bo Yuan, —Fuzzy Sets and Fuzzy Logic-Theory and Applications‡, Prentice Hall, 1996.
4. James A. Freeman and David M. Skapura, —Neural Networks Algorithms, Applications, and Programming Techniques‡, Addison Wesley, 2003.

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IV-II Semester

Mini Project -- 2

- There shall be a seminar presentation in IV year II semester.
- For the seminar, the student shall collect the information on a specialized topic, prepare a technical report, and submit it to the department.
- It shall be evaluated by the departmental committee consisting of Head of the Department, seminar supervisor and a senior faculty member.