RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

CSE-Artificial Intelligence and Machine Learning/ Artificial Intelligence and Machine Learning, VI-Semester

Departmental Elective AL603 (A) Image and Video Processing

Course Objective:

The students will be able to work with images and videos in several ways. These methods can be used as pre-processing steps for complex models.

Detailed Contents:

Module 1: Image representation and analysis, Introduction to computer Vision, Numerical representation of images, Image augmentation, enhancement, processing, color transforms, geometric transforms, feature recognition and

extraction

Module 2: Image Segmentation Object detection, breaking image into parts, finding contours and edges of various objects in image, Background subtraction for video.

Module 3: Object Motion and tracking Tracking a single point over time, motion models to define object movement over time, analyze

videos as sequences of individual image frames, methods to track a set of features over time,

matching features from image frame to other, tracking a moving car using optical flow

Module 4: Robotic localization

Bayesian statistics to locate a robot in space, sensor measurements to safely navigate an

environment, Gaussian uncertainty, histogram filter for robot localization in python.

Module 5: Image Restoration

Degradation model, noise models, estimation of degradation function by modeling, restoration

using Weiner filters and Inverse filters

Laboratory/ Practicals (if any): Mention list of Practicals

1. Various forms of image representation
2. Apply various image segmentation algorithms
3. Apply object motion and tracking
4. Apply object localization
5. Apply image restoration

Text Books/Suggested References:

1. Audio Video Systems, Bali & Bali, Khanna Book Publishing 2020.
2. Handbook of Image and Video Processing by Alan C. Bovik, Academic Press, 2000.
3. Python 3 Image Processing, Ashwin Pajankar, BPB Publication, 2019.
4. https://www.coursera.org/learn/image-processing

Course Outcomes: After completion of course, students would be able to:

1. Understand images and videos representation in a detailed manner.
2. Apply ML techniques for image processing in different scenarios.
3. Apply various object detection and image segmentation algorithms
4. Apply various image restoration techniques and algorithm

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Departmental Elective AL603 (B) Data and Visual Analytics

Unit 1 : Data Definitions and Analysis Techniques: Elements, Variables, and Data categorization Levels of Measurement Data management and indexing Introduction to Statistical Concepts: Sampling Distributions, Resampling, Statistical Inference and Descriptive Statistics, Measures of central tendency, Measures of location of dispersions

Unit 2: Advance Data analysis techniques: Statistical hypothesis generation and testing, Chi-Square test, t-Test, Analysis of variance, Correlation analysis, Maximum likelihood test, Regression Modelling, Multivariate Analysis, Bayesian Modelling, Inference and Bayesian Network, Regression analysis

Unit 3: Data Wrangling: Intro to Data Wrangling, Gathering Data, Assessing Data, Cleaning Data.

Data Visualization in Data Analysis: Design of Visualizations, Univariate Exploration of Data, Bivariate Exploration of Data, Multivariate Exploration of Data, Explanatory Visualizations.

Unit 4: Data Ecosystem: Overview of the Data Analyst Ecosystem, Types of Data, Understanding Different Types of File Formats, Sources of Data, Overview of Data Repositories, NoSQL, Data Marts, Data Lakes, ETL, and Data Pipelines, Foundations of Big Data, Big Data processing tools such as Hadoop, Hadoop Distributed File System (HDFS), Hive, and Spark

Unit 5: Data Visualization tools: Python visualization libraries (matplotlib, pandas, seaborn, ggplot, plotly), Introduction to PowerBI tools, Examples of inspiring (industry) projects- Exercise: create your own visualization of a complex dataset.

Text Books/References:

1. Joel Grus, Data Science from Scratch, Shroff Publisher Publisher /O'Reilly Publisher Media
2. Annalyn Ng, Kenneth Soo, Numsense! Data Science for the Layman, Shroff Publisher Publisher
3. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly Publisher Media.
4. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge
University Press.
5. Jake VanderPlas, Python Data Science Handbook, Shroff Publisher Publisher /O'Reilly Publisher Media 6. Philipp Janert, Data Analysis with Open Source Tools, Shroff Publisher Publisher /O'Reilly Publisher Media.

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CSE-Artificial Intelligence and Machine Learning/ Artificial Intelligence and Machine Learning, VI-Semester

Departmental Elective AL603 (C) Pattern Recognition

Course Objective: To help students understand basic mathematical and statistical techniques commonly used in pattern recognition. To introduce students to a variety of pattern recognition algorithms.

Detailed Contents:

Module 1: Introduction and mathematical Preliminaries Principles of pattern recognition: Uses, mathematics, Classification and Bayesian rules, Clustering vs classification, Basics of linear algebra and vector spaces, Eigen values and eigen vectors, Rank of matrix and SVD

Module 2: Pattern Recognition basics Bayesian decision theory, Classifiers, Discriminant functions, Decision surfaces, Parameter estimation methods, Hidden Markov models, dimension reduction methods, Fisher discriminant analysis, Principal component analysis, non-parametric techniques for density estimation, nonmetric methods for pattern classification, unsupervised learning, algorithms for clustering: Kmeans, Hierarchical and other methods

Module 3: Feature Selection and extraction Problem statement and uses, Branch and bound algorithm, Sequential forward and backward selection, Cauchy Schwartz inequality, Feature selection criteria function: Probabilistic separability based and Interclass distance based, Feature Extraction: principles

Module 4: Visual Recognition Human visual recognition system, Recognition methods: Low-level modelling (e.g. features), Midlevel abstraction (e.g. segmentation), High-level reasoning (e.g. scene understanding); Detection/Segmentation methods; Context and scenes, Importance and saliency, Large-scale search and recognition, Egocentric vision, systems, Human-in-the-loop interactive systems, 3D scene understanding.

Module 5: Recent advancements in Pattern Recognition Comparison between performance of classifiers, Basics of statistics, covariance and their properties, Data condensation, feature clustering, Data visualization, Probability density estimation, Visualization and Aggregation, FCM and soft-computing techniques, Examples of real-life datasets.

Laboratory/ Practicals:

1. Data extraction
2. Pre-processing of images
3. Image segmentation
4. Image classification AICTE

Text Books/Suggested References:

1. Pattern Recognition and Machine Learning by Christopher M. Bishop, Springer, 2006.
2. Pattern Classification by Richard O. Duda , Peter E. Hart, David G. Stork, Wiley, 1973.
3. https://nptel.ac.in/courses/106/106/106106046/

Course Outcomes: After completion of course, students would be able to:

1. Understand basic mathematical and statistical techniques commonly used in pattern recognition.
2. Apply a variety of pattern recognition algorithms.
3. Understand and apply various pre-processing algorithms.
4. Apply various algorithms for image classification.