b) Objectives

At the end of the course, the students will be prepared to:

1. Demonstrate a broad understanding of the standard image processing issues and analysis techniques used in the commercial and scientific community.
2. Perform techniques to enhance of contrast and color, and thereby the visual perception, of contrast degraded imagery.
3. Remove noise and other imaging artefacts from real-world imagery using a variety of filtering techniques in both the spatial and frequency domain.
4. Demonstrate an understanding of spatial resampling, linear spatial transforms and registration techniques.
5. Employ such techniques to resample imagery and accurately register pairs of images.
6. Apply and understand image analysis techniques to imagery in order to detect structures such as edges, lines and corners.

Digital Image Processing

UNITWISE SYLLABUS

1 **Introduction to Image Processing:** Introduction to Digital Image Processing, Human visua system image acquisition, camera, sampling theory. Image resizing, color fundamentals, colo models histogram Processing, contrast and brightness adjustment, arithmetic/logic operation. Spatial filtering, contrast enhancement, edge sharpening.

2 **Image Transformation Techniques:** 2D Fourier transform, Frequency domain processing, ringing artifact, pixel operations, geometric processing. Image restoration, denoising, deblur discrete wavelet transform.

3 **Operations on Image:** Image segmentation, Edge detection, edge, linking, hough transform thresholding, Region based segmentation, watershed segmentation, motion-based segmentati

4 **Introduction of Information Theory:** Morphological image processing. Multi-resolution processing. Elements of information theory, Lossless and Lossy coding, Huffman coding, arithmetic coding, run-length coding.

5 **Introduction of Pattern Recognition and Classification Techniques :**Introduction, Desigr principles of pattern recognition system Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA). Classification Techniques – Nearest Neighbor (NN) Rule,Bayes Classifier. Support Vector Machine (SVM), K – means clustering.

2. To become familiar with different data mining tools such as WEKA, RapidMiner, KNIME, Orange, NLTK etc. (source: http://thenewstack.io/six-of-the-best-open-source-data-mining-tools/)

Data Mining & Data Warehousing

UNITWISE SYLLABUS

1. **Data Mining**: Introduction, Data warehouses, Transactional databases, Advanced Data Information Systems and Applications, Data Mining Functionalities, Classification of data mining systems, data mining task primitives, Integration of data mining systems with a data warehouse systems, Data Preprocessing: Descriptive data summarization, Data cleaning, Data Integration and Transformation, Data Reduction, Data discretization and Concept hierarchy generation.
2. **Data Warehouse and OLAP technology:** Multidimensional data model, Data Warehouse architecture and Implementation: OLAP, ROLAP, MOLAP, HOLAP etc., Data Cubes, Indexing OLAP data, OLAP queries, Full Cube Computation, BUC, Star-cubing, Discovery-driven exploration of data cubes.
3. **Frequent Patterns, Associations and Classification:** Association Rules, Frequent Itemsets, Closed Itemsets, Apriori algorithm, Generating association rules from frequent itemsets, Mining Closed Frequent Itemsets, Correlation Analysis, Metarule guided mining of Association Rules, Constraint Pushing, Classification v/s Prediction methods, Classification by Decision Tree Induction, Bagging and Boosting.
4. **Data Mining techniques**: Rule-based Classification, Rule extraction from a Decision Tree, Support Vector Machines for linearly and non-linearly separable data, Classification by Association Rule Analysis, k-Nearest-Neighbor Classifiers, Case-based Reasoning, **Prediction:** Linear v/s Non-linear Regression, Accuracy and Error measures: Hold-out method, Cross-validation, Bootstrap, estimating confidence intervals, ROC curves
5. **Clustering:** Types of data in Cluster Analysis, Categorization of Clustering methods, Partitioning Methods: k-means, k-Medoids, CLARANS, Hierarchical Methods: BIRCH, ROCK, Desity-based Methods: DBSCAN, Grid-based Methods, Mining Time-series data, Introduction to Text Mining, Graph Mining, Social Network Analysis, and Web or Link Mining

Text Books

1. Jiawei Han, Micheline Kamber (2012), Data Mining: Concepts and Techniques, Morgan Kaufmann series in data management systems, 3rd Edition, Publisher Elsevier, 2012, ISBN-9380931913, 9789380931913
2. Ian H. Witten, Eibe Frank, Mark A. Hall (2011), Data Mining: Practical Machine Learning Tools and Techniques, 3rd Edition, MK Elsevier

3. To give in-depth knowledge about artificial neural network and evolutionary computation.

Machine Learning & Soft Computing

UNITWISE SYLLABUS

1. **Machine Learning and applications**: Machine Learning, Applications of ML, Intelligent Systems, Introduction to Computer vision, Natural Language Possessing, Soft Computing etc, Types of Learning: Supervised, Unsupervised, and Reinforcement Learning, Decision Tree learning, Bayesian Learning and Statistical natural language processing
2. **Connectionist Models/ANN:** Foundations for Connectionist Networks, Biological Inspiration: Different Architectures and Output Functions: Feed-forward, Feedback, Recurrent Networks, Step, Sigmoid and Sigmoid Function; Different Models: MacCulloch and Pitts Model, Hopfield Model and Memories, Boltzmann Machines and Energy Computations. Learning Problems and Issues in feed-forward model: Supervised learning, Perceptron Learning, Delta rule and Backpropagation Learning.
3. **Unsupervised Learning with ANN**: Competitive Learning, Hebbian Coincidence Learning, Attractor Networks, SOM, Adaptive Resonance Theory (ART): Architecture, classifications, Implementation and training, Introduction to Deep learning and Ensemble methods
4. **Genetic Algorithm and Applications:** Introduction to genetic algorithms (GA), encoding, fitness functions, genetic operators, reproduction, evolutionary strategies, Applications of GA in Data Mining, and other applications e.g. Travelling Salesman problem, differential evolution, co-evolution, multi-objective GA (MOGA), Neuro-Genetic hybrid algorithm; Swarm Intelligence: Introduction, Swarm Based versus Population based techniques, Particle Swarm Optimization, Ant Colony Optimization
5. **Fuzzy Logic:** Introduction to Fuzzy Systems – fuzzy sets: properties and operations: union, intersection, complement, s-norm, t-norm, alpha-cut; Fuzzy logic and fuzzy rules, Mamdani fuzzy rule inferencing mechanism, Fuzzy logic based Systems: e.g. Room Cooler; introduction to Neuro Fuzzy Systems: modeling fuzzy neuron, fuzzy neural network etc.

Text Books

1. Tom M. Mitchell: Machine Learning, McGraw-Hill, International Edition 1997, ISBN 0-07-115467-1
2. Elaine Rich, Kevin Knight and B. Nair: Artificial Intelligence, 2009, Tata McGraw Hill, 3rd Ed, ISBN-10: 0-07-008770-9
3. S. Rakasekharan, GA Vijayalakshmi, Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI.
4. Stuart Russel and Peter Norvig: Artificial Intelligence–A Modern Approach, 3rd Ed., 2012, Pearson Education, ISBN: 0-13-790395-2 (2nd edition downloadable)

- features of a modern programming language, such as support for data structures and object-oriented software development, for use when they become necessary.
- Python is highly interactive. Expressions and statements can be entered at an interpreter's prompts to allow the programmer to try out experimental code and receive immediate feedback. Longer code segments can then be composed and saved in script files and be loaded and run as modules or standalone applications.
- Python is general purpose. In today's context, this means that the language includes resources for contemporary applications, including media computing and networks.
- Python is free and is in widespread use in industry.

Upon completion of this course, students will be able to:

- Execute Python code in a variety of environments
- Use correct Python syntax in Python programs
- Use the correct Python control flow construct
- Write Python programs using various collection data types
- Write home grown Python functions
- Use many of the standard Python modules
- Trap various errors via the Python Exception Handling model
- Use the IO model in Python to read and write disk files
- Create their own classes and use existing Python classes
- Understand and use the Object Oriented paradigm in Python programs
- Use the Python Regular Expression capabilities for data verification and Pattern Matching.

b) Objectives: The educational objectives of the Pattern matching using Python Program are to produce graduates who are able to:

1. Combine some of the best features of mathematics, engineering, and natural science.
2. Understand the meaning of Problem solving by learning the ability to formulate problems, think creatively about solutions, and express a solution clearly and accurately.
3. Analysis and interpretation of Data.
4. Design and provide proper structure for the unstrutured data.
5. Reduce the data matching, searching and processing time

Pattern Matching using Python

UNITWISE SYLLABUS

1. Introduction Concepts: History, Features, Setting up path, Working with Python, Basic Syntax variable and Data Types,Operators, conditional statements,Looping statements,control statements. Input/output: Printing on Screen, Reading data from keyboard, Opening and closing file, Reading and writing files, I/O Functions.

2. String Manipulation and Pattern Matching: Accessing Strings, Basic Operations, String slices, Functions and Methods, Regular Expressions, Match function, Search function, Matching vs Searching, Modifiers, Patterns, Pattern Matching.

3. Basic Data Structures and OOP concepts: List, Accessing list, Working with lists, Operations, related Functions and Methods, Tuple, Accessing tuples, Working with tuples, Operations, related Functions and Methods, Dictionary, Working with dictionary, Accessing values in dictionaries, Working with dictionaries, Operations, related Functions and Methods. OOPs concepts, Class and object, Attributes, Inheritance, Overloading, Overriding, Data hiding.

4. Functions and Modules: Defining a function, Calling a function, Types of functions Function Arguments, Anonymous functions, Global and local variables, Introduction to Modules, Importing module, Math module, Random module, Packages.

5. CGI and Database: Introduction, Architecture, CGI environment variable, GET and POST methods Cookies, File upload, Database connectivity, Introduction, Connections, Executing queries, Transaction.

Text Books

1. Think Python- How to think like a Computer Scientist, By Allen B. Downey, Green Teen press, 2008.
2. Fundamental of Python - By Kenneth A. Lambert, Course Technology, 2010.
3. Alberto Apostolico, Zvi Galil: Pattern Matching algorithms, Oxford University Press.

Reference Books

1. Stuart Russel and Peter Norvig: Artificial Intelligence–A Modern Approach, 3rd Ed., 2012, Pearson Education.
2. Think Python, by Allen B. Downey, second edition, O'Reilly, Sebastopol, California.

c) Outline

Week	Topics
Week 1:	Introduction
Week 2:	Basic Concepts of Python
Week 3:	String Manipulation- Basic Operations
Week 4:	Pattern Matching , Searching and Data processing
Week 5:	Basic Data Structures List, Tuple and Dictionary.
Week 6:	Functions- Inbuilt and User-Defined
Week 7:	Basic Operations and Functions related to basic Data structures
Week 8:	Basic OOPs Concepts in Python
Week 9:	Inheritance,Overloading, Overriding, Data hiding.
Week 10:	Modules- Inbuilt and User-Defined
Week 11 :	Important Packages of Python related to Data Processing
Week 12:	Database Connectivity, CGI Concepts