

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 visual system image acquisition, camera, sampling theory. Image resizing, color fundamentals, color 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, deblurring, discrete wavelet transform.
- 3 **Operations on Image:** Image segmentation, Edge detection, edge, linking, hough transform thresholding, Region based segmentation, watershed segmentation, motion-based segmentation.
- 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, Design 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, Density-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 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 unstructured 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 |

Course Code: CBCS 337.1/ CSEC 55.03
Course Title: Modeling and Simulation

Unit I

Concepts of Systems, Models, and Simulation; Distributed Lag Model, Cobweb Models, The process of a simulation Study, Exponential Growth Models, Exponential Decay Models, Type of simulation, Discrete-Event Simulation: Time-Advance Mechanisms, Components and Organization of a Discrete-Event Simulation Model; Monte Carlo Method; Simulation of Single-Server Queuing System, Simulation of an Inventory System.

Unit II

Continuous Simulation: Pure-pursuit Problem.

Random Number Generators: Linear Congruential Generators, Other kinds of Generators, Testing Random-Number: Frequency Test, Autocorrelation Test ; Generating Random Variates: Inverse – Transform technique, acceptance rejection technique.

Unit III

Comparisons of Simulation Packages with programming languages; An introduction of different types of simulation languages: Continuous and discrete simulation languages; GPSS: An Overview of GPSS; SIMULA; SIMSCRIPT; Factors in Selection of discrete system simulation; Object-Oriented Simulation.

Unit IV

Verification and Validation of Simulation Models: Validating first-time model, Subsystem validity, Internal validity, sensitive analysis, face validity.

Output Analysis for a single Model: Transient and Steady-State Behavior of a Stochastic Process, Type of Simulations with regard to output Analysis, Statistical Analysis for Terminating Simulations.

C. BOOKS: In order to achieve the objectives of the course and retrospective student learning outcomes, following books are prescribed:

1. Nina Godbole, Sunit Belapur, "Cyber Security - Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Publications, April, 2011
2. Mead & Moody, "Cyber Security Engineering", Pearson Ed, 2017
3. Robert Jones, "Internet Forensics: Using Digital Evidence to Solve Computer Crime", O'Reilly Media, October 2005
4. Chad Steel, "Windows Forensics: The field guide for conducting corporate computer investigations", Wiley India Publications, December 2006

D. DETAILED SYLLABUS: As indicated and outlined earlier that the content to be covered is divided logically into five units in order to achieve the objectives of the course. The details of unit wise syllabus are as follows:

1. **Cyber Crime:** Cybercrime and Information Security, Cybercriminals; Classifications of Cybercrimes: E-Mail Spoofing, Spamming, Cyber defamation, Internet Time Theft, Salami Attack/Salami Technique, Data Diddling, Forgery, Web Jacking, Newsgroup Spam/Crimes Emanating from Usenet Newsgroup, Industrial Spying/Industrial Espionage, Hacking, Online Frauds, Pornographic Offenses , Software Piracy, Computer Sabotage, E-Mail Bombing/Mail Bombs, Usenet Newsgroup as the Source of Cybercrimes , Computer Network Intrusions, Password Sniffing, Credit Card Frauds, Identity Theft.
2. **Cyber Offenses:** Cybreoffences and its Categories; Attacks Planning: Reconnaissance, Passive Attack, Active Attacks, Scanning and Scrutinizing gathered Information; Attacks, Social Engineering, and Classification of Social Engineering; Cyberstalking: Types of Stalkers, Cases Reported on Cyberstalking, How Stalking Works? Real-Life Incident of Cyberstalking, Cybercafe and Cybercrimes; Botnets: The Fuel for Cybercrime, Botnet; Attack Vector Cloud Computing and Services.

3. **Cybercrime with Mobile and Wireless Devices:** Proliferation of Mobile and Wireless Devices, Trends in Mobility; Credit Card Frauds in Mobile and Wireless Computing Era: Types and Techniques of Credit Card Frauds, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices; Authentication Service Security: Cryptographic Security for Mobile Devices; LDAP Security for Hand-Held Mobile Computing Devices, RAS Security for Mobile Devices, Media Player Control Security; Networking API Security for Mobile Computing Applications; Attacks on Mobile Phones; Unconventional/Stealth Storage Devices, Protecting Data on Lost Devices; Laptop Users Organizational Measures for Handling Mobile Devices-Related Security Issues; Organizational Security Policies and Measures in Mobile Computing Era: Security Policies, Operating Guidelines; and Organizational Policies.
4. **Cyber Security: Tools and Methods:-** Proxy Servers and Anonymizers, Phishing, Cracking: Online Attacks, Offline Attacks, Strong, Weak and Random Passwords, Random Passwords, Keyloggers and Spywares: Software Keyloggers, Hardware Keyloggers, Antikeylogger, Spywares, Virus and Worms: Types of Viruses, Trojan Horses and Backdoors; Steganography: Steganalysis, DoS and DDoS Attacks: DoS Attacks, Classification of DoS Attacks, Types or Levels of DoS Attacks, Tools Used to Launch DoS Attack, DDoS Attacks; SQL Injection Attacks, Buffer Overflows; Attacks on Wireless Networks: Traditional Techniques, Wi-Fi-based Frauds and Misuses, Securing the Wireless Networks; Identity Theft: Introduction, Phishing: Methods of Phishing, Phishing Toolkits and Spy Phishing, Phishing Countermeasures, Identity Theft, PII, Identity Theft, Techniques of ID Theft, Identity Theft-Countermeasures, & Online Identity.
5. **Cyber Security: Legal Perspectives:-** Need for Cyberlaws, The Indian Context; Indian IT Act; Admissibility of Electronic Records; Amendments, Positive Aspects of the ITA 2000, Weaknesses; Challenges to Indian Scenario, Consequences, Amendments; Indian ITA 2008: Overview, Cybercafe-Related Matters, State Government Powers Impacted by the Amendments to the Indian IT Act, Impact of IT Act Amendments Impact Information Technology Organizations, Cybercrime and Punishment, Cyberlaw, Technology and Students: Indian Scenario