Department of Computer Science

University *of* Kerala

M.Tech Programme in Computer Science

(with specialization in Digital Image Computing)

Syllabus

AIM

The aim of this programme is to provide a platform for the graduates to develop an ability to identify, critically analyze, formulate and solve research problems with advanced knowledge in the area of Digital Image Processing.

PROGRAMME OBJECTIVES

- To develop the graduates to be successful professionals in industry, academia, research, entrepreneurship.
- To provide the graduates flair of research by making them to do research-oriented projects.
- To provide advanced technical skills in the area of Image Processing and Machine Intelligence to graduates who can perform better as an individual or in a team; through their critical analytical and research skills.
- To develop the ability to apply mathematical and engineering skills in a pragmatic manner to solve problems.
- To develop an ability to identify, critically analyze, formulate and solve research problems in Digital Image Processing.
- To develop the skills for writing technical and scientific research publications.
- To develop the thinking skills and hence promoting innovation and research.
- To provide support to the graduates who can pursue life-long learning to chase their dreams.

Structure of the Program

Sem	Course Code	Title	CRD
I	COS-C-611	Mathematical Foundations of Image Processing	4
	COS-C-612	Soft Computing Techniques	3
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	COS-C-614	Pattern Recognition	3
	COS-C-615	Laboratory - I	2
	COS-E-616(i)	Machine Learning Techniques	3
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	COS-E-616(iii)	Fractal Theory and Applications	3
	COS-E-616(iv)	Parallel Computing	3
	COS-E-616(v)	Wavelet Analysis and Applications	3
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II	COS-C-621	Applications of Image Processing	3
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	COS-C-623	Data Compression	3
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	COS-E-626(i)	Video Surveillance	3
	COS-E-626(ii)	Satellite Image Processing	3
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	COS-E-626(iv)	Texture Analysis	3
	COS-E-627(i)	Visual Cryptography	3
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	COS-E-627(iii)	Intelligent Data Mining	3
III	COS-C-631	Research Methodology	4
	COS-D-632	Dissertation(Part-I)	10
IV	COS-D-641	Dissertation(Part-II)	16
List of Extra Departmental Electives			
	COS-X-611	Introduction to Scilab	2
	COS-X-631	Introduction to Digital Image Processing	2

Semester : I
Course Code : COS-C-611
Course Title : MATHEMATICAL FOUNDATIONS OF IMAGE PROCESSING
Credits : 4

AIM

The aim of this course is to inculcate a comprehensive knowledge of Digital Images and various techniques of Digital Image Processing.

OBJECTIVES

- Give an in-depth knowledge about the basic theory and algorithms related to Digital Image Processing.
- Provide awareness about the current technologies and issues specific to Digital Image Processing.
- Provide hands-on experience in using computers to process digital images.
- Expose students to MATLAB Image Processing Toolbox, Python and OpenCV.

COURSE CONTENT

MODULE I : Elements of Image Processing, Digital Image Processing, Image Processing Techniques, Digital Image representation, Digital Image Classification, Image Types, Applications of Image Processing. Signals, Impulse Sequence, Exponential Sequence, Periodic Sequence, Linear Systems, Shift-Invariant systems, Linear Shift Invariant (LSI) systems, Convolution and Correlation.

MODULE II: Image Transforms, Classification of Image Transforms, Fourier Transform, Properties of Fourier Transform, 2D Discrete Fourier Transform (DFT), Z-transform, Causal Systems, Random Signals, Stationary Process, Markov Process, Karhunen-Loeve (KL) Transform.

MODULE III: Intensity Transformation and Spatial Filtering, Intensity Transformation Functions, Piecewise Linear Transformation Functions, Histogram Processing, Histogram Equalization, Histogram Matching, Local Enhancement, Histogram statistics, Enhancement using Arithmetic/Logic operations, Image Subtraction, Image Averaging

MODULE IV: Spatial Filtering, Smoothening Spatial Filters, Sharpening Spatial Filters, Laplacian Filter, Unsharp masking and High Boost Filter, Gradient operators – Edge detection filters, Filtering in Frequency domain, Frequency Domain Smoothening Filters: Ideal Filter, Butterworth Filter, Gaussian Filter, Frequency Domain Sharpening Filters, Laplacian in Frequency domain, Homomorphic Filtering.

MODULE V: Image degradation/Restoration process model, Noise probability density functions, Spatial Filtering: Mean Filters, Order-statistics filter, Adaptive Filters, Periodic Noise Reduction – Frequency domain filters: Band-reject filters, Band-pass filters, Notch filters. Estimating the degradation function, Inverse filtering, Wiener filtering, Performance measures. Color image processing: Color fundamentals, Color models – RGB, CMYK, HSI. Full color image processing, Color image smoothening and sharpening, color edge detection. Point and line detection.

Module VI: Hough Transform. Image segmentation: Fundamentals, Thresholding, Optimum global thresholding – Otsu's method. Region-based segmentation: Region growing, Region Splitting and Merging. Segmentation using Morphological Watersheds.

REFERENCES

- Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", 4th Ed., Pearson, March 2017.
- Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson, 1st Ed., 1988.
- William K. Pratt, "Digital Image Processing: PIKS Scientific Inside", John Wiley & Sons, 4th Ed., 2007.
- Azriel Rosenfield, Avinash C. Kak, "Digital Picture Processing", Morgan Kaufmann, 2nd Ed., 1982.
- Bernd Jahne, "Digital Image Processing", Springer, 6th Ed., 2005.

Semester : I
Course Code : COS-C-612
Course Title : SOFT COMPUTING TECHNIQUES
Credits : 3

AIM

The aim of this course is to expose the students to various soft computing techniques, and understand their key aspects related to computing in terms of its tolerance to imprecision and uncertainty.

OBJECTIVES

- To become familiar with neural networks and understand their features and applications.
- To get exposed to the mathematical background for solving problems using neural network learning algorithms.
- To get exposed to the ideas of fuzzy logic and also provide knowledge about the use of inference systems and approximate reasoning in solving complex tasks.
- To familiarize with genetic algorithms useful for solving complex optimization.

COURSE CONTENT

MODULE I: Basic of Artificial Neural Networks – Characteristics, Terminology, Models of Neuron, Topology, Basic Learning laws. Activation and Synaptic Dynamics – Activation Dynamics and Synaptic Dynamics Models, Learning methods. Feed-Forward Neural Networks

MODULE II: Analysis of Pattern Association Networks – Linear Associative Network. Pattern Classification Networks – Perceptron, Perceptron classification, Perceptron learning law, Linear Separability, Multilayer Perceptron. Pattern Mapping Networks- Backpropagation algorithm

MODULE III: Feedback Neural Networks – Linear Auto Associative FF networks, Pattern Storage Networks – Hopfield Network, Stochastic networks and Simulated Annealing, Boltzmann machine.

MODULE IV: Associative memory, Bidirectional Associative Memory, Multidirectional Associative Memory, Temporal Associative Memory, Pattern Mapping, RBF Networks, Counter propagation network, Adaptive Resonance Theory (ART).

MODULE V: Classical Sets – Operations and properties, Fuzzy sets – Operations and Properties, Crisp Relations, Fuzzy Relations, Fuzzy Equivalence Relations, Features of Membership Functions, Various forms, Fuzzification and Defuzzification, λ-cuts for Fuzzy Relations, Classical Logic, Fuzzy Logic – Approximate reasoning. Fuzzy Rule-based Systems, Development of membership functions.

MODULE VI: Genetic Algorithms – Biological Terminology. Elements of GA – GA Operators, A Simple Genetic Algorithm. GA in Problem Solving – Data Analysis and Prediction, Mathematical Models of Simple GA. Encoding a problem for GA – Adapting the encoding – Selection methods – Genetic Operators.

REFERENCES

- B. Yegnanarayana, "Artificial Neural Networks", PHI, 1999.
- Timothy J.Ross, "Fuzzy Logic Engineering Applications", John Wiley & Sons Ltd, 2nd Ed, 2004.
- Mitchell Melanie, "An Introduction to Genetic Algorithms", MIT Press, 1998.
- S.N. Sivanandam, S.N. Deepa, " Principles of Soft Computing", Wiley India, 2nd Ed., 2011.
- Jang J.S.R.,Sun C.T and Mizutani E – "Neuro Fuzzy and Soft computing", Pearson Education (Singapore) 2004.
- Laurene Fauseett: "Fundamentals of Neural Networks", Prentice Hall India, New Delhi,1994.
- David A. Coley, "Introduction to Genetic Algorithms for Scientists and Engineers", World Scientific Publishers, 1999.
- Simon Haykin, Neural Networks-A comprehensive Foundation, Pearson education.

Semester : I
Course Code : COS-C-613
Course Title : ADVANCED COMPUTER GRAPHICS
Credits : 3

AIM

The aim of the course is to provide the knowledge about the algorithms used in computer graphics and its techniques like modelling and rendering of objects. This course also gives an introduction for the advanced concepts in Computer Graphics.

COURSE OBJECTIVES

- To introduce the computer graphics algorithms.
- To introduce the advanced concepts of 2D and 3D transformations and Projections.
- To impart the idea of shading techniques and illumination models.
- To introduce Visible Surface detection methods.
- To discuss the advanced rendering techniques.
- To understand OpenGL programming for rendering techniques.

COURSE CONTENT

MODULE I : Introduction to Computer Graphics, Display Devices – LCD, TFT, LED, Line drawing algorithms- DDA, Bresenham line drawing, Circle-drawing algorithms- Midpoint, Ellipse-generating algorithms - Filling Algorithms –Window-to-Viewport Transformation, 2D Transformations, 3D Transformations- Translation- Rotation- Scaling

MODULE II: Stable fluid Solver, Lattice Boltzmann method, Bezier Curves, Splines, B-splines, Visible Surface Detection Methods-Depth Buffer Method- Depth Sorting Method- A- Buffer Method - Scan line Method- Area Subdivision Method

MODULE III: Projection – Perspective and Parallel, Illumination Models- Ambient Light- Diffuse Reflection- Specular Reflection, Shading Techniques – Constant Intensity Shading, Gouraud Shading, Phong Shading. Animation- Design of Animation Sequences- Key Frame Systems.

MODULE IV: Introduction to Fractals- Fractal Dimension-Classification of Fractals- Open GL:- Advantages of Open GL, OpenGL programming language, Shadowing Techniques, Texture mapping. Texture Filtering, Texture blending, Bump Mapping- Frame Mapping- Environment Mapping

MODULE V: Advanced Rendering Techniques:- Photorealistic rendering: Global Illumination, Ray Tracing, Radiosity, Monte Carlo Ray Tracing algorithm- Advantages and Limitations, Photon mapping - Two pass method

MODULE VI: Volume Rendering:- Pipeline- Volume Slicing- Volume modelling and Rendering overview, Direct volume rendering- Volume Ray casting- Splatting- Shear Warping- Texture based volume rendering- Marching cubes Algorithm

REFERENCES

- Donald D. Hearn, M Pauline Baker, Warren Carithers, " Computer Graphics with Open GL ", PHI, 4th Ed., 2010.
- Dave Shreiner, "OpenGL Programming Guide: The Official Guide to Learning OpenGL,Versions 3.0 and 3.1", Addison Wesley, 7th Ed., 2009
- Steven Harrington,Computer graphics: A Programming approach, McGraw Hill, 2nd Ed.1987
- Donald D. Hearn, M Pauline Baker, Warren Carithers, " Computer Graphics with Open GL ", PHI, 4th Ed., 2010.
- Tomas Akenine-Moller, Eric Haines, Naty Hoffman, "Real-Time Rendering", AK Peters, 3rd d.,2008.
- Alan Watt and Mark Watt, "Advanced Animation and Rendering Techniques" AddisonWesley, 1992.
- Matt Pharr and Greg Humphreys, "Physically based rendering: From Theory to Implementation", Morgan Kaufmann, 2nd Ed., 2010.
- James D. Foley, Andries van Dam, Steven K. Feiner and John F. Hughes, "Computer Graphics: Principles and Practice in C", Addison Wesley, 2nd Ed., 1995.

Semester : I
Course Code : COS-C-614
Course Title : PATTERN RECOGNITION
Credits : 3

AIM

The aim of this course is to learn how a computer recognize patterns from data sets. This course also discusses the main concepts for model selection and parameter estimation in recognition, decision making and statistical learning problems.

OBJECTIVES

- To give basics of pattern recognition concepts with applications to computer vision.
- To provide knowledge of models, methods and tools used to solve classification, feature selection and density estimation problems.
- To provide knowledge of recognition, decision making and statistical learning problems.
- Provide knowledge of current research topics and issues in Pattern Recognition.

COURSE CONTENT

MODULE I : Introduction: Machine Perception, Image Processing and Pattern Recognition, Pattern Recognition Systems, Design cycle, Learning and Adaptation, Applications of pattern recognition; Statistical Pattern Recognition: Probability theory basics, Probability density function, Normal density, Bivariate and Multivariate density functions.

MODULE II : Classifiers: Naives Classifier, Bayes Classifier, Discriminant Functions, Decision Surfaces, Linear Discriminant Function based classifiers, Perceptron, Support Vector Machine, Applications.

MODULE III : Non Parametric Decision Making: Histograms, Kernel density estimation, Nearest Neighbor Classification, Adaptive Decision Boundaries, Adaptive Discriminant Functions, Minimum Squared Error functions.

MODULE IV: Clustering: Similarity measures, Clustering criteria, Distance functions, Hierarchical clustering, Single Linkage, Average Linkage and Complete Linkage algorithms, Ward's Method. Partitional Clustering, Forgy's Algorithm, K-means algorithm, Fuzzy C means algorithm, ISODATA algorithm. Clustering Large Datasets, DBSCAN.

MODULE V : Feature Extraction and Selection, Binary feature selection. Dimensionality Reduction: Problems of dimensionality, Component analysis and discriminants, Principal Component Analysis, Linear Discriminant Analysis.

MODULE VI : Recent advances in Pattern Recognition: Neural Network structures for Pattern Recognition, Self organizing networks, Fuzzy pattern classifiers, Pattern classification using Genetic Algorithms, real life applications.

REFERENCES

- R.O. Duda, P.E. Hart, D.G. Stork, "Pattern Classification", John Wiley and Sons,2000.
- V. S. Devi, M. N. Murty, "Pattern Recognition: An Introduction", Universities Press, Hyderabad, 2011.
- Earl Gose , Steve Jost, "Pattern Recognition and Image Analysis", PHI Publishers, 1997.
- Robert J. Schalkoff, "Pattern Recognition : Statistical Structural and Neural
- Approaches", John Wiley & Sons Inc., New York, 1992.
- Tou and Gonzales, "Pattern Recognition Principles", Wesley Publications Company, London 1974.

Semester : I
Course Code : COS-C-615
Course Title : LABORATORY - I
Credits : 2

AIM

The aim of this course is to provide the practical knowledge in implementing various Image Processing algorithms using standard software such as MATLAB/ PYTHON.

OBJECTIVES

- To familiarize with the software tools for scientific applications.
- To implement basic and advanced image processing algorithms.
- To give a flair of research by implementing mini project in image processing domain.

COURSE CONTENT

Following experiments, related to image processing concepts need to be implemented:

- Convolution
- Correlation
- Image Transforms
- Filtering in Spatial domain
- Filtering in Frequency domain
- Restoration
- Enhancement
- Color image processing
- Segmentation

Students should undertake a research-oriented mini project to get an exposure to the recent research developments in the domain of Digital Image Processing. A detailed project report should be submitted and its evaluation should be conducted at the end of the semester.

Semester : I
Course Code : COS-E-616(i)
Course Title : MACHINE LEARNING TECHNIQUES
Credits : 3

AIM

This course aims to provide an exposure to the basic principles and techniques of Machine Learning and its wide applications.

OBJECTIVES

- To get an exposure to various machine learning algorithms and their use in intelligent systems.
- To get practical knowledge in implementing machine learning algorithms using PYTHON.
- To identify and formulate machine learning problems in our day-to-day life and solve it using standard tools.
- To get awareness about the current state-of-the-art machine learning algorithms and explore the possibility to apply them in the Image Processing domain.

COURSE CONTENT

MODULE I: Definition of Learning Systems, Goals and Applications of Machine Learning, Aspects of Developing a Learning System, Concept Representation, Function Approximation, Types of learning methods, Inductive Classification, Decision Tree Learning, Ensemble Learning, Rule Learning, Experimental Evaluation of Learning Algorithms.

MODULE II: Supervised Learning - Rule induction & Decision trees, classifiers and its Evaluation-Accuracy, precision and recall, F1-value, ROC curve, Scoring and ranking;

MODULE III: Support Vector Machines, Quadratic Programming, Kernels for Learning Non-linear Functions, Regression, Linear Least Squares Regression, Kernel Regression.

MODULE IV: Unsupervised Learning - Principal components analysis, Self-organizing maps; Reinforcement Learning –Introduction and applications, Q learning, Clustering, Monte Carlo Methods for evaluation.

MODULE V: Probabilistic Models: Classification, Mixture Models, EM Models, Hidden Markov Model, Bayesian Learning, Markov Random Field, Conditional Random Field, Exact Inference, Approximate Inference, Instance-Based Learning.

MODULE VI: Extreme Learning Machine, Active Learning, Deep Learning, Convolutional Neural Networks, Introduction to Bio-inspired Computing, Swarm Intelligence – Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Artificial Bee Colony (ABC) Algorithm, Bacterial Foraging Optimization (BFO).

REFERENCES

- Tom M. Mitchell, “Machine Learning”, McGraw-Hill Series in Computer Science, 1st Ed., 2017. ISBN-13: 978-1259096952.
- N.P.Padhy,”Artificial Intelligence and Intelligent Systems”, Oxford University Press, 2005, ISBN-13: 978-0195671544.
- Kevin Murphy, "Machine Learning – A Probabilistic Perspective (Adaptive Computation and Machine Learning series) ", MIT Press, 2012, ISBN-13: 978-0262018029.
- Yuxi (Hayden) Liu, "Python Machine Learning by Example", Packt Publishing Limited, May 2017, ISBN-13: 978-1783553112.
- Andreas Muller, "Introduction to Machine Learning with Python: A Guide for Data Scientists",Shroff/O'Reilly; 1st. Ed., 2016, ISBN-13: 978-9352134571.
- Ethem Alpaydin, "Introduction to Machine Learning", PHI, 3rd. Ed., 2015, ISBN-13: 978-8120350786.
- Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning (Adaptive Computation and Machine Learning series), MIT Press, January 2017, ISBN-13: 978-0262035613.

Semester : I
Course Code : COS-E-616(ii)
Course Title : KNOWLEDGE BASED SYSTEMS
Credits : 3

AIM

The aim of this course is to provide a thorough knowledge in the field of artificial intelligence. The course discusses the knowledge based systems, the representation and accessing of knowledge in the system.

OBJECTIVES

- To provide an exposure to knowledge based system, its architecture, types of knowledge, knowledge bases, inference engine, self learning etc.
- To develop knowledge based systems and learn how the knowledge can be acquired, shared and updated.
- To learn how the knowledge representation and reasoning are performed.
- To learn how reasoning with uncertain information can be performed.
- To learn about knowledge management models and the agent based systems.

COURSE CONTENT

MODULE I: Introduction to Knowledge Based Systems – Objectives of KBS, Components, Categories, Difficulties with the KBS. Knowledge Based System Architecture – Source of Knowledge, Types of Knowledge, Basic Structure, Knowledge Bases

MODULE II: Inference Engine, Self Learning, Reasoning, Explanation, Applications. Limitations of Knowledge Based Systems.

MODULE III: Developing Knowledge Based Systems – Knowledge Based System development Model, Knowledge Acquisition, Techniques for Knowledge Acquisition, Sharing Knowledge, Updating Knowledge.

MODULE IV: Knowledge Representation and Reasoning – The propositional calculus and Resolution, Predicate calculus and Resolution, Representing Procedural Knowledge, Reasoning with Uncertain Information, Learning and Acting with Bayes Nets.

MODULE V: Knowledge Management - Introduction, Perspectives, Evolution, Elements of Knowledge Management, Knowledge Management Process, Tools and Technologies, Knowledge Management Roles and Responsibilities, Knowledge Management Models.

MODULE VI: Agent Based Systems – Characteristics, Types of Agents, Agent Communication Language, Multi Agent Systems.

REFERENCES

- Rajendra Akerkar, Priti Sajja, "Knowledge-Based Systems", Jones & Bartlett Learning,1st Ed., 2010.
- Nils J Nilsson "Artificial Intelligence – A New Synthesis", Morgan Kaufman Publishers, 1st Ed., 2003.
- Cornelius T Leondes, "Knowledge-Based Systems: Techniques and Applications", Academic Press, 1st Ed., 2000.
- 4. Elias M Awad, Hassan M Ghaziri, "Knowledge Management", Pearson Education, 1st Ed., 2007.

Semester : I
Course Code : COS-E-616(iii)
Course Title : FRACTAL THEORY AND APPLICATIONS
Credits : 3

AIM

The aim of the course is to provide background knowledge of theory of fractals and introduce how these concepts can be applied in image processing.

OBJECTIVES

- To introduce the basic concept of fractals and its properties.
- To impart the knowledge about the methods for calculating fractal dimension.
- To introduce the concepts of Diffusion Limited Aggregation and Cellular Automata.
- To understand the concept of Fractal Image Compression.
- To provide the knowledge of Fractal and Texture Analysis.

COURSE CONTENT

MODULE I: Introduction to fractals, fractal geometry, properties of fractals, self similarity. Generation of Von Koch Curve, Koch Snowflake , Koch Star , Hilbert Curve , Sierpinski gasket , Cantor Set. Fractals and dimensions, methods of counting fractal dimension- walking divider, box counting, prism counting, fractional brownian motion. Similarity dimension, mass dimension, area-perimeter relation.

MODULE II: Algebra of Dimensions-Union, Intersection, Product, Projection. Iterated Function Systems, IFS for Sierpinski Gasket, Sierpinski Carpet, Koch Curve, Koch Snowflake. Lindermayer systems. Escape time fractals- Mandelbrot Set and Julia Sets.

MODULE III: Random fractals- fractional brownian motion, Cellular Automata, Applications of Cellular Automata. Diffusion-Limited Aggregation, Generating Random Fractal Terrain, Strange Attractors- Rossler Attractor, Lorenz Attractor.

MODULE IV: Fractal and Texture Analysis- Image Segmentation problem- Texture and Fractal Geometry- Fractal Properties- Random Scaling Fractals- Stochastic differential equations of fractional order- Real life Fractional Brownian Motion

MODULE V: Fractal to Segment Images- Object Segmentation- Texture Segmentation- Edge Detection-Texture Parameters- Statistical Moments- Generalized Texture Measures- Fractal Segmentation- Extraction of Fractal Dimension

MODULE VI: Fractal image compression- Contractive Mapping- Iterated Function System and Collage Theorm, PIFS Compression- Color Considerations- Video Considerations- Fractal Texture Maps.

REFERENCES

- Fractal Geometry in Digital Imaging, Martin J. Turner, Jonathan M. Blackledge, Patrick R. Andrews, Academic Press, ISBN 0127039708, 9780127039701
- Fractal Image Compression: Theory and Application,Yuval Fisher,Springer Science & Business Media, 2012, ISBN 1461224721, 9781461224723
- Fractals Everywhere, Michael F. Barnsley, Hawley Rising, Morgan Kaufmann, ISBN 0120790696, 9780120790692

Semester : I
Course Code : COS-E-616(iv)
Course Title : PARALLEL COMPUTING
Credits : 3

AIM

The aim of this course is to expose the students to parallel and distributed computing with special focus on writing parallel code for processor intensive applications to be run on GPU and cluster computing systems.

OBJECTIVES

- To understand the characteristics of parallel systems and distributed infrastructures.
- To learn how to design parallel programs and how to evaluate their performance.
- To enable the students to write parallel code for high performance computing applications.
- To expose the students to parallel computing libraries such as OpenMP, MPI, PVM and CUDA.

COURSE CONTENT

MODULE I: Introduction: Serial to Parallel thinking, History of parallel computers, Performance metrics - speedup, utilization, efficiency, scalability. Models of Parallel Computation SIMD, MIMD, PRAM (EREQ, CREW, CRCW), NC. Parallel Computer Organization, Pipelining and Throughput, Latency and Latency hiding.

MODULE II: Memory Organization, Inter-process communication, Inter-connection network, Message passing, Shared/Distributed memory.

MODULE III: Basic Parallel Algorithmic Techniques: Pointer Jumping, Divide-and-Conquer, Partitioning, Pipelining, Accelerated Cascading, Symmetry Breaking, Synchronization (Locked, Lock-free) Parallel Algorithms, Data organization for shared/distributed memory, Min/Max, Sum, Searching, Merging, Sorting, Prefix operations N-body problems, Matrix operations.

MODULE IV: Overview of Cluster based distributed computing: Hardware technologies for cluster computing, Software and software architectures for cluster computing: Shared memory (OpenMP) and Message-Passing (MPI/PVM) models. Dynamic process creation, one-sided communication, Parallel I/O.

MODULE V: Overview of GPUs: architecture, features and Programming model. System issues: cache and data management, languages and compilers, stream processing, GPU-CPU load balancing. Writing Parallel Programs, GPU-Compute Architecture, CUDA, Memory organization in CUDA.

MODULE VI: Multi-Core CPU programming, MPI, PVM, Performance evaluation and scalability, Image Processing using GPU and Cluster Computing.

REFERENCES

- Joseph Jaja, "Introduction to Parallel Algorithms", Addison-Wesley Professional, 1st Ed., 1992.
- Ananth Grama, George Karypis, Vipin Kumar, Anshul Gupta, "Introduction to Parallel Computing", Addison-Wesley Professional, 2nd Ed., 2003.
- Michael Quinn, "Parallel Programming in C with MPI and OpenMP", McGraw-Hill, 1st Ed., 2003.
- Jason Sanders, Edward Kandrot, "CUDA by Example: An Introduction to General-Purpose GPU Programming", Addison-Wesley Professional, 1st Ed., 2010.
- David Culler, J.P. Singh, Anoop Gupta, "Parallel Computer Architecture: A Hardware/Software Approach", Morgan Kaufmann, 1st Ed., 1998.
- William Gropp, Steven Huss-Lederman, Andrew Lumsdaine, Ewing L. Lusk, Bill Nitzberg, William Saphir, Marc Snir, "MPI - The Complete Reference. Volume 2, The MPI Extensions", MIT Press, 2nd Ed., 1998.
- David B. Kirk, Wen-mei W. Hwu, "Programming Massively Parallel Processors: A Hands-on Approach", Morgan Kaufmann, 1st Ed., 2010.
- Rob Farber, "CUDA Application Design and Development", Morgan Kaufmann, 1st Ed., 2011.

Semester : I
Course Code : COS-E-616(v)
Course Title : WAVELET ANALYSIS AND APPLICATIONS
Credits : 3

AIM

The aim of this course is to provide basic mathematical outline for wavelets and wavelet families with special emphasis on its application in the image processing domain.

OBJECTIVES

- To provide the basic knowledge of wavelets.
- To learn different types of wavelet families.
- To understand the application of image processing with wavelets.
- To impart the concept of multi-resolution analysis.

COURSE CONTENT

MODULE I: Introduction: Wavelet, Organization of Wavelets, Wavelet tree for a signal. Mathematical Framework: Fourier Transform to Gabor Transform, Continuous transform in wavelets, Orthonormal wavelet bases: Continuous to Discrete Transform, Multi-resolution analysis, Scaling function and wavelet.

MODULE II: Wavelet packets, Bi-orthogonal wavelet bases. From wavelet bases to Fast Algorithm: Mallat Algorithm, Efficient calculation of the coefficients, Justification: projection and twin scales, Complexity of the algorithm.

MODULE III: Wavelet families: Orthogonal wavelets with compact support: Daubechies wavelets, Symlets, Coiflets. Biorthogonal wavelets with compact support, Orthogonal wavelets with non-compact support, Real Wavelets without filters, Complex wavelets without filters.

MODULE IV: Finding and Designing a wavelet: Construction of wavelets for continuous analysis, Construction of wavelets for discrete analysis, Lifting.

MODULE V: Image Processing with wavelets: Wavelets for the image: 2D wavelet decomposition, Approximation and detail coefficients. Edge Detection and Textures, Fusion of images, Denoising of images,

MODULE VI: Image Compression: Compression and Wavelets, Principle of Compression by wavelets, Compression Methods: Thresholding Coefficients, Selection of Coefficients, True Compression, EZW Coding, Overview of Applications.

REFERENCES

- Michel Misiti, Yves Misiti, Georges Oppenheim, Jean-Michel Poggi, “Wavelets and their Applications”, Wiley-ISTE, 1st Ed., 2007.
- David F. Walnut, “An Introduction to Wavelet Analysis”, Birkhäuser, 1st Ed., 2001.
- C. Sidney Burrus, Ramesh A. Gopinath, Haitao Guo, “Introduction to Wavelets and Wavelet Transforms: A Primer”, Prentice Hall, 1st Ed., 1997.
- Lakshman Prasad, S. Sitharama Iyengar, “Wavelet Analysis with Applications to Image Processing”, CRC Press, 1st Ed., 1997.
- Michael W. Frazier, “An Introduction to Wavelets Through Linear Algebra”, Springer, 1st Ed., 1999.
- Gerald Kaiser, “A Friendly Guide to Wavelets”, Birkhäuser, 1st Ed., 2010.
- P. Wojtaszczyk, “A Mathematical Introduction to Wavelets”, Cambridge University Press, 1st Ed., 1997.

Semester : I
Course Code : COS-E-616(vi)
Course Title : IMAGE AND VIDEO QUALITY ASSESSMENTS
Credits : 3

AIM: The aim of this course is to provide the foundation knowledge in various quantitative metrics used for assessing the quality of image/video data.

OBJECTIVES

- To understand the basic and advanced image quality assessment metrics.
- To impart the knowledge of basic and advanced video quality assessment metrics.
- To provide the knowledge about the significance of reference and no-reference based image/video quality assessment metrics.
- To get an insight into the latest research development in the domain of image/video quality assessment metrics.

COURSE CONTENT

MODULE I: Fundamentals of Human Vision and Vision Modeling: Color Vision, Luminance and the Perception of Light Intensity, Spatial Vision and Contrast Sensitivity, Temporal Vision and Motion, Visual Modeling.

MODULE II: Video Quality Testing: Subjective Assessment Methodologies, Selection of Test Materials, Selection of Participants, Experimental Design, International Test Methods, Objective Assessment Methods. Perceptual Video Quality Metrics: Quality Factors, Metrics Classification, Pixel-Based Metrics, The Psychophysical Approach, Engineering Approach, Metric Comparisons.

MODULE III: Philosophy of Picture Quality Scale: PQS and Evaluation of Displayed Image, Construction of a Picture Quality Scale, Visual Assessment Tests, Results of Experiments, Key Distortion Factors, Applications of PQS. Structural Similarity Based Image Quality Assessment: Structural Similarity and Image Quality, Structural Similarity (SSIM) Index, Image Quality Assessment Based on the SSIM Index.

MODULE IV: Vision Model Based Digital Video Impairment Metrics: Vision Modeling for Impairment Measurement, Perceptual Blocking Distortion Metric, Perceptual Ringing Distortion Measure.

MODULE V: Computational Models for Just-Noticeable Difference: Single-Stimulus JNDT Tests, JND with DCT Sub-bands, JND with Pixels, JND Model Evaluation.

MODULE VI: No-Reference Quality Metric for Degraded and Enhanced Video: State-of-the-art for No-Reference Metrics, Quality Metric Components and Design, No-Reference Overall Quality Metric, Performance of the Quality Metric. Video Quality Experts Group.

REFERENCES

- H. R. Wu and K. R. Rao. “Digital Video Image Quality and Perceptual Coding”, CRC Press, 2006. ISBN-13: 978-0-8247-2777-2.
- Stefan Winkler. "Digital Video Quality: Vision Models and Metrics", Wiley Publishers, 1st Ed., 2005. ISBN-13: 978-0470024041.
- Oleg S. Pianykh. "Digital Image Quality in Medicine - Understanding Medical Informatics", Springer, 2014 Ed., 2013. ISBN-13: 978-3319017594.
- Shahriar Akramullah. "Digital Video Concepts, Methods, and Metrics: Quality, Compression, Performance, and Power Trade-off Analysis", Apress; 2014 Ed., 2014. ISBN-13: 978-1430267126.
- Chenwei Deng, Lin Ma, Weisi Lin, King Ngi Ngan. "Visual Signal Quality Assessment: Quality of Experience (QoE)", Springer; 2015 Ed., 2014. ISBN-13: 978-3319103679.
- Madhuri A. Joshi, Mehul S. Raval, Yogesh H. Dandawate, Kalyani R. Joshi, Shilpa P. Metkar. "Image and Video Compression: Fundamentals, Techniques, and Applications", CRC Press, 1st Ed., 2014. ISBN-13: 978-1482228229.

Semester : II
Course Code : COS-C-621
Course Title : APPLICATIONS OF IMAGE PROCESSING
Credits : 3

AIM

The aim of this course is to understand the application areas of Image processing. The course covers Computed Tomography (CT), Magnetic Resonance Imaging (MRI), PET, SPECT etc. and its reconstruction methods. It also discusses many of the current methods used to enhance and extract useful information from medical images and the various biometric systems.

OBJECTIVES

- To know how to use of the biological signals in diagnosis, patient monitoring and physiological investigation.
- To know the physical basis and engineering principles underlying common approaches in acquiring 2D and 3D images for biomedical applications, including x-ray imaging, tomographic techniques.
- To understand different analysis techniques used to automatically process and analyze these images, including different image representations, image enhancement and restoration and edge detection, automatic image segmentation and registration.
- To know some biomedical applications such as Image Guided Surgery, Image Guided Therapy, Computer Aided Diagnosis/Diagnostic Support Systems.

COURSE CONTENT

MODULE I Medical Image Processing: Introduction to medical imaging, brief history, importance, applications, trends, challenges; Medical Image Formation Principles: X-Ray and Computed Tomography(CT) imaging , Basic principles of CT, 2D Image reconstruction-Fourier space and filtered backprojection methods, Iterative reconstruction.

MODULE II : Imaging Modalities: Magnetic Resonance Imaging (MRI) Mathematics of MR, spin physics, NMR spectroscopy, imaging principles, Nuclear Imaging- positron emission tomography (PET) , single photon emission Tomography (SPECT), Ultrasound Imaging ,mathematical principles, applications; Medical Image Storage: Archiving and Communication Systems and Formats, Picture archiving and communication system (PACS), Formats - DICOM, Radiology Information Systems (RIS) and Hospital Information Systems (HIS).

MODULE III : Medical Image Segmentation: Histogram-based methods, Region growing, watersheds, Multispectral Techniques, Segmentation by Fuzzy clustering methods and issues, Segmentation with Neural Networks, Segmentation with deformable models.

MODULE IV : Medical Image Registration: Introduction, Intensity-based methods, Joint histograms, Information theory measures, cost functions, clinical applications of Image registration; Medical Image Search and Retrieval: Current technology in medical image search, content-based image retrieval, new trends;

MODULE V : Applications: Image Guided Surgery, Image Guided Therapy, Computer Aided Diagnosis/Diagnostic Support Systems. Biometrics: Introduction, Finger print as a biometric, fingerprint based identification system architecture, finger print representation, feature extraction, classification, matching.

MODULE VI : Face recognition from Images and videos: face detection, feature extraction methods, Eigen faces, fisher faces, advanced feature extraction methods, classification and recognition, Neural network, fuzzy logic and genetic algorithm based techniques (over view) Iris Recognition: Locating iris, feature encoding, recognition methods.

REFERENCES

- Bankman I.N. “Hand book of Medical Imaging-Processing and Analysis” , Academic Press
- Bovik A.I. “Handbook of Image and Video processing”, Academic Press.
- Paul Suetens, “Fundamentals of Medical Imaging”, Cambridge University Press, Second Edition
- Jiri Jan, “Medical Image Processing, Reconstruction and Restoration- Concepts and
- Methods”, CRC Tayler & Francis, 2006.
- L. Landini, V. Positano, M.L. Santarelli, “Advanced Image Processing in Magnetic
- Resonance Imaging”, CRC Tayler & Francis, 2005.

Semester : II
Course Code : COS-C-622
Course Title : COMPUTER VISION
Credits : 3

AIM

The aim of this course is to expose the students to fundamental concepts of Computer Vision such as Imaging & Image representation, Binary image analysis, Morphology, Region properties, Color & Shading, Texture analysis, CBIR, Motion estimation, 2D Matching, Perceiving 3D from 2D, 3D sensing, Object pose estimation etc.

OBJECTIVES

- To get exposure to the mathematical and computational techniques used in computer vision.
- To develop skills in designing and implementing basic computer vision applications.
- To understand the feature description and extraction methods used in computer vision.
- To understand how to capture and extract relevant visual information from images and videos to automatically interpret the 2D/3D scene.
- To develop a computer based system with vision capabilities.

COURSE CONTENT

MODULE I: Imaging and Image Representation: Imaging Devices, 3D structure from 2D images, Five frames of reference. Binary Image Analysis: Pixels and Neighborhoods, Applying masks to images, Counting the objects in an image, Connected components labeling.

MODULE II: Binary image morphology, Region properties, Region adjacency graphs, Thresholding, Overview of Pattern Recognition and Image filtering concepts.

MODULE III: Color and Shading: Color bases, Color histograms, Color segmentation, Shading. Texture: Texture, Texels and Statistics, Texel based Texture Descriptions, Quantitative Texture Measures, Texture Segmentation.

MODULE IV: Content based image retrieval: Image distance measures, Database organization. Motion from 2D image sequences: Computing Motion Vectors, Computing paths of moving points, Detecting significant changes in video. Overview of image segmentation.

MODULE V: Matching in 2D: Registration of 2D data, Representation of points, Affine mapping functions, 2D object recognition via Affine and Relational Matching.

MODULE VI: Perceiving 3D from 2D images: Labeling of line drawings from blocks world, 3D cues available in 2D images, Perspective imaging model, Depth perception from stereo. 3D sensing and Object pose Computation: 3D Affine transformations, Camera Model, Affine calibration matrix, Improved Camera calibration method, Pose estimation, 3D object reconstruction.

REFERENCES

- Linda G. Shapiro, George C. Stockman, "Computer Vision", Prentice Hall, 1st Ed., 2001.
- Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 1st Ed., 2010.
- David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach", 2nd Ed., 2011.
- Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 1st Ed., 2012.
- Ramesh Jain, Rangachar Kasturi, Brian G. Schunck, "Machine Vision", McGraw-Hill, 1st Ed., 1995.

Semester : II
Course Code : COS-C-623
Course Title : DATA COMPRESSION
Credits : 3

AIM

This course aims to give a rigorous introduction into the fundamental concepts of data compression with strong emphasis on the mathematical techniques.

OBJECTIVES

- To understand how digital data can be compressed using lossless and lossy techniques.
- To provide a strong mathematical background in the field of coding theory.
- To expose the students to various compression techniques widely used in the standard formats.

COURSE CONTENT

MODULE I: Introduction: Compression Techniques, Modeling and Coding, Mathematical Preliminaries for Lossless compression: Information Theory, Models, Coding: Uniquely decodable codes, Prefix codes, Kraft-McMillan Inequality.

MODULE II: Huffman Coding: Minimum Variance Huffman Codes, Length of Huffman Codes, Adaptive Huffman Coding, Applications, Golomb codes, Rice codes, Tunstall codes. Arithmetic Coding: Coding a sequence, Generating a binary code, Comparison of Huffman and arithmetic coding, Applications.

MODULE III: Dictionary Techniques: Static Dictionary, Digram coding, Adaptive Dictionary, LZ77, LZ78, LZW algorithms, Applications.

MODULE IV: Context-based Compression: Prediction with partial match (ppm), Burrows-Wheeler Transform (BWT), CALIC, JPEG standard, JPEG-LS, Run-Length Coding, JBIG, JBIG2.

MODULE V: Mathematical Preliminaries for Lossy Coding: Distortion Criteria, Rate Distortion Theory. Scalar Quantization: Quantization problem, Uniform Quantizer, Lloyd-Max Quantizer, Adaptive Quantization, Nonuniform Quantization, Entropy-Coded Quantization,.

Module VI: Vector Quantization: LBG Algorithm, Tree Structured and Structured Vector Quantizers. Differential Coding: Basic algorithm, DPCM. Transform Coding: Transforms of Interest, JPEG.

REFERENCES

- Khalid Sayood, "Introduction to Data Compression", Morgan Kaufmann Publishers, 4th Ed., 2012.
- David Salomon, "Data Compression – The Complete Reference", Springer, 4th Ed., 2006.
- Alistair Moffat, Andrew Turpin, "Compression and Coding Algorithms", Kluwer Academic Publishers, 1st Ed., 2002.
- Vasudev Bhaskaran, Konstantinos Konstantinides, "Image and Video Compression Standards", Kluwer Academic Publishers, 2nd Ed., 2003.
- Mark Nelson, Jean-Loup Gailly, "The Data Compression Book", John Wiley & Sons, 2nd Ed., 1995.
- John Miano, "Compressed Image File Formats", Addison Wesley Professional, 1st Ed., 1999.
- Peter Wayner, "Compression Algorithms for Real Programmers", Morgan Kaufmann, 1st Ed., 1999.

Semester : II
Course Code : COS-C-624
Course Title : LABORATORY -II
Credits : 2

AIM

The aim of this course is to provide the practical knowledge in implementing various Data Compression algorithms using PYTHON.

OBJECTIVES

- To familiarize with the programming concepts.
- To understand about the data compression concepts.
- To understand the image compression concepts.
- To implement image processing concepts.
- To develop existing compression algorithms.
- To give a flair of research by implementing mini project.

COURSE CONTENT

Following experiments, related to Data Compression concepts need to be implemented:

- Entropy
- Testing Uniquely Decodable Codes
- Testing Prefix Codes
- Huffman algorithm
- Adaptive Huffman algorithm
- Golomb code
- Rice code
- Tunstall code
- Integer Arithmetic coding
- LZ77 , LZ78, LZW
- BWT
- CALIC
- LBG
- JPEG

Students should undertake a research-oriented mini project to get an exposure to the recent research developments in the domain of Image/Video compression. A detailed project report should be submitted and its evaluation should be conducted at the end of the semester.

Semester : II
Course Code : COS-C-625
Course Title : SEMINAR
Credits : 2

AIM

The aim of the seminar is to make the students aware and understand the recent trends and technologies in image processing research area.

OBJECTIVES

- To enhance the presentation skills.
- To boost the communication skills of the student.
- To develop learning skills.
- To upgrade the knowledge of the student.

COURSE CONTENT

Each student is required to select a research paper from an IEEE/ACM/Springer/Elsevier Journal on recent trends and technologies in image processing and allied research areas. Students should give a presentation with good quality slides and they should also prepare a well documented report in approved format and submit to the department.

Semester : II
Course Code : COS-E-626(i)
Course Title : VIDEO SURVEILLANCE
Credits : 3

AIM: The aim of this course is to introduce the fundamental theory and techniques for efficient representation and processing of video surveillance data and to cover a broad understanding of various applications.

OBJECTIVES

- To understand the fundamentals of video surveillance.
- To impart the knowledge of pedestrian detection and tracking.
- To learn the underlying principles of vehicle tracking and detection.
- To provide the knowledge about human motion recognition.

COURSE CONTENT

MODULE I: Fundamentals: Image feature extraction: Feature point detection, Scale Invariant Feature Transform, Edge Detection, Color features. Multiple View Geometry: Perspective Projection Camera Model, Epipolar Geometry, Probabilistic inference

MODULE II: Pattern recognition and Machine learning: SVM and AdaBoost. Background Modeling and Subtraction: Kernel Density Approximation, Background Modeling and Subtraction Algorithms.

MODULE III: Pedestrian Detection and Tracking: Pedestrian detection by boosting local shape features: Tree learning algorithms, Edgelet features. Occluded pedestrian detection by part combination. Pedestrian tracking by Associating Detection Responses.

MODULE IV: Vehicle Tracking and Recognition: Joint tracking and Recognition framework, Joint appearance-motion generative model, Inference algorithm for joint tracking and recognition.

MODULE V: Human Motion Tracking: Image feature representation, Dimension reduction and Movement dynamics learning. Human action recognition: Discriminative Gaussian Process dynamic model.

MODULE VI: Human Interaction recognition: Learning human activity, Track-body Synergy framework. Multi-camera calibration and global trajectory fusion: Non-overlapping and overlapping cameras. Applications: Attribute-based people search, Soft biometrics for video surveillance: Age estimation from face, Gender recognition from face and body.

REFERENCES

- Yunqian Ma, Gang Qian, " Intelligent Video Surveillance: Systems and Technology", CRC Press, (Taylor & Francis Group), 2010.
- Fredrik Nilsson, Communications Axis, "Intelligent Network Video: Understanding Modern Video Surveillance Systems", CRC Press (Taylor & Francis Group), 2008.
- Anthony C. Caputo, "Digital Video Surveillance and Security", Butterworth-Heinemann, 1st Ed., 2010.
- Herman Kruegle, "CCTV Surveillance, Second Edition: Video Practices and Technology", Butterworth-Heinemann, 2nd Ed., 2006.

Semester : II
Course Code : COS-E-626(ii)
Course Title : IMAGE AND VIDEO WATERMARKING
Credits : 3

AIM: The aim of the course is provide a comprehensive knowledge of watermarking methods and introduce the techniques used for watermarking in image and video.

OBJECTIVES

- To introduce the basic concepts in Watermarking and Information Hiding.
- To provide the knowledge of Geometric models of watermarking.
- To impart the basic idea of image watermarking algorithms.
- To understand different video watermarking algorithms.

COURSE CONTENT

MODULE- I: Introduction- Information Hiding- Steganography- Watermarking- History and importance of Watermarking- Watermarking requirements- Application of Watermarking-

MODULE- II : Properties of Image Watermarking systems- Evaluating water marking systems-Bench marking- Scope of testing- Models of Image Watermarking- Components of Communication systems- Secure transmission

MODULE- III : Geometric models of water marking- distributions and regions in media space- Modeling Watermark detection by correlation- linear correlation- Normalized Correlation- Correlation coefficient

MODULE IV : Basic Message Encoding- Mapping messages into message Vectors-Direct message coding- Multi symbol message coding- Error correction coding- trellis coding and Viterbi decoding

MODULE- V : Image Watermarking- Correlation based Watermarking- Transform based Watermarking- Fractal based watermarking

MODULE- VI : Video Water marking- Introduction- Applications of watermarking video content- Challenges in Video Water Marking- Major Trends in Video Watermarking

REFERENCES

- Digital Watermarking and Steganography, 2nd Edition, by Cox, Miller, Bloom, Fridrich, and Kalke, 2007, 9780123725851
- 2.BorkoFurht, EdinMuharemagic and Daniel Socek, Multimedia Encryption and Watermarking, Springer, 2005 , 978-0-387-24425-9
- Jen- Shyang Pan, Hsiang- Cheh Huang and Lakhi C. Jain, Intelligent Watermarking Techniques, World Scientific, 2004, 978-981-238-757-8 (hardcover)

Web Resources

- G. C. Langelaar, I. Setyawan and R. L. Lagendijk, "Watermarking digital image and video data. A state-of-the-art overview," in *IEEE Signal Processing Magazine*, vol. 17, no. 5, pp. 20-46, Sep 2000.
- GwenaëlDoërr, Jean-LucDugelay, "A guide tour of video watermarking", Signal Processing: Image Communication, Volume 18, Issue 4, April 2003, Pages 263-282
- Gerhard C. Langelaar, Iwan Setyawan, Reginald L. LagendijkWatermarking Image and Video Data- State of Art Overview, IEEE SIGNAL PROCESSING MAGAZINE SEPTEMBER 2000

Semester : II
Course Code : COS-E-626(iii)
Course Title : INTRODUCTION TO BIOMETRICS
Credits : 3

AIM: The aim of the course is introduce the concepts of Biometrics and multimodal biometrics and its applications.

OBJECTIVES

- To discuss the main concepts in biometrics and different algorithms.
- To understand the concepts of Gait and DNA recognition.
- To understand the concepts of Voice and Iris recognition.
- To understand the performance metrics for biometric evaluation.
- To introduce the concepts of multi biometrics and fusion schemes.

COURSE CONTENT

MODULE I : Overview of biometrics - properties of biometric system,- Biometric identifiers - Biometric subsystems - System performance and design issues- Competing system design issues . - Biometric identification - Biometric verification - Biometric enrollment - Biometric system security

MODULE II : Authentication and Biometrics- Secure authentication protocols- Access control security services- Authentication methods - Authentication protocols- Matching biometric samples- Identification-Screening - Verification - Continuity of identity

MODULE III : Hand Geometry Biometrics - Applications- Challenges- Phases in Hand Geometry recognition, Gait recognition- HumanID Gait Challenge Problem- Temporal Alignment based approaches- Baseline Gait Algorithm Shape based approaches- DNA as a biometric- DNA sources- basics of DNA- DNA replication- DNA extraction- DNA sequencing

MODULE IV : Iris recognition- Active Contours for iris segmentation- Fourier-based Trigonometry and Correction - Detecting and Excluding Eyelashes, Voice Biometrics- Identity information in the speech signal - Feature Extraction and Tokenization- Text-dependent speaker recognition, Palm Print Recognition- Features -System Framework- Recognition Engine

MODULE V : Basic System Errors- Matching -Two kinds of errors- Score distributions - Estimating errors from data and match engines - Definitions of FAR and FRR, positive authentication- Receiver Operating Characteristic (ROC) - Using the ROC curve

MODULE VI : Introduction to multi biometrics- Taxonomy of Multi biometric Systems- levels of fusion- sensor level fusion- feature level fusion- feature normalization- feature selection or transformation- score level fusion- classifier based fusion schemes

REFERENCES

- Guide to Biometrics,By: Ruud M.Bolle,Sharath Pankanti, Nalini K. Ratha,Andrew W. Senior, Jonathan H. Connell,Springer 2009, 978-1-4419-2305-9
- Biometrics Personal Identification in Networked Society, Jain, Bolle, Pankanti (ed.s) 1999, 978-0-387-28539-9
- K. Jain, A. Ross, K. Nandakumar, Introduction to Biometrics: A Textbook, (2011), Springer Publishers, 2011. ISBN: 978-0-387- 77325-4.
- Ross, Arun; Nandakumar, Karthik; Anil, Jain, Handbook of Multibiometrics, (2006). Springer Publishers 1st Edition, ISBN: 978-0-387-22296-7
- A .K. Jain, P. J. Flynn and A. Ross, Handbook of Biometrics, (2007), Springer 978-0-387-71040-2

Semester : II
Course Code : COS-E-626(iv)
Course Title : VISUAL CRYPTOGRAPHY
Credits : 3

AIM: The aim of this course is to introduce the knowledge of Visual Cryptography and sharing schemes in Visual Cryptography.

OBJECTIVES

- To impart the basic knowledge of Steganography.
- To provide the knowledge of construction of Visual Secret Sharing scheme.
- To understand the concept of Visual Cryptography for color images.
- To introduce the concepts of Visual Mutiple Secret Sharing schemes.

COURSE CONTENTS

MODULE I : Basics of Steganography , Data Hiding- Secret Image Sharing- Visual Cryptography- Half tone Visual Cryptography- Blue Noise Error Diffusion- Visual Secret Sharing- Construction of Visual Secret Sharing scheme

MODULE II: Halftone VSS Construction Using Error Diffusion-Share structure-Distribution of SIP and ABP- Generation of Halftone shares via Error Diffusion-Halftone VSS Construction Using Parallel Error Diffusion-Quality of Halftone Shares

MODULE III : Visual Cryptography for Color Images- Color Superposition- Color Vision and Color Models- Lattices- Darkening Problem- Annihilator Color-Identity Color-Formal Models for Colored VCS- Models for B&W W-VC and Color VC, SC, ND Models

MODULE IV : Visual Cryptography Schemes for SC model- V Schemes- BDD Schemes-KY and YL schemes- CDD Schemes and a lower bound- Schemes for general model-(2,2) threshold schemes-(2,n) threshold schemes

MODULE V : Visual Cryptography for Multiple Secrets- Introduction- Naor and Shamir's Basic Visual Secret Sharing Scheme- Visual Two-Secret Sharing Schemes - Wu and Chen's scheme- Wu and Chang's scheme

MODULE VI : Visual Multiple-Secret Sharing Schemes- Shyu et.al's scheme-Informal description- Encoding circle share A- Encoding Circe Share B-General Agorithm- Fenget.al's scheme

REFERENCES

- Stelvio Cimato, "Visual Cryptography and Secret Image Sharing", CRC Press 2017, 9781138076044
- BorkoFurht, EdinMuharemagic and Daniel Socek, Multimedia Encryption and Watermarking, Springer, 2005 , 978-0-387-24425-9
- Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson Education, Fourth Edition, 978-0133356724, 2017
- Jen- Shyang Pan, Hsiang- Cheh Huang and Lakhi C. Jain, Intelligent Watermarking Techniques,World Scientific., 2004, 978-981-238-757-8 (hardcover)
- Josef Pieprzyk, Thomas hardjino and Jennifer Sebberry, Fundamentals of computer security,Springer International Edition 2003, 978-3-540-43101-5

Semester : II
Course Code : COS-E-627(i)
Course Title : SATELLITE IMAGE PROCESSING
Credits : 3

AIM : The aim of this course is to impart a knowledge in Satellite Image Processing, Geographical information systems and Remote Sensing.

OBJECTIVES

- To discuss basic principles in satellite image processing.
- To introduce the concepts of remote sensing.
- To introduce the concepts of Geographical Information Systems.
- To introduce Hyperspectral and multispectral satellite images.
- To discuss change detection algorithms.
- To learn image fusion techniques for satellite images.

COURSE CONTENT

MODULE I : Satellite Imaging Principles- Image Representation- Different techniques of Image acquisition- Satellite Image characteristics and different resolutions - Electromagnetic spectrum, Solar Reflection and Thermal emission –Type of Bands

MODULE II : SAR Image Processing- Polarimetric SAR Image Analysis- Contextual Classification- Principles of image interpretation- SAR Interferometry (InSAR)Technique- Image merging and mosaicking techniques - Applications of Image Analysis

MODULE III : Stereo Image Analysis- Change Detection- Hypothesis-test-based approach - MAD transformation approach- Image Mining- Snow Glacier Applications- Visual Interpretation of Satellite Imagery.

MODULE IV : Introduction to GIS- Basic Geographic concepts, GIS Applications GIS data models- GIS model for multiple maps, Maps and GIS- Classes of Maps, Mapping process, Geographic coordinate system of earth.

MODULE V : Principles of Remote Sensing– Remote sensing system Classification. Extraction of metric information from remotely sensed images, Integration of Geographic Information Systems and Remote Sensing.

MODULE VI : Introduction to Advanced Satellite Imaging techniques - Panchromatic Image- Hyperspectral Imagery - Multispectral Imagery- Satellite Image fusion- Qualitative image assessment metrics

REFERENCES

- Gonzalez, Rafael C. and Richard E. Woods "Digital Image Processing (3rd Edition)", Pearson Education, London.
- Lillesand, T.M., Kiefer, R.W. and Chapman, J.W., "Remote Sensing and Image Interpretation by", (5th Ed.), John Wiley & Sons, 2007.
- Remote Sensing and Digital Image Processing, Jarocińska, Anna, van der Meer, Freek D., Springer, 2016.
- Drury, S. A., "Image Interpretation in Geology", 2nd Ed, Allen & Unwin, 1993.
- Chilès, J.P. and Delfiner, P., 1999. Geostatistics – Modeling Spatial Uncertainty, John Wiley & Sons, Inc., New York
- John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 4th Edition, 2015.
- Robert Shcowebgerdt, Remote sensing models & methods for image processing, 3 rd edition, 2004.

Semester : II
Course Code : COS-E-626(ii)
Course Title : TEXTURE ANALYSIS
Credits : 3

AIM: The aim of the course is to provide the knowledge of texture modelling and introducing the concepts of 3D texture analysis.

OBJECTIVES

- To impart the knowledge of Texture modelling and synthesis.
- To provide the knowledge of Statistical and Syntactic texture description methods.
- To introduce the concepts of Fractals and texture analysis.
- To provide a background knowledge of Color Texture Analysis.

COURSE CONTENT

MODULE I: Introduction to Texture Analysis - Significance- Application - Taxonomy of Texture models- Texture Modelling and Synthesis- Methods based on spatial frequencies- Geometrical Methods for Texture Analysis- Model Based methods

MODULE II : Statistical texture description -Texture Classification- Local Statistical Operators for Texture Classification - TEXEMS: Random Texture Representation and Analysis- Syntactic and Hybrid texture description methods

MODULE III: Fractal Feature and Texture Analysis – Fractional Brownian Motion- Lacunarity, Fractal texture description- Markov Random Field, Use of MRF to characterise textures, Auto normal Markov random field model.

MODULE IV : Autocorrelation function as a texture descriptors- Texture features from Fourier transform- Quantitative Texture Measures- Edge density and direction- Binary Textures- Shape grammars - Colour Texture Analysis

MODULE V : 3D Texture Analysis -Shape, Surface Roughness and Human Perception - Texture for Appearance Models in Computer Vision and Graphics- Color Texture Classification- Trace Transform

MODULE VI : From Dynamic Texture to Dynamic Shape and Appearance Models- Divide-and-Texture: Hierarchical Texture Description - Face Analysis Using Local Binary Patterns - Texture Features - Texture Recognition

REFERENCES

- Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", 3rd Ed., PHI, 2007.
- Majid Mirmehdi Xianghua Xie, Jasjit Suri ,Handbook of Texture Analysis, Wiley, 2008
- Maria Petrou, Gracia Sevilla, Image Processing- Dealing with Texture, Wiley, 2006
- Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis and Machine Vision”, 2nd Edition, Thomson Learning, 1999.
- Linda G. Shapiro, George C. Stockman, “Computer Vision”, Prentice Hall, 1st Ed., 2001

Semester : II
Course Code : COS-E-626(iii)
Course Title : INTELLIGENT DATA MINING
Credits : 3

AIM

This course aims to provide the fundamentals of data mining techniques and different data mining algorithms for complex and sophisticated mining applications.

OBJECTIVES

- To understand the fundamentals of Data Mining and Data Ware Housing.
- To identify and analyze patterns in the data for mining.
- To understand the concept of Attribute Oriented Induction.
- To learn the mining algorithms for graph mining and social network analysis.
- To understand the concepts and mining algorithms for temporal and sequence data.
- To introduce text mining and approaches.

COURSE CONTENT

MODULE I: Introduction: Data Mining Functionalities - Classification of Data Mining systems, Data Mining task Primitives, Major issues in Data Mining- Data Preprocessing: Descriptive data summarization, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation

MODULE II : Data Warehouse and OLAP Technology- Data Warehouse- Multidimensional Data Model- Data Cubes- Star Schema, Snow Flake Schema- Fact Constellation- Measures- Concept Hierarchies- OLAP Operations- Three Tier Data Warehouse Architecture, Design and Construction of Data Warehouse Implementation-Type of OLAP Servers

MODULE III : Data Generalization- Attribute-Oriented Induction for Data Characterization Efficient Implementation of Attribute-Oriented Induction- Presentation of the Derived Generalization Mining Class Comparisons: Discriminating between Different Classes Class Description: Presentation of Both Characterization and Comparison

MODULE IV : Mining Frequent Patterns, Associations- Market Basket Analysis- Frequent Pattern Mining- Association Rule Mining, Apriori Algorithm- Improving the efficiency- Mining various kinds of association rules- Mining Multilevel, Multidimensional Association rules from Relational databases and Data warehouses

MODULE V : Mining Time series data and Sequence data - Mining Time-Series Data Trend Analysis-Similarity Search in Time-Series Analysis - Mining Sequence Patterns in Biological Data - Alignment of Biological Sequences - Hidden Markov Model for Biological Sequence Analysis

MODULE VI : Graph Mining - Methods for Mining Frequent Subgraphs Mining Variant and Constrained Substructure Patterns- Social Network Analysis- Link Mining - Mining on Social Networks- Text Mining - Text Data Analysis and Information Retrieval

REFERENCES

- Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", Morgan Kaufmann, 2nd Ed., 2005.
- Margaret H. Dunham, "Data Mining: Introductory and Advanced Topics", Prentice Hall,1st Ed., 2002.
- Da Ruan, Guoqing Chen, Etienne E. Kerre, Geert Wets, "Intelligent Data Mining: Techniques and Applications (Studies in Computational Intelligence)", Springer, 1st Ed.,2010.
- Masoud Mohammadian, "Intelligent Agents for Data Mining and Information Retrieval",Idea Group Publishing, 2004
- Hand, Mannila and Smyth: Principles of Data Mining, MIT Press, 2001.
- Witten and Frank: Data Mining: Practical Machine Learning Tools and Techniques with Java Implementations, Morgan Kaufmann, 2000.
- Mitchell: Machine Learning, McGraw-Hill, 1997.

Semester : III
Course Code : COS-C-631
Course Title : RESEARCH METHODOLOGY
Credits : 4

AIM

The aim of this course is to give an orientation to the students on research activities and to provide the fundamentals of research methods. It includes discussions on sampling techniques, research designs and analysis techniques.

OBJECTIVES

- To understand the basic outline of research process.
- To critically analyze and prepare a literature review.
- To learn professional ethics and code of ethics in research. .
- To learn how to prepare and execute a research project.
- To learn how to write a research publication.

COURSE CONTENT

MODULE I: Introduction to Research Methodology :Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Creativity and Innovation, Thinking skills, Creative Thinking, Critical Thinking, Productive Thinking ; Logical thinking, Inductive and Deductive logic.

MODULE II : Criteria of a good research, Steps in Research Process- Defining the Research Problem: Selecting the Problem, Necessity of defining the problem, Techniques in defining the problem, Research Ethics, Plagiarism

MODULE III : Literature review : Importance of literature review - Literature Search Procedure- Primary and Secondary sources, reviews, - Purpose of literature review- Kinds of literature- Critical literature review - Identifying gap areas from literature review

MODULE IV: Research Design: Features of a good design- Different Research Designs - Basic Principles- Hypothesis: Development of working hypothesis. Procedure for hypothesis testing-Hypothesis testing techniques - Power of a hypothesis test, Limitations of tests of hypothesis.

MODULE V : Structure and Components of Research Report, Data Presentation, Types of Report, Layout of Research Report, Mechanism of writing a research Thesis, Formats of a research paper (Science/ Engineering/ Technology research papers), IMRAD format, IEEE/ACM Professional Societies paper formats, Reference Citing Styles

MODULE VI : Publication Process: Peer review process, Open Access publications, other emerging trends in research communications, Shodhganga, Advanced academic search skills in Internet, Google Scholar, Scopus, Impact Factor, h-Index, g- index, Copyrights and Patents, IPR Laws.

REFERENCES

- Kothari, C.R., “Research Methodology: Methods and Techniques”, New Age Publisher, 2006.
- Michael P. Marder, “Research Methods for Science”, Cambridge University Press, 1st Ed., 2011.
- C Murthy "Research Methodology", Vrinda Publications, 2009
- Donald H. McBurney, “Research Methods”, 5th Edition, Thomson Learning, 2006.
- Ranjit Kumar, “Research Methodology: A Step-by-Step Guide for Beginners”, SAGE Publications, 3rd Ed., 2010

Semester : III
Course Code : COS-C-632
Course Title : DISSERTATION (Part-1)
Credits : 10

AIM

The main objective of the dissertation is to provide an opportunity to each student to perform an independent study and research in the area of specialization under the guidance of a faculty member in the department.

OBJECTIVES

- To identify a specific topic for dissertation in the area of Digital Image Processing.
- To do a preliminary study on the topic and give a presentation on it.
- To implement the initial phase of the work as the first part of the dissertation.
- To present the progress of the research work based on the results and analysis.
- To prepare and submit a well written report in the department.
- To get a thorough understanding of problem solving in a research project.

COURSE CONTENT

The dissertation work shall be carried out in the department under the guidance of an internal guide. However any specific request from the student to work in a National Level Institute/ R&D company in the industry can also be considered with specific conditions.

Semester : IV
Course Code : COS-C-641
Course Title : DISSERTATION (Part-2)
Credits : 16

AIM

The main objective of the second part of the dissertation is to provide an opportunity to each student to extend the work done in the first phase and hence explore the possibilities to design and develop a new technique or algorithm on their area of work.

OBJECTIVES:

- To study the related and recent works in the area of dissertation.
- To apply critical thinking and design new strategies for the work.
- To implement and analyse the performance of the new method.
- To propose a new algorithm in the area of study.
- To prepare a dissertation on the work done in the prescribed format.
- To do a presentation on the entire work done as part of the course.

COURSE CONTENT

The second phase of the dissertation work shall be carried out as the extension of the first work. At the end of the course, all the students should submit a dissertation with the details of the work done, findings and suggestions. There will be internal and external evaluations of the work.

SEMESTER : I
COURSE CODE : COS-X-611
COURSE TITLE :INTRODUCTION TO SCILAB
CREDITS : 2

AIM: To familiarize students with the Scilab Software and different operations.

COURSE OBJECTIVES

- To understand the fundamentals of Scilab
- To familiarize with programming in Scilab
- To create applications to solve problems in Scilab
- To understand the statistics functions for programing in Scilab

COURSE CONTENT

Module – I : Introduction to Scilab – Why Scilab, downloading & installing scilab, Scilab Environment – manipulating the command line, working directory, comments, variables in memory, the scilab menu bar, demos.

Module II : Scalars & Vectors – initializing vectors in scilab, mathematical operations on vectors, relational operations ,logical operations on vectors, built-in logical functions-conditional statements, Mathematical functions on scalars, complex numbers, trigonometric functions

Module - III : Matrices – introduction, arithmetic operators for matrices, basic matrix processing- Accessing and Addressing Matrix- Mathematical Operations with Matrix

Module IV: Polynomials – introduction, creating polynomials, basic polynomial commands, finding roots of polynomial, polynomial arithmetic

Module V : Plotting- Plotting 2D graphs - Plotting 3D graphs- Functions in Scilab-Applications - Numerical Linear Algebra(Solving linear equations, Eigen values)

Module VI : Statistics – basic statistical functions, applying statistical functions on matrices, distributions, frequency of values of a matrix or vector, centre, weighted centre, central moment, correlation, covariance, variance matrix, frequencies, cumulative sum, fisher test.

REFERENCES

- Vinu V. Das, Programming in Scilab 4.1, New Age Publishers,2008
- Ramachandran Hema, Achuthsankar S Nair, Scilab (A Free Software to Matlab), S Chand 2011
- Dr. M. Affouf, Scilab by Example, CreateSpace Independent Publishing 2012

SEMESTER : III
COURSE CODE : COS-X-631
COURSE TITLE : INTRODUCTION TO DIGITAL IMAGE PROCESSING
CREDITS : 2

AIM

The aim of this course is to introduce the concepts of image processing and the different image processing tasks.

OBJECTIVES

- To understand the different tasks in digital image processing.
- To introduce the concepts of sampling and quantization.
- To understand about Image restoration techniques.
- To provide the knowledge of various spatial and frequency domain filtering techniques.
- To introduce the concept of Image segmentation and thresholding techniques.
- To introduce the concept of Morphological Image Processing.

COURSE CONTENT

MODULE I : Images and Pictures- Image Processing- Image Acquisition and Sampling- Aspects of Image Processing- Types of digital images- Quantization and dithering- Histograms

MODULE II : Filtering- Low and High Pass filters- Guassian Filters- Edge Sharpening- Non linear filters- region of interest processing- Image Interpolation- Enhancement by Spatial Filtering

MODULE III : Fourier transforms of Images- Filtering in frequency domain- Ideal Filtering- Butterworth Filtering- Homomorphic filtering.

MODULE IV : Image Restoration- Degradation model- Types of Noises- Median Filtering- Average Filtering- Adaptive Filtering- Wiener Filter.

MODULE V : Image Segmentation- Thresholding- Otsu's Thresholding- Adaptive Thresholding- Edge detection- Watershed algorithm- Hough Transform.

MODULE VI : Mathematical Morphology- basic ideas- Dilation - Erosion- Opening- Closing- Hit or miss transforms- Gray Scale morphology- Processing of color images

REFERENCES

- Alasdair McAndrew , Introduction to Digital Image Processing with Matlab, Cengage Learning, 2004
- Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", 3rd Ed., PHI, 2007.
- Anil K. Jain, “Fundamentals of Digital image Processing”, Prentice Hall, US Ed., 1989.
- William K. Pratt, “Digital Image Processing: PIKS Scientific Inside”, Wiley Interscience, 4th Ed., 2007.