Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
Syllabus for M. Sc. In Human Computing & Artificial Intelligence
(Effective for Academic Session 2019-2020)

Semester III

Paper: Image Processing
Code: ADS 301
Contacts Hours / Week: 4T
Credits: 4

Objectives

Learn implementations of various digital **image** applications

Units	Course Content
1	INTRODUCTION Origin of Digital Image processing – fundamental steps – Components of Image processing system – Visual perception – Light and EM spectrum – Image sensing and acquisition – Image sampling and Quantization – relationship between pixels
2	IMAGE ENHANCEMENT Spatial Domain: Gray level transformation – Histogram processing – Arithmetic / Logic operations- Spatial filtering – smoothing filters – sharpening filters Frequency Domain
3	IMAGE RESTORATION Model of Image degradation/ restoration process – Noise models – mean filters – order statistics – adaptive filters – band reject – band pass – notch – optimum notch filters – Linear, position invariant degradations –establishing degradation functions – Inverse filtering – Weiner – least square – Geometric mean filters
4	IMAGE COMPRESSION Fundamentals – Image compression models – Information theory – error free compression: variable length – LZW – Bit plane – Lossless predictive coding; Lossy compression: Lossy predictive – transform – wavelet coding; Image compression standards IMAGE SEGMENTATION, REPRESENTATION & DESCRIPTION Segmentation: Detection of discontinuities – Edge linking & Boundary detection – Thresholding – region based segmentation. Representation & Description: Chain codes – Polygonal approximations – signatures – Boundary segments – Skeletons; Boundary Descriptors – Regional descriptors

Reference Books

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing” , 2nd edition , Pearson Education, 2007.
2. Digital Image Processing, M.Anji Reddy, Y.Hari Shankar, BS Publications.
3. S.Annadurai, R.Shanmugalakshmi, “fundamentals of Digital Image Processing”, Pearson Education, 2007
4. Rafael C. Gonzalez, Richard E. Woods, Eddins, “Digital Image Processing using MATLAB” , Pearson Education, 2005
5. Anil Jain K. “Fundamentals of Digital Image Processing”, PHI.
6. William Pratt , “Digital Image Processing”, Wiley Interscience, 2nd edition. M. TECH.

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Paper: Machine Learning
Code: DTM 302
Contacts Hours / Week: 4T
Credits: 4

Objectives

To enable the students to:

state-of-the-art methods and modern programming tools for data analysis using machine learning programs and algorithms

Units	Course Content
1	INTRODUCTION - Well-posed learning problems, Designing a learning system, Perspectives and issues in machine learning Concept learning and the general to specific ordering – Introduction, A concept learning task, Concept learning as search, Find-S: finding a maximally specific hypothesis, Version spaces and the candidate elimination algorithm, Remarks on version spaces and candidate elimination, Inductive bias
2	Decision Tree learning – Introduction, Decision tree representation, Appropriate problems for decision tree learning, The basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning Artificial Neural Networks – Introduction, Neural network representation, Appropriate problems for neural network learning, Perceptions, Multilayer networks and the back propagation algorithm, Remarks on the back propagation algorithm, An illustrative example face recognition Advanced topics in artificial neural networks Evaluation Hypotheses – Motivation, Estimation hypothesis accuracy, Basics of sampling theory, A general approach for deriving confidence intervals, Difference in error of two hypotheses, Comparing learning algorithms
3	Bayesian learning – Introduction, Bayes theorem, Bayes theorem and concept learning, Maximum likelihood and least squared error hypotheses, Maximum likelihood hypotheses for predicting probabilities, Minimum description length principle, Bayes optimal classifier, Gibs algorithm, Naïve bayes classifier, An example learning to classify text, Bayesian belief networks The EM algorithm Computational learning theory – Introduction, Probability learning an approximately correct hypothesis, Sample complexity for Finite Hypothesis Space, Sample Complexity for infinite Hypothesis Spaces, The mistake bound model of learning - Instance-Based LearningIntroduction, k -Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning Genetic Algorithms – Motivation, Genetic Algorithms, An illustrative Example, Hypothesis Space Search, Genetic Programming, Models of Evolution and Learning, Parallelizing Genetic Algorithms

4	Learning Sets of Rules – Introduction, Sequential Covering Algorithms, Learning Rule Sets: Summary, Learning First Order Rules, Learning Sets of First Order Rules: FOIL, Induction as Inverted Deduction, Inverting Resolution M. TECH. (NEURAL NETWORKS)-R13 Regulations Analytical Learning - Introduction, Learning with Perfect Domain Theories: Prolog-EBG Remarks on Explanation-Based Learning, Explanation-Based Learning of Search Control Knowledge Combining Inductive and Analytical Learning – Motivation, Inductive-Analytical Approaches to Learning, Using Prior Knowledge to Initialize the Hypothesis, Using Prior Knowledge to Alter the Search Objective, Using Prior Knowledge to Augment Search Operators, Reinforcement Learning – Introduction, The Learning Task, Q Learning, Non-Deterministic, Rewards and Actions, Temporal Difference Learning, Generalizing from Examples, Relationship to Dynamic Programming

References Books:

1. Machine Learning – Tom M. Mitchell, - MGH
2. Machine Learning: An Algorithmic Perspective, Stephen Marsland, Taylor & Francis (CRC)
3. Machine Learning: Rajiv Chopra (Khanna)
3. Cover, T. M. and J. A. Thomas: Elements of Information Theory. Wiley.
4. Charniak, E.: Statistical Language Learning. The MIT Press.
5. Jelinek, F.: Statistical Methods for Speech Recognition. The MIT Press.
6. Lutz and Ascher - "Learning Python", O'Reilly
7. Jeeva Jose, Machine Learning using Python, Khanna Publishing House

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Paper: Operation Research
Code: CGA 303
Contacts Hours / Week: 4T
Credits: 4

Objectives

To enable the students to:
Understand queuing models and linear as well as non-linear programming

Units	Course Content
1	UNIT 1: QUEUEING MODELS 9 Poisson Process – Markovian Queues – Single and Multi:server Models – Little‘s formula – Machine Interference Model – Steady State analysis – Self Service Queue.
2	**UNIT II** ADVANCED QUEUEING MODELS 9 Non: Markovian Queues – Pollaczek Khintchine Formula – Queues in Series – Open Queueing Networks –Closed Queueing networks.
3	**UNIT III** SIMULATION 9 Discrete Even Simulation – Monte – Carlo Simulation – Stochastic Simulation – Applications to Queueing systems.
4	**UNIT IV** LINEAR PROGRAMMING 9 Formulation – Graphical solution – Simplex method – Two phase method : Transportation and Assignment Problems. NON:LINEAR PROGRAMMING 9 Lagrange multipliers – Equality constraints – Inequality constraints – Kuhn : Tucker conditions – Quadratic Programming

References Books:

1. Winston.W.L. ―Operations Research‖, Fourth Edition, Thomson – Brooks/Cole, 2003.
2. Taha, H.A. ―Operations Research: An Introduction‖, Ninth Edition, Pearson Education Edition, Asia, New Delhi, 2002.
3. Robertazzi. T.G. ―Computer Networks and Systems – Queuing Theory and Performance 4. Evaluation, Third Edition, Springer, 2002 Reprint.
5. Ross. S.M., ―Probability Models for Computer Science, Academic Press, 2002.

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Paper: Modeling & Simulation
Code: AIB 304
Contacts Hours / Week: 3T
Credits: 3

Objectives

To enable the students to:
Understand queuing models and linear as well as non-linear programming

Units	Course Content
1	o SimulationBasics o Handling Stepped and Event-based Time in Simulations o Discrete versus ContinuousModelling o NumericalTechniques o Sources and Propagation of Error
2	HybridSimulations o Converting to Parallel and DistributedSimulations o Partitioning the Data o Partitioning the Algorithms o Handling Inter-partition Dependencies
3	o Dynamical, Finite State, and Complex Model Simulations o Graph or Network Transitions Based Simulations o Actor Based Simulations o Mesh Based Simulations o Probability and Statistics for Simulations and Analysis o Introduction to Queues and Random Noise o Random Variates Generation o SensitivityAnalysis
4	Simulations Results Analysis and Viewing Tools o Display Forms: Tables, Graphs, and Multidimensional Visualization o Terminals, X and MS Windows, and WebInterfaces o Validation of Model Results

References Books:

1. The Nature of Code: Simulating Natural Systems with Processing by Daniel Shiffman - The Nature of Code , 2012

Paper: Cloud Computing
Code: ISO 305
Contacts Hours / Week: 3T
Credits: 3

Objectives

To enable the students to:
provide with the comprehensive and in-depth knowledge of Cloud Computing concepts, technologies, architecture and applications by introducing and researching state-of-the-art in Cloud Computing fundamental issues, technologies, applications and implementations

Units	Course Content
1	CLOUD COMPUTING Understanding the Cloud Computing – Cloud Architecture – Cloud Storage – Advantages, Disadvantages of Cloud Computing – Companies in the Cloud Today – Developing Cloud Services – Web:Based Application – Pros and Cons of Cloud Service Development – Types of Cloud Service Development – Software as a Service – Platform as a Service – Web Services – On:Demand Computing – Discovering Cloud Services Development Services and Tools – Amazon Ec2 – Google App Engine – IBM Clouds
2	CLOUD COMPUTING FOR EVERYONE Centralizing Email Communications – Collaborating on Schedules, To:Do Lists, Contact Lists and Group Projects and Events – Cloud Computing for the Community and Corporation, Using Cloud Services: Collaborating on Calendars, Schedules and Task Management – Exploring Online Scheduling Applications, Online Planning and Task Management – Collaborating on Event Management, Contact Management, Project Management, Word Processing and Databases – Storing and Sharing Files
3	VIRTUALIZATION & CLOUD COMPUTING * Virtualization & Cloud Computing Overview – Case Study: Enterprise Virtualization & Cloud Computing – Definitions – Hypervisor / Virtual Machine Monitor Architecture – CPU Virtualization Extensions – Network and Storage Virtualization Architecture
4	VIRTUALIZED ENTERPRISE * Smashing the Virtualized Stack – Case Study: Owning the Virtualized Enterprise – CPU & Chipsets – VMM/Hypervisor/Host – VMs/Guest – Control & Management planes & APIs. CLOUD SECURITY AND PRIVACY Infrastructure security – Data Security and Storage – Identity and access management – Security management in the cloud – privacy – Security as a cloud service

References Books:

1. Michael Miller, Cloud Computing: Web: Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.

2. Christofer Hoff, Rich Mogull, Craig Balding, Hacking Exposed: Virtualization & Cloud Computing: Secrets & Solutions [Paperback], McGraw:Hill Osborne (20 Jan 2012) *

3. Haley Beard, Cloud Computing Best Practices for Managing and Measuring Processes for On:demand Computing, Applications and Data Centers in the Cloud with SLAs, Emereo Pty Limited, July 2008.

4. Tim Mather, Subra Kumaraswamy, Shahed Latif, Cloud Security and Privacy – An Enterprise Perspective on Risks and Compliance, By O'Reilly Media, 2009

Practical

Paper: Advanced data Structure Programming
Code: ADP 391
Contacts Hours / Week: 2P
Credits: 2

Units	Course Content
1	**LAB EXERCISES:** Each student has to work individually on assigned lab exercises. Lab sessions could be scheduled as one contiguous four-hour session per week or two two-hour sessions per week. There will be about 15 exercises in a semester. It is recommended that all implementations are carried out in Java. If C or C++ has to be used, then the threads library will be required for concurrency. Exercises should be designed to cover the following topics: 1. Implementation of graph search algorithms. 2. Implementation and application of network flow and linear programming problems. 3. Implementation of algorithms using the hill climbing and dynamic programming design techniques. 4. Implementation of recursive backtracking algorithms. 5. Implementation of randomized algorithms. 6. Implementation of various locking and synchronization mechanisms for concurrent linked lists, concurrent queues, and concurrent stacks. 7. Developing applications involving concurrency.

2	**OUTCOMES:** Upon completion of the course, the students will be able to • Design and apply iterative and recursive algorithms. • Design and implement algorithms using the hill climbing and dynamic programming and recursive backtracking techniques. • Design and implement optimization algorithms for specific applications. • Design and implement randomized algorithms. • Design appropriate shared objects and concurrent objects for applications. • Implement and apply concurrent linked lists, stacks, and queues.

References Books:

1. Jeff Edmonds, "How to Think about Algorithms", Cambridge University Press, 2008.
2. M. Herlihy and N. Shavit, "The Art of Multiprocessor Programming", Morgan Kaufmann, 2008.
3. Steven S. Skiena, "The Algorithm Design Manual", Springer, 2008.
4. Peter Brass, "Advanced Data Structures", Cambridge University Press, 2008.
5. S. Dasgupta, C. H. Papadimitriou, and U. V. Vazirani, "Algorithms" , McGrawHill, 2008.

Paper: Practical on Machine Learning
Code: PML 392
Contacts Hours / Week: 2P
Credits: 2

Course Content
Speech Recognition (HMMs, ICA)
Computer Vision
Time Series Prediction (weather, finance)
Genomics (micro-arrays, SVMs, splice-sites)
NLP and Parsing (HMMs, CRFs, Google)

Text and InfoRetrieval (docs, google, spam, TSVMs) Medical (QMR-DT, informatics, ICA) Behavior/Games

Reference Books:

- Stephen Marsland, Machine Learning: An Algorithmic
- Christopher M. Bishop, Pattern Recognition and Machine
- Tom Mitchell, Machine Learning
- V.K. Jain, Machine Learning