Data Structures and Algorithms (MCS-141)

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Unit 1: 8 lectures

Introduction- Asymptotic notation, Notations of best, worst and average case complexity, Methods of solving recurrences using recursion tree and Master method. Searching an element in an array using linear search and binary search. Iterative and recursive algorithms (Towers of Hanoi, Euclid's GCD algorithm), Sorting arrays using selection sort, insertion sort, quicksort and merge sort, Heaps, Insertion into a Max Heap, Deletion from a Max Heap.

Unit II: 10 lectures

Basic Data Structures- Array based and linked list-based implementation of Stack and Queues, Circular Queues, Priority Queues, Application of Stacks (infix expression to postfix form and evaluation of postfix expression), Linked lists - Single and Doubly linked lists, Circularly Linked Lists. Graphs - Adjacency matrix and adjacency list representations, DFS, BFS, Trees - rooted tree representation, traversal of trees, binary search trees.

Unit III: 8 lectures

Greedy Algorithms – Greedy Strategy, Minimum spanning trees - Kruskal and Prim algorithms, Huffman Coding, Fractional Knapsack.

Dynamic Programming – Dynamic Programming Approach, Matrix Chain Multiplication, Optimal Binary Search Tree, All Pairs Shortest Paths, Longest Common Subsequence.

Unit IV: 8 lectures

String Matching – Naïve string-matching algorithm, Robin-Karp Algorithm.

Advanced Data Structures- B-Trees, Insertion and deletion in B-Trees, AVL Trees, Hash Tables, Hash Tables, Hash Functions, Collision Resolution.

Unit V: 6 lectures

NP-Completeness - Importance of NP-completeness, P, NP, NP Complete and NP hard problems.

Approximation Algorithms- The vertex cover problem, The set-covering problem, The subset-sum problem, The traveling salesman problem,

Textbook(s)

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein. Introduction to Algorithms, Third Edition, PHI Learning, 2009. ISBN:978-81-203-4007-7.
2. Sanjoy DasGupta, C. H. Papadimitriou, Umesh Vazirani. Algorithms, First Edition, Tata McGraw Hill, 2006. ISBN: 978-0073523408.
3. Fundamentals of Computer Algorithms, Ellis Horowitz, Satraj Sahani and Rajasekharan, 2nd Edition, 2009, University Press Pvt. Ltd.

Cryptography and Network Security MCS-142

Objectives:

- To understand the fundamental principles of cryptography and network security.
- To explore various cryptographic algorithms and secure communication protocols.
- To analyze security threats and vulnerabilities in networked systems.
- To gain hands-on experience in implementing cryptographic techniques.

Unit 1: Introduction to Cryptography

1.1 Overview of Cryptography
1.2 Historical Development of Cryptography
1.3 Symmetric vs. Asymmetric Cryptography
1.4 Key Management and Distribution

Unit 2: Cryptographic Algorithms

2.1 Symmetric Key Cryptography

- DES, AES, Blowfish, IDEA
- Modes of Operation (ECB, CBC, CFB, OFB, CTR)

2.2 Asymmetric Key Cryptography

- RSA Algorithm
- ECC (Elliptic Curve Cryptography)

- Digital Signatures and Certificates (DSA, ECDSA)
  2.3 Hash Functions
- MD5, SHA-1, SHA-2, SHA-3

Unit 3: Network Security Basics

3.1 Overview of Network Security
3.2 Types of Attacks (Passive, Active, Man-in-the-Middle, DoS, DDoS)
3.3 Firewalls and their Types
3.4 Intrusion Detection Systems (IDS) and Intrusion Prevention Systems (IPS)

Unit 4: Secure Communication Protocols

4.1 Overview of Protocols and their Importance
4.2 TLS/SSL
4.3 IPsec and VPNs
4.4 Secure Email Protocols (PGP, S/MIME)
4.5 HTTPS and Web Security

Unit 5: Cybersecurity and Ethical Hacking

5.1 Principles of Cybersecurity
5.2 Ethical Hacking Methodologies
5.3 Penetration Testing Tools
5.4 Case Studies of Major Security Breaches

Recommended Textbooks:

1. William Stallings, "Cryptography and Network Security: Principles and Practices."
2. Behrouz A. Forouzan, "Cryptography and Network Security."
3. Charlie Kaufman, Radia Perlman, and Mike Speciner, "Network Security: Private Communication in a Public World."

ARTIFICIAL INTELLIGENCE (MCS-143)

UNIT 1 - Introduction to Artificial Intelligence:

Definition and history of AI, Applications and scope of AI, Intelligent agents and their environments. **Problem-Solving and Search Techniques:** Uninformed search strategies (e.g., breadth-first, depth-first), Informed search strategies (e.g., A*, heuristic search), Constraint

UNIT 2 - Knowledge Representation and Reasoning:
Logic and Reasoning: Propositional and predicate logic, Ontologies and semantic networks, Reasoning under uncertainty, Knowledge-based AI, Inference in first-order logic, Building knowledge bases. Knowledge acquisition and representation, learning by induction – explanation based learning.

UNIT 3 - Knowledge Representation, Knowledge Organisation and Manipulation:
Knowledge-General Concepts – Representations and Mappings-Approaches to Knowledge Representation-Procedural vs Declarative Knowledge, forward vs backward reasoning, matching techniques – control knowledge/strategies-symbol reasoning under uncertainty – introduction to non – monotonic reasoning-logic for monotonic reasoning-implementation issues-augmenting a problem solver statistical reasoning.

UNIT 4 - Machine Learning, Neural Networks and Deep Learning Techniques:
What is Machine Learning? Supervised learning (e.g., regression, classification), Unsupervised learning (e.g., clustering, dimensionality reduction), Reinforcement learning ML in practice: Applications and case studies, Importance of data preprocessing, Data cleaning, Regression and Classification Algorithms – Linear and Logistic Regression, KNN, Decision Tree. Clustering in Machine Learning. Introduction to neural networks, ANN, Deep learning architectures – CNN, RNN, RCNN, Training and optimization techniques

UNIT 5 - Perceptron – Communication and Expert Systems
Natural Language Processing: Syntax and semantics, Speech recognition, Machine translation, Pattern Recognition. Expert Systems - Components of expert systems, Inference engines, Architecture of Expert system, MYCIN, DENDRAL.

Text Books

1. **Elaine Rich and Kelvin Knight, Artificial Intelligence, Tata McGraw Hill, New Delhi, 1991.**
2. **Stuart Russell and Peter Norvig, Artificial Intelligence: A modern approach. Prentice Hal, 1995**

References

1. **Nilson N.J. Principles of Artificial Intelligence, Springer Verlag, Berlin, 1980.**
2. **Patterson, Introduction to Artificial Intelligence and Expert systems, Prentice Hall of India, New Delhi, 1990**

Data Warehousing and Data Mining (MCS-124)

Objective

- To understand the principles of Data warehousing and Data Mining.
- To be familiar with the Data warehouse architecture and its Implementation.
- To know the Architecture of a Data Mining system.
- To understand the various Data preprocessing Methods.
- To perform classification and prediction of data.

UNIT I

Data Warehousing and Business Analysis: - Data warehousing Components –Building a Data warehouse –Data Warehouse Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.

UNIT II

Data Mining: - Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture Of A Typical Data Mining Systems- Classification Of Data Mining Systems.

Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.

UNIT III

Classification and Prediction: - Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.

UNIT IV

Cluster Analysis: - Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.

UNIT V

Mining Object, Spatial, Multimedia, Text and Web Data:

Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.

Outcome

- Technical knowhow of the Data Mining principles and techniques for real time applications.

Text Book

1. Jiawei Han, Micheline Kamber and Jian Pei “Data Mining Concepts and Techniques”, Third Edition, Elsevier.

Reference Books

1. Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition.
2. K.P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India.
3. G. K. Gupta “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India.
4. Pang-Ning Tan, Michael Steinbach and Vipin Kumar “Introduction to Data Mining”, Pearson Education.

Big Data Analytics (MCS-129)

Objective

1. Understand the need for Bid Data Analytics
2. Master the concepts of large scale file systems and map reduce framework 3. Master the concepts of mining data streams
4. Master the concepts of Link analysis and frequent item sets discovery from Big data
5. Master the concepts of clustering for streams and parallelism.

Unit No.	Topics	Hours
1	Introduction to Big Data: Big data time line, Why this topic is relevant now? Is big data fad? Where using big data makes a difference? Introduction to statistical modeling and machine learning, Ordinary data processing versus big data processing: Challenges and opportunities	6
2	Map Reduce and the New Software Stack: Distributed File Systems, Map Reduce, Algorithms Using Map Reduce, Complexity Theory for Map Reduce	12
	Mining Data Streams: The Stream Data Model, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments and Windowing, Decaying Windows	
3	Link Analysis: Page Rank and Efficient Computation of Page Rank, Topic-Sensitive Page Rank, Link Spam, Hubs and Authorities	10
	Frequent Item sets from Big Data: The Market-Basket Model, Market Baskets and the A-Priori Algorithm, Handling Larger Datasets in Main Memory, Limited-Pass Algorithms, Counting Frequent Items in a Stream	
4	Clustering for Big Data: Introduction to Clustering Techniques, Hierarchical Clustering, Clustering in Non-Euclidean Spaces, Clustering for Streams and Parallelism	14
5	Mining Social Network Graphs: Social Networks as Graphs, Clustering of SocialNetwork Graphs, Direct Discovery of Communities, Partitioning of Graphs, Finding Overlapping Communities, Neighborhood Properties of Graphs	
	Total Lectures	42

References 1.

1. Anand Rajaraman and Jeffery David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012
2. 2. Jared Dean, Big Data, Data Mining and Machine Learning, Wiley Big data Series, 2014
3. 3. Judith Hurwitz, Alan Nugent, Fern Halper and Marica Kaufman, Big Data for Dummies, Wiley Press, 2013

Computer Science and Engineering

1. Subject Code: MCS 301 Course Title: **Soft Computing**
2. Contact Hours: L: 3 T: - P:
3. Examination Duration (Hrs): Theory 3 Practical
4. Relative Weight: CWS 25 PRS Nil MTE 25 ETE 50 PRE Nil
5. Credits: 3
6. Semester: 3
7. Subject Area: Core Course
8. Pre-requisite: Basic knowledge of artificial Intellegence subject
9. Objective: To familiarize with soft computing concepts. To introduce the ideas of Neural networks, fuzzy logic and use of heuristics based on human experience.To introduce theconcepts of Genetic algorithm and its applications to soft computing using some applications.

Learning outcomes:

1. Recognize the feasibility of applying a soft computing methodology for a particularproblem
2. Able to apply Artificial Neural Networks to solve various problems
3. Apply neural networks to pattern classification and regression problems
4. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems
5. Apply genetic algorithms to combinatorial optimization problems
6. Evaluate and compare solutions by various soft computing approaches for a givenproblem.

10. Details of the Course:-

Sl. No.	Contents	Contact Hours
Unit I	Fundamentals of ANN: The Biological Neural Network, Artificial Neural Networks - Building Blocks of ANN and ANN terminologies: architecture, setting of weights, activation functions - McCulloch-pitts Neuron Model, Hebbian Learning rule, Perception learning rule, Delta learning rule.	8
Unit II	Models of ANN: Single layer perception, Architecture, Algorithm, application procedure - Feedback Networks: HopfieldNet and BAM - Feed Forward Networks: Back Propogation Network (BPN) and Radial Basis Function Network (RBFN) – Self Organizing Feature Maps: SOM and LVQ	8
Unit III	Fuzzy Sets, properties and operations - Fuzzy relations, cardinality, operations and properties of fuzzy relations, fuzzy composition.	8

Unit IV	Fuzzy variables - Types of membership functions - fuzzy rules:Takagi and Mamdani – fuzzy inference systems: fuzzification, inference, rulebase, defuzzification.	8
Unit V	Genetic Algorithm (GA): Biological terminology – elements ofGA: encoding, types of selection, types of crossover, mutation, reinsertion – a simple genetic algorithm – Theoretical foundation: schema, fundamental theorem of GA, building block hypothesis.	10
	Total	42

Text Books

1. S. N. Sivanandam, S. Sumathi, S.N. Deepa, Introduction to Neural Networks usingMATLAB 6.0 , Tata McGraw-Hill, New Delhi, 2006
2. S. N. Sivanandam, S.N. Deepa, Principles of Soft Computing, Wiley-India, 2008.
3. D.E. Goldberg, Genetic algorithms, optimization and machine learning, Addison Wesley2000.

Reference Books

1. Satish Kumar, Neural Networks – A Classroom approach, Tata McGraw-Hill, NewDelhi, 2007.
2. Martin T. Hagan, Howard B. Demuth, Mark Beale, Neural Network Design,
3. Thomson Learning, India, 2002.
4. B. Kosko, Neural Network and fuzzy systems, PHI, 1996.
5. Klir& Yuan, “Fuzzy sets and fuzzy logic – theory and applications, PHI, 1996.
6. Melanie Mitchell, An introduction to genetic algorithm, PHI, India, 1996.