Ph.D. COURSEWORK UNDER FACULTY of ENGINEERING

700003-B9: Advances in Computer Engineering

Note: Each Unit is of 2 credits. A candidate has to take any *three* units (6 credits)

Unit 1: Natural Language Processing

Introduction to Natural Language Understanding, An Outline of English Syntax, Grammars and Parsing, Grammars for Natural Language, Toward Efficient Parsing, Ambiguity Resolution: Statistical Methods, Linking Syntax and Semantics, Ambiguity Resolution, Scoping and the Interpretation of Noun Phrases.

References

1. James Allen, "Natural Language Understanding", Pearson Education, 2nd Edition
2. Akshar Bharati, Vineet Chaitanya, Rajiv Sangal, "Natural Language Processing- A Paninian Perspective", PHI
3. Christopher D. Manning and Hinrich Schütze. 1999. Foundations of Statistical Natural Language Processing. MIT Press.

Unit-2: Compilers

Introduction, types of Parsers, LL (k) and LALR (k) parsers, three address codes. Introduction to code generation, simple code generation algorithm, DAGs Introduction to Code Optimization, basic blocks and flow graphs, common subexpression elimination, loop optimization, loop invariant computations, dead code elimination, code movement

Reference

1. Alfred V. Aho, Ravi Shethi, Jeffrey D Ullman,"Compilers- principle, techniques and tools", Pearson Education, 2006
2. V Raghvan,"Principles of Compiler Design",Tata McGraw Hill,,2010

Unit-3: Digital Image Processing

Digital image fundamentals: image digitization, sampling and quantization, image resolution, color perception & processing, image processing: pixel based transformation, geometric transformation, local processing restoration, binary image processing: thresholding, runlength encoding, distance transforms, medial axis transforms, morphological operations, region segmentation & representation: split & merge algorithm, region growing, image filtering histogram modification, linear and Gaussian filters, contours , digital curves, polyline splitting, Hop_ Along algorithm, Conic & Splines Hough transform, Fourier description, textures: statistical syntactic and model based methods, Texture image analysis, image transforms :Fourier, Hadamard, discrete cosine, wavelets and other orthogonal transforms, compression image (predictive compression methods, vector quantization, hierarchical & progressive methods, JPEG & MPEG), Motion picture analysis.

References:

1. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", Prentice Hall Publisher, 2008, 3rd Edition
2. William K Pratt, "Digital Image Processing", John Willey (2001)
3. Millman Sonka, Vaclav hlavac, Roger Boyle, Broos/colic,"Image Processing Analysis and Machine Vision", Thompson Learning (1999).
4. A.K. Jain, "Fundamentals of Digital Image Processing", PHI, New Delhi (1995)
5. Chanda Dutta Magundar,"Digital Image Processing and Applications", PHI, 2000

Unit-4: Wireless Technology.

WSN: Design issues, System Architecture, Sensor Network OS Tiny OS, Nes C Language, Distributed data processing, Synchronization and localization, Communication and routing, Security issues , services and applications

Mobile Ad-hoc Networks: Location Management Schemes, Routing.

GSM and satellite Communication: Architecture, hand-off and power management.

Wireless Network Standards & Protocols: 802.11.X, 802.16.x, 802.15.X, Comparison 802.11a, 11b, 11g, Challenges for MAC, DCF and PCF, WEP& EAP

QoS in wireless Network: Parameters Throughput or bandwidth, Delay or latency Delay variation (delay jitter), Loss or error rate

References

1. Holger Kars," Protocols and architectures for WSN" , Wiely publication.
2. M Jochen Schiller, "Mobile communication", Person Publication.
3. Mathew Gast, "802.11 wireless Networks the definitive guide", O'Reilly.

Unit-5: Network Security

Network threats and attacks, Security Services, Number Theory Concepts, Cryptographic algorithms, Network Security Protocols, System Security, Security research in wired, wireless and ubiquitous networks, Security Standards and RFCs

References

1. William Stallings, "Cryptography and Network Security", Fourth Edition,Pearson Education 2007.
2. Behrouz A. Forouzan, "Cryptography & Network Security", TMH 2007.
3. Robert Bragg, Mark Rhodes, "Network Security: The complete reference", TMH

Unit-6: Artificial Intelligence

AI problems, AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation. Searching: Searching for solutions, uniformed search strategies, Heuristic functions. Constrain satisfaction problems: Game Playing Alpha-Beta pruning, Evaluation functions, cutting of search, Knowledge Representation & Reasons logical Agents, logic, propositional logic, Resolution patterns in propositional logic, Resolution, Forward & Backward Chaining, Planning – Classical planning problem, Language of planning problems, Expressiveness and extension, planning with state.

References

1. Stuart Russel,Peter Norvig, "Artificial Intelligence – A Modern Approach", Second Edition, PHI/Pearson Education.
2. Patrick Henry Winston, "Artificial Intelligence", 3rd Edition, Pearson Education.

Unit-7: Language Translation

Language Processing: applications and key issues; lexicon and morphology; Phrase structure grammars and English syntax; Part of speech tagging; Syntactic parsing, top-down and bottom-up parsing strategies; Semantics, Word Sense Disambiguation, Semantic parsing; Information retrieval and Question answering; knowledge representation and reasoning, local discourse context and reference

References

1. Christopher D. Manning and Hinrich Schütze, "Foundations of Statistical Natural Language Processing", MIT Press,1999.
2. James Allen, "Natural Language Understanding", Pearson Education, 2nd Edition

Unit-8: Machine Learning

Designing a Learning system, Learning Process, Learning methods, Forms of learning, Induction learning, Learning with complex data, learning with Hidden variables, Parametric-Nonparametric methods, Multivariate methods, Feature extraction, clustering, Decision tree, Artificial Neural networks, Self Organization Map, Regression, Radial Basis Function networks, Function Approximation, Hopfield models Evaluating Hypotheses, Computational Learning theory, Instance based learning, rule based learning, Analytical Learning, Reinforcement learning, Hidden Markov Models, Probability, classification, Linear Discrimination.

References

1. Simon Hhaykin, "Neural networks - A comprehensive foundations", Pearson Education 2nd Edition 2004.
2. Ethem Alpaydin, "Introduction to Machine Learning", PHI
3. Tom Mitchell, "Machine Learning", MGH

Unit-9: Graphics & Visualization

Picture analysis, Modeling: 2D, 3D Geometric modeling and transformations, projections, Clipping, curves and fractals. Illumination models and Rendering: Light, Ambient Light, Diffuse reflection, Specular reflection, Shading algorithms, Color models, Ray tracing, Texture mapping. Scientific Visualization: Methods of Scientific Exploration, Data Aspects and Transformations, Time-Tested Principles for Good Visual Plots, Tone Mapping, Matters of Perception, Visualizing Multidimensional Data, Scalar Data Visualization, Vector Data Visualization. Graphics User Interfaces, image manipulation and storage, advanced modeling techniques.

References

1. Peter Shirley, Ashikhmin Gleicher et. al.,"Fundamentals of Computer Graphics", A. K. Peters Ltd., 2005
2. Hearn and Baker,"Computer Graphics", PHI
3. Van Dan Feiner, Hughes, Foley, "Computer Graphics: Principles and Practice", PHI

Unit-10: Advanced Algorithms and Applications

Problem solving, Probabilistic analysis and randomized algorithms, Perfect Hashing, The Floyd-Warshall algorithm, Johnson's algorithm for sparse graphs, NP-hard problems, Approximation algorithms, Online algorithms and competitive analysis. Linear-Programming Algorithms: Structure of Optima, Interior Point. Computational geometry: convex hull. Random Walks and Markov chains

References

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein**,** "Introduction to Algorithms," Third Edition PHI 2010.

Unit-11: Data warehousing and Mining

Data Mining Tasks, Data Warehouse (Multidimensional Data Model, Data Warehouse Architecture, Implementation), Data Warehousing to Data Mining, Data Preprocessing: Why Preprocessing, Cleaning, Integration, Transformation, Reduction, Discretization, Concept Hierarchy Generation, Descriptive Statistical Measures, Classification: Decision Trees, Model Over fitting, Bayesian Classification, Rule-based classification, Nearest Neighbor Classifier, Classification by Back-propagation, Support vector machines, Association Rule Based, Other Classification Methods, Prediction, Classifier Accuracy, Cluster Analysis: K-means, Agglomerative Hierarchical Clustering, DBSCAN, Association Rules: Apriori algorithm, FP-growth algorithm, Advanced techniques, Data Mining software and applications: Text mining (extracting attributes/keywords, structural approaches - parsing, soft parsing, Bayesian approach to classifying text), Web mining (classifying web pages, extracting knowledge from the web), Data Mining software and applications

Reference

1. J. Han and M. Kamber, "Data Mining- Concepts and Techniques", 2nd Edition, Morgan Kaufmann, 2006.
2. M argaret H. Dunham," Data Mining Introductory and Advanced Topics", Prentice Hall
3. P. Tan, M. Steinbach and V.,Kumar, "Introduction to Data Mining", Addison Wesley, 2006.

Unit-12: Parallel and Distributed Systems

Terminology of Parallel and Distributed Computing, Parallel and Distributed Architectures, Parallel Performance, Shared Memory and Threads, Parallel Algorithms, Message Passing, Distributed Systems, Distributed Coordination, Distributed File Systems, Distributed Shared Memory, Cloud Computing, Computational Grids and Applications

References

1. G Coulouris, J Dollimore and T Kindberg, “Distributed Systems Concepts and Design”, Third Edition, Pearson Education.
2. Kai Hwang, Faye A.Brigs, “Computer Architecture and Parallel Processing”, Mc Graw Hill