# Ph.D. Course work

# Pre-Ph.D. Examination Syllabus


DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING,

K L UNIVERSITY,

VADDESWARAM - 522502, ANDHRA PRADESH, INDIA.

**Pre-PhD Subjects List**

**LTPS: 3-0-0-0**

| S.No | Paper 1 | Subject Code |
|---|---|---|
| 1 | RESEARCH METHODOLOGY | 21RES104 |

| SNO | PAPER 2 | Subject Code | PAPER 3 | Subject Code |
|---|---|---|---|---|
| 1 | Information Retrieval System | 21CS201 | Big Data Analytics | 21CS301 |
| 2 | Data Ware Housing And Mining | 21CS202 | Cloud Computing | 21CS302 |
| 3 | Computer Networks | 21CS203 | Distributed Databases | 21CS303 |
| 4 | Data Center Virtualization | 21CS204 | Research Foundations for Pattern Recognition | 21CS304 |
| 5 | Network Security | 21CS205 | Soft Computing | 21CS305 |
| 6 | Evolution of Architectures | 21CS206 | Software Engineering | 21CS306 |
| 7 | Software Testing And Quality Assurance | 21CS207 | Cryptography & Network Security | 21CS307 |
| 8 | Foundations of Data Science for Extensive Research | 21CS208 | Web Security | 21CS308 |
| 9 | Advanced Data Structures | 21CS209 | Wireless Sensor Networks | 21CS309 |
| 10 | Digital Image Processing | 21CS210 | Software Project Management | 21CS310 |
| 11 | Bio-Informatics | 21CS211 | Artificial Intelligence | 21CS311 |
| 12<br>13 | Software Reliability | 21CS212 | Virtual and Augmented Reality | 21CS312 |
| 14 | Deep Learning | 21CS213 | Data Security & Privacy | 21CS313 |
| 15 | Distributed Computing | 21CS214 | Wirless Communication and Mobile Computing | 21CS314 |
| 16 | Mobile Cloud | 21CS215 | Parallel Algorithms | 21CS315 |
| 17 | Financial Engineering & Business Intelligence | 21CS216 | Blockchain and Cryptocurrencies | 21CS316 |
| 18 | Quantum computing | 21CS217 | Machine Learning | 21CS317 |
| 19 | Object Oriented Analysis and Design | 21CS218 | Speech Processing | 21CS318 |
| 20 | Advances in Computing | 21CS219 | Natural Language Processing | 21CS319 |
| 21 | Signal Processing | 21CS220 | Cloud Security | 21CS320 |

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|---|---|---|---|---|
| 22 | Artificial Neural Networks | 21CS221 | Cognitive Computing | 21CS321 |

# Information Retrieval

**Unit-1:**

**Introduction to Information Retrieval:** The nature of unstructured and semi-structured text. Inverted index and Boolean queries.

**Text Indexing, Storage and Compression:**Text encoding: tokenization, stemming, stop words, phrases, index optimization. Index compression: lexicon compression and postings lists compression. Gap encoding, gamma codes, Zipf's Law. Index construction. Postings size estimation, merge sort, dynamic indexing, positional indexes, n-gram indexes.

**Unit-2:**

**Retrieval Models:** Boolean, vector space, TFIDF, Okapi, probabilistic, language modeling, latent semantic indexing. Vector space scoring. The cosine measure. Efficiency considerations. Document length normalization. Relevance feedback and query expansion. Rocchio.

**Unit-3:**

**Performance Evaluation:** Evaluating search engines. User happiness, precision, recall, F-measure. Creating test collections: kappa measure, interjudge agreement.

**Text Clustering:** Clustering versus classification. Partitioning methods. k-means clustering. Mixture of gaussians model. Hierarchical agglomerative clustering. Clustering terms using documents.

**Unit-4:**

**Text Categorization and Filtering:**Introduction to text classification. Naive Bayes models. Spam filtering. Vector space classification using hyperplanes; centroids; k Nearest Neighbors. Support vector machine classifiers. Kernel functions. Boosting.

**Unit-5:**

**Web Information Retrieval:** Hypertext, web crawling, search engines, ranking, link analysis, PageRank, HITS.

**Retrieving Structured Documents:** XML retrieval, semantic web

**Text Books:**

1. **Introduction to Information Retrieval** by Christopher D. Manning

**Reference Book:**

2. **Natural Language Processing and Information Retrieval** by *Tanveer Siddiqui and U. S.Tiwary*

# DATA WARE HOUSING & DATA MINING

**Syllabus**

**UNIT – I**

The compelling need for data warehousing: Escalating need for strategies information, Failures of Past Decision-Supporting System, Operational Versus Decision-Supporting System, Data Warehousing- The only Viable Solution, data Warehouse Defined. The Building Blocks: Defining Features, Data Warehouse and Data Marts, Overview of the Components, Metadata in the Data Warehouse. Planning and Planning Management: Planning your Data Warehousing, The Data Warehouse Project, The project team, Project Management Considerations. Defining the Business Requirement: Dimension Analysis, Information Package- A New Concept, Requirements Gathering Methods, Requirements Definition: Scope and content. Requirements as the Driving force for Data Warehousing: Data Design, The Architectural Plan, Data Storage Specification, and Information Delivery Strategy.

**UNIT – II**

The Architectural Component: Understanding Data Warehouse Architecture, Distinguishing Characteristics, Architectural framework, Technical Architecture. Infrastructure as the Foundation for Data Warehousing: Infrastructure Support Architecture, Hardware Operational System, Database Software, Collection of Tools. The Significant Role of Metadata: Why Metadata is Important, Metadata Types by Functional Areas, Business Metadata, How to Provide Metadata. Principles of Dimensional Modeling: From Requirement to Data Design, The STAR Schema, STAR Schema keys, Advantages of STAR Schema. Dimensional Modeling: Updates to the Dimensional Tables, Miscellaneous Dimensions, The Snowflake Schema, Aggregate Fact Tables, and Families of STARS. Data Extraction, Transformation, and Loading. OLAP in the Data Warehouse: Demand for Online Analytical Processing, Major Features and Functions, OLAP Models, OLAP Implementation Consideration

**UNIT – III**

Introduction : Data mining, kinds of data mined, kinds of patterns mined, technologies used: statistics, Machine learning, Database systems and Data Warehousing, Information Retrieval, Major issues in Data Mining: Mining methodology, User Interaction, Efficiency and Scalability, Diversity and database types, Data Mining & society.

**UNIT – IV**

Data Preprocessing: Overview, Data cleaning, Data Integration, Data Reduction, Data Transformation, Data cleaning: Missing Values, Noisy data, Data cleaning as a process. Data Integration: Entity identification problem, Redundancy and Correlation Analysis, Tuple duplication, Data value conflict detection and Resolution. Data Reduction: Overview, wavelet transforms, Principle components Analysis, Attribute subset selection, Regression and log-linear models, Histograms, clustering, sampling, Data cube Aggregation. Data Transformation and Data Discretization by Binning, Discretization by Histogram Analysis, Discretization by cluster, Decision Tree and correlation Analysis, concept Hierarchy generation for Nominal data.

**UNIT – V**

Mining Frequent Patterns, Association and Correlations: Basic Concepts, Frequent itemset Mining methods: Apriori Algorithm, Generate Association rules from Frequent itemsets, Improving the efficiency of Apriori, A pattern-growth approach for mining frequent itemsets, using frequent itemset using Vertical data format, Mining closed and max. patterns. Pattern Evaluation Methods, Advanced Pattern Mining: A Road map, Pattern mining in Multilevel, Multidimensional space, Constraint Based Frequent Mining, Classification: Basic Concepts, Decision Tree induction, Bayes Classification Method, Rule based Classification, Model evaluation & selection, techniques to improve classification accuracy. Classification Advanced Methods: Bayesian Belief networks, Classification by Back Propagation, Support Vector Method, Classification using frequent Patterns, lazy learners, other classification methods. Cluster Analysis: Basic Concepts & Methods, Cluster Analysis, partitioning methods, Hierarchical Methods, Density based Methods, Grid based Methods, Evaluation of Clustering. Advanced Cluster Analysis: Probabilistic Model based Clustering, Clustering High Dimensional Data, Clustering Graph & Network data, Clustering & Constraints.

**Textbooks:**

1. Data warehousing fundamentals, first edition, paulraj ponniah, Wiley.

2. Data Mining Concept & Techniques, Jiawei Han|Micheline Kamber|Jian Pei, 3rd Edition, M K Publishers.

**Reference Books:**

1.Data Warehousing in the real world, low price edition, Sam Anahory, Dennis Murray, Pearson Education.

2. Data warehousing Tool kit

3. Data Mining Techniques: For Marketing, Sales, and Customer Relationship Management by Gordon S. Linoff and Michael J. Berry (Apr 12, 2011).

4. Data Mining: A Tutorial Based Primer by Richard Roiger and Michael Geatz (Oct 6, 2002).

# COMPUTER NETWORKS

**SYLLABUS**

**UNIT I**

Introduction: OSI, TCP/IP and other networks models, Examples of Networks: Novell Networks, Arpanet, Internet, Network Topologies WAN, LAN, MAN. Physical Layer : Transmission media copper, twisted pair wireless, switching and encoding asynchronous communications; Narrow band, broad band ISDN and ATM.

**UNIT-II**

Network Layer: Virtual circuit and Datagram subnets-Routing algorithm shortest path routing, Flooding, Hierarchical routing, Broad cast, Multi cast, distance vector routing.

**UNIT–III**

Dynamic routing – Broadcast routing. Rotary for mobility. Congestion, Control Algorithms – General Principles – of Congestion prevension policies. Internet working: The Network layer in the internet and in the ATM Networks.

**UNIT–IV**

Transport Layer: Transport Services, Connection management, TCP and UDP protocols; ATM AAL

Layer Protocol.

**UNIT – V**

Application Layer – Network Security, Domain name system, SNMP, Electronic Mail; the World WEB, Multi Media.

**TEXT BOOKS :**

1. Computer Networks — Andrew S Tanenbaum, 4th Edition. Pearson Education/PHI

2. Data Communications and Networking – Behrouz A. Forouzan.Third Edition TMH.

**REFERENCES:**

1. An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition, Pearson Education

2. Understanding communications and Networks, 3rd Edition, W.A. Shay, Thomson

# DATA CENTRE VIRTUALIZATION

**Syllabus**

**Unit I**

**Data Center Challenges:** How server, desktop, network Virtualization and cloud computing reduce data centre footprint, environmental impact and power requirements by driving server consolidation; **Evolution of Data Centres:** The evolution of computing infrastructures and architectures from stand alone servers to rack optimized blade servers and unified computing systems (UCS).

**Unit II**

**Enterprise-level Virtualization:** Provision, monitoring and management of a virtual datacenter and multiple enterprise-level virtual servers and virtual machines through software management interfaces; **Networking and Storage in Enterprise Virtualized Environments**: Connectivity to storage area and IP networks from within virtualized environments using industry standard protocols.

**Unit III**

**Virtual Machines & Access Control:** Virtual machine deployment, modification, management. monitoring and migration methodologies.

**Unit IV**

**Resource Monitoring**: Physical and virtual machine memory, CPU management and abstraction techniques using a hypervisor.

**Unit V**

**Virtual Machine Data Protection**: Backup and recovery of virtual machines using data recovery techniques; **Scalability**: Scalability features within Enterprise virtualized environments using advanced management applications that enable clustering, distributed network switches for clustering, network and storage expansion; High Availability **:** Virtualization high availability and redundancy techniques.

**Reference Books:**

1. Mickey Iqbal 2010, IT Virtualization Best Practices: A Lean, Green Virtualized Data Center Approach, MC Press [ISBN: 978-1583473542]

2. Mike Laverick, VMware vSphere 4 Implementation [ISBN: 978-0071664523]

3. Jason W. McCarty, Scott Lowe, Matthew K. Johnson, VMware vSphere 4 Administration Instant Reference [ISBN: 978-0470520727]

4. Brian Perry, Chris Huss, Jeantet Fields, VCP VMware Certified Professional on vSphere 4 Study Guide [ISBN: 978-0470569610]

5. Brian Perry, Chris Huss, Jeantet Fields, VCP VMware Certified Professional on vSphere 4 Study Guide [ISBN: 978-0470569610]

6. Jason Kappel, Anthony Velte, Toby Velte, Microsoft Virtualization with Hyper-V: Manage Your Datacenter with Hyper-V, Virtual PC, Virtual Server, and Application Virtualization [ISBN: 978-0071614030]

# NETWORK SECURITY

**Syllabus**

**Unit I:**

Introduction to Network Security: Attacks, services, Security. A model of Inter network Security, Steganography, One time PADS. Basic and ESOTERIC Cryptographic Protocols: Key Exchange, Authentication, Formal Analysis of Authentication and key Exchange Protocols, Multiple & Public Key Cryptography, Secret Splitting & Sharing Secure elections, Secure multiparty, Communication, Digital Cash.

**Unit II:**

Crypto Graphic Algorithms (Block Cipher): RC2, GOST, CAST, BLOW FISH, SAFEER, RC5, NEWDES, CRAB, Theory of Block Cipher design. Key Management: Key lengths, Generating Keys, Transferring, Verification, Updating, Storing, Backup, Compromised, Lifetime of, Destroying Keys, Public key Management.

**Unit III:**

Digital Signature Algorithms: Digital Signature, DSA, DSA variants, Gost, Discrete Lagorithm, One – Schnorr – Shamir digital Signatures, Esign, Cellular Automata. Mails: Electronic Mail & IO Security good Privacy, SIMIME, IP Security Architecture, Authentication Header, Encapsulating Security, Pay load Key Management Issues.

**Unit IV:**

Security: Web Security Web Security requirements, Secure Sockets Layer and Transport Layer Security, Secure Electronic Transaction.

**Unit V:**

Viruses and Threats: Intruders, Viruses, Worms and Firewalls Intruders, Viruses and Related Threats, Firewall Design Principles, Trusted Systems.

**REFERENCE BOOKS:**


1. Applied Cryptography, 7/e, Bruce SCHNEIER John Wiley & Sons Inc.

2. Cryptography and Network Security, William Stallings, PHI.

3. Introduction to cryptography with coding Theory, 7/e, Wade Trappe, C. Washington, PEA.

4. Cryptography and Information Security, V.K. Pachghare, PHI.

5. Cryptography and Network Security, Forouzan, TMH, 2007.

6. Cryptography and Network Security, 2/e, Kahate , TMH.

7. Modern Cryptography, Wenbo Mao, PEA

# EVOLUTION OF SOFTWARE ARCHITECTURES

**Syllabus**

**Unit-I – Introduction to Software Architecture**

Meaning and Concept of Software Architecture - Definitions of Software Architecture- Characteristics - Types of Architectures..

**Unit-II-Architectural Styles**

Architectural styles and Technologies, Heterogeneity Layered Systems, Repositories, Pipes and Filters, Data Abstraction and Object Oriented Paradigm, Event – Based Implicit Invocation, Interpreters, Process Control ,Other familiar Architectures, Heterogeneous Architecture.

**Unit-III-Software Architecture Design and Quality Aspects**

Design spaces and rules for Interfaces, Work flow, Databases – Interoperability - Software Agents and Compatibility - Quality Attributes, Performance, Scalability, Modifiability, Integration, Application Security, Application Availability, Other Quality Attributes - Caveats.

**Unit-IV- Common & Popular Architectures**

N-Tier Architectures: 1-tier, 2-tier, 3-tier and Multi-tier Architectures – Advantages and disadvantages. Event-driven Architectures: Event flow - Simple and Multi-event Stream processing. Micro kernel Architectures: Components of Micro-kernel architecture – Managing Plug-in Modules. Space-based architectures: Components of Space-based architectures- Advantages.

**Unit-V-Web Service-Oriented Architecture**

Evolution of SOA - Web Services- Principles – Building blocks of SOA-Service Description, Discovery and Delivery Strategies - SOAP – WSDL - SOA Business Process Design WS-BPEL language basics-WS Coordination – Specific Technologies that support SOA.

**Text Books:**


1. Mary Shaw and David Garlan, Software Architecture- Perspectives on an Emerging Discipline, Prentice-Hall of India, 2004.
2. Ian Gorton, Essential Software Architecture Springer International Edition -2006
3. Thomas Erl ," Service-Oriented Architecture: Concepts, Technology & Design", Pearson Education P Ltd 2008.


. **Reference Books:**


1. Richard N. Taylor, Nenad Medvidovic, Eric Dashofy, "Software Architecture: Foundations, Theory, and Practice", Wiley, 2009.
2. Len Bass, Paul Clements, Rick Kazman: Software Architecture in Practice, 2/e, Pearson Education, 2003.
3. Thomas Erl,"SOA Principles Of Service Design"Pearson Exclusives 2007.
4. Tomas Erl and Grady Booch,"SOA Design Patterns"Printice Hall 2008.111

# SOFTWARE TESTING AND QUALITY ASSURANCE

**Syllabus**

**Unit I**

Introduction, Basics of Software Testing, Testing Principles, Goals, Testing Life Cycle, Phases of Testing, Defects, Defect Life Cycle, Defect Report, Test Plan(IEEE format), Importance of testing in software production cycle.

**Unit II**

Introduction, Need of black box testing, Black box testing Concept, Requirement Analysis, Test case design criteria, Testing Methods, requirement based testing, Positive & negative testing, Boundary value analysis, Equivalence Partitioning class, state based or graph based, cause effect graph based, error guessing, documentation testing & domain testing, design of test cases. Black-Box testing.

**Unit III**

Introduction, Need of white box testing, Testing types, Test adequacy criteria, static testing by humans, Structure - logic coverage criteria, Basis path testing, Graph metrics, Loop Testing, Data flow testing, Mutation Testing, Design of test cases. Testing of Object oriented systems, Challenges in White box testing.

**Unit IV**

Test organization, Structure of testing, Measurement tools, testing metrics: Type of metric – Project, Progress, Productivity, Metric plan, Goal Question metric model, Measurement in small & large system. Other Software Testing: GUI testing, Validation testing, Regression testing, Scenario testing, Specification based testing, Adhoc testing, Sanity testing, Smoke testing, Random Testing.

**Unit V**

Software quality, Quality attribute, Quality Assurance, Quality control & assurance, Methods of quality management, Cost of quality, Quality management, Quality factor, Quality management & project management.

**Text books:**

1.Software Testing, Second Edition By: Ron Patton, Pearson Education ISBN-13: 978-0-672-32798-8

2.Software Testing Principles and Tools By M.G. Limaye TMG Hill Publication, ISBN 13:978-0-07-013990-9

**References:**

1.Metric and Model in Software Quality Engineering, By Stephen H Kan, Pearson Education ISBN 81-297-0175-8

2. Effective methods for software testing by William Perry , Willey Publication, ISBN 81-265-0893-0

3.Foundation of software testing by Dorothy Graham, Erik Van Veenendaal. CENGAGE learning , ISBN 978-81-315-0218-1

# Foundations of Data Science for Extensive Research

**Unit I:** Likelihood, Random variables, Random samples, Maximum likelihood estimation, likelihood profile, Rules for expectation and variance, Generating random variables, Empirical distribution, Monte Carlo estimation; law of large numbers, Central limit theorem.

**Unit II:** Inference: Estimation, confidence intervals, hypothesis testing, prediction. Bootstrap, Bayesianism. Regression (Linear and Multiple), Logistic regression, natural parameters.

**Unit III:** Feature spaces. Vector spaces, bases, inner products, projection. Model fitting as projection. Linear modeling. Choice of features.

**Unit IV:** Random processes. Markov chains. Stationarity and convergence. Drift models. Examples, including estimation and memory.

**Unit V:** Probabilistic modelling. Independence; joint distributions. Descriptive, discriminative, and causal models. Latent variable models. Random fields.

Reference Books :

1. Doing Data Science ,Straight talk from the front line- Rachel schutt&cathy o'neil ,o'reilly

2. Probability and Statistics for Data Science-Carlos Fernandez-Granda

3. Data Science and Big DataAnalytics: Discovering, Analyzing, Visualizing, and Presenting Data 1st Edition

4. Hands-On Exploratory DataAnalysis with Python, Suresh Kumar Mukhiya Usman Ahmed, Pack 5. Data Science & Big Data Analytics:Discovering, Analyzing, Visualizing and Presenting Data EMC Education Services, Willey

# ADVANCED DATA STRUCTURES

**Syllabus**

**UNIT-I**

**Introduction:** Algorithms, algorithms as a technology, Analyzing algorithms , Designing algorithms, Asymptotic notations, standard notations, common functions, Recurrences – substitution method, master method. **Sorting and order statistics:** Merge sort, Quick sort, Heap sort, sorting in linear time, Median and order statistics.

**UNIT-II**

**Data structures:** Elementary Data Structures – Linked lists, Stacks, Queues, Hash Tables – Direct address tables, Hash tables, Hash functions, Open addressing, Search Trees – Binary search trees, Red-Black Trees. **Advanced Data Structures:** B – Trees, Binomial Heaps, Fibonacci Heaps, Data Structures for Disjoint Sets

**UNIT-III**

**Graph Algorithms:** Elementary graph algorithms – Representation of graphs, BFS, DFS, Topological Sort, Strongly connected components, Minimum Spanning Trees – The algorithms of Kruskal and Prim's. Single-Source Shortest Paths: The Bellman-Ford algorithm, Single source shortest paths in DAG's, Dijkstra's algorithm, All-Pair Shortest paths – Shortest paths and Matrix multiplication, Floyd-Warshall algorithm. Maximum Flow: Flow networks, The Ford-Fulkerson method, Maximum Bipartite matching.

**UNIT-IV**

**Advanced Design and Analysis Techniques:** Greedy Algorithms – An activity – selection Problem, Elements of greedy strategy, Huffman codes. Dynamic Programming: Matrix Chain multiplication, Elements of dynamic programming, Optimal Binary Search Trees.

**UNIT-V**

**String Matching:** The naïve string matching algorithm, Rabin-Karp algorithm, Knuth-Morris-Pratt algorithm. **NP-Completeness:** Polynomial time, Verification, NP-Completeness and reducibility, NP-Completeness proofs, NP-Complete problems**.**

**Textbooks:**

1. Introduction to Algorithms, second edition, T.H.Cormen, C.E.Leiserson,R.L.Rivest, and C.Stein,PHI Pvt.Ltd./ Pearson Education

**Reference Books:**

1. Algorithm Design: Foundations,Analysis and Internet examples, M.T.Goodrich and R.Tomassia,John wiley and sons.

2. Fundamentals of Computer Algorithms,Ellis Horowitz,Satraj Sahni and S.Rajasekharam,Galgotia publications pvt. Ltd.

3. Introduction to Design and Analysis of Algorithms A strategic approach, R.C.T.Lee, S.S.Tseng, R.C.Chang and T.Tsai, Mc Graw Hill.

4. Data structures and Algorithm Analysis in C++, Allen Weiss, Second edition, Pearson education.

5. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson education.

# DIGITAL IMAGE PROCESSING

**UNIT I : Introduction :**
Fundamental steps of image processing, components of an image processing of system. The image model and image acquisition, sampling and quantization, relationship between pixels, distance functions, scanner.

**UNIT II : Transformation and Filtering :**
Statistical and spatial operations, Intensity functions transformations, histogram processing, smoothing &sharpening,spatial filters Frequency domain filters, homomorphic filtering, image filtering & restoration. Inverseandweiner filtering, FIR weiner filter, Filtering using image transforms, smoothing splines and interpolation.

**UNIT III : Segmentation and Edge Detection** :
Segmentation and Edge detection region operations, basic edge detection, second order detection, crack edgedetection, gradient operators, compass and laplace operators, edge linking and boundary detection,thresholding, regionbased segmentation, segmentation by morphological watersheds.

**UNIT IV : Pattern Recognition Fundamentals**:
Basic Concepts of pattern recognition, Fundamental problems in pattern recognition system,design concepts and methodologies, example of automatic pattern recognitionsystems, a simple automatic pattern recognition model

**UNIT V: Solar image processing and analysis**
Automatic extraction of filaments-Local thresholding, globalthresholding, featureextraction, experimentresults, solar flare detection, future analysis and pre processing, classificationrates, solar corona mass ejection detection.

**TEXT BOOKS :**


1. Digital Image Processing, 3/e,,Rafael C. Gonzalez, Richard E. Woods, PE
2. Fundamentals of Digital Image processing by Dr.RajuAnitha,Dr.Krishna Mohan &Mr.J.Satish Babu.Ed1,WN Publication.
3. Pattern recognition Principles, Julus T. Tou, and Rafel C. Gonzalez, Addision-Wesly
4. Image processing and pattern Recognition,Frank,Y.SHIH,Wiley publication


**REFERENCE BOOKS:**


5. Image Processing, Analysis and Machine Vision" by Milan Sonka and Vaclav Hlavac and Roger Boyle.
6. Principles of Digital Image Processing ,Wilhelm Burger, Mark J. Burge

# BIO-INFORMATICS

**Syllabus**

**UNIT I:**

**INTRODUCTION:** The Central Dogma, The Killer Application, Parallel Universes – Watson's Definition – Top Down Versus Bottom up – Information Flow , Convergence Databases , Data Management , Data Life Cycle , Database Technology , Interfaces Implementation.

**UNIT II:**

**NETWORKS:** Networks , Geographical Scope , Communication Models , Transmissions Technology , Protocols ,Bandwidth , Topology , Hardware , Contents , Security , Ownership Implementation , Management. **SEARCH ENGINES:** The search process , Search Engine Technology , Searching and Information Theory , Computational methods , Search Engines and Knowledge Management.

**UNIT III:**

**DATA VISUALIZATION:** Data Visualization , sequence visualization , structure visualization , user Interface , Animation Versus simulation , General Purpose Technologies. **STATISTICS:** Statistical concepts , Microarrays , Imperfect Data , Randomness Variability, Approximation , Interface Noise , Assumptions , Sampling and Distributions , Hypothesis Testing , Quantifying Randomness , Data Analysis , Tool selection statistics of Alignment

**UNIT IV:**

**DATA MINING:** Clustering and Classification , Data Mining , Methods , Selection and Sampling , Preprocessing and Cleaning , Transformation and Reduction , Data Mining Methods , Evaluation , Visualization , Designing new queries , Pattern Recognition and Discovery , Machine Learning , Text Mining , Tools.

**PATTERN MATCHING:** Pairwise sequence alignment , Local versus global alignment Multiple sequence alignment ,Computational methods , Dot Matrix analysis , Substitution matrices , Dynamic Programming , Word methods , Bayesian methods , Multiple sequence alignment , Dynamic Programming , Progressive strategies , Iterative strategies , Tools Nucleotide Pattern Matching , Polypeptide pattern matching , Utilities , Sequence Databases.

**UNIT - V:**

**MODELING AND SIMULATION:** Drug Discovery , components , process , Perspectives, Numeric considerations , Algorithms , Hardware Issues , Protein structure , AbInitio Methods,Heuristic methods , Systems Biology , Tools , Collaboration and Communications, standards , Issues , Security , Intellectual property.

**REFERENCE BOOKS**


1. Bio Informatics Computing, Bryan Bergeron, PHI, 2003.

2. Introduction to Bio Informatics, Attwood, Smith, Longman, 1999. CSE / Pre PhD R1032

3. Bio-Informatics, D Srinivasa Rao, Biotech.

4. Bio Informatics Computing, Bergeron, PHI

5. Bio Informatics, Managing scientific Data, Lacroix, Terence Critchlow, Elsevier

6. Bio Informatics Methods and Applications, Rastogi, Mendiratta, Rastogi, PHI

# SOFTWARE RELIABILITY

**Syllabus**

**UNIT - 1 INTRODUCTION TO RELIABILITY ENGINEERING**

Reliability — Repairable and Non Repairable systems — Maintainability and Availability — Designing for higher reliability — Redundancy — MTBF — MTTF MDT - MTTR— k out of in Systems.

**UNIT - 2 SOFTWARE RELIABLITY**

Software reliability - Software reliability Vs Hardware reliability – Failures and Faults - Classification of Failures – Counting – System Configuration – Components and Operational Models – Concurrent Systems – Sequential Systems – Standby Redundant systems.

**UNIT - 3 SOFTWARE RELIABILITY APPROACHES**

Fault Avoidance — Passive Fault detection — Active Fault Detection — Fault Tolerance - Fault Recovery - Fault Treatment.

**UNIT - 4 SOFTWARE RELIABILITY MODELING**

Introduction to Software Reliability Modeling – Parameter Determination and Estimation - Model Selection – Markovian Models – Finite and Infinite failure category Models – Comparison of Models – Calendar Time Modeling.

**UNIT - 5 SPECIAL TOPICS IN SOFTWARE RELIABLITY**

Management Techniques for reliability - Organization and Staffing — Programming Languages and Reliability — Computer Architecture and Reliability — Proving Program correctness & Reliability Design - Reliability Testing – Reliability Economics.

**TEXT BOOKS**

1. John D. Musa, " Software Reliability", McGraHill, 1985
2. Glenford J. Myers, "Software Reliability ", Wiley Interscience Publication, 1976

**REFERENCE BOOKS**

1. Patric D. T.O connor," Practical Reliability Engineering" , 4th Edition, John Wesley & sons , 2003.
2. Anderson and PA Lee : " Fault tolerance principles and Practice ", PHI ,1981
3. Pradhan D K (Ed.): " Fault tolerant computing – Theory and Techniques", Vol1 and Vol 2 , Prentice hall, 1986.
4. E.Balagurusamy ," Reliability Engineering", Tata McGrawHill, 1994.

# Deep Learning

Syllabus:

Unit 1: Feed forward networks and training,Machine learning vs and Deep learning, Activation functions, initialization, regularization, batch normalization, model selection, ensemble techniques

Unit II: Convolutional neural networks , Fundamentals, architectures, pooling, visualization Deep learning for spatial localization, Transposed convolution, efficient pooling, object detection, semantic segmentation. Recurrent neural networks

Unit III: Recurrent neural networks (RNN), long-short term memory (LSTM), language models, machine translation, image captioning, video processing, visual question answering, video processing, and learning from descriptions

Unit IV: Deep generative models • Boltzmann Machine and Auto-encoders, variational auto-encoders, generative adversarial networks, autoregressive models, generative image models.

Unit V: Deep reinforcement learning, Temporal difference learning, Policy gradient methods, Q-learning, Deep Q-Learning

Textbook:

1.Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016. http://www. deeplearningbook.org.

Reference Book:

1) François Chollet , Deep learning with Python, 2017 Manning publications

# DISTRIBUTED COMPUTING

**Syllabus**

**Unit I:** Introduction to distributed programming: Anatomy of a Distributed Application, Requirements for Developing Distributed Applications, What Does Java Provide? Introduction to sockets programming: Sockets and Streams, URLs, URL Connections, and Content Handlers, The Class Loader.

**Unit II:** Distributing Objects: Why Distribute Objects, What's So Tough About Distributing Objects?, Features of Distributed Object Systems, Distributed Object Schemes for Java, CORBA, Java RMI, RMI vs. CORBA Threads: Thread and Runnable, Making a Thread, Managing Threads at Runtime, Networked Threads

**Unit III:** Security: Security Issues and Concerns, The java.security Package, Identities and Access Control, Keys: Public, Private, and Secret, Digital Signatures, Data Encryption, Choosing a Cryptographic Algorithm. Message-Passing Systems: Messages Defined, Why Do We Need Messages?, Message Processing, Fixed Protocols, Adaptable Protocols, Message Passing with Java Events, Using Remote Objects Databases: An Overview of JDBC, Remote Database Applications, Multi-Database Applications.

**Unit IV:** RMI: The Basic Structure of RMI, The Architecture Diagram Revisited, Implementing the Basic Objects, The Rest of the Server, The Client Application The RMI Registry: Why Use a Naming Service? The RMI Registry, The RMI Registry Is an RMI Server, Examining the Registry, Limitations of the RMI Registry, Security Issues Naming Services: Basic Design, Terminology, and Requirements, Requirements for Our Naming Service, Federation and Threading, The Context Interface, The Value Objects, ContextImpl, Switching Between Naming Services, The Java Naming and Directory Interface (JNDI) The RMI Runtime: Reviewing the Mechanics of a Remote Method Call, Distributed Garbage Collection, RMI's Logging Facilities, Other JVM Parameters

**Unit V:** Service Oriented Architecture: Introduction, Defining a Service, Defining SOA, Identifying Service Candidates, Identifying Different Kinds of Services, Modeling Services, Making a Service Composable, Supporting Your SOA Efforts, Selecting a Pilot Project, Establishing Governance. Introduction to Web Services: Introduction, Using Publicly Available Web Services to Test Against, Installing Metro, Installing Oracle WebLogic, Creating and Deploying the Simplest Web Service, Creating and Deploying a Service to WebLogic, Setting Up a Maven 2 Service and Client Project, Understanding WSDL, Using References in NetBeans to Generate Web Service Clients, Monitoring SOAP Traffic with Metro, Monitoring SOAP,Traffic with TCPMon.

**REFERENCE BOOKS:**

1. Java Distributed Computing, Jim Farley, O'Reilly.

2. Java RMI Designing and Building,The Basics of RMI Applications, William Grosso, O'Reilly.

3. Java SOA Cookbook SOA Implementation Recipes, Tips, Techniques, Eben Hewitt, O'Reilly, 2009.

4. Service Oriented Architecture With Java, Malhar Barai, Vincenzo Caselli, Binildas A. Christudas, Packt Publishing, 2008.

5. Distributed Programming with Java, Qusay H. Mahmoud, Manning Publisher 2000.

6. Java in Distributed Systems, Concurrency, Distribution and Persistence, Marko Boger, 2001.

# MOBILE CLOUD

**Syllabus**

**Unit-I**

Mobile Connectivity Evolution: From Single to Multiple Air Interface Devices, Network Evolution: The Need for Advanced Architectures.

**Unit-II**

Mobile Clouds: An Introduction, Cooperation and Cognition in Mobile Clouds, Mobile Cloud Classification and Associated Cooperation Approaches.

**UNIT-III**

Sharing Device Resources in Mobile Clouds, Wireless Communication Technologies, Building Mobile Clouds.

**UNIT-IV**

Mobile Cloud Formation and Maintenance, Cooperative Principles by Nature, Social Mobile Clouds, Green Mobile Clouds: Making Mobile Devices More Energy Efficient.

**UNIT-V**

Mobile Clouds Applications, Future Developments of Mobile Clouds.

**Text Book:**

1. Frank H. P. Fitzek, Marcos D. Katz, Mobile Clouds: Exploiting Distributed Resources in Wireless, Mobile and Social Networks, Wiley Publications, ISBN: 978-0-470-97389-9, Jan 2014.

**References**

1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, and Michael Morgano, Android for Programmers: An App-Driven Approach, Prentice Hall, November 3, 2011.

# Data Analytics for Financial Engineering Syllabus

**Unit-1** Introduction to analytics for business, predicting outcomes, statistical learning Linear regression models, quality of predictions, resampling methods: Cross-validation and the bootstrap, subset selection, ridge and lasso regressions, financial analytics
**Unit-2** Classification models: logistic regression and linear discriminant analysis, k-nearest neighbors and tree based methods, support vector machines
**Unit-3** Unsupervised learning methods: clustering, principal component analysis and partial least squares Predictions and skill versus luck, Difference-in-differences method, Matched pairs and causal inference
**Unit-4** Predictive financial analytics: Identifying trends and signals in financial data Prescriptive analytics: Simulating complex scenarios, optimizing critical decisions, optimization with multiple objectives, simulation and optimization in R, applications in retailing and e-commerce
**Unit-5** Prescriptive financial analytics: Algorithmic trading, portfolio optimization

**Textbook**

1. Ledolter, J. (2013). Data Mining and Business Analytics with R. Wiley. Reference Books 1. Lawrence C. Galtiz, Irwin. Financial Engineering
2. Marshall, J. F. and Bansal, V. K. 2006. Financial Engineering: A Complete Guide to Financial Innovation, Prentice Hall of India.
3. Paul Glasserman, Monte Carlo Methods in Financial Engineering, Springer.
4. Edwards, F. R. and Ma, C. W. 1992, Futures and Options, McGraw-Hill International.
5. Rebonato, R. Interest Rate Option Models: Understanding, Analyzing and Using Models for Exotic Interest Rate Options, John Wiley and Sons

# Object Oriented Analysis and Design

**Syllabu s**

**UNITI: S**oftware engineering and failures, software engineering concepts, software engineering development activities, managing software development, ARENA case study

**UNIT II:** Project organization and communication: introduction, an overview of projects, project organization concepts, project communication concepts, organizational activities. Requirements Elicitation: Introduction,overview, concepts, activities, managing requirements Elicitation, ARENA case study

**UNITIII:** Analysis: Introduction, overview, concepts, activities, managing analysis, ARENA case study. System design: decomposing the system, Introduction, overview, concepts, activities, managing system design, ARENA case study. Object design: reusing pattern solutions- introduction, overview, reuse concepts, reuse activities, managing reuse, ARENA case study.

**UNITIV:** Object design: specifying interfaces- introduction, overview, concepts, activities, managing object design, ARENA case study, Introduction to UML, Unified Process, Requirements: The Requirements overflow, use case modeling, advanced use case modeling Analysis: The analysis workflow, Objects and classes, finding analysis classes, Relationships, inheritance and polymorphism, Analysis packages, use case realization, Activity diagrams.

**UNIT V:** Design: The design workflow, design classes, refining analysis relationships, interfaces and components, use case realization - design, state machines. Implementation: The implementation workflow, deployment, mapping models to Code: introduction, overview, concepts, activities, managing implementation, ARENA case study. Testing: introduction, overview, concepts, activities, managing testing. Rationale managements: introduction, overview, concepts, activities, managing rationale, configuration management: introduction, overview, concepts, activities, managing configuration management.

**TEXT BOOKS:**


1. Bernd Bruegge Allen H. Dutoit" Object Oriented SoftwareEngineering using UML, patterns and Java",Third Edition, Pearson Education
2. Jim Arlow, IlaNeustadt," UML 2 and the Unified Process-Practical Object-Oriented Analysis and Design", Pearson Education, Second Edition.


**REFERENCE BOOKS:**


3. G. Booch, ObjectOriented Analysis and Design with Applications 2/e Pear- son
4. C. Larman, Applying UML and patterns,Pearson
5. R. Fairly, Software Engineering, Mc Graw Hill Publishing Co.
6. G. Booch, J. Rumbaugh, J. Jacobson,The Unified ModelingLanguage – User Guide Addison– Wesley
7. C.Ghezzi, M. Jazayeri and D. Mandrioli, Fundaments of Software Engineer- ing prentice Hall of India,Ltd.
8. R.S Pressman, Software Engineering: A Practitioner's Approach, 5/e, Mc Graw Hill International Edition

# ADVANCES IN COMPUTING

**Syllabus**

**UNIT I:**

**Grid Computing:** Data & Computational Grids, Grid Architectures and its relations to various Distributed Technologies. Autonomic Computing, Examples of the Grid Computing Efforts (IBM)

**UNIT II:**

Cluster Computing 1: Cluster setup & its Administration, Performance Models & Simulations; Networking, Protocols & I/O, Lightweight Messaging systems, Active Messages

**UNIT III:**

Cluster Computing 2: Distributed shared memory, parallel I/O Clusters, Jib and Resource management system, scheduling parallel jobs on clusters

**UNIT IV:**

Cluster Computing 3: Load sharing and Fault tolerance manager, parallel programming scheduling techniques, Dynamic load balancing, Example Cluster System – Beowlf, COMPaS and NanOS

**UNIT V:**

Pervasive Computing : Pervasive Computing concepts & Scenarios, Hardware & Software, Human - machine interface Device connectivity, Java for Pervasive devices, Application examples, Quantum Computing : Introduction to Quantum Computing, QUbits, Quantum Mechanics, Quantum gates, Applications of quantum computing.

**REFERENCE BOOKS:**

1. J. Joseph & C. Fellenstein, Grid Computing, PEA.

2. Raj Kumar Buyya, High performance cluster computing, PEA.

3. J.Burkhardt et .al, Pervasive computing, PEA.

4. Vishal Sahni, Quantum computing, TMH.

5. Marivesar, Approaching quantum computing, PEA.

6. Neilsen & Chung L, Quantum computing and Quantum Information, Cambridge University Press.

7. A networking approach to Grid Computing , Minoli, Wiley.

# BIG DATA ANALYTICS

**Syllabus**

**Unit-1:**

Big Data, Complexity of Big Data, Big Data Processing Architectures, Big Data Technologies, Big Data Business Value, Data Warehouse, Re-Engineering the Data Warehouse, Workload Management in the Data Warehouse, New Technology Approaches.

**Unit-2:**Integration of Big Data and Data Warehouse, Data Driven Architecture, Information Management and Lifecycle, Big Data Analytics, Visualization and Data Scientist, Implementing The "Big Data" Data. Choices in Setting up R for Business Analytics, R Interfaces, Manipulating Data, Exploring Data, Building Regression Models, Clustering and Data Segmentation, Forecasting and Time Series Models.

**Unit-3:**Writing Hadoop Map Reduce Programs, Integrating R and Hadoop, Using Hadoop Streaming with R, Learning Data Analytics with R and Hadoop, Understanding Big Data Analysis with Machine Learning. Big Data, Web Data, A Cross-Section of Big Data Sources and the Value They Hold, Taming Big Data, The Evolution of Analytic Scalability.

**Unit-4:**The Evolution of Analytic Processes, The Evolution of Analytic, Processes The Evolution of Analytic Tools and Methods. Legacy Data, Hypothesis Testing, Prediction, Software, Complexity, Business problems suited to big data analytics.

**Unit-5:** High Performance Appliances for Big Data Management, Using Graph analytics, The New Information Management Paradigm, Big Data's Implication for Businesses, Big Data Implications for Information Management, Splunk's Basic Operations on Big Data.

**Textbooks:**

1. Data Warehousing in the Age of Big Data by Krish Krishnan, Morgan Kaufmann.

2. A.Ohri, “R for Business Analytics”, Springer, 2012.

**References:**

1. Big Data Analytics with R and Hadoop by Vignesh Prajapati

2. Principles of Big Data Preparing, Sharing, and Analyzing Complex Information, 1st Edition, by J Berman, published by Morgan Kaufmann

3. “Big Data Analytics - From Strategic Planning to Enterprise Integration with Tools,

Techniques, NoSQL, and Graph” By David Loshin, Morgan Kaufmann

4. Big Data Imperatives: Enterprise 'big Data' Warehouse, 'BI' Implementations and Analytics by Soumendra Mohanty, Apress

5. Big Data Analytics Using Splunk By Peter Zadrozny , Raghu Kodali, Apress 2013

6. Franks, Bill, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, Wiley, 1st Edition, 2012.

7. Big Data Application Architecture Q&A: a Problem - Solution Approach Nitin Sawant, Himanshu Shah

8. Big Data Now: Current Perspectives from O'Reilly Radar By O'Reilly Radar Team

# CLOUD COMPUTING

**Unit-I**

Overview of Computing Paradigm :Recent trends in Computing: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing. Evolution of cloud computing: Business driver for adopting cloud computing.

Introduction to Cloud Computing :Cloud Computing (NIST Model): Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers; Properties, Characteristics & Disadvantages: Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing;Role of Open Standards

**Unit-II**

Cloud Computing Architecture:Cloud computing stack: Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services; Service Models (XaaS): Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS); Deployment Models: Public cloud, Private cloud, Hybrid cloud, Community cloud.

**Unit-III**

Infrastructure as a Service(IaaS): Introduction to IaaS, IaaS definition, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine(VM). Resource Virtualization: Server, Storage, Network, Virtual Machine(resource) provisioning and manageability, storage as a service, Data storage in cloud computing(storage as a service); Examples: Amazon EC2, Renting, EC2 Compute Unit, Platform and Storage, pricing, customers, Eucalyptus.

Platform as a Service(PaaS):Introduction to PaaS: What is PaaS, Service Oriented Architecture (SOA), Cloud Platform and Management, Computation, Storage, Examples, Google App Engine, Microsoft Azure, SalesForce.com's Force.com platform.

**Unit-IV**

Software as a Service(PaaS):Introduction to SaaS, Web services, Web 2.0, Web OS, Case Study on SaaS. Service Management in Cloud Computing: Service Level Agreements(SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling: Benefitting enormously, Managing Data, Looking at Data, Scalability & Cloud Services, Database & Data Stores in Cloud, Large Scale Data Processing.

**Unit-V**

Cloud Security: Infrastructure Security: Network level security, Host level security, Application level security, Data security and Storage: Data privacy and security Issues, Jurisdictional issues raised by Data location, Identity & Access Management, Access Control, Trust, Reputation, Risk, Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations.

**Reference Books:**


1. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010

# DISTRIBUTED DATABASES

**Syllabus**

**UNIT I**

Introduction: Distributed Data Processing, Distributed Database System, Promises of DDBSs, Complicating Factors, Problem Areas Distributed DBMS Architecture DBMS Standardization, Architectural Models for Distributed DBMSs, Distributed DBMS Architecture, Global Directory Issues

**UNIT II**

Distributed Database Design: Alternative Design Strategies, Distribution Design Issues, Fragmentation, Allocation. Semantic Data Control: View Management, Data Security, Semantic Integrity Control.

**UNIT III**

Overview of Query Processing: Query Processing Problem, Objectives of Query Processing, Complexity of Relational Algebra Operations, Characterization of Query Processing, Layers of Query Processing Query Decomposition and Data Localization: Query Decomposition, Localization of Distributed Data Optimization of Distributed Queries Query Optimization, Centralized Query Optimization, Join Ordering in Fragment Queries, Distributed Query Optimization Algorithms

**UNIT IV**

Introduction to Transaction Management: Definition of a Transaction, Properties of Transactions, Types of Transactions, Architecture Revisited Distributed Concurrency Control Serializability Theory, Taxonomy of Concurrency Control Mechanisms, Locking-Based Concurrency Control Algorithms, Timestamp based Concurrency Control algorithms, Optimistic Concurrency Control Algorithms, Deadlock Management, Relaxed Concurrency Control

**UNIT V**

Distributed DBMS Reliability: Reliability Concepts and Measures, Failures and Fault Tolerance ion Distributed Systems, Failures in Distributed DBMS, Local Reliability Protocols, Distributed Reliability Protocols, Dealing with site failures, Network Partitioning, Architectural Considerations Parallel Database Systems Database Servers, Parallel Architectures, Parallel DBMS Techniques, Parallel Execution Problems

**Textbook:**

1. Principles of Distributed Database Systems, Second Edition, M.Tamer Ozsu, Patrick Valduriez, Pearson Education, 1999.

**Reference Book:**

1. Distributed Database Management Systems: A Practical Approach] Saeed K. Rahimi ,Frank S. Haug , Wiely,2010

# Research Foundations for Pattern Recognition

**Unit-1:** Introduction, Features, feature vectors, classifiers, Supervised, semi-supervised and unsupervised learning, Classifiers based on bayes decision theory, estimation of unknown probability density functions, Nearest neighbour rule, Bayesian networks.

**Unit-II** : Linear classifiers, Perceptron algorithm, least square methods, logistic discrimination, support vector machines, Non-linear classifiers, The XOR problem, 2-layer and 3-layer perceptrons, Beyond SVM paradigm, decision trees, combining classifiers.

**Unit-III** : Featue Selection, Preprocessing, feature selection based on statistical hypothesis testing, ROC Curve, data transformation and dimensionality reduction, K-L Transform, SVD, ICA, Kernel PCA, DFT, all Transforms, Regional features, features for text, shape and size characterization, Fractals, features for speech and audio classification.

**Unit-IV** : Template matching, context dependent classification, supervised learning, clustering basic concepts, proximity measures, sequential algorithms, modification of BSAS, neural network implementation, hierarchical clustering algorithms.

**Unit-V** : Schemes based on function optimization, fuzzy clustering algorithms, possibilistic clustering, hard clustering algorithms, vector quantization, clustering algorithms based on graph theory, competitive learning algorithms, binary morphology clustering algorithms, boundary detection algorithms, valley – seeking clustering algorithms, kernel clustering methods, density-based algorithms for large data sets, cluster validity.

Text book: -


1. Pattern recognition, Sergios Theodoridis, Konstantinos Koutroumbas, 4th edition, Academic press [Elsevier], ISBN- 978-1-59749-272-0.


References: -


1. Pattern Recognition and Machine Learning, Book by Christopher Bishop, ISBN 978-0-387-31073-2, Springer, 2006.
2. Handbook of Pattern Recognition and Image Processing, Tzay Y. Young, ISBN-13: 978-0123954701, Academic press.Pattern Recognition and Computational Intelligence Techniques Using Matlab Transactions on Computational Science and Computational Intelligence), ISBN-13 : 978-3030222727, Springer, 2020, first edition.
3. Pattern Recognition, A Quality of Data Perspectiveby Wladyslaw Homenda, Witold Pedrycz 9781119302858, Wiley publishers, 2018.

# SOFT COMPUTING

**Syllabus**

**UNIT-I:**

**Introduction to Neuro-Fuzzy and soft computing:** computing constituents and conventions, characteristics. **Fuzzy set theory:** basic definitions and terminology, set-theoretic operations, Mf formulation and parameteization. **Fuzzy rules and reasoning:** extension principles and fuzzy relations, fuzzy if-then rules, fuzzy reasoning. Fuzzy inference systems: mamdani fuzzy models, sugeno fuzzy models, Tsukamoto fuzzy models, other considerations.

**UNIT-II**

**Regression and optimization:** least-squares methods for system identification. Introduction, basics of matrix manipulation and calculus, least-square estimator, geometric interpretation of LSE, recursive least squares estimator, recursive LSE for time varying systems, statistical properties and maximum likelihood estimator, LSE for nonlinear models. **Derivative-based optimization:** introduction, descent methods, the method of steepest descent, newtons methods, step-size determination, conjugate gradient methods, analysis of quadratic case, non linear least square problems, incorporation of stochastic mechanisms. **Derivative-free optimization:** introduction, genetic algorithms, simulated annealing, random search, downhill simple search.

**UNIT-III**

**Neural Networks:** Adaptive networks, supervised learning neural networks, unsupervised learning and other neural networks. neuro-fuzzy modeling: ANFIS, **Coative Neuro-Fuzzy Modeling:** Towards Generalized ANFIS. **Advanced Neuro-Fuzzy modeling:** classification and regression trees, data clustering algorithms, rule based structure identification.

UNIT-IV

**Neuro Fuzzy control:** ANFIS: introduction, architecture, hybrid learning algorithm, learning methods that cross fertilize ANFIS and RBFN, ANFIS as a universal approximation. Simulation examples: example 1.Modeling a two-input sinc function, Example 2. Modeling a three input non-linear function, example 3. On-line identification in control systems, example 4. Predicting chaotic time series. coactive neuro-fuzzy modeling: Towards Generalized **ANFIS:** introduction, framework, neuron functions for adaptive networks, neuro-fuzzy spectrum, analysis of adaptive learning capability.

**NEURO-FUZZY CONTROL-I**

Introduction, framework, control systems and neuro-fuzzy control, expert control, inverse learning, specialized learning, back-propagation through time and real-time recurrent learning.

**NEURO-FUZZY CONTROL-II**

Introduction, Reinforcement learning control, Gradient-free optimization, Gain Schediling, Feedback Linearization and Sliding Control.

**UNIT-V**

**GENETIC ALGORITHMS:** A Genetic Introduction to Genetic Algorithms: What are Genetic Algorithms, Robustness of Traditional Optimization and search methods, goals of Optimization, How genetic algorithms different from traditional methods, A Simple Genetic Algorithm, Genetic Algorithms at work.

**Genetic Algorithms Revisited:** Mathematical Foundations Computer implementation of a genetic algorithm.

**Advanced Operations and Techniques in Genetic Search:** Introduction to Genetics based Machine Learning, Applications of Genetics based Machine Learning.

**Text Books:**

1. Neuro-Fuzzy And Soft Computing BY "J-S.R.Jang, Ct. Sun, E.Mizutani" Prentic-Hall Of India Private Limited Publications.

2. Genetic Algorithms BY “David E. Goldberg” Pearson Education.

**REFERENCES:**

1. Neural Networks and Learning Machines By “Simon Haykin”3rd Edition, Phi Publication.

2. Fuzzy Sets and Fuzzy Logic By “George J. Klir|Bo|Yuan” In Phi Publications.

# SOFTWARE ENGINEERING

**Syllabus**

**Unit – I**

Software and Software Engineering: Nature of software, software application domains, unique nature of web applications, software engineering, software process, software engineering practice, software myths. Process Models: Generic process model, prescriptive process models, specialized process models, unified process, personal and team process models, product and process. Agile development: Agility, agile process, extreme programming and other agile process models.

**Unit – II**

Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management. System models: Context Models, Behavioral models, Data models, Object models, structured methods.

**Unit – III**

Design concepts: Design process, Design concepts, design model. Architecture Design: Software architecture, architectural styles, architectural design, assessing alternative architectural designs, architectural mappings using data flow. Component-level design: Designing class based components, conducting component level design.

**Unit – IV**

User interface design: The golden rules, user interface analysis and design, interface analysis, interface design steps. Quality concepts: software quality, software quality dilemma, achieving software quality. Software quality assurance: Elements of software quality assurance, sqa tasks, goals. Formal approaches.

**Unit – V**

Software testing strategies: A strategic approach to software testing, strategic issues, test strategies for conventional software, validation testing, system testing.

**Text book:**

1. Roger S.Pressman ,"Software Engineering – A Practitioner's Approach 7th Edition 2010, Mc Graw Hill.

**Reference Book:**

1) Ian Sommerville,'Software Engineering', Sixth Edition,2001,Pearson Education.

# Cryptography & Network Security

**Syllabus**

**UNIT –I:**

**Introduction to Security:** Security Concepts, Security Attacks, Security Services and Mechanisms, A model for network Security, **Classical Encryption Techniques:** Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor machines, steganography

**UNIT –II:**

**Block Ciphers and DES:** Traditional Block Cipher Structure, DES, DES Example, Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles. **AES:** Finite Field Arithmetic, AES Structure, AES Transformation Functions, AES Example, AES Implementation. **Block Cipher Operation:** Multiple Encryption and Triple DES, electronic code book mode, cipher block chaining mode, cipher feedback mode, output feed back mode, counter mode, **Pseudorandom Number Generation and Stream Ciphers:** Principles and Pseudorandom Number Generation, Pseudorandom Number, Generators, Pseudorandom Number Generation using a Block Cipher, Stream, Ciphers, RC4.

**UNIT –III:**

**Public-key Cryptography and RSA:** Principles of Public-Key Cryptosystems, the RSA algorithm. Attacks and counter measure on RSA, Improvements on RSA, **Other Public-key Cryptosystems:** Diffie-Hellman Key Exchange, ElGamal Cryptosystem, Elliptic Curve Arithmetic Elliptic Curve Cryptography, **Cryptographic Hash Functions:** Applications of Cryptographic Hash functions, Two Simple Hash Functions, Requirements and Security, Hash Functions based on Cipher Block Chaining, SHA.

**UNIT –IV:**

**Messageauthenticationcodes:**Requirements,functions,MACs,securityofMACs,HMAC.**Digital Signatures:**ElGamalDigitalSignature,Schnorrdigitalsignature,DSS.**Keymanagementanddistribution:** Symmetric key distribution using symmetric encryption, symmetric key distribution using asymmetric encryption, distribution of public keys, X.509 Certificates, Public-Key Infrastructure, **User Authentication protocols:**RemoteUserAuthenticationPrinciples,RemoteUserAuthenticationusingSymmetricEncryption, Kerberos, Remote User Authentication Using Asymmetric Encryption

**UNIT –V:**

**Transport-Level Security:** Web Security issues, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH),**Electronic Mail Security:**PrettyGoodPrivacy,S/MIME,DomainKeysIdentifiedMail, **IPSecurity:**IPSecurityOverview.IP SecurityPolicy,EncapsulatingSecurityPayload,CombiningSecurityAssociations,InternetKeyExchange, CryptographicSuites

**Books:**

1. Cryptography and Network Security Principles and Practice, by William stallings, Pearson, 7th edition, 2017.

2. WilliamStallings,"NetworkSecurityEssentials: Applications and standards",PearsonEducation,7thEdition,2017.
3. Applied Cryptography: Protocols, Algorthms and Source Code in C, by Bruce Schneier, Second Edition , John Wiley & Sons, Inc., 2015
4. Applied Cryptography for Cyber Security and Defense: Information Encryption and Cyphering, by Hamid R. Nemati and Li Yang, IGI Global, 2011

# WEB SECURITY

**Syllabus**

**UNIT I**

Introduction: The Web Security Landscape, Architecture of the World Wide Web, Cryptography basics, Cryptography and the web, Understanding SSL and TLS, Digital Identification: Passwords, Biometrics and Digital Signatures.

**UNIT II**

Digital Certificates, CAs and PKI, Web's war on privacy, privacy protecting techniques, privacy protecting technologies

**UNIT III**

Web Server Security: Physical security for servers, Host security for servers, securing web applications.

**UNIT IV**

Web Server Security: Deploying SSL server certificates, securing your web service, computer crime Security for content providers: Controlling access to web content, Client-side digital certificates, code signing and Microsoft's Authenticode .

**UNIT V**

Security for content providers: Pornography, Filtering software, Censorship, privacy policies, legislation, P3P, Digital Payments, Intellectual property and actionable content.

**Textbook**

1. Web Security, Privacy and Commerce, Simson Garfinkel, Gene Spafford, 2nd Edition, O'REILLY, 2002. Pvt. Ltd.

# WIRELESS SENSOR NETWORKS

SYLLABUS

**UNIT I :** Basics of Wireless Sensors and Applications, The Mica Mote, Sensing and Communication Range, Design Issues, Energy consumption, Clustering of Sensors, Applications

**UNIT II:** Data Retrieval in Sensor Networks, Classification of WSNs, MAC Layer, Routing Layer, High-Level Application Layer Support, Adapting to the Inherent Dynamic Nature of WSNs

**UNIT III:** Sensor Network Platforms and Tools, Sensor Network Hardware, Sensor Network Programming Challenges, Node-Level Software Platforms.

**UNIT IV:** Operating System: TinyOS, Imperative Language: nesC, Dataflow Style Language: TinyGALS, Node-Level Simulators, ns-2 and its Sensor Network Extension, TOSSIM.-

**UNIT V:** Sensor Network Databases : Challenges ,Query Interfaces, High level Database Organization, In-Network Aggregation, Data-centric Storage, Temporal Data.

TEXT BOOKS:

1. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science Imprint, Morgan Kauffman Publishers, 2005, rp2009.

REFERENCES:

1. Adhoc Wireless Networks: Architectures and Protocols, C.Siva Ram Murthy, B.S.Murthy, Pearson Education, 2004

2. Wireless Sensor Networks: Principles and Practice, Fei Hu, Xiaojun Cao, An Auerbach Book, CRC Press, Taylor & Francis Group, 2010

3. Wireless Ad hoc Mobile Wireless Networks: Principles, Protocols and Applications, Subir Kumar Sarkar et al., Auerbach Publications, Taylor & Francis Group, 2008.

4. Wireless Sensor Networks: Signal Processing and Communications Perspectives, Ananthram Swami et al., Wiley India, 2007, rp2009.

# SOFTWARE PROJECT MANAGEMENT

**Syllabus**

**Unit-1 Introduction to software project management**

Project Stakeholders, Project Management Knowledge Areas, Project Management Tools and Techniques, Program and Project Portfolio Management, the Role of the Project Manager, the Project Management Profession, Project Phases and the Project Life Cycle.

**Unit-2 software project Time and Cost management**

Time management: The Importance of Project Schedules, Estimating Activity Resources, Estimating Activity Durations, Developing the Schedule, Controlling the Schedule, Using Software to Assist in Project Time Management. Cost management: The Importance of Project Cost Management, Basic Principles of Cost Management, Estimating Costs, Types of Cost Estimates, Cost Estimation Tools and Techniques, Determining the Budget, Controlling Costs.

**Unit-3 Human Resources Management**

The Importance of Human Resource Management, Keys to Managing People, Developing the Human Resource Plan, Acquiring the Project Team, Developing the Project Team, Managing the Project Team, Using Software to Assist in Human Resource Management.

**Unit-4 Risk Management**

Planning Risk Management, Common Sources of Risk on Information Technology Projects, Identifying Risks, Performing Qualitative Risk Analysis, Performing Quantitative Risk Analysis, Planning Risk Responses, Monitoring and Controlling Risks, sing Software to Assist in Project Risk Management.

**Unit-5 procurement Management**

Strategic Planning and Project Selection, Developing a Project Charter, Developing a Project Management Plan, Directing and Managing Project Execution, Monitoring and Controlling Project Work ,Performing Integrated Change Control, Closing Projects or Phases.

**Textbook:**

1. “INFORMATION TECHNOLOGY PROJECT MANAGEMENT”, Kathy Schwalbe,6th edition, Cengage Learning, 2011.

# ARTIFICIAL INTELLIGENCE

**Syllabus**

**Unit-1**

**Introduction to Artificial Intelligence:** AI Problems, The underlying Assumption, AI Techniques, Level of the Model Problems, Problem spaces &Search: Defining the Problem as a state space search, Production System, Problem Characteristics, Production System Characteristics.

**Unit-2**

**Heuristic Search Techniques:** Generate and Test, Hill Climbing, Best first Search, Problem Reduction, Constraint Satisfaction , Means-Ends Analysis.

**Unit-3**

**Knowledge Representation Issues:** Representation and Mapping, Approaches to Knowledge Representation, Issues in Knowledge Representation, The Frame Problem Predicate Logic: Representing simple facts in logic, Computable Functions and Predicates, Resolution, Natural Deduction.

**Unit-4**

**Representing Knowledge using rules :** Procedural Versus Declarative Knowledge, Logic Programming , Forward Versus Backward Reasoning, Matching, Control Knowledge

**Unit-5**

**Common Sense:** Qualitative Physics, Common Sense Ontologies, Memory Organization Expert Systems: Representing and Using Domain Knowledge, Expert System Shells, Knowledge Acquisition

**Text Book:**

Elaine Rich & Kevin Knight," Artificial Intelligence ", 2nd Edition ,(Tata McGraw Hill Edition)

**Reference Books:**

Patrick Henry Winston, 'Artificial Intelligence', Pearson Education,2003

# VIRTUAL AND AUGMENTED REALITY

## SYLLABUS

### UNIT I INTRODUCTION

Introduction to VR, Historical perspective, Birds-eye view: general, Hardware, software, Sensation and perception. Geometry of Virtual Worlds: Geometric modeling, Transforming models, Matrix algebra , 2D and 3D rotations, Homogeneous transforms , The chain of viewing transforms, Eye transforms, Canonical view transform, Viewport transform. Light and Optics, Visual Physiology, Visual Perception, Tracking Systems, Visual Rendering,

### UNIT II VISUAL PHYSIOLOGYAND PERCEPTION

Parts of the human eye, photoreceptors and densities, scotopic and photopic vision, display resolution requirements, eye movements, neural vision structures, sufficient display resolution, other implications of physiology on VR. Photoreceptors, Sufficient resolution for VR, Light intensity, Eye movements, Neuroscience of vision. Depth perception, Motion perception, Frame rates and displays

### UNIT III TRACKING

Overview, Orientation tracking, Tilt drift correction, Yaw drift correction, Tracking with a camera, Perspective n-point problem, Filtering, Lighthouse approach, Velocities, acceleration, vestibular system, virtual world physics, simulation, collision detection, avatar motion

### UNIT IV RENDERING

Visual Rendering: Visual Rendering-Overview, Shading models Rasterization, Pixel shading, VR-specific problems, Distortion shading, Post-rendering image warp

### UNIT V AUDIO AND INTERFACES

Audio: Physics and physiology, Auditory perception, Auditory localization, Rendering, Spatialization and display, Combining other senses. Interfaces: Locomotion, Manipulation, System control, Social interaction, Evaluation of VR Systems.

**Text Books:**


1. C. Burdea and Philippe Coiffet, Virtual Reality Technology, Second Edition, Gregory, John Wiley and Sons, Inc.,2008
2. Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan and Claypool, New York, NY, USA.


**References**


1. Future Cyborgs: Human-Machine Interface for Virtual Reality Applications by Robert R Powell. 2012.

2. George Mather, Foundations of Sensation and Perception:Psychology Press; 2 edition,2009
3. Peter Shirley, MichaelAshikhmin, and Steve Marschner, Fundamentals of Computer Graphics, A K Peters/CRC Press; 3 edition,2009.
4. The history of the future: Oculus, Facebook and the Revolution that swept Virtual Reality, by Blake J. Harris,2019.
5. Virtual Reality by Steven M. LaValle. Cambridge University Press.2019.

# DATA SECURITY & PRIVACY

**Unit I**

Introduction to Databases Security Problems in Databases Security Controls, Security Models – 1: Introduction Access Matrix Model Take-Grant Mode! Acl cn Model PN Model Hartsor and Hsiao's Model Fernandez's Model Bussolati and Martella's Model for Distributed databases - Security Models – 2:Bell and LaPadula's Model Biba's Model Dion's Model Sea View Model Jajodia and Sandhu'r Model The Lattice Model for the Flow Control conclusion.

**Unit II**

Security Mechanisms: Introduction User Identification/Authentication Memory, Memory Protection Resource Protection Control Flow Mechanisms Isolation Security Functionalities in Some Operating Systems Trusted Computer System Evaluation Criteria - Security Software Design: Introduction A Methodological Approach to Security Software Design Secure Operating System Design Secure DBMS Design Security Packages Database Security Design.

**Unit III**

Statistical Database Protection & Intrusion Detection Systems: Introduction Statistics Concepts and Definitions Types of Attacks Inference Controls evaluation Criteria for Control Comparison. Introduction IDES System RETISS System ASES System Discovery.

**Unit IV**

Enterprise Security Architecture - Security as a Process-Security Data- Enterprise Security as a Data Management Problem- Tools for Data Management- David Isenberg and the "Stupid Network"-Extensible Markup Language- The XML Security Services Signaling Layer-XML and Security Standards- The Security Pattern Catalog Revisited-XML-Enabled Security Data-HGP: A Case Study in Data Management. Business Cases and Security: Building Business Cases for Security.

**Unit V**

Security – Encryption – Digital Signatures – Authorization – Authenticated RPC - Integrity - Consistency - Database Tuning - Optimization and Research Issues. Case Studies Security – Encryption – Digital Signatures – Authorization – Authenticated RPC - Integrity - Consistency - Database Tuning - Optimization and Research Issues. Case Studies.

**References:**

1. Database Security by Castano, Silvana; Fugini, Maria Grazia; Martella, Giancarlo, Pearson Edition, 1994

2. Database Security and Auditing: Protecting Data Integrity and Accessibility 1st Edition, Hassan Afyouni Thomos Edition, 2006

3. Philip M. Lewis, Arthur Bernstein and Michael Kifer, "Databases and Transaction

Processing: An Application-Oriented Approach", Addison-Wesley, 2002.

4. R. Elmasri and S.B. Navathe, "Fundamentals of Database Systems", 3rd Edition,

Addison Wesley, 2004.

5. Abraham Silberschatz, Henry. F. Korth and S.Sudharsan, "Database System Concepts", 4th Edition, Tata McGraw Hill, 2004.

6. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", 3rd Edition, TMH, 2003.

# WIRELESS COMMUNICATIONS AND MOBILE COMPUTING

**Syllabus**

**UNIT -I:**

**The Cellular Concept-System Design Fundamentals:** Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies- Prioritizing Handoffs, Practical Handoff Considerations, Interference and system capacity – Co channel Interference and system capacity, Channel planning for Wireless Systems, Adjacent Channel interference , Power Control for Reducing interference, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring .

**UNIT –II:**

**Mobile Radio Propagation: Large-Scale Path Loss:** Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Reflection-Reflection from Dielectrics, Brewster Angle, Reflection from prefect conductors, Ground Reflection (Two-Ray) Model, Diffraction-Fresnel Zone Geometry, Knife-edge Diffraction Model, Multiple knife-edge Diffraction, Scattering, Outdoor Propagation Models- Longley- Ryce Model, Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model, Wideband PCS Microcell Model, Indoor Propagation Models- Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model, Ericsson Multiple Breakpoint Model, Attenuation Factor Model, Signal penetration into buildings, Ray Tracing and Site Specific Modeli

**UNIT –III:**

**Introduction to Mobile Computing Architecture:** Mobile Computing – Dialog Control – Networks –Middleware and Gateways – Application and Services – Developing Mobile Computing Applications –Security in Mobile Computing – Architecture for Mobile Computing – Three Tier Architecture – Design considerations for Mobile Computing – Mobile Computing through Internet – Making existing Applications Mobile Enabled.

**Cellular Technologies: GSM, GPS, GPRS, CDMA and 3G:** Bluetooth – Radio Frequency Identification – Wireless Broadband – Mobile IP – Internet Protocol Version 6 (IPv6) – Java Card –GSM Architecture – GSM Entities – Call Routing in GSM – PLMN Interfaces – GSM addresses and Identifiers – Network aspects in GSM – Authentication and Security – Mobile computing over SMS –GPRS and Packet Data Network – GPRS Network Architecture – GPRS Network Operations – Data Services in GPRS – Applications for GPRS – Limitations of GPRS – Spread Spectrum technology –Is-95 – CDMA Versus GSM – Wireless Data – Third Generation Networks – Applications on 3G

**UNIT –IV:**

**Wireless Application Protocol (WAP) and Wireless LAN:** WAP – MMS – Wireless LAN Advantages – IEEE 802.11 Standards – Wireless LAN Architecture –Mobility in wireless LAN**Intelligent Networks and Interworking :** Introduction – Fundamentals of Call processing –Intelligence in the Networks – SS#7 Signaling – IN Conceptual Model (INCM) – soft switch – Programmable Networks – Technologies and Interfaces for IN. **Client Programming, Palm OS, Symbian OS, Win CE Architecture:** Introduction – Moving beyond the Desktop – A Peek under the Hood: Hardware Overview – Mobile phones – PDA

– Design Constraints in Applications for Handheld Devices – Palm OS architecture – Application Development – Multimedia – Symbian OS Architecture – Applications for Symbian, Different flavors of Windows CE -Windows CE Architecture **J2ME:** JAVA in the Handset – The Three-prong approach to JAVA Everywhere – JAVA 2 Micro Edition (J2ME) technology –

Programming for CLDC – GUI in MIDP – UI Design Issues – Multimedia – Record Management System – Communication in MIDP – Security considera considerations in MIDP – Optional Packages

**UNIT –V:**

**Voice Over Internet Protocol and Convergence:** Voice over IP- H.323 Framework for Voice over IP – Session Initiation Protocol – Comparison between H.323 and SIP – Real Time protocols –Convergence Technologies – Call Routing – Voice over IP Applications – IP multimedia subsystem (IMS) – Mobile VoIP **Security Issues in Mobile Computing:** Introduction – Information Security – Security Techniques and Algorithms – Security Protocols – Public Key Infrastructure – Trust – Security Models – Security

**TEXT BOOKS:**

1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., 2002, PHI.

2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.

3. Mobile Cellular Communication – Gottapu Sasibhushana Rao, Pearson Education, 2012.

4. Mobile Computing – Technology, Applications and Service Creation – Asoke K Talukder, Roopa R Yavagal, 2009, TATA McGraw Hill

5. Mobile Communications – Jochen Schiller – 2nd Edition – Pearson Education

**REFERENCE BOOKS:**

1. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE.

2. Wireless Digital Communications – Kamilo Feher, 1999, PHI.

3. Wireless Communication and Networking – William Stallings, 2003, PHI.

4. Wireless Communication – Upen Dalal, Oxford Univ. Press.

5. Wireless Communications and Networking – Vijay K. Gary, Elsevier.

6. The CDMA 2000 System for Mobile Communications – Vieri Vaughi, Alexander Damn Jaonvic – Pearson

7. Adalestein : Fundamentals of Mobile & Parvasive Computing, 2008, TMH

# PARALLEL ALGORITHMS

**Syllabus**

**UNIT I:**

Introduction: Computational demand in various application areas, advent of parallel processing, terminology pipelining, Data parallelism and control parallelism-Amdahl's law. Basic parallel random access Machine Algorithms-definitions of P, NP and NP-Hard, NP-complete classes of sequential algorithms-NC –class for parallel algorithms.

**UNIT II:**

Organizational features of Processor Arrays,Multi processors and multicomputers.Mapping and scheduling aspects of algorithms. Mapping into meshes and hyper cubes-Load balancing-List scheduling algorithm Coffman-graham scheduling algorithm for parallel processors.

**UNIT III:**

Elementory Parallel algorithms on SIMD and MIMD machines, Analysis of these algorithms. Matrix Multiplication algorithms on SIMD and MIMD models.

Fast Fourier Transform algorithms. Implementation on Hyper cube architectures. Solving linear file - system of equations, parallelizing aspects of sequential methods back substitution and Tri diagonal.

**UNIT IV:**

Parallel sorting methods---Odd-even transposition Sorting on processor arrays.Biotonic – merge sort on shuffle –exchange ID –Array processor, 2D-Mesh processor and Hypercube Processor Array. Parallel Quick-sort on Multi processors. Hyper Quick sort on hypercube multi computers. Parallel search operations. Ellis algorithm and Manber and ladner's
Algorithms for dictionary operations.

**UNIT V:**

Parallel algorithms for Graph searching— All Pairs shortest paths and minimum cost spanning tree.

Parallelization aspects of combinatorial search algorithms with Focus on Branch and Bound Methods and,Alpha-beta Search methods.

**REFERENCE BOOKS:**

1. Parallel computing theory and practice, MICHAEL J.QUINN

2. Programming Parallel Algorithms, Guy E. Blelloch, Communications of the ACM

3. Algorithms for Parallel processing, Michael T Heath, Abhiram Ranade, Schreiber(Ed), Springer.

4. Handbook of Parallel Computing Models, algorithms and applications, Samgithevar Rajasekharan, John Reif(Ed), Taylor and Franics group.

5. Parallel Processing and Parallel Algorithms: Theory and Computation, Seyed H. Roosta, Springer

# Blockchain and Cryptocurrencies

**Syllabus:**

**Unit I:**

**Introduction to Cryptography:** Structure of cryptosystem – symmetric key cryptography – asymmetric key cryptography – types of attacks – authentication models – SHA-256 Hash algorithm – RSA algorithm – Elliptic Curve cryptography – Digital signature standards. **Basics of Blockchain concepts:** Architecture – Properties of Blockchain – Distributed ledger – Merkle tree – structure of a block – Smart contract – Crowd funding – Transaction – Double spending – Block propagation.

**Unit II:**

**Types of Blockchain:** Blockchain Compenents – Permissioned Blockchain – Permissionless Blockchain – Consortium Blockchain – Consensus – Proof of Work, Proof of Stack, Proof of Burn, Proof of Elapsed Time – Mining – **Consensus Algorithms:** PAXOS consensus Algorithm – RAFT consensus Algorithm – Byzantine general problem – Practical Byzantine fault tolerance Algorithm – Three phase commit Protocol.

**Unit III:**

Blockchain Components and Concepts – **Hyperledger Fabric**: Transaction Flow **– Fabric Details:** Ordering Services, Channels (Single and Multiple Channels), Peer, Client Applications, Certificate Authority – Membership and Identity Management – Hyperledger Fabric Network Setup. **Hyperledger Composer**: Application Development, Network Administration.

**Unit IV:**

**Applications: Financial Services**: Cross border payments, KYC, international trade - **Health Care**: Food safety - **Supply chain and Logistics**: Trade logistics supply chain, diamond provenance, addressing supply chain fraud - **Public Sector**: Energy, Govt. applications (passport, audit and compliance, digital identity) - **Retail**: Hyperledger Indy, GST – **Insurance**: Claims Processing, Risk Provenance - **Security**: Open Network security properties, membership and access control architecture, privacy using channels in hyperledger fabric, Ledger in hyperledger fabric.

**Unit V:**

**Smart Contract Programming (Solidity):** Global variable and functions – expressions and control structures – arrays, enums, structs, mappings, special variables – **Functions:** function modifiers, view function, pure functions, fallback function, function overloading, mathematical and cryptographic functions – **common pattern:** withdrawal pattern, restricted access – contracts, inheritance, constructors, abstract contracts, interfaces, libraries, assembly, exceptions, events, and logging – truffle basics and unit testing.

**Reference Books:**


1. William Stallings, "Cryptography and Network Security: Principles and Practice", 7th Edition, Pearson Education, 2017.
2. Chandramouli Subramanian, Asha A George, Abhilash K A, Meena Karthikeyan, "Blockchain Technology", University Press (India) Private Limited, 2021
3. Ritesh Modi, "Solidity Programming Essentials: A beginners guide to build smart contractsfor Ethereum and blockchain", Packt publishing Ltd, UK, 2018

4. Behrouz A. Forozan and Debdeep Mukhopadhyay, “Cryptography and Network Security”, 3rd Edition, McGraw Hill Education (India) Private Limited, 2015.

# CLOUD SECURITY

**Syllabus Unit-I**

**Security Concepts:** Confidentiality, privacy, integrity, authentication, non-repudiation, availability, access control, defence in depth, least privilege, how these concepts apply in the cloud, what these concepts mean and their importance in PaaS, IaaS and SaaS. e.g. User authentication in the cloud;

**Cryptographic Systems**: Symmetric cryptography, stream ciphers, block ciphers, modes of operation, public-key cryptography, hashing, digital signatures, public-key infrastructures, key management, X.509 certificates, OpenSSL.

**Unit-II**

**Multi-tenancy Issues:** Isolation of users/VMs from each other. How the cloud provider can provide this; **Virtualization System Security Issues**: e.g. ESX and ESXi Security, ESX file system security, storage considerations, backup and recovery;

**Unit-III**

**Virtualization System Vulnerabilities**: Management console vulnerabilities, management server vulnerabilities, administrative VM vulnerabilities, guest VM vulnerabilities, hypervisor vulnerabilities, hypervisor escape vulnerabilities, configuration issues, malware (botnets etc).

**Unit-IV**

**Virtualization System-Specific Attacks:** Guest hopping, attacks on the VM (delete the VM, attack on the control of the VM, code or file injection into the virtualized file structure), VM migration attack, hyperjacking. **Technologies for Virtualization-Based Security Enhancement:** IBM security virtual server protection, virtualization-based sandboxing;

**Unit-V**

**Storage Security**: HIDPS, log management, Data Loss Prevention. Location of the Perimeter.

**Legal and Compliance Issues:** Responsibility, ownership of data, right to penetration test. local law where data is held, examination of modern Security Standards (eg PCIDSS), how standards deal with cloud services and virtualization, compliance for the cloud provider vs. compliance for the customer.

**Reference Books:**

1. Tim Mather, SubraKumaraswamy, ShahedLatif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance [ISBN: 0596802765]

2. Ronald L. Krutz, Russell Dean Vines, Cloud Security [ISBN: 0470589876]

3. John Rittinghouse, James Ransome, Cloud Computing [ISBN: 1439806802]

4. J.R. ("Vic") Winkler, Securing the Cloud [ISBN: 1597495921]

# Machine Learning

SYLLABUS:

**Unit-1**

Introduction and Decision Trees: Well-posed Learning problems. Designing a Learning System: Choosing the Training Experieance,Choosing the Target Function, Choosing a Representation for the Target function, Choosing a Function Approximation Algorithm, The final Design.Persepective and Issues in Machine Learning: Issues in Machine Learning.

DecisionTree Learning: Introduction, Decision Tree Representation, Appropriate Problems for Decision Tree Learning. The Basic Decision Tree Learning Algorithm: Which attribute is the Best classifier, an illustrative example, Hypothesis Space Search in Decision Tree Learning? Inductive Bias in Decision Tree Learning: Restriction Biases and preference Biases, why prefer short Hypotheses. Issues in Decision Tree Learning: Avoding Over fitting the Data, Incorporating Continuous-valued Attributes, Alternative Measures for Selecting Attributes, Handling Training Examples with Missing Attribute Values, Handling Attributes with Differing Costs.

**Unit-2**

Bayesian Learning: Introduction, Bayes Theorem.Bayes Theorem

Concept Learning: Brute-Force Bayes Concept Learning, MAP Hypothesis and Consistent Learners. Maximum Likelihood and Least-squared Error Hypotheses, Maximum Likelihood Hypothesis for predicting probabilities: Gradient Search to Maximize Likelihood in a Neural Net. Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Naive Bayes Classifier, and An Example: Learning to classify Text.

**Unit-3**

Bayesian Belief Networks: Conditional Independence, Representation, Inference, Learning Bayesian Belied Networks, Gradient Ascent Training of a Bayesian Netwworks, Learning the structure of Bayesian Networks. The EM Algorithm: Estimate Means of K Gaussians, General Statement of EM Algorithm, Derivation of the K Means Algorithm.

Artificial Neural Networks:Introduction,Neural Network Representations, Appropriate Problems for Neural Network Learning,Perceptrons,Multi Layer Networks and BACK PROPAGATION Algorithm, Remarks on the BACK PROPAGATION Algorithm, An IIustrative Example: Advanced Topics in Artificial Neural Networks.

**Unit-4**

Genetic Algorithms: Motivation, Genetic Algorithms, An illustrative Example, Hypothesis Space Search, Genetic programming, Models of Evolution and Learning, Parallelizing Genetic Algorithms

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. Introduction to Analytical Learning,Inductive and Analytical Learning Problems,Learning with Perfect Domain Theories: PROLOG-EBG,Remarks on Explanation Based Learning,Explanation Based Learning of Search Control Knowledge.

**Text Books: 1**. Tom M.Mitchell ,"Machine Learning",McGraw Hill,1997

2. Peter Flach, Machine Learning, The and Science of Algorithms that make sense of data, Cambridge University Press, 2012.

**Reference Books:**

1. Ethem Alpaydin, "Introduction to Machine Learning", The MIT Press, (2010)

2. Stephen Marsland, "Machine Learning an Algorithmic Perspective", CRC Press,(2009)

# Quantum Computing

**Syllabus**

**Unit-1**: Introduction, Overview of classical mechanics, limitations, Need for quantum mechanics, Advantages and risks involved with quantum mechanics, Evolution of quantum computing, Quantum processors, Quantum architecture and explanation of various components. Applications.

**Unit-II**: QISKit, Awesome SDK for Quantum Programming in Python - Installing the QISKit, Setting Up in Windows, Setting Up in Linux CentOS, Qubit 101: It's Just Basic Algebra, Algebraic Representation of a Quantum Bit, Changing the State of a Qubit with Quantum Gates, Universal Quantum Computation Delivers Shortcuts over Classical, Computation -Your First Quantum Program, SDK Internals: Circuit Compilation and QASM, Running in a Real Quantum Device, Quantum Assembly: The Power Behind the Scenes, Quantum entanglement

**Unit-III:** Quantum random number generation, Super dense coding, Quantum teleportation, Deutsch-Jozsa algorithm, Bernstein-Vazirani, Simons algorithm, Boson sampling problem, Grover and Shors algorithm, Quantum approximate optimization algorithm.

**Unit-IV:** Quantum circuits, quantum fourier transforms and its applications, quantum search algorithms, quantum computers- physical realization, Quantum meta-heuristics and its applications.

**Unit-V:** Quantum noise and quantum operations, Distance measures for quantum information, Quantum error-correction, Entropy and information, Quantum information theory, Overview of quantum machine learning, Roadmap to Quantum deep learning.

Textbooks: -


1. Quantum Computation and Quantum Information, Michael A. Nielsen, Isaac L. Chuang, ISBN 978-1-107-00217-3, Cambridge University Press.
2. Practical Quantum Computing for Developers Programming Quantum Rigs in the Cloud using Python, Quantum Assembly Language and IBM QExperience, Vladimir Silva, 978-1-4842-4217-9, https://doi.org/10.1007/978-1-4842-4218-6, Apress.


Reference books: -


1. Quantum computing for everyone, Bernhardt, Chris, 9780262350914, The MIT Press, 2019.
2. Mathematics of Quantum Computing: An Introduction, Wolfgang Scherer, 9783030123581, Springer, 2019.

# NATURAL LANGUAGE PROCESSING

**Syllabus**

**Unit1: Introduction:** overview of NLP. Statistical machine translation. Language models and their role in speech processing. The problem of ambiguity. NLP tasks in syntax, semantics, and pragmatics. **Words:** Structure, Semantics, Parts of Speech, Sentences: Basic ideas in compositional semantics, Classical Parsing (Bottom up, top down, Dynamic Programming: CYK parser). Sentences: Parsing using Probabilistic Context Free Grammars and EM based approaches for learning PCFG parameters.

**UnitII: N-gram Language Models and Information Theory:** The role of language models. Simple N-gram models, Entropy, relative entropy, cross entropy. Statistical estimation and smoothing for language models. Part Of Speech Tagging and Sequence Labeling. Lexical syntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training). n-gram models.

**UnitIII:** Syntactic-parsing: Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Top-down and bottom-up parsing, empty constituents, left recursion. Modern Statistical Parsers Search methods in parsing: Agenda-based chart, A*, and "best-first" parsing. Discriminative parsing. Discourse: Reference resolution and phenomena, syntactic and semantic constraints on Coreference, pronoun resolution algorithm, text coherence, discourse structure.

**UnitIV:** Semantic Analysis: Lexical semantics and word-sense disambiguation. Dependency parsing. Semantic Role Labeling and Semantic Parsing. Information Extraction (IE): Named entity recognition and relation extraction. IE using sequence labelling. Information sources, rule-based methods, evaluation (recall, precision). Additional topics: Advanced Language Modelling (including LDA), other applications like summarization.

**UnitV**: Statistical Machine Translation (MT), Alignment Models. Statistical Alignment Models and Expectation Maximization (EM) EM and its use in statistical MT alignment models. The EM algorithm. Machine Translation (MT): Basic issues in MT. Rule based Techniques, Statistical Machine translation (SMT), word alignment, phrase-based translation, and synchronous grammars, case study: IBM models.

**Text books:**


1. Daniel and James H. Martin "An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Second Edition.

2. Bird, S., Klein, E., Loper, E. (2009). Natural Language Processing with Python. Sebastopol, CA: O'Reilly Media.


**Reference Books**:

1. James A.. Natural language Understanding 2e, Pearson Education, 1994
2. Bharati A., Sangal R., Chaitanya V.. Natural language processing: a Paninian perspective, PHI, 2000
3. Siddiqui T., Tiwary U. S.. Natural language processing and Information retrieval, OUP, 2008.
4. Manning, Christopher D.; Hinrich Schuetze; Foundations of Statistical Natural Language Processing Cambridge, MIT Press, 1999.
5. Kiraz, George Anton; Computational Nonlinear Morphology: With Emphasis on Semitic Languages Cambridge University Press, 2001, 171 pages

# Speech Processing

**UnitI:** Overview of speech communication, Speech signal to symbol (sound unit) transformation, nature of speech signal, Speech Production and Perception, Phonetics and Phonology, Acoustics Phonetics, Speech Prosody, Different types of Speech Sound units.

**UnitII:** Time and frequency domain analysis, Review of DSP techniques, z-transform, Discrete Fourier transform, short-time analysis of speech, linear prediction analysis, Linear prediction cepstral coefficients (LPCC), Cepstral analysis, Mel frequency cepstral coefficients (MFCC), spectrograms, Segmental analysis of speech,

**UnitIII:** Traditional Aproaches: Dynamic time warping (DTW), Gaussian mixture models (GMM), hidden Markov models (HMM), Neural network models, Support vector machines

**UnitIV**: State of the Art Models: Deep Neural Networks, LSTM Recurrent neural networks, Convolutional neural networks, Reinforcement learning

**UnitV:** Speech recognition, Speaker recognition, Speech synthesis, Speech enhancement, Language identification, Emotion recognition, Prosody manipulation.

**PREFERRED TEXT BOOKS:**


1. L. R. Rabiner, B. H. Juang, and B. Yegnanarayana, "Fundamental of Speech Recognition", Pearson Education Inc., New Delhi, India, 2009
2. L.R.Rabiner and R.W.Schafer, Digital processing of speech signals, Pearson LPE (1993).
3. Douglas O'Shaugnessy,"Speech Communication,Human and Machine",IEEE Press, 2000.
4. T.F Quatieri, "Discrete-Time Speech Signal Processing- Principles and Practice", Pearson, 2002.
5. J R Deller, J H L Hansen, J G Proakis, "Discrete-time Processing of Speech Signals, IEEE, Wiley. 1999.
6. Machine Learning, Tom M. Mitchell, Mg-Graw Hill, Indian Edition, 2019
7. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, The MIT Press, November 2016.
8. Springer Handbook of Speech Processing, J. Benesty, 2008.

# Signal Processing

## Syllabus

**UnitI: Introduction to Signals and Systems-Types of Signals:** Analog signals, deterministic, non-deterministic, random signals, periodic, aperiodic signals, sampling, Nyquist theorem, Quantization, discrete time signals, digital signals, Systems: properties of systems, linearity, super position principles, shift invariance, causality and stability, impulse response,

**UnitII:** Difference Equations, Convolution, Phase and group delays. Fourier- series for periodic signals, Fourier transforms, properties of Fourier transform, DTFT, Discrete Fourier transforms, Fast Fourier Transforms,

**UnitIII: Transforms & Filter Design: Z-Transforms, Region of Convergence:** Properties of Z-Transforms. Causality and stability of filters, FIR, IIR, Pole, Zero representation, Digital filter design: FIR filter design - low pass, high-pass, band-pass and band-reject filters, IIR filter design, Frequency response of filters, All pass filters, Filter realizations.

**UnitIV: 1D, 2D & 3D Signal Processing:** Windowing techniques, Short-term processing, enhancement techniques, Video signal processing with techniques for denoising, feature extraction. Codecs: for Speech, image and video signals. Acquisition, enhancement techniques, feature extraction, analysis & synthesizing techniques for audio, image and video signals.

**UnitV: Signal Processing for Intelligent Systems:** DNN, RNN, CNN, GAN, Capsule, Siamese & Residual Networks based tool kits for Speech and Image processing – pre-processing, data augmentation, feature extraction, recognition, classification, and synthesis.

**Reference Books:**


1. J. G. Proakis and M G , Monolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, PHI,

2. V. Oppenheim and R. W. Schafer. discrete time signal processing, Prentice hall, MIT press

3. Discrete-Time Speech Signal Processing: Principles and Practice by Thomas F. Quatieri

4. R. Gonzalez and R. Woods, “Digital Image Processing”, 4 th Ed., Pearson, 2018

5. Handbook of Image and Video Processing by Alan C. Bovik

# Artificial Neural Networks (ANN)

Basics of Artificial Neural Networks: Historical perspective; Characteristics of Neural Networks; Artificial Neural Networks (ANN) terminology; Neuron Models; Topology; Basic learning laws

Pattern Recognition Tasks by ANNs: Activation dynamics models; Synaptic dynamics models; Learning methods; Stability and convergence; Recall; Functional Units for Pattern Recognition Tasks

Feedforwad Neural Networks: Analysis of Pattern association; pattern classification and pattern mapping by feedforwad neural networks (FFNNs); Hebbian Rule; Perceptron learning; Delta rule; Backpropagation Algorithm; Gradient descent and its variants

Fedback Neural Networks: Analysis of linear autoassociative networks; Hopfield model for pattern storage; Stochastic networks and Simulated annealing; Restricted Boltzmann machine.

Reference Books:

1. B. Yegnanarayana "Artificial Neural Networks", PHI, 2006.

2. Simon Haykin, " Neural Networks: A Comprehensive Foundation", Pearson Prentice Hall, 2008.

3. Christopher M Bishop, "Neural networks for Pattern Recognition", Oxford, Indian Edition, 2010.

# COGNITIVE ENGINEERING

## Syllabus

**Unit-I:** Overview of Nervous System: Cellular components of Nervous system; Organizational Principles of Neural System: Organelles and Their Functions; Membrane Potential and Action Potential; Synaptic transmission and Cellular signalling (Basic Neurochemistry)

Introduction to Cognitive Neuroscience: General Introduction and philosophy of Mind; Cellular/Molecular Basis of Cognition; Visual perception and Object recognition; Spatial Processing and Attention; Concept Formation, Logic and Decision Making; Problem Solving, Creativity and Intelligence; Learning Memory (I)- Memory Models and Short-Term Memory; Learning Memory (II)- Long term potentiation and Long-Term Memory.

**Unit-II**: Functional neuro-imaging of cognition and Image processing: PET(Positron Emission Tomography); Concepts of NMR (Nuclear Magnetic Resonance) and fMRI (Functional MRI); DTI(Diffusion Tensor Imaging); Image processing for brain functioning

Signal Processing and Neural engineering: Physiological signals– Generation and Sensing; Bio-signal acquisition; Data pre-processing; Feature Extraction; Applications:-Brain Computer Interface and Neuro-feedback

**Unit-III:** Naturalistic Decision Making: Skills-Rules-Knowledge, Abstraction Hierarchy, Decision Ladder, Mental Models, Recognition-Primed Decisions, Knowledge-based expert systems, Team performance, Domain characteristics and constraints, Strategies, Heuristic Reasoning, Problem-solving as search through a problem-space.

**Unit-IV:** Cognitive Task Analysis: Cognitive Work Analysis, Knowledge Acquisition, Information Flow, Communication Paths, Tools used, Constraints,Distributed cognition - "knowledge in the head" and "knowledge in the world",Field studies and observation, Disturbance Management, Alarm Management, Latent Errors, Human Errors, Usability Testing.

**UnitV:** Problem Types: Problem Solving, Information Retrieval, Diagnosis, Planning, Scheduling, Resource Allocation.Domains: Aviation, Driving, Trains, Dispatching, Emergency Management, Health Care, Process Control, Military Command and Control, Sports.

## Text Books and References


1. **Hutchins, E. (1995). Cognition in the Wild. Cambridge, MA: MIT Press.**
2. **Montgomery, D. C. (1991). *Design and Analysis of Experiments, Third Edition*. New York: John Wiley & Sons.**
3. **Rasmussen, J., Pejtersen, A., and Goodstein, L. (1994) Cognitive Systems Engineering. New York, NY: John Wiley and Sons.**
4. **Wickens, C., Gordon, S., and Liu, Y. (1998). An Introduction to Human Factors Engineering. New York: Addison Wesley Longman.**
5. **Dale Purves, Neuroscience, Sinauer Associates, Inc (2001)**
6. **Handbook of Psychophysiology, Cambridge University Press (Third Edition)(2007)**
7. **Michael S. Gazzaniga, The Cognitive Neurosciences, (Fourth Edition) MIT, (2009)**
8. **Robert L. Solso,Otto H. MacLin, M. Kimberly MacLin, Cognitive Psychology (Eighth Edition), Pearson (2007)**
9. **PetterLaake, HaakonBreienBenestad,Research Methodology in the Medical and Biological Sciences, Academic Press (2007)**