

## **Advanced Software Engineering**

Overview of Software Engineering, Methods of Analysis and Design of Software Systems: Structured and Object Oriented, Coding Standards and Guidelines, Theoretical Foundation of Testing: Coverage Criteria, Software Testing Techniques and Strategies, Software Debugging; Software Project Metrics and Estimation Techniques: Empirical, Heuristic and Analytical Techniques; Software Project Planning and Scheduling: PERT and CPM; Software Project Crashing; Software Reliability Metrics and Models, Software Availability, Software Risk and Configuration Management; Software Reuse and Re-engineering; CASE Tools and Support; Software Quality Assurance.

### **Text/ Reference Books:**

- Pressman, R., Software Engineering – A Practitioner’s approach, Sixth Edition, McGrawHill International Edition.
- Ghezzi, C., Jazayeri, M., Mandrioli, D., Fundamentals of Software Engineering, Second Edition, Pearson Education.
- Peters, J.F., Pedreyz, W., Software Engineering - An Engineering Approach, John Wiley and Sons. Sommerville, I., Software Engineering, Sixth Edition, Pearson Education.
- Taha, H.A., Operations Research – An Introduction, Seventh Edition, Pearson Education.

## **Big Data Analytics**

Introduction to Data Mining, Data Analytics, Predictive Analysis and Business Intelligence, Large Scale File System, Mining Big Data, Advanced Data Analytics and Machine Learning, Big Data Streams and Real Time Predictive Analysis, Tools and Visualization, Link Analysis, Web Analytics, Collaborative Filtering, Social Network Analysis, Issues, Challenges and Opportunities with Big Data and its Analytics

### **Text/ Reference Books:**

- Rajaraman, A., Ullman, J. D., Mining of Massive Datasets, Cambridge University Press, United Kingdom, 2012
- Barlow, M., Real-Time Big Data Analytics: Emerging Architecture, O Reilly, 2013
- Baesens, B., Analytics in a Big Data World, Wiley, 2016
- Bell, J., Machine Learning for Big Data, Wiley, 2016

## **Computer Vision**

Introduction to vision; Camera models; Camera calibration; Multi-view geometry and reconstruction; Edge/ Feature extraction; Correspondence and tracking; 3D structure/ motion estimation; basics of object recognition.

### **Text/ Reference Books:**

- R Szeliski, Computer Vision: Algorithms and Applications, Springer, 2011.

- R Hartley, A Zissermann, Multi-view Geometry in Computer Vision, Cambridge University Press, 2004.
- D A. Forsyth, J Ponce, Computer Vision: A Modern

### **Data Communication and Computer Networks**

Data Communication – Analog and digital communications, Channel characteristics, modulation, encoding schemes; Error Detection and correction, Flow control, multiplexing switching, Multiple access techniques, Routing – shortest path algorithms, routing protocols, virtual path routing, Network Protocols – IP, TCP, UDP, FTP, SMTP, etc, Performance Evaluation – Queuing models, Traffic model – deterministic and stochastic

#### **Text/ Reference Books:**

- Leon Garcia and Indra Widjaja, Communication Networks: Fundamental Concepts and Key Architecture, 2 nd ed., Tata McGraw-Hill, 2004
- Anurag Kumar, D. Manjunath and Joy Kuri, Communication Networking: An analytical approach, Elsevier, 2004.
- Dimitri Bertsekas and Robert Gallager, Data Networks, 2 nd ed., PHI, 2001.
- Thomas G. Roberttazzi, Computer Networks and Systems, 3 rd ed. Springer, 2002.

### **Data Mining and Knowledge Discovery**

Concepts of data mining and knowledge discovery: Input – concepts, instances, attributes; Knowledge representation of outputs; Data mining methodologies – classification, prediction, regression, association, clustering, outlier analysis, Advanced data mining models – Machine learning: incremental learning, reinforcement learning, genetic algorithms, neural networks, intelligent agents based learning; Soft Computing: Concepts and ML models using Fuzzy set theory and Rough set theory. Applications of data mining in complex data: world-wide web, Streams, Scientific, spatial Current topics

#### **Text/ Reference Books:**

- Han, J. and Kamber, M., Data Mining: Concepts and Techniques, Morgan Kaufmann, 2e, 2007. 2. Witten, Ian H. and Frank Eibe, Data Mining: Practical Machine Learning Tools and Techniques with Java Implementations. Morgan Kaufmann, 2e,2005
- Tan, P., Kumar, V. and Steinbach, M., Introduction to Data Mining, Pearson Education Inc. 2007
- Hand, David, Mannila Heikki and Smyth Padheaic, Principles of Data Mining, PrenticeHall India, 2004 (Indian reprint)
- Thuraisingham, B., Data Mining: Technologies, Techniques, Tools, and Trends, CRC Press, 1999.

### **Large Scale Graph Algorithms and Application**

Introduction and Application of Large-scale Graph, Characteristics, Complex Data Sources - Social Networks, Simulations, Bioinformatics; Categories- Social, Endorsement, Location, Co-occurrence graphs; Basic and Advanced Large-scale Graph Analysis- List Ranking, Link

Analysis, Page Ranking Algorithms; Distributed Computation for Massive Data Sets-Spectral, Modularity-based Clustering, Random Walks; Large Graph Representation and Implementation V-Graph Representation, MapReduce, Surfer, GraphLab; Advanced Topics-Power Law Distribution, Game-Theoretic Approach, Rank Aggregation and Voting Theory, Recommendation Systems, Social network analysis: case study □Facebook, LinkedIn, Google+, and Twitter

#### **Text/ Reference Books:**

- Social and Economic Networks by Matthew O. Jackson (Nov 21, 2010)
- Stanley Wasserman, Katherine Faust "Social Network Analysis Methods and Applications" (Structural Analysis in the Social Sciences) 1995
- Tanja Falkowski "Community Analysis in Dynamic Social Networks" 2009
- Ladislav Novak, Alan Gibbons, "Hybrid Graph Theory and Network Analysis" Cambridge Tracts in Theoretical Computer Science 2009
- Eric D. Kolaczyk, "Statistical Analysis of Network Data Methods and Models" Springer Series in Statistics 2009
- Akihito Hora, Nobuaki Obata Quantum Probability and Spectral Analysis of Graphs" 2007

#### **Mobile Ad Hoc Networks**

Fundamentals of Wireless Communication Technology – Radio Propagation Mechanisms, Multiple Access Techniques, Characteristics of wireless Channel. Ad Hoc Networks – Definition, Application, challenges, Traffic profile, and challenges, Media Access protocols Topology-based routing; Position-based routing, Mobility and location Management, Transport Protocols, Energy Conservation Issues QoS, Security issue, Simulation of protocols.

#### **Text/ Reference Books:**

- C. Siva Ram Murthy and B.S. Manoj, Ad Hoc Wireless Networks – Architecture and Protocols, Pearson Education, 2004 (Low price edition)
- C.K. Toh, Ad hoc Mobile Wireless Networks – Protocols and Systems, Prentice Hall, 2002
- Ivan Stojmenovic (ed), Handbook of Wireless Networks and Mobile Computing, John Wiley, 2002

#### **Multicast Communication**

Introduction, Application, Characteristics, Multicast Backbone Architecture, Multicast Routing, Basic Routing Algorithm, Group Dynamics, Multicast routing between domains, Ip multicast, Multicast in transport protocols, address allocation, Multicast LANs, Reliable Multicast, Congestion control, Security issues.

#### **Text/ Reference Books:**

- Morgan Kaufmann, Ralph Wittmann, Martina Zitterbart ,Multicast Communication: Protocols, Programming and Applications, Edition 2000, Academic Press, USA.
- Kennet Miller, Multicast Networking and Application, AW publication, 2008.

- David Makofske, Kevin Almeroth, Multicast sockets: Practical Guide for Programmers, Edition 2003, Elsevier, USA.

### **Natural Language Processing**

General Characteristics of Natural language – ambiguity, incompleteness, imprecision; Linguistic Essentials – Part of speech, Lexicography, morphology, Phrase structure grammar, theory, Semantics and pragmatics; Grammatical frameworks – Chomsky hierarchy, X-bar theory, LFG, Unification grammar; Efficient parsing for Natural languages; Knowledge Representations – Frames, Scripts, Conceptual graphs; Statistical Techniques – Elementary Probability theory, Essential information theory; Applications of Statistical Techniques - Word Sense Disambiguation, Lexical Acquisition, Markov Model for Part-of-speech tagging , Probabilistic CFG, Probabilistic parsing, Statistical Alignment and machine translation, Clustering.

#### **Text/ Reference Books:**

- Manning D. Statistical Foundation of Natural language Processing, MIT Press, 1999.
- James A. Introduction to Natural Language Understanding, Addison Wesley, 1991.
- Harris M.D. Natural Language Processing, Benjamin/Cumming, 1991

### **Network Security**

Introduction, Security goals, attacks, services and mechanisms, cryptography and steganography, Symmetric Key cipher-substitution ciphers, Transposition ciphers, stream and block ciphers, Modern block ciphers, Modern stream ciphers, DES and AES, Elliptic curve cryptosystems, RSA, Message integrity, Digital signature, Public key distribution, IPsec, SET, ESP, PGP, SSL, Security in wireless.

#### **Text/ Reference Books:**

- Stallings, Cryptography and Network Security: Theory and practice, JohnWiley, 2013.
- Behrouz A. Forouzan, Cryptography and Network security, Tata Mcgraw Hill 2010.
- Bible Eric Cole, Ronald L.Krutz, Network security, Welley 2009.
- Stinson D., Cryptography, Theory and Practice, CRC Press, Boca Raton, FA 2005.

### **Object Oriented Software Engineering**

Object Oriented Concepts; Modeling with UML; Analysis - Object Model, Dynamic Model; System Design - Addressing Design Goals; Object Design; Reusability - Introduction to Design Patterns; Mapping Models to Code; Testing Techniques - Unit, Integration and System Testing

#### **Text/ Reference Books:**

- Bruegge B. and Dutoit A.H., Object-Oriented Software Engineering, Using UML, Patterns, and Java, 3rd Edition, Prentice-Hall, 2010

- Booch G., Rumbaugh J and Jacobson I., The Unified Modeling User Guide, Addison Wesley Longmen, 2nd Edition, 2005
- Gamma, et al., Design Patterns, Elements of Reusable Object Oriented Software", Addison Wesley, 1st Edition, 1994
- Craig Larman, Applying UML and Patterns - An Introduction to Object-Oriented Analysis and Design and Iterative Development, Prentice Hall, 3rd Edition, 2008.

### **Performance Modeling of Computer Communication Networks**

Role of Modeling and Analysis, Examples of Performance Modeling, Analytic Models, Elements of Stochastic process, Poisson Process, Basic Queuing models, M/M/1; M/M/∞; M/G/ ∞; M/M/m; M/M/m/m Queues with Product formula. Cell and Burst scale Traffic Models: Round trip time distribution, PING data, Markov modulated Poisson Process, Long Range Dependence, Heavy Tail Distribution. Traffic Control: Admission Control, Effective Bandwidth, Statistical Multiplexing gain, Access Control: Leaky bucket System. Multi access Modelling: Slotted ALOHA Markov chain, Diffusion Approximation Approach, CSMA, Congestion Control, Window Control, Modelling TCP, Window Size, TCP Window Dynamics.

#### **Text/ Reference Books:**

- M. N. O. Sadiku, S. M. Musa, Performance Analysis of Computer Networks, Springer, 2013.
- I. Kaj, Stochastic Modeling in Broadband Communication Systems, SIAM, 2002 .
- H. Kobayashi, B. L. Mark, System Modeling and Analysis, Foundations of System Performance Evaluation, Pearson Prentice Hall, 2009.
- M.H. Balter, Performance Modeling and Design of Computer Systems, Cambridge Univ. Press , 2013.

### **Swarm Intelligence**

Introduction to Models and Concept of Computational Intelligence, Social Behavior as Optimization: Discrete and Continuous Optimization Problems, Classification of Optimization Algorithms, Evolutionary Computation Theory and Paradigm, Swarm and Collective intelligence, Swarm Intelligence Techniques: Particle Swarm Optimization, Ant Colony Optimization, Artificial Bees and Firefly Algorithm etc., Hybridization and Comparisons of Swarm Techniques, Application of Swarm Techniques in Different Domains and Real World Problems.

#### **Text/ Reference Books:**

- Engelbrecht, A.P. Computational Intelligence: An Introduction, Second Edition, John Wiley and Sons, 2007.
- Kennedy, J. and Eberhart, R.C., Swarm Intelligence, Morgan Kaufmann Publishers, 2001
- Bonabeau, E., Dorigo, M. and Theraulaz, G., Swarm Intelligence: From Natural to Artificial Systems, Oxford University Press, 1999
- Dorigo, M., Stutzle, T., Ant Colony Optimization, MIT Press, 2004
- Parsopoulos, K.E., Vrahatis, M.N., Particle Swarm Optimization and Intelligence: Advances and Applications, Information Science Reference, IGI Global, 2010

- Clerc, M., Particle Swarm Optimization, ISTE, 2006 7. Nature Inspired Metaheuristic Algorithms, Xin-She Yang, Luniver Press, 2010

### **Service Oriented Architecture**

SOA Fundamentals - definition, characteristics; Architecture; Evolution; Web Service; Web Service Composition - Orchestration and Choreography; Interoperability; WS\*, Metadata; Security; XML Technology - name-spaces, schema, well-formed XML documents; WSDL - name spaces, Abstract and Concrete Models; Universal Description, Discovery and Integration (UDDI), SOAP (messaging framework); Composition Languages - BPEL and CDL 19 | 23

#### **Text/ Reference Books:**

- Thomas Erl, Service Oriented Architecture (SOA) : Concepts, Technology and Design, Prentice Hall, 2008 2. Newcomer E. and Lomow G, Understanding SOA with Web Services, Addison Wesley, 2004
- <http://www.w3.org/xml>
- <http://www.w3.org/TR/wsdl>
- <http://docs.oasis-open.org/wsbpel/2.0/OS/wsbpel-v2.0-OS.html>
- <http://www.w3.org/TR/ws-cdl-10/>

### **Wireless Communication and Mobile Computing**

Mobile radio systems-, Paging systems, cordless telephone system, cellular telephone system, Cellular Concept: Frequency reuse, channel assignment, hand off, Interference and cell splitting, sectoring, Improving Coverage and capacity in Cellular systems. Propagation modeling: Outdoor/ Indoor Propagation models, Small scale Multipath propagation- Rayleigh fading, Ricean Fading, Nakagami fading, Shadowing, lognormal shadowing fading model, outage probability, coverage estimation under shadowing, and multipath fading. Wireless Networks 802.11, frequency-hopping, encoding and modulation, MAC Layer Protocol Architecture Multiple access with collision avoidance protocol, Virtual Carrier-Sensing, DCF Protocol, PCF Operation. Mobility: challenges, limits and connectivity, mobile TCP, mobile IP and cellular IP in mobile computing.

#### **Text/ Reference Books:**

- Rappaport, Wireless communications: principal and practice , Pearson ed.
- Matthew s. Gast, 802.11 wireless networks, o'reilly
- Andrea Goldsmith ,Wireless communication , cambridge university press ed .
- Jochen Schiller , Mobile communications, phi/person edu., 2 nd ed.,