Savitribai Phule Pune University
(Formerly University of Pune)
Board of Studies, Department of Technology
Computer & Information (CI) Technology
Curriculum Structure for M.Tech Program

Sr. No.	Subject Code	Subject Name	Credits	Teaching Scheme (Theory)	Teaching Scheme (Lab)
Semester (I)					
1	MTC1	Mathematics for Technology	3	√	
2	CIC2	Advanced Data Structure	3	√	
3	CIC3	Advanced Database Systems	3	√	
4	CIE1	Elective-1	3	√	
5	CIE2	Elective-2	3	√	
6	CIL1	Lab Practice - 1	3		√
7	CIS1	Seminar - 1	1		√
Semester (II)					
8	CIC4	Network System Design	3	√	
9	CIC5	Parallel and Distributed Algorithms	3	√	
10	CIE3	Elective-3	3	√	
11	CIE4	Elective-4	3	√	
12	CIE5	Elective-5	3	√	
13	CIL2	Lab Practice - 2	3		√
14	CIS2	Seminar - 2	1		√
Semester (III)					
15	CID1	Soft Skills / Research Methodology	3	√	
16	CID2	Elective 6 /DS(Directed Study)	3	√	
17	CIMP1	Interim Project	8		√
Semester (IV)					
18	CIMP2	Final Project (Dissertation Submission)	18		√
		TOTAL CREDITS	70		

AUDIT COURSES				
Sr. No.	**Subject Code**	**Subject Name**	**Credits**	**Semester**
1	CYSA	Cyber Security	2	I
2	HRE101	Human Rights & Duties	1	II
3	HRE102/HRE103	Human Rights & Vulnerable Groups/Law Policy , Society & Enforcement mechanism	1	III

Notes:

1) Electives can also be Open Electives in spirit of CBCS.

2) Maximum 25% Open Electives are allowed.

3) Candidates are expected to perform minimum three (3) assignments for every Lab Practice, and submit report as a bona fide document to supervisor/course instructor. The assignment may be in the form of modeling/ simulation/ programming/ experimental investigation/ fieldwork

4) The candidates are expected to select three electives from the list provided in Table(s) in this document

Savitribai Phule Pune University
Board of Studies
Computer & Information (CI) Technology
Curriculum Structure for Integrated M.Tech-PhD Program

Sr. No.	Subject Code	Subject Name	Credits	Teaching Scheme (Theory)	Teaching Scheme (Lab)
Semester (I)					
1	MTC1	Mathematics for Technology	3	√	
2	CIC2	Advanced Data Structure	3	√	
3	CIC3	Advanced Database Systems	3	√	
4	CIE1	Elective-1	3	√	
5	CIE2	Elective-2	3	√	
6	CIL1	Lab Practice - 1	3		√
7	CIS1	Seminar - 1	1		√
Semester (II)					
8	CIC4	Network System Design	3	√	
9	CIC5	Parallel and Distributed Algorithms	3	√	
10	CIE3	Elective-3	3	√	
11	CIE4	Elective-4	3	√	
12	CIE5	Elective-5	3	√	
13	CIL2	Lab Practice - 2	3		√
14	CIS2	Seminar - 2	1		√
Semester (III)					
15	CID1	Soft Skills / Research Methodology	3	√	
16	CID2	Elective 6 /DS(Directed Study)	3	√	
17	CID3	Elective 7 /DS(Directed Study)	3	√	
17	CIS3	Seminar - 3	1		√
Semester (IV)					
18	CIPR	Ph.D Pre-registration	--		√

Semester (V)					
19	CIR1	Ph.D Pre-registration	--		√
Semester (VI)					
20	CIR2	Ph.D Pre-registration	--		√
Semester (VII)					
21	CIR3	Ph.D Pre-registration	--		√
Semester (VIII)					
22	CIR4	Ph.D Pre-registration	--		√
Semester (IX)					
22	CIR5	Ph.D Pre-registration	--		√
Semester (X)					
22	CIR6	Ph.D Pre-registration	--		√
Semester (XI)					
22	CIFP	Ph.D viva-voce presentation	--		√

AUDIT COURSE				
Sr. No.	**Subject Code**	**Subject Name**	**Credits**	**Semester**
1	CYSA	Cyber Security	2	I
2	HRE101	Human Rights & Duties	1	II
3	HRE102/HRE103	Human Rights & Vulnerable Groups/ Human Rights & Duties in India: Law Policy , Society & Enforcement mechanism	1	III

Notes:

1) Electives can also be Open Electives in spirit of CBCS.

2) Maximum 25% Open Electives are allowed.

3) Candidates are expected to perform minimum three (3) assignments for every Lab Practice, and submit report as a bona fide document to supervisor/course instructor. The assignment may be in the form of modeling/ simulation/ programming/ experimental investigation/ fieldwork

4) The candidates are expected to select three electives from the list provided in Table(s) in this document

LIST OF ELECTIVES FOR BOARD OF COMPUTER & INFORMATION TECHNOLOGY		
Sr. No.	Subject Code	Subject Name
1	CIE1	Privacy and Security in Cloud Computing
2	CIE2	Soft Computing Techniques
3	CIE3	Network System Design
4	CIE4	Advanced Operating Systems
5	CIE5	Software Engineering for Embedded Systems
6	CIE6	Digital Communication and Computer Networks
7	CIE7	Machine Learning
8	CIE8	Client-Server Based IT Solutions
9	CIE9	Semantic Web
10	CIE10	Aspect Oriented Programming
11	CIE11	Software Product Assurance
12	CIE12	Software Metrics
13	CIE13	Real Time Software and Systems
14	CIE14	Image and Video Processing
15	CIE15	Grid Computing
16	CIE16	Computer Architecture
17	CIE17	Information Technology and Systems
18	CIE18	Information Retrieval
19	CIE19	Engineering Entrepreneurship
20	CIE20	Web Systems Integration
21	CIE21	Cloud Computing

22	CIE22	Engineering Statistics and Quality
23	CIE23	Business Intelligence
24	CIE24	Meshups
25	CIE25	Security Issues in Web-based Systems
26	CIE26	Intelligent Web
27	CIE27	Advanced Computer Architecture
28	CIE29	Software Project Management
29	CIE30	Advanced Software Engineering
30	CIE31	Advanced Information Retrieval
31	CIE32	Internet Applications
32	CIE33	Web Service
33	CIE34	Component Based Development
34	CIE35	Mobile and Wireless Security
35	CIE36	Big Data Analytics
36	CIE37	PERT/CPM
37	CIE38	Knowledge Management and Applications
38	CIE39	Advanced Computer Vision
39	CIE40	Digital Forensics
40	CIE41	Data analytics with R
41	CIE42	Distributed Systems
42	CIE43	Internet of Things
43	CIE44	Brain Computer Interface
44	CIE45	Deep Learning
45	CIE46	Introduction to Linguistics and NLP

46	CIE47	Image Processing
47	CIE48	Cloud Security and Digital Forensics
48	CIE49	Semantics in Linguistics
49	CIE50	Advanced Machine Learning
50	CIE51	Advanced Data Mining
51	CIE52	Natural Language Processing
52	CIE53	Web App Security
53	CIE54	Intellectual Property Rights
54	CIE55	Remote Sensing & Geographical Information System
55	CIE56	Text and Web Mining
56	CIE57	Fundamentals of IoT
57	CIDS1	Time Series Method for Forecasting with R

MATHEMATICS FOR TECHNOLOGY (COMPUTATIONAL METHODS)

Unit 1: Numerical differentiation I:

Partial differential equation Laplace and Poisson's equation-solution, method of characteristics for solution of initial boundary value problems, relaxation method

Unit 2: Numerical differentiation II:

Finite Difference, Gaussian elimination and Gauss, Jordan methods, matrix inversion, Gauss Seidel method –Newton- Raphson method

Unit 3: Statistics and Probability:

Moments, Skewness and Kurtosis, Probability, conditional probability, various theoretical distributions like binomial, normal, log-normal, Poisson, gamma distribution, Pearson type I, II & II distribution test of significance, Gumbel distribution, testing of hypotheses – Large sample tests for mean and proportion, Chi-square test, errors, types of errors.

Unit 4: Regression and Correlation:

Regression and correlation – rank correlation – multiple and partial correlation – analysis of variance-one way and two way classifications – experimental design – Latin square design

Unit 5: Transforms:

Laplace Transformer: LT of standard function, inversions and their application in civil engg. Fourier Transformer: Fourier integral, Fourier transform and their application in civil engg.

Unit 6: Matrix method and Finite element:

Matrix method analysis (Stiffness) co ordinate calculation for different types of structure. Finite element method basics (1D and 2D) co ordinate calculations.

Reference Books

1. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).
2. Venkatraman, M.K., Numerical Methods in Science and Engineering, National Publisher Company.
3. Numerical Methods by Krishna Raju
4. Shanthakumar M.S., Numerical Methods & Analysis
5. Gupta, S.C. and Kapur, V.K., "Fundamentals of Mathematical Statistics ", Sultan Chand & Sons, New Delhi, 1999.

S.P.Pune University
Department of Technology
SYLLABUS FOR MTech- Integrated MTech-PhD (Computer and Information Technology)

Parallel and Distributed Computing

Scope and issues of parallel and distributed computing, Taxonomy of parallel structures, Control mechanism, Address-Space Organization, Interconnection connection networks: Static and Dynamic interconnection networks, evaluating static interconnection networks, embedding other networks (Linear Array, Mesh, Binary Tree) into a hypercube; Routing mechanisms for static interconnection networks: Store and Forward (SF) Routing; Cut - Theory (CT) Routing; Cost-Performance trade-off; Architectural Models for Parallel Algorithm design, Simple message transfer between two processors; One-to-all broadcast; All-to-all broadcast; Reduction and prefix sums; One-to-all personalized communication; All-to-all personalized communication; circular shift, Performance matrices for Parallel systems: Run time, Speed up, Efficiency and Cost; The effect of granularity and data mapping on performance; Scalability of parallel systems; Iso-efficiency metric of scalability; Mini computer model; Workstation pool model; Client-server model; Pool of processors model; Hybrid model

Network technologies and Protocols, Building blocks; Client-server communication; group communication; Case study: Inter processor communication in UNIX; Design issues in Remote procedure calling; Implementation; Case Studies: SUN and ANSA; Various sorting and searching algorithms, performance metrics for parallel algorithm implementations.

References

1. *Vipin Kumar, Ananth Grama, Anshul Gupta and George Karypis, Introduction to Parallel Computing, Addison Wesley (2003) 2nd ed.*
2. *George Coulouris, Jean Dollimore and Tim Kindberg, Distributed Systems Concepts and Design, Addison-Wesley (2000) 3rd ed.*
3. *S G Akl, The Decision and Analysis of Parallel Algorithms, Prentice Hall (1989).*
4. *Hwang, Kai, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw Hill (1992).*
5. *J Jaja, An Introduction to Parallel Algorithms, Addison Wesley (1992).*
6. *T G Lewis and H El Rewini, Introduction to Parallel Computing, Prentice-Hall (1992).*
7. *M J Quinn, Parallel Computing: Theory and Practice, McGraw Hill (1994) 2nd ed.*

Computer Architecture

Fundamentals of computer design, instruction set principles and examples, pipelining, advanced pipelining and instruction-level parallelism, memory-hierarchy design and survey of design issues in storage, interconnection network and multiprocessor systems.

Quantitative Measure of Performance for Evaluation of Designs, Instruction Set Architecture: Principles and Examples, Process Design: Data path and control units, Pipelining: Advanced design technologies and hazards, Instruction-level parallelism, Memory subsystems: Caches, Input/Output subsystems: Interfacing I/O to CPU/OS, Memory subsystems: Caches, Architectural support for security

References

1. *Computer Organization and Design: The hardware/Software Interface (4th edition), By David A. Patterson and John L. Hennessy, Morgan Kaufmann, 2008.*

Advanced Database Systems

Concurrency & Recovery Management in Centralized DBMS, Concept of Transaction and its properties, Scheduling of transactions, Conflict operations, Two Phase Locking protocol, Recovery management in Centralized DBMS, Distributed DBMS - Concepts and design, functions and architecture of a DDBMS, distributed relational database design, Transparencies in a DDBMS, Date's Twelve rules for a DDBMS, Distributed transaction management, distributed concurrency control, distributed deadlock management, distributed database recovery, Replication servers, and Distributed query optimization, Mobile databases

Advanced database applications, weakness of RDBMS, storing objects in a relational database, next-generation database systems, OODBMS perspectives, persistence, issues in OODBMS, advantages and disadvantages of OODBMS, Object-oriented database design, Object relational DBMS: Introduction, third generation database manifestos, SQL8, Object oriented extensions in Oracle, Comparison of ORDBMS and OODBMS, Web technology and DBMS

Requirements for web-DBMS integration, web-DBMS architecture, advantages and disadvantages of web-DBMS approach, approaches to integrating the web and DBMS, Oracle Internet Application Server (IAS), Data Warehousing Concepts, OLAP and Data mining, Evolution of data warehousing, data warehousing concepts, benefits and problems of data warehousing, comparison of OLTP systems and data warehousing, On-Line Analytical Processing, Introduction to data mining.

References

1. *Thomas Connolly, Carolyn Begg, Database Systems, Dorling Kingsley (2009) 4th ed.*
2. *H. F. Korth and A. Silverschatz, Database Concepts, Tata McGraw Hill (2003) 3rd ed.*
3. *Hoffer, Prescott, Mcfadden, Modern Database Management, Pearson education (2008) 3rd ed.*
4. *Elmasri, Navathe, Fundamentals of Database systems, Addison Wesley (2003) 4th ed.*
5. *C. J. Date, An Introduction to Database Systems, Pearson education (2002) 7th ed.*
6. *C.S.R. Prabhu, Object-oriented Database Systems, Eastern Economy Edition (2005) 2nd ed.*

Software Project Management

Characteristics of a software project, Software scope and feasibility, resources, the SPM plan, Size/scope estimation, Decomposition techniques, WBS, Sizing, Function point, LOC, FP vs LOC, GANTT Charts, Activity networks, PERT/CPM networks, COCOMO I, COCOMO II models, Quality control, Quality assurance, Formal Technical Reviews, The SQA Plan, ISO and CMM standards, Reactive vs. proactive Risk strategies, Risk projection, Risk Refinement, Risk Monitoring, Monitoring and management, RMMM plan, Earned Value Analysis, Team structures: hierarchical, Egoless, chief programmer, mixed; Team software Process; Resource leveling, Building a team: Skill sets, Configuration Management: Baselines, Configurable items, SCM repository, SCM process, version control change control, configuration audit, Project Monitoring and Control - Audits and Reviews

References

1. *Pankaj Jalote, Software Project Management in Practice, Pearson Education Asia (2002).*
2. *Bob Hughes and Mike Cotterell, Software Project Management, Tata McGraw Hill Publishing Company Ltd., New Delhi (2006) 3rd ed.*
3. *Roger Pressman, A practitioner's Guide to Software Engineering, Tata McGraw Hill (2004).*
4. *Tom Demarco, Controlling Software Project Management, Measurement, Prentice Hall, New Jersey (1982).*
5. *Watts S. Humphrey, Winning with Software An Executive Strategy, Pearson Education Asia (1998).*
6. *Philip Metzger, Managing A Programming Project, Prentice Hall, New Jersey (1983).*
7. *Tom Glib, Finzi Susannah, Principles of Software Engineering Management, Addison Wesley, England (2000).*

Fundamentals of Computer/Network Security

Introduction to the study of computer and network security from the view of information warfare, Information system threats, vulnerabilities and defensive mechanisms including cryptography, crypto-analysis, authentication, digital signatures, PKI, buffer overflow, vulnerability analysis, penetration testing, firewall and IDS, DDoS attacks and their defenses

Introduction to computer and Network Security, Security policies and security standards, Basic cryptography, Crypto-analysis, Digital certificate creation and signing, PKI, Use of digital certificates in secure email and web system mutual authentication, Network Attacks, Penetration Testing, Backtrack tool set, Nessus network scanner, and Metasploit, Buffer Overflow attacks and defense, Network Defenses, Firewalls, IP tables, IDS, Snort, DDoS and Autonomous Anti-DDos Defense, Access Control, Multilevel Security, SELinux, Privilege Management

References

1. *Ross Anderson, Security Engineering,John Wiley & Sons, ISBN 0-471-38922-6. (Can be downloaded here - http://www.cl.cam.ac.uk/~rja14/book.html)*

Security and Privacy in the Cloud

Security and privacy in the cloud, including confidentiality, integrity, and availability, authentication, identity and access management in the cloud, Current state of cloud security and privacy research

Review of the current state of data security and storage in the cloud, including confidentiality, integrity, and availability, Identity and access management (IAM) practice for authentication, authorization, and auditing of the users accessing cloud services, Discovery of security management frameworks and standards relevant for the cloud, Understanding of privacy aspects needed to consider in the cloud, including how they compare with traditional computing models, Importance of audit and compliance functions within the cloud, various standards and frameworks, Examination of security delivered as a service: a different facet of cloud security

References

1. *Cloud Security and Privacy: An Enterprise Per... (Paperback) by Tim Mather, Subra Kumaraswamy*

Soft Computing Techniques

Neural Networks History, overview of biological Neuro-system, Mathematical Models of Neurons, ANN architecture, Learning rules, Learning Paradigms-Supervised, Unsupervised and reinforcement Learning, ANN training Algorithms-perceptions, Training rules, Delta, Back Propagation Algorithm, Multilayer Perceptron Model, Hopfield Networks, Associative Memories, Applications of Artificial Neural Networks

Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets, Membership Function, Fuzzy rule generation, Fuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations,Aggregation Operations,
Fuzzy Arithmetic, Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations,
Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks,
Application of Fuzzy Logic: Medicine, Economics etc,
An Overview of Genetic Algorithms (GAs), GA operators, GA in problem solving, Implementation of GA

References

1. *Klir and Yuan, Fuzzy Systems, Prentice Hall (2001).*
2. *Vijay Lakshmi, Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, Soft Computing Paradigms, Prentice Hall of India (2008).*
3. *Timothy Ross, Fuzzy Logic, Wiley India (2007) 2nd ed.*

Network System Design

Review of Protocols & Packet Format, Network Systems & the Internet, Network Systems Engineering, Packet Processing, Achieving high speed, Network Speed, Hardware, Software & hybrids, A conventional computer system, Fetch-Store paradigm, Network Interface Card functionality, Onboard address recognition, Packet Buffering, Promiscuous mode

IP Datagram, Fragmentation, Reassembly, Forwarding, TCP Splicing, RISC vs CISC, Network Processors, Ingress & Egress Processing, Parallel & Distributed Architecture, Network Processor Design, Examples of Commercial Network Processors, Overview of Intel Network Processor, Micro engine Programming, Core Programming

References

1. *Network Systems Design using Network Processor, Douglas Comer, Pearson Education, ISBN 81-7808-994 (2004).*
2. *IXP 1200 Programming, Erik J. Johnson and Aaron Kunze, Intel Press (2002).*

Advanced Operating Systems

Multi-core processor architectures, virtualization of guest kernels, monitoring of kernel behaviors, Architectures and internals of open source based operating systems, including Linux and Open Solaris, process and thread management, static and dynamic tracing along with OS performance issues, Tools to observe operating system behavior of Memory, File, Zone, Device management

References

1. *Solaris Internals, Second Edition: Richard McDougall, Jim Mauro, Pearson Education: ISBN: 81-317-1620-1(2009).*
2. *Open Solaris student guide, available from Sun Microsystems.*

Software Engineering for Embedded Systems

Embedded Computers, Characteristics of Embedded Computing Applications, Challenges in Embedded Computing system design, Embedded system design process- Requirements, Specification, Architectural Design, Designing Hardware and Software Components, System Integration, Formalism for System Design- Structural Description, Behavioral Description

Programming in assembly Language and High level language C /C++ and/OR Java. Compilers and Cross compilers, Source Code Engineering Tools, Programme modeling concept in single and multiprocessor system software, Software Engineering Practices in the Embedded software Development Process

OS Services, goals and structures, features, characteristics, process management, memory management, File system organization and implementation, I/O subsystem, Real time task models and performance metrics, Real time features of Vx works, WIN CE, QNX, Nucleus, RT Linux. Network OS, Inter process communication of Processes, Tasks and Threads, OS Security Issues, One case study, Introduction to mobile OS and programming of mobile OS

System-on-a-Chip (SoC), IP Blocks and Design Reuse, Processor Cores and SoC, Non-programmable accelerators, reconfigurable logic, multiprocessing on a chip, symmetric multiprocessing, heterogeneous multiprocessing, use of simulators, Compilers, Loaders, Linkers, locators, assemblers, Libraries, post run optimizer, debuggers, profiling techniques, binary utilities, linker script**,** system simulation, In Circuit Emulation, Validation and verification, Hardware Software partitioning, Co-design

References

1. *Wolf, W., High-Performance Embedded Computing Architectures, Applications, and Methodologies, Morgan Kaufman Publishers (2006).*
2. *Heath, S., Embedded Systems Design, Elsevier Science (2007).*
3. *Fisher, J. A., Faraboschi, P. and Young, C., Embedded Computing - A VLIW Approach to Architecture, Compilers and Tools, Morgan Kaufman (2005).*
4. *Simon, D. E., An Embedded Software Primer, Dorling Kingsley (2005).*

Digital Communication and Computer Networks

Digital data transmission modes, methods and media, Encoding & decoding principles, Identify and describe the protocol data units, networking devices, and purpose of the seven layers of the OSI model and compare that with the TCP/IP protocol stack, Protocols on the transport layer, reliable communication. Routing packets through a LAN and WAN, Link State and Distance Vector, Compare and contrast different data-link protocols including Ethernet, Token Ring and Wireless (802.11).

References

1. *James F. Kuros and Keith W. Ross. Computer Networking: A Top-Down Approach (2002).*
2. *Featuring the Internet, Addison Wesley (2001) 3rd ed.*

Machine Learning

Designing a Learning System, Perspectives and Issues in machine learning, Decision Tree learning, Appropriate problems for decision tree Learning, Basic Decision tree learning algorithms, Issues in Decision tree learning, Estimating Hypothesis accuracy, Comparing learning algorithms, Analytical Learning: Inductive and Analytical learning problems, Explanation based learning of search control knowledge

Introduction to Regular Expression and Finite Automata, Follow Automata, Conversion of DFA to RE using vertical and horizontal chopping, Multi-node loop, Reducing NFAs by invariant equivalences, Finite automata on infinite words and trees, Finite automata and monadic second order (MSO) logic on words and trees, Decidability of MSO theory of various infinite graphs, Application of Regular expression in Natural Language processing, Finding pattern in DNA and protein sequence, grep in Unix, Regular expression in Scheduling of process, Regular expression in perl, Context free grammar and Parsing, Application of context free grammar in Markup language and XML

References

1. *Tom M. Mitchell, Machine Learning, Tata McGraw Hill (1997).*
2. *Nils J. Nilsson, Introduction to Machine Learning, Online available at http://ai.stanford.edu/~nilsson/mlbook.html.*
3. *E. Hopcroft and J.D. Ullman, Introduction to Automata Theory, Narosa (2002).*
4. *Stephen Marsland, Machine Learning and Pattern Recognition, Chapmanand and Hall/CRC (2009).*
5. *John Levine, Tony Mason, Doug Brown, Lex and Yacc, O'REILLY (1992).*
6. *E. Hopcroft and J.D. Ullman," Introduction to Automata Theory, Languages of Computations", Addison-Wesley (2006).*
7. *Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman Compilers: Principles, Techniques, and Tools, Dorling Kingsley (2008) 2nd ed.*

Client – Server Based IT Solutions

Concept of Client-Server Technology, Client-Server Technology and Heterogeneous Computing, Costs and Benefits of Client Server Computing Implementation and Scalability, Client-Server Model, Motivation, Terminology and Concepts, Applications, Concurrency in Network, Concurrency in Clients, Concurrency in Servers, Context Switching and Protocol Software Design, Advantages of concurrency, Classful and classless addressing

Interprocess communication using pipes, FIFO or named pipes, Mutex and Condition variables, Record locking, IPC facilities: Message passing, Semaphores, shared memory, Multitasking with Processes and Threads, Scheduling, Synchronization, Memory, Communications, TCP Client algorithms, Socket Interface, Programming a UDP Client. The Conceptual Server algorithm, Basic Types of Servers and their comparisons, Interactive Server algorithms, Concurrent Server algorithms, Problem of Server Deadlock, Architecting Portable Application Code, Architecting Platform-Independent Source-Code, Operating System / Communications/ File System independent modules, Client Server Applications Architecting using Frameworks

References

1. *Douglas E. Comer, David L. Stevens, Inter-networking with TCP/IP: Client Server Programming and Applications: Vol. III, PHI (1996).*
2. *Jaffrey D. Schank, Client server Applications and Architecture, BPB Novell press (2000).*
3. *Douglas J. Reilly, Client-server Developers guide, Addision Wesley Developers press (1999).*

Web Services

Managing the web services specifications, key components, tools and vendors, advantages of web services, disadvantages and pitfalls of Web Services, comparison of web services and other technologies, Goals, SOA, Major components of the architecture SOAP, XML, HTTP, Cookies, WSDL, XML schema, UDDI, Interactions between components

Introduction to Semantic Web: Web2.0, Web3.0, Grammar rules,namespace schema ,RDF,RDFS,OWL, ontologies, Creating web services with state-of-the-art tolls like Apache Axis, Java (J2EE), .NET, IBM Web sphere, creating web services clients, comparison of various web services tools, Web service interoperaibility, security, and future of web services

References

1. *Understanding Web Services, XML, WSDL, SOAP, and UDDI, Eric Newcomer (2002).*
2. *Web Technologies: A complete Science Perspective, Jeffrey C. Jackson,, Pearson Education(2007).*
3. *Understanding SOA with Web Services, Eric Newcomer, Greg Lomow, Pearson Education (2004).*

Aspect Oriented Programming

Evolution of programming methodologies, What are aspects and how are they useful, OOPS Vs. AOP, What kind of problems can AOP solve, Tips and tricks for effective use of AOP , different AOP tools, importance of AOP in software development, Global trends in software development using AOP, Thinking aspects - in software design, code and testing. Writing and deploying reusable aspects, Using AOP to get more value from design patterns, Writing efficient AOP code Separation of concerns, point-cuts, Static aspects Dynamic aspects, Introduction to AspectJ, Meta-AspectJ, String templates, Template meta-programming, Domain modelling, Model transformations, Model-driven Architecture (MDA) , Embedding Domain-specific Languages

References

1. *Siobhán Clarke, Elisa Baniassad , "Aspect-Oriented Analysis and Design: The Theme Approach", Addison-Wesley Object Technology Series (2005).*
2. *Ivan Kiselev, "Aspect-Oriented Programming with AspectJ", SAMS (2002).*
3. *Ramnivas Laddad, "AspectJ in Action: Practical Aspect-Oriented Programming", Manning (2003).*
4. *Adrian Colyer, Andy ClementGeorge Harley Matthew Webster, " Eclipse AspectJ: Aspect-Oriented Programming with AspectJ and the Eclipse AspectJ Development Tools", Addison-Wesley Professional (2004).*
5. *Kleppe, Anneke G. "The model driven architecture : practice and promise", Addison-Wesley (2003).*
6. *The AspectJ Programming Guide. Available at:* http://www.eclipse.org/aspectj/doc/released/progguide/index.html.

Software Product Assurance

Introduction, Visibility, Traceability, Lifecycle, Changes, Baselines, Baseline Update, Software Configuration, Product Integrity, Element of Software Product Assurance, Establishing and Maintaining Control, Knowing about Discrepancies in Software products, Bookkeeping

References

1. *William L. Bryan, Software Product Assurance, Prentice Hall*

Software Metrics

Measurement in everyday life, measurement in software engineering, scope of software metrics, representational theory of measurement, measurement and models, measurement scales, meaningfulness in measurement, goal-based framework for software measurement, classifying software measures, determining what to measure, software measurement validation, empirical investigation, types of investigation, planning and conducting investigations, Metrics data collection and analysis: What is good data, how to define the data, how to collect the data, how to store and extract data, analyzing software-measurement data, frequency distributions, various statistical techniques

Measuring size, aspects of software size, length, functionality and complexity, measuring structure, types of structural measures, control-flow structure, modularity and information flow attributes, data structures, Modeling software quality, measuring aspects of software quality, software reliability, basics of software reliability, software reliability problem, parametric reliability growth models, predictive accuracy, recalibration of software-reliability growth predictions, importance of operational environment, wider aspects of software reliability, The intent of object-oriented metrics, distinguishing characteristics of object-oriented metrics, various object-oriented metric suites LK suite, CK suite and MOOD metrics, Runtime Software Metrics, Extent of Class Usage, Dynamic Coupling, Dynamic Cohesion, and Data Structure Metrics, The intent of component-based metrics, distinguishing characteristics of component-based metrics, various component-based metrics, Measuring productivity, teams, tools, and methods.

References

1. *Norman E. Fenton and Shari Lawrence Pfleeger, Software Metrics: A rigorous and Practical Approach, International Thomson Computer Press (1997) 2nd ed.*
2. *Capers Jones, Applied Software Measurement, McGraw Hill (2008).*
3. *Mark Lorenz, Jeff Kidd, Object-Oriented Software Metrics, Prentice Hall (1994).*
4. *Robert B Grady, Practical Software Metrics For Project Management And Process Improvement, Hewlett Packard Professional Books (2004) 1st ed.*

Real Time Software and Systems

Real Time Software (RTS), Characteristics of RTS, Real Time Operating Systems (RTOS), Types of RTOS, Characteristics of RTOS, Processors and micro controllers of RTS, Skill set required for various types of RTS, SDLC for RTS, Process models for RTS-SPIRAL, incremental Xtreame, prototyping, RAD, Risk & Failure Analysis

RT requirement eliciation and analysis using structured and object-oriented approach, Applications of formal methods for requirement specification, Architecture properties, RT Architecture, design temporal & non temporal, Techniques, scheduling- (Tasks, T&S, RM scheduling), verification& validation, test strategy, RTS test techniques, Introduction to languages used for development of RTS, Introduction to Tools

References

1. *Alan C Shaw: Real-Time Systems and software, John Wiely and Sons (2001).*
2. *Philip Laplante: Real-Time Systems and design and analysis, an engineer's handbook, IEEE computer society press (2004) 3rd ed.*
3. *J. E .Cooling:Software design for Real-Time Systems, Chapman and Hall(1991).*
4. *Krishna M Kavi, Real-Time Systems, abstraction, languages and design methodologies, IEEE Computer Society press (1998).*

Image and Video Processing

Digital image representation, fundamental steps in image processing, elements of digital image processing systems digitization, A Simple Image Model, Sampling and Quantization, Relationship between Pixel, Image Formats, Image Transforms, Histogram processing, image subtraction, image averaging, smoothing filters, sharpening filters, enhancement in frequency and spatial domain, low pass filtering, high pass filtering

Fundamentals, Image Compression Models, Elements of Information Theory, Error-Free Compression, Lossy Compression, Recent Image Compression Standards, Introduction to Digital Video, Spatial and Temporal Redundancy, Entropy Coding, Motion Estimation, I, B, P Pictures, Generic Inter-Frame Video Codec, Recent Video Compression Standards, Video Surveillance, Video Coding for Broadcasting Applications, Content based Video Databases

References

1. *Gonzalez, R.C., and Woods, R.E., Digital Image Processing, Dorling Kingsley (2009) 3rd ed.*
2. *Jain A.K., Fundamentals of Digital Image Processing, Prentice Hall (2007).*
3. *Tekalp A.M., Digital Video Processing, Prentice Hall (1995).*
4. *Ghanbari M., Standard Codecs: Image Compression to Advanced Video Coding, IET Press (2003).*
5. *Sonka M., Image Processing and Machine Vision, Prentice Hall (2007) 3rd ed.*
6. *Wang Y., Ostermann J., and Zhang Y., Video Processing and Communications, Prentice Hall (2001).*

Grid Computing

Definition of Grid, history and evolution of Grid Computing, Virtual Organizations, Computational Grid projects around the world, Grid challenges, Grid organizations, Service Oriented Architecture (SOA), Issues in Management of Grid Models, Components of Layered Grid Architecture, Open Grid Services Architecture (OGSA), Grid architecture models, Grid Resource Information Service (GRIS). Resource infrastructure, Globus: Overview, resource specification language, information services, Globus Resource Allocation Manager (GRAM), job submission with managed-job-globusrun, security, scheduling, Grid FTP protocol, overview of other middleware like Condor, Condor-G

Resource Discovery and Information Services, Information directory services, schedulers and resource brokers, Characterization of resource management problems based on job requirements, algorithms, tools and sample resource management systems, Monitoring, Scheduling, Performance tuning, Debugging and performance diagnostic issues, Grid security demands and solutions; authentication, authority, assurance, accounting, trust, group communication for large-scale, dynamic, multi-organization environments, Functionality and underlying infrastructure for sample general and application specific portals, Key issues for data management in Grids, including file transfer, data replication, data caching issues, catalog issues, Topics from Seti project, Sun Grid engine, EuroGrid and some other national grid projects, Overview of Grid simulation, Grid Economy, Semantic Grid, Autonomic Grid, Cloud Computing.

References

1. *Foster, I. and Kesselman, C. (eds.). The Grid: Blueprint for a New Computing Infrastructure. Morgan Kaufmann Publishers, (1999).*
2. *Luis Ferreira et al., Grid Computing in Research and Education, ibm.com/redbooks, (September 2003).*
3. *Joshy Joseph and Craig Fellenstein, Grid Computing, Person Edition, (2004).*
4. *Ahmar Abbas, Grid Computing: A Practical Guide to Technology and Applications, Firewall Media (2004).*
5. *Maozhen Li, Mark Baker, "The Grid Core Technologies", John Wiley & Sons, (2005).*

Mobile and Wireless Network Security

Cryptographic protocols for mobile & wireless networks, management issues in mobile and wireless computing, privacy and anonymity in wireless computing, security architecture & protocols in WLANs, B3G/4G mobile networks, security and privacy in mobile and wearable devices, sensors to enable security, security and privacy in pervasive computing.

References

1. *Atul Kahate , Cryptography and Network Security, TMH*
2. *RK Tewari, PK Sastry KV Ravi Kumar, Computer Crime and Computer Forensics, Select Publishers Delhi*
3. *William Stallings, Cryptography and Network Security - Principles and Practice, PHI*

Meshups

Transclusion: Client and Server based remixing of Information. Working with XML, Validating XML content, Online bookmarking, Designing, Creating and Publishing Blogs, RSS, Wikis, Bookmark sharing, Folksonomies and tagging, Tag cloud to blogs, Online sharing, RDF, Design, Create and Publish, Webcasts, AudioPodCasts, VideoPodCasts, Screencasts, Using Camtasia, Create API for use with Meshups, reuse API from Google/ Yahoo/ Microsoft: GIS / Maps / Satellite tools, Use SWX API with social networking sites like: Flickr or Twitter

References

1. *Raymond Yee, Pro Web 2.0 Mashups: Remixing Data and Web Services, ISBN(Feb 2008).*
2. *Scott Davis, Google Maps API V2 at (*http://www.pragprog.com/titles/sdgmapi2/google-maps-api-v2*).*

Security Issues in Web-based systems

Threats, enforcing security, authentication processes, encryption of data, defensive programming and ethical hacking in addition to ASP.NET

References

1. *Mark Burnett , Hacking the Code: ASP.NET Web Application Security*
2. *Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, Terron Williams, Gray Hat Hacking, The Ethical Hackers Handbook, 3rd Edition*

Component Based Development

Component Definition: Definition of Software Component and its Elements. Component Models and Component Services: Concepts and Principles, COTS Myths and Other Lessons Learned in Component-Based Software Development, Roles for Component-Based Development, Common High Risk Mistakes in Component-Based Software Engineering, CBSE Success Factors: Integrating Architecture, Process, and Organization, Software Engineering Practices: The Practice of Software Engineering, From Subroutines to Subsystems: Component-Based Software Development, The Design Of Software Component Infrastructures: Software Components and the UML, Component Infrastructures: Placing Software Components in Context, Business Components, Components and Connectors: Catalysis Techniques for Defining Component Infrastructures, An Open Process for Component-Based Development, Designing Models of Modularity and Integration

The Management Of Component-Based Software Systems: Measurement and Metrics for Software Components, The Practical Reuse of Software Components, Selecting the Right COTS Software: Why Requirements are Important, Software Component Project Management Processes, The Trouble with Testing Software Components, configuration Management and Component Libraries, The Evolution, Maintenance and Management of Component-Based Systems, Component Technologies: Overview of the CORBA Component Model, Transactional COM+: Designing Scalable Applications, The Enterprise JavaBeans Component Model, Choosing Between COM+, EJB, and CCM, Software Agents as Next Generation Software Components, Legal And Regulatory: CBSE as a Unique Engineering Discipline, The Future of Software Components: Standards and Certification, Commercial Law Applicable to Component-Based Software, The Effects of UCITA on Software Component Development and Marketing, Future of CBSE

References

1. *Daniel Wygant, COM/DCOM Unleashed, Macmillan Publishing (1999).*
2. *Dale Rogerson, Inside COM Programming Series, Microsoft Press (1997).*
3. *Singly and Panos, Professional COM Applications with ATL, Wrox Press (1995).*
4. *Don Box; Essential COM, Addison-Wesley (2002).*
5. *Tom Armstrong; The Active Template Library: A Developers Guide, IDG Books (1997).*

Advanced Computer Architecture

Parallelism in uniprocessor system; parallel computer structure, architectural classification schemes, Memory hierarchy, Virtual memory system, memory allocation and management, cache memory management, Instruction and arithmetic pipelines design, linear and non-linear pipeline pipeline processors, superscalar and superpipeline design, SIMD array processors, SIMD interconnection network, Associative array processors

Multiprocessor architecture (loosely coupled, tightly coupled), interconnection networks, cache coherence and synchronization mechanism multiprocessor operating systems, exploiting concurrency, Special architecture: Dataflow architecture, VLSI computing structure

References

1. *A Quantitative Approach by David A. Patterson, John L. Hennessy, David Goldberg, MKP (2006) 3rd ed.*
2. *Parallel Computer Architecture: A Hardware/Software Approach David Culler and J.P. Singh with Anoop Gupta, Morgan Kaufmann (August 1998).*
3. *High-performance Computer Architecture, by Harold Stone Addison Wesley (1993) 3rd ed.*

Software Engineering Concepts and Methods

History; definitions; why engineered approach to software development; Software development process models from the points of view of technical development and project management: waterfall, rapid prototyping, incremental development, spiral models, Agile Software Development, Emphasis on computer-assisted environments. Selection of appropriate development process, Formal, semi-formal and informal methods; Requirements elicitation, requirements specification; Data, function, and event-based modeling; Some of the popular methodologies such as Yourdons SAD, SSADM etc; CASE tools-classification, features, strengths and weaknesses; ICASE; CASE standards

Principles of software projects management; Organizational and team structure; Project planning; Project initiation and Project termination; Technical, quality, and management plans; Project control; Cost estimation methods: Function points and COCOMO, Quality control, quality assurance and quality standards with emphasis on ISO 9000; Functions of software QA organization does in a project; interactions with developers; Quality plans, quality assurance towards quality improvement; Role of independent verification & validation; Total quality management; SEI maturity model; Software metrics, Need for configuration management; Configuration management functions and activities; Configuration management techniques; Examples and case studies, Basic Terminology, Testing Techniques and strategies, Brief introduction to various standards related to Software Engineering

References

1. *Pressman, Roger, Software Engineering - A Practitioners Approach, McGraw Hill (2008) 6th* ed.
2. Sommerville*, Ian, Software Engineering, Addison-Wesley Publishing Company, (2006) 8th* ed.
3. *Peter, James F., Software Engineering - An Engineering Approach, John Wiley (2004).*
4. Jalote*,* Pankaj*,* An *integrated Approach to Software Engineering,* Narosa *(2005).*

Statistical Methods and Algorithms

Nature and objectives of research, Study and formulation of research problem, Scope and formulation of hypothesis, Preparation and presentation of research proposal using statistical package, Appraisal of axiomatic approach of probability, Conditional probability, Baye's rule, Conditional distributions, and conditional expectations, Basics of markov chains, Finite state space, Markov chains, Transition and stationary markov chains. Continuous time markov process: continuous time branching processes, Kolmogorov, Forward and backward equations, Pure birth, Pure death, Birth and death process

One Way Classification: ANOVA for fixed effect model, ANOVA for Random Effect Model, Two-way Classification (one observation per cell): ANOVA for fixed effect model, ANOVA for Random Effect Model, Completely Randomised Design, Randomised Block Design, Latin Square Design, their statistical analysis and variance of estimates, Analysis of Covariance, Introduction, multivariate normal distributions, Mean vector, Variance-covariance matrix, Correlation matrix and their estimation for multivariate data., Step wise regression, Selection of best set of variables, Classification and discrimination problems. Factor analysis and principal component analysis. Illustrative examples and Multivariate data analysis using statistical package

Components of time series, Analysis of time series, Measurement of trend, Measurement of seasonal variations , Measurement of cyclic variations , Auto-Regression Analysis, Auto-correlation , Random component in time series, Implementation of statistical techniques using statistical packages viz. SPSS, Mathematica including evaluation of statistical parameters and data interpretation, Regression Analysis, covariance, Analysis of variance, multivariate data analysis and problems based on time series and forecasting

References

1. *Medhi, J., Stochastic Processes, New Age International (2005).*
2. *Populis,A., Random Variables and Stochastic Processes, Tata McGraw Hill (2002).*
3. *Montgomery, Introduction to Statistical Quality Control, John Wiley and Sons (2005).*
4. *Bhuyan,K.C., Multivariate Analysis and Its Applications, New Central Book Agency (2002).*
5. *Anderson,T.W., An Introduction to Multivariate Statistical Analysis, John Wiley and Sons (2003).*
6. *Goon, Das, Gupta, Fundamental of Statistics Vol.-II, World Press (1999).*

Advanced Data Structure

Arrays, linked lists, stacks, queues, binary trees, hashing, graphs, sorting & searching techniques, Properties of sparse matrices, Linked list representation of sparse matrices, Properties of threaded trees, insertion, deletion and traversal, Properties of AVL trees, rotations, insertion and deletion, Properties of red-black trees, rotations, insertion and deletion, Definition of B-trees, basic operations on B-trees, deleting a key from a B-tree, Properties of Min-max heaps, building a heap, basic operations on heaps, application of min-max heaps

Binomial tress and binomial heaps, operations on binomial, Structure of Fibonacci heaps, merge able heap operations, decreasing a key and deleting a node, bounding a maximum degree, Disjoint set operations, linked list representation of disjoint sets, disjoint set forests, Topological sort, minimum Spanning tree, single-source shortest paths, all-pairs shortest paths, bi-connected components, strongly connected components, cycles, articulation points, bridges, string-matching algorithm, Rabin-Karp algorithm, String matching with automata, Knuth-Morris-Pratt algorithm, Boyer-Moore algorithm

References

1. *Thomas* Coremen*, Introduction to Algorithms, Second edition, Prentice Hall of India (2007) 2nd* ed*.*
2. *Mark Allen Weiss, Data Structures & Algorithm analysis in C, Dorling Kingsley (2002) 3rd* ed*.*
3. *T*annenbaum*,* Augenstein *and* Langsam*, Data Structures using C and C++, Dorling Kingsley (2008) 3rd* ed*.*