SEMESTER I

CS601 - Mathematical Foundation for Computer Science

Credits: 3

Objectives

- To impart the fundamental concepts of logic, abstract algebra, and linear algebra.
- To impart probability, graph theory, etc.

Unit I Functional Logic

Logical Statements – Normal forms – Predicate calculus – Inference – Theory for Statement Calculus and Predicate Calculus –Resolution Proof system. Congruence, Fermat's theorem, Euler function, Chinese remainder theorem.

Unit II Combinatory and Probability

Review of Permutation and Combination - Mathematical Induction - Pigeon hole principle - Principle of Inclusion and Exclusion - generating function- Probability Distribution Counting- Discrete random variable - Continuous random variable – inequality - geometric and binomial distributions.

Unit III Algebraic Structures

Semi goup - Monoid – Groups - Cyclic group - Permutation group(Sn and Dn) - Substructures - Homomorphism of semi group - monoid and groups - Cosets and Lagrange Theorem – Normal Subgroups - Rings and Fields.

Unit IV Recursive Functions, Graphs and Trees

Recursive functions - Primitive recursive functions - computable and non - computable functions- Graphs - Euler tours - planar graphs - Hamiltonian graphs - Euler's formula - applications of Kuratowski's theorem - graph colouring - chromatic polynomials – trees - weighted trees - the maxflow min-cut theorem.

Unit V Latticesand Complexity Classes

Partial order relation, poset - Lattices, Hasse diagram - Boolean algebra.- Turing Machines- Recursive and Recursively Enumerable languages. - Cantor’s Diagonalization theorem.- NP-Hard and NP-complete Problems - Cook's theorem NP completeness reductions.

Outcomes

- Ability to apply mathematical foundations in many areas of computer science like algorithms, computer networks, cryptography, etc.

Teaching and Evaluation guidelines

- 50% on Problems, and 30% on Theorems, and 20% on Proofs.

Text Books

1. Kenneth Hoffman, “Linear Algebra”, Second Edition, PHI Learning, 2015.

2. Gersting J.L., “Mathematical Structure for Computer Science”, Seventh Edition,W.H. Freeman and Co., 2014.
3. Donald F. Stanat and David F. McAllister, “Discrete mathematics in Computer Science”, Pearson education 1977.

References

1. K.H. Rosen, “Discrete Mathematics and its Applications”,Seventh Edition McGraw Hill Education, 2011.
2. Lidl and pitz, “Applied Abstract Algebra”,Second Edition, Springer, 1998.

CS603- ADVANCED DATA STRUCTURES AND ALGORITHMS

Credits: 3

Objectives

- To introduce and practice advanced algorithms and programming techniques necessary for developing sophisticated computer application programs.
- To impart various programming constructs such as divide-and-conquer, backtracking, and dynamic programming.
- To impart new techniques for solving specific problems more efficiently and for analyzing space and time requirements.

Unit-I Algorithmic Notations and Basic Data Structures

Introduction to Algorithms: Review of order notation and growth of functions – recurrences - probability distributions – average case analysis of algorithms. Basic data structures: stacks - queues - linked lists and applications.

Unit-II Hashing and Binary Trees

Hashing: Direct access tables and hash tables - hash functions and relates analysis. Trees: Binary Search trees and Operations - AVL Trees and balancing operations - Red Black Trees and operations.

Unit-III Graph Algorithms

Graphs: BTrees – definition – properties - operations, data structures for disjoint sets. Graph algorithms : MST single source all pair shortest paths – BFS – DFS - topological sort - strongly connected components.

Unit-IV Concurrent Data Structures

Linked List- The Role of Locking- List Based Sets-Concurrent Reasoning-Coarse Grained Synchronization-Fine Grained Synchronization-Optimistic synchronization-Lazy Synchronization, Concurrent stacks and elimination.

Unit-V Algorithmic Paradigms

Algorithmic paradigms: Greedy Strategy - Dynamic programming - Backtracking - Branch and Bound - Randomized algorithms.

Outcomes

- Ability to understand techniques such as brute force, greedy, and divide and conquer.
- Ability to understand advanced Abstract Data Type (ADT) and data structures in solving real world problems.

Evaluation Guidelines

- 40% on Problems (Higher Order Thinking), and 40% on Comparisons and Statements(Medium Order Thinking), and 20% on Definitions (Lower Order Thinking).

Text Books

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest," Introduction to Algorithms", Third Edition, Prentice hall, 2015.
2. M. Herlihy and N. Shavit, "The Art of Multiprocessor Programming", Morgan Kaufmann, 2012.
3. H. S. Wilf, "Algorithms and complexity", Second Edition, Prentice hall, 2003.

References

1. Research Papers published in IEEE, ACM, Elsevier publishers, etc.

CS605- ADVANCED CONCEPTS IN OPERATING SYSTEM

Credits: 3

Objectives

- To impart the characteristics of Operating System (OS) in Multiprocessor and Multicomputer.
- To impart the issues related to designing OS.
- To impart the latest trends in building Mobile OS.

Unit-I Multiprocessor Operating Systems

System Architectures: Structures of OS – OS design issues. Process synchronization: Process Scheduling and Allocation- memory management.

Unit-II Distributed Operating Systems

System Architectures: Design issues – Communication models – clock synchronization. Mutual exclusion: Election algorithms- Distributed Deadlock detection- Distributed scheduling.

Unit-III UNIX Processes

The Environment of a UNIX Process- main function- Process termination- command-line arguments-Environment List- Memory Layout of a C Program- Shared Libraries- Memory Allocation- Environment Variables- setjmp and longjmp functions- getrlimit- setrlimit function- UNIX Kernel Support for Processes.

Unit-IV Process Control and Signals

Process Identifiers- fork- vfork- exit- wait- waitpid- race conditions- exec functions- changing user ids- Interpreter files- systems function- Process Accounting- User Identification- Process Times. Signals : The Unix Kernel Support for Signals- Signal Mask- sigaction- the SIGCHLD signal and waitpid function- the sigsetjmp and siglongjmp functions- kill-alarm- Interval Timers.

Unit-V Daemon Processes and Inter Process Communication

Daemon Processes: Daemon Characteristics-Daemon Conventions- client-servier Model. Inter Process Communication: Pipes-popen- pclose-FIFOs- Message Queues- Semaphores.

Outcomes

- Ability to understand advanced concepts in OS
- Ability to develop OS for distributed systems
- Ability to develop modules for mobile devices

Evaluation Guidelines

- 30% on Design(Higher Order Thinking), and 40% on Architecture, Structure, and Models (Medium Order Thinking) and 30% on Techniques(Lower Order Thinking).

Text Books

1. M Singhal and NG Shivaratri, “Advanced Concepts in Operating Systems”, First Edition, Tata McGraw Hill Inc, 2011.
2. W. Richard Stevens, Stephen A. Rago “Advanced Programming in the UNIX Environment”, Third Edition, Pearson Education/PHI, 2013.

References

1. A S Tanenbaum, “Distributed Operating Systems”, Fourth Edition, Pearson Education Asia, 2009.
2. Research Papers published in IEEE, ACM, Elsevier publishers, etc.

CS607- ADVANCED NETWORK PRINCIPLES AND PROTOCOLS

Credits: 3

Objectives

- To impart the architecture of the Internet protocols as a layered model.
- To impart the fundamentals of data transmission, encoding, multiplexing.
- To impart the various components of wide area networks and local area networks work together

Unit-I Introduction and Data link Layer

Introduction to Networks: Applications- Architecture - Topology – Switching. MAC Protocols: SLIP - PPP- ALOHA protocols – CSMA/CD -IEEE802.3 – IEEE 802.4 – IEEE 802.5 - CSMA/CA - IEEE 802.11 - IEEE 802.15.4 – IEEE 802.16.

Unit-II Network Layer Issues and Protocols

Network Layer: Issues - Routing - Congestion control. Inter networking: Issues –Address Learning Bridges – Spanning tree -Source routing –Bridges – Routers - Gateway.

Unit-III Advanced Network Layer Protocols

Network Protocols: IPV4 – IPV6 - IP datagram - Routing Protocols (RIP, BGP, OSPF) – ARP – RARP - DHCP - Subnet Addressing - Classless Interdomain Routing (CIDR).

Unit-IV Transport Layer Issues and Protocols

Transport Layer: Design issues -Connection Management -Transmission Control Protocol (TCP) - User Datagram Protocol (UDP) – Congestion Control Management Protocols – TCP TAHOE – TCP VEGAS – CUBIC

Unit-V Application Layer Issues and Protocols

Application Layer Protocol: SSH -TFTP-FTP-SMTP– DNS – Bootstrap Network Time Protocol-SNMP.

Outcomes

- Ability to understand the different layers of TCP/IP protocol stack
- Ability to analyze the working principle of different protocols at different layers

Teaching and Evaluation Guidelines

- 20% on Synthesis (Higher Order Thinking), 40% on Analysis (Medium order Thinking) and 40% on Conceptual understanding (Lower Order Thinking).

Text Books

1. Andrew S. Tanenbaum and David J. Wetherall, “Computer Networks”, Fifth Edition, Pearson, 2011.
2. William Stallings, "Data and Computer Communications”, Ninth Edition, Pearson, 2011.

Reference Book

1. W Richard Stevens and G. Gabrani, "TCP/IP Illustrated-Volume I, The protocols", Second Edition, Pearson Education, 2011.

CS609-NETWORK PROGRAMMING LABORATORY

Credits: 2

Objectives

- To impart client and server applications using the "Sockets" API and the implementation of Data link layer protocol and TCP layer.
- To impart computer communication network simulations.
- To impart modeling techniques using OPNET or NS-2simulation software.

Experiments

- Exercises on Socket Programming using Java.
- Exercises using NS3 Network Simulator.
- Setting up of various network topologies.
- Implementation of various MAC protocols.
- Measurement of routing protocols.
- Analysis of TCP/IP protocol under various mechanisms.
- Setting up network that carries various application protocols and analyzing the performances.
- Analyzing the various performance metrics for different application protocols.

Outcomes

- Ability to understand the working principle of Socket programming.
- Ability to work with the simulators such as OPNET or NS-2 toolkit.

References

1. W. Richard Stevens, "UNIX Network Programming–Networking APIs: Sockets and XTI" Volume1, Third Edition, Prentice Hall, 2010.
2. L. Peterson and S. Davie, "Computer Networks: A Systems Approach – Network Simulation Experiments in OPNET", Fourth Edition, Elsevier, 2008.
3. Research Papers published in IEEE, ACM, and Elsevier publishers.

CS611 - ADVANCED PROGRAMMING LABORATORY

Credits: 2

Objectives

- To impart the features of object oriented programming.
- To impart various programming constructs.
- To impart the OS internals.

Experiments

- Exercises using Linux tools – Grep, awk, tr
- Exercises using Linux IPC and system calls
- Exercises in Python/C++/ Java

Outcomes

- Ability to develop shell scripts for various applications.
- Ability to gain in-depth knowledge about OS internals.
- Ability to understand Object oriented concepts and developing software modules.

References

1. Arnold Robbins, Nelson H. F. Beebe," Classic Shell Scripting", O'Reilly Media, 2005
2. H. Schildt, "Java: The Complete Reference", ninth Edition, McGraw-Hill Education. 2014.
3. H. Schildt "C++: The Complete Reference", Fourth Edition, McGraw-Hill Education (India) Pvt Limited, 2003.
4. Mark Lutz "Learning Python", Fifth Edition, O'Reilly Media, 2013.
5. Research Papers published in IEEE, ACM, Elsevier publishers, etc.

SEMESTER-II

CS602- ADVANCED DATABASE MANAGEMENT SYSTEM

Credits: 3

Objectives

- To impart the basic concepts and terminology related to DBMS and Relational Database Design
- To impart advanced DBMS techniques to construct tables and write effective queries, forms, and reports
- To impart the concept of a database transaction and related database facilities, including concurrency control, journaling, backup and recovery, and data object locking and protocols.

Unit-I Introduction

Formal review of relational database and FDs Implication – Closure - its Correctness.

Unit-II Basic Algorithms

3NF and BCNF - Decomposition and synthesis approaches - Review of SQL99 - Basics of query processing - external sorting - file scans.

Unit-III Advanced Concepts

Processing of joins - materialized vs. pipelined processing - query transformation rules - DB transactions - ACID properties - interleaved executions – schedules – serializability.

Unit-IV Lock Based Protocols

Correctness of interleaved execution- Locking and management of lock - 2PL – deadlocks - multiple level granularity - CC on B+ trees - Optimistic CC.

Unit-V Log Based Recovery and Database System Architectures

T/O based techniques- Multiversion approaches- Comparison of CC methods- dynamic databases- Failure classification- recovery algorithm- XML and relational databases- Parallel databases - Emerging database applications -Recent trends and developments.

Outcomes

- Ability to write complex queries including full outer joins, self-join, sub queries, and set theoretic queries.
- Ability to understand the file organization, Query Optimization, Transaction management, and database administration techniques

Evaluation Guidelines

- 30% on Application (Higher Order Thinking), 50% on Problems and Analysis (Medium Order Thinking) and 20% on Models and Architecture (Lower Order Thinking).

Text Books

1. R. Elmasri and S. B. Navathe, "Fundamentals of Database Systems", SeventhEdition, Pearson Education, 2015.
    a. Silberschatz, H. Korth, S. Sudarshan, “Database system concepts”, Sixth Edition, McGraw Hill, 2011.

References

1. Research Papers published in IEEE, ACM, Elsevier publishers, etc.

CS604 - SEMINAR AND TECHNICAL WRITING

Credits: 2

Objectives

- To develop soft skill**.**
- To understand research papers and prepare presentation material.
- To improve oral communication skills through presentation.
- To prepare original technical write upon the presentation.

Methodology

- To choose the area of interest.
- To identify current literatures.
- To choose state of the art survey paper/research paper.
- To consult and get confirmed with Seminar Coordinator.
- To prepare the PowerPoint presentation on recent trends.
- To present as per schedule drawn by Seminar Coordinator.
- To prepare a technical write-up and submit to Seminar Coordinator.
- To attend Guest lecturers/Seminars and submit the report.

Outcomes

- Improvement in proficiency in English.
- Improvement in presentation skill.
- Improvement in analytical and reasoning ability.
- Improvement in technical writing.

References

1. Research Papers published in IEEE, ACM, Elsevier publishers, etc.

CS606- ADVANCED DBMS LABORATORY

Credits: 2

Objectives

- To explore the features of a Database Management Systems.
- To interface a database with front end tools.
- To impart the internals of a database system.

Experiments

- Basic SQL.
- Intermediate SQL.
- Advanced SQL.
- ER Modeling.
- Database Design and Normalization.
- Accessing Databases from Programs using JDBC.
- Building Web Applications using PHP & MySQL.
- Indexing and Query Processing.
- Query Evaluation Plans.
- Concurrency and Transactions.
- Big Data Analytics using Hadoop.

Outcomes

- Ability to use databases for building web applications.
- Ability to gain knowledge on the internals of a database system.

References

1. R. Elmasri and S. B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2015.
2. Silberschatz, H. Korth, S. Sudarshan, “Database system concepts”, Sixth Edition, McGraw Hill, 2011.
3. Research Papers published in IEEE, ACM, Elsevier publishers, etc.

SEMESTER III

CS613- INTERNSHIP

Credits: 2

Objectives

- To develop institute-industry interaction.
- To know the industry practices.
- To understand cutting edge technology in the chosen area.

Methodology

- To identify industries offering internship by Training and Placement Office.
- To identify industries offering internship by students in consultation with the Internship. Coordinator (Faculty) and Training and Placement Office.
- To avail during summer vacation (not more than 3 months).
- To submit a report based on the work done during internship to the Internship Coordinator.

Outcomes

- Exposure to industry practices.
- Strengthened institute-industry relationship.
- Bridging academic knowledge with industry input.

SEMESTER I

ELECTIVES

CS651 - CLOUD COMPUTING

Credit: 3

Objectives

- To impart an in-depth and comprehensive knowledge of the Cloud Computing.
- To impart the frontier areas of Cloud Computing.
- To shed light on the Security issues in Cloud Computing.

Unit-I Introduction to Computing

History of Centralized and Distributed Computing – Overview of DistributedComputing - Cluster Computing – Grid computing. - Technologies for Network basedsystems- System models for Distributed and cloud computing - Software environments for distributed systems and clouds.

Unit-II Introduction to Cloud Computing

Cloud issues and challenges – Properties – Characteristics - Service models – Deployment models – Cloud resources - Network and API - Virtual and Physical computational resources - Data-storage – Virtualization concepts – Types of Virtualization - Introduction to Various Hypervisors – High Availability (HA) / Disaster Recovery (DR) using Virtualization - Moving VMs.

Unit-III Cloud Services

Service models- Infrastructure as a Service (IaaS) – Resource Virtualization: Server, Storage – Network – Case studies - Platform as a Service (PaaS) – Cloud platform & Management: Computation, Storage – Case studies. - Software as a Service (SaaS) – Web services- Web2.0- Web OS – Case studies – Anything as a service (XaaS).

Unit-IV Cloud Programming and Software Environments

Parallel and Distributed Programming paradigms – Programming on Amazon AWS and Microsoft Azure – Programming support of Google App Engine – Emerging Cloud software Environment.

Unit-V Cloud Access

Authentication, authorization and accounting – Cloud Provenance and metadata - Cloud Reliability and faulttolerance – Cloud Security – privacy – policy and compliance - Cloud federation, interoperability and standards.

Outcomes

- Ability to explain the core issues of cloud computing such as security, privacy and interoperability.
- Ability to provide the appropriate cloud computing solutions and recommendations according to the applications used.

Teaching and Evaluation guidelines

50% on Analysis (Higher Order Thinking), and 30% on Paradigms (Medium Order Thinking), and 20% on Terms and Terminologies (Lower Order Thinking)

Text Book

1. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, "Distributed and cloud computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Elsevier, 2013.

Reference Books

1. Barrie Sosinsky, "Cloud Computing Bible" John Wiley&Sons, 2011.
2. Tim Mather, Subra Kumaraswamy and Shahed Latif, Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance, O'Reilly, 2009.
3. Research Papers published in IEEE, ACM, and Elsevier publishers

CS653 - COMPUTER GRAPHICS AND IMAGE PROCESSING

Credit: 3

Objectives

- To impart basic algorithms for computer graphics and image processing.
- To impart various filters, Point processing, and Arithmetic operations in image processing.

Unit-I Graphics System and Graphical User Interface

Pixel, Resolution, Video display devices - Types – Graphical devices – Direct screen interaction – Logical input function –GKS. User dialogue – Interactive Picture construction techniques.

Unit-II Geometric Display Primitives and Attributes

Geometric display primitives: Points, Lines and Polygons. Point display method – Line drawing: DDA 2D Transformations and Viewing, Transformations - types – matrix representation – Concatenation - Scaling, Rotation, Translation, Shearing, Mirroring. Homogeneous coordinates – Window to view port transformations. Windowing and Clipping: Point, Lines, and Polygons - boundary intersection methods.

Unit-III Digital Image Fundamentals

Image Formation and types – Basic geometric transformations – Fourier Transforms – Walsh Transforms – Hadamard Transforms – Discrete Cosine – Hotelling Transforms.

Unit-IV Image Enhancement and Restoration

Histogram Modification Techniques – Image Smoothening –Image Sharpening – Image Restoration – Degradation Model – Noise Models – Spatial Filtering –Frequency Domain Filtering.

Unit-V Image Segmentation and Recognition

Detection of Discontinuities – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Morphology operations. Pattern classification -Clustering and Matching - Knowledge representation and use for scene analysis and image understanding (2D and 3D) - Object recognition and identification – Case study of various applications.

Outcomes

- Ability to create software tools for Games and Animation
- Ability to understand Computer Graphics and Image Processing Techniques

Evaluation Guidelines

- 50% on Applications, and 30% on Comparisons and Statements, and 20% on Definitions.

Text Book

1. Donald Hearn & M. Pauline Baker, and Warren R. Carithers, “Computer Graphics”, Fourth Edition, Prentice-Hall of India, 2011.

Reference Book

1. Newmann W.M. and Sproull R.F., “Principles of Interactive Computer Graphics”,Second Edition, Tata McGraw-Hill, 2008.

CS655 - OPEN SOURCE PROGRAMMING

Credits: 3

Objectives

- To impart Open Source Programming concepts.
- To impart applications based on Open Source Soft wares.

Unit-I Introduction

Introduction to open source programming languages: advantages and drawbacks - threats and vulnerabilities - Introduction to shell programming. Operating System – Linux.

Unit-II PHP

PHP Language Basics- Functions - calling a function- variable function - anonymous function, Strings – cleaning- encoding and escaping- comparing strings. Arrays – storing data in arrays- extracting multiple values- traversing- sorting arrays. Objects – creation - introspection- serialization. Web Techniques – processing forms and maintaining state.

Unit-III Web Database Applications

Three-tier architecture - Introduction to Object oriented programming with PHP 5. Database basics: MYSQL - querying web databases - writing to web databases - validation with Javascript - Form based authentication - protecting data on the web.

Unit-IV PERL, TCL and PYTHON

PERL: Numbers and Strings- Control Statements- Lists and Arrays- Files- Pattern matching- Hashes- Functions. Introduction to TCL/TK - Introduction to Python.

Unit-V Security in Web Applications

Recognizing web application security threats: Code Grinder - Building functional and secure web applications - Security problems with JavaScript - vulnerable CGI scripts - Code Auditing and Reverse Engineering - types of security used in applications.

Outcomes

- Ability to develop codes in open source web applications.
- Ability to understand the risks associated with the open source Codes and CGI scripts.

Evaluation guidelines

- 40% on Analysis and synthesis (Higher Order Thinking), 30 % on Application (Medium Order Thinking), and 30% on knowledge and comprehension (Lower Order Thinking).

Text Book

1. Kevin Tatroe, Peter MacIntyre, Rasmus Lerdorf, “Programming PHP”, Third Edition, O’Reilly Media, 2013.

References

1. Research Papers published in IEEE, ACM, Elsevier publishers, etc.

CS657 - ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

Credits: 3

Objectives

- To impart intelligent systems in e-learning, e-commerce, tele-medicine, automation, and bio-technology industries
- To impart an expert system using appropriate knowledge based software tools

Unit-I Overview of Artificial Intelligence

Definition and Importance of Knowledge - Knowledge Based Systems - Representation of Knowledge - Knowledge Organization - Knowledge Manipulation, and Acquisition of Knowledge– Introduction to LISP – PROLOG – Syntax and Functions.

Unit-II Dealing with Inconsistencies and Uncertainties

Introduction. Truth Maintenance Systems - Default Reasoning and the Closed World Assumption - Predicate Completion and Circumscription - Modal and Temporal Logics

Unit-III Search and Control Strategies

Introduction - Preliminary Concepts - Examples of Search Problems - Uninformed or Blind Search - Informed Search - Searching And-Or Graphs. Matching Techniques: Introduction - Structures Used in Matching - Measures for Matching - Matching Like Patterns - Partial Matching

Unit-IV Knowledge Representation

Syntax and Semantics for Propositional logic - Syntax and Semantics for FOPL - Properties of Well Formed Formula - Conversion to Clausal Form - Inference Rules, The Resolution Principle - No deductive Inference Methods - Representations Using Rules – Probabilistic Reasoning: Introduction - Bayesian Probabilistic Inference - Possible World Representations – Dumpster Shafer Theory

Unit-V Knowledge Organization and Management

Introduction - Indexing and Retrieval Techniques - Integrating Knowledge in Memory - Memory Organization Systems. Expert Systems**:** Introduction - Rule Based System Architecture - Non-Production System Architecture - Dealing with uncertainty - Knowledge Acquisition and Validation - Knowledge System Building Tools.

Evaluation guidelines

- 50% on Analysis, and 30% on Systems and Models, and 20% on Tools and Terminologies.

Outcome

- Ability to design, build, and implement an expert system and to provide solutions to real world problems

Text Book

1. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert Systems, Second Edition PHI Learning”, 2009.

Reference Book

1. E. Rich & K. Knight,” Artificial Intelligence”, Third Edition, TMH, New Delhi, 2008.

CS659 - DATA WAREHOUSING AND DATA MINING

Credit: 3

Objectives

- To impart the principles of Data warehousing and Data Mining.
- To impart the various Data preprocessing Methods.

Unit-I Data Warehousing and Business Analysis

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

Unit-II Data Mining

Data Mining: Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation - Architecture Of A Typical Data Mining Systems - Classification Of Data Mining Systems. Association Rule Mining:- Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis - Constraint –Based Association Mining.

Unit-III Classification and Prediction

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

Unit-IV Cluster Analysis

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

Unit –V Mining Object, Spatial, Multimedia, Text and Web Data

Multidimensional Analysis and Descriptive Mining of Complex Data Objects. Spatial Data Mining Multimedia Data Mining. Text Mining. Mining the WWW.

Outcome

- Ability to understand Data Mining principles and techniques for real time applications.

Teaching and Evaluation Guidelines

- 40% on Analysis, Evaluation and synthesis (Higher Order Thinking), and 30% on Application (Medium Order Thinking), and 30% on Knowledge and Comprehension (Lower Order Thinking).

Text Book

1. Jiawei Han, Micheline Kamber and Jian Pei “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2012.

Reference Books

1. Alex Bersonand Stephen J. Smith “Data Warehousing, Data Mining &OLAP”, Fourth Edition(Reprint),Tata McGraw Hill Edition,2007.
2. K.P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Prentice Hall India Learning Private Limited, 2006.

CS661 – INTERNET OF THINGS (IoTs)

Credits: 3

Objectives

- To have a grasp on Data and Knowledge Management and use of Devices in IoT Technology
- To understand State of the Art – IoT Architecture
- To understand real world IoT Design constraints
- To study the security and privacy issues in IoT

Unit-I Introduction

Internet & Web Basics - IoT - The Vision, Applications, IoT Standardization – IoT Components – Sensors – Actuators – Intelligent Analytics – Intelligent Analysis

Unit-II IoT Architecture

Traditional TCP/IP protocol stack and IoT Protocol Stack – Data Formats – Representational State Transfer (REST) and activity streams – Business Aspects and models

Unit-III IoT Communication

Fundamentals- Devices and gateways, Local and wide area networking, Data management, Communication protocols – Constrained Application Protocol (CoAP), Web Socket, PUSH - Everything as a Service (XaaS), Knowledge Management.

Unit-IV IoT Implementation and Security

Introduction to Raspberry Pi, Arduino Boards – Operating System (Micro Python) – Python Programming language – Multiple security levels – Security and Privacy Issues in IoT – Privacy preserving algorithms in IoT – Complexity Analysis of the cryptographic algorithms in IoT.

Unit- V Case Study and implications

Real-World Design Constraints- Technical Design constraints - Data representation and visualization, Interaction and remote control. Case Studies: IoT in Disaster Management System, &IoT in Agriculture – Societal Implications.

Outcomes

- Working ability with Raspberry Pi
- Demonstration of real world IoT application
- To analyze the security constraints in IoT applications

Teaching and evaluation guidelines

- 40% on Design, 40% on Comparisons and Statements, 20% on Techniques and Definitions

Textbook

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, First Edition, Academic Press, 2014.

Reference Books

1. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, First Edition, VPT, 2014.
2. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013

SEMESTER II ELECTIVES

CS652 - DISTRIBUTED SYSTEMS

Credit: 3

Objectives

- To impart broad and up-to-date coverage of the principles and practice in the area of Distributed Systems.
- To understand the heterogeneous systems and their functionalities.

Unit-I Basic Concepts

Distributed systems: Definition -Examples - Resource sharing and the Web Challenges -System models -Architecture and fundamental models. Networking: Inter process communication - External data representation and marshalling – Client-server and Group communication.

Unit-II Distributed Objects and Process

Distributed objects and remote invocation, Communication between distributed objects, Remote procedure call, Events and notifications. Distributed Operating System: Architecture - Protection - Processes and Threads – Communication and invocation. Security techniques: Cryptographic algorithms – Access control – Digital signatures – Cryptography pragmatics, Needham-Schroeder, Kerberos, Securing electronics transaction, IEEE802.11 WiFi.

Unit-III Operating System Issues

Distributed file systems - Name services, Domain name system, Directory and discovery services, Peer to peer systems, Napster file sharing system, Peer to peer middle ware routing overlays – Clocks, Events and process states. Clock Synchronization : Logical clocks - Global states. Distributed debugging. Distributed mutual exclusion: Elections. Multicast communication.

Unit-IV Distributed Transaction Processing

Transactions: Nested transactions - Locks - Optimistic concurrency control – Time Stamp ordering- Flat and nested distributed transactions - Atomic commit protocols - Concurrency control in distributed transactions – Distributed deadlocks – Transaction recovery . Overview of replication, Distributed shared memory and Web services.

Unit-V Distributed Algorithms

Synchronous network model: Algorithms - leader election - maximal independent set.
Asynchronous system model: I/O automata - operations on automata – fairness – shared memory model. Mutual exclusion: model - stronger conditions – lockout –free mutual exclusion algorithms. Asynchronous network model: Algorithms – leader election in a ring and an arbitrary network.

Outcomes

- Ability to develop skill set in developing a distributed system.
- Ability to design and evaluate and protocols for various distributed systems.

Teaching and Evaluation Guidelines

- 30% on Problems and Analysis (Higher Order Thinking), and 30% on Application (Medium Order Thinking), and 40% on Conceptual Understanding (Lower Order Thinking).

Textbooks

1. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2011.
2. Andrew S. Tanenbaum, Maartenvan Steen, "Distributed Systems Principles and Paradigms", Second Edition (Reprint),Pearson Education, 2013.
3. Nancy A. Lynch, "Distributed Algorithms", Hardcourt Asia Pvt. Ltd., Morgan Kaufmann, 1996.

References

1. Research Papers published in IEEE, ACM, and Elsevier publishers

CS654 - DESIGN AND ANALYSIS OF PARALLEL ALGORITHMS

Credits: 3

Objective

- To impart about parallel computing models, design and analyze parallel algorithms for PRAM machines and Interconnection networks.

Unit-I Models of Computer

Structures and algorithms for array processors: SIMD Array Processors –Interconnection Networks – Parallel algorithms for Array processors. Multiprocessor architecture: multiprocessor control and algorithms – parallel algorithms for multiprocessors.

Unit-II Selection and Sorting

Selection: broadcast- all sums- parallel selection. Searching a random sequence - sorted sequence on PRAM models – Tree and Mesh.

Unit-III Merging

Merging: network for merging - merging on PRAM models. Sorting on a linear array: EREW , CREW and CRCW - SIMD models – MIMD Enumeration sort.

Unit-IV Matrix Operations

Matrix operations: Transposition – Matrix by matrix multiplication – matrix by vector multiplication. Numerical problems: solving systems of linear equations –finding roots of non linear equations on PRAM models.

Unit-V Graphs

Graphs: Connected components –dense graphs-sparse graphs – Directed graphs – Biconnected components - Ear decomposition. Minimum spanning tree: Sollin's algorithm.

Outcome

- Ability to design and analyze parallel algorithms

Teaching and Evaluation guidelines

- 50% on Problems (Higher Order Thinking), and 30% on Comparisons, Issues, and Analysis (Medium Order Thinking), and 30% on Definition (Lower Order Thinking).

Text Book

1. Kai Wang and Briggs,"Computer Architecture and Parallel Processing",Third edition, McGraw Hill, 2015.
2. S. G. Akl, "Design and Analysis of Parallel Algorithms", Prentice Hall Inc., 1992.

References

1. Joseph Jaja, "An Introduction to parallel Algorithms", First Edition, Pearson Education India, 1992.
2. Research Papers published in IEEE, ACM, and Elsevier publishers.

CS656 - WIRELESS SENSOR NETWORKS

Credits: 3

Objectives

- To impart the fundamentals of wireless sensor networks and its application to critical real time scenarios.
- To impart the various protocols at various layers and its differences with traditional protocols.

Unit-I Introduction

Fundamentals of wireless communication technology - The electromagnetic spectrum radio propagation - characteristics of wireless channels - modulation techniques - multiple access techniques - wireless LANs – PANs – WANs – MANs - Wireless Internet.

Unit-II Introduction toadhoc/sensor networks

Key definitions of adhoc / sensor networks - unique constraints and challenges - advantages of ad-hoc/sensor network - driving applications - issues in adhoc wireless networks - issues indesign of sensor network - sensor network architecture - data dissemination and gathering.

Unit-III MAC Protocols

Issues in designing MAC protocols for adhoc wireless networks – Design Goals- Classification of MAC protocols - MAC protocols for discovery- sensor networks – location- quality - other issues - S-MAC - IEEE 802.15.4

Unit- IV Routing Protocols

Issues in designing a routing protocol - Classification of routing protocols – Types: Table-driven - On-Demand – Hybrid – Flooding – Hierarchical - power aware routing protocols.

Unit-V QoS and Energy Management

Issues and Challenges in providing QoS – Classifications – MAC - Network Layer solutions – QoS frameworks – Need for energy management – Classification – Battery- Transmission power - System power management schemes.

Outcomes

- Ability to build a WSN network.
- Ability to analyze the critical parameters in deploying a WSN.
- Ability to understand various routing protocols at different layers.

Evaluation guidelines

- 50% on Analysis and Evaluation, and 30% on Techniques and Methods, and 20% on Theorems and Terminologies.

Text Book

1. C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks",First Edition, Prentice Hall Education, 2004.

Reference Book

1. Feng Zhao and Leonides Guibas, "Wireless sensor networks", Elsevier publication, 2004.

CS658 - REAL TIME SYSTEMS

Credits: 3

Objectives

- To impart issues related to the design and analysis of systems with real-time constraints.
- To impart the various Uniprocessor and Multiprocessor scheduling mechanisms.
- To impart on various real time communication protocols.
- To study the difference between traditional and real time databases

Unit-I Introduction – Real time systems

Issues in real-time computing – Structure of a real time system – Task classes - Architecture , operating system and other issues – Performance measures for real-time systems - Program run-time estimation – Uniprocessor scheduling algorithm – Task assignment.

Unit-II Real time Programming languages and Databases

Language characteristics - Data typing – Control structures – Blocks – Procedures and functions – Packages – Exception handling – Task scheduling – Timing specification – Experimental languages - Flex – Euclid – Real time Databases – Real time vs. General-Purpose Databases - Transaction priorities – Concurrency control issues – Disk scheduling algorithms – Two phase approach to improve predictability – Database for Hard Real-Time Systems.

Unit-III Real time Communication

Introduction - Network topologies and architecture issues – protocols – contention based, token based, stop-and-go multi hop protocol, polled bus, hierarchical round robin, deadline based protocol, fault tolerant routing - RTP and RTCP.

Unit-IV Fault-Tolerance Techniques

Introduction – Causes - Fault types - Fault detection – Fault and error containment – Redundancy – Data diversity – Reversal checks – Malicious or byzantine failures - Integrated failure handling.

Unit-V Reliability Evaluation Techniques and Clock Synchronization

Obtaining parameter values – Reliability model for hardware redundancy – Software error models – Clocks – A Non fault Tolerant synchronization algorithm - Impact of faults - Fault tolerant synchronization in hardware – Synchronization in software.

Outcomes

- Ability to learn Real-time programming environments.
- Ability to develop real time systems.

Evaluation guidelines

- 50% on Problems , and 30% on Algorithms, and 20% on Terms and Terminologies.

Text Book

1. C.M. Krishna, Kang G. Shin – “Real Time Systems”, First Edition, Tata McGraw Hill

Companies, Inc., New York, 2009.

References

1. Philip A. Laplante and Seppo J. Ovaska, "Real-Time Systems Design and Analysis: Tools for the Practitioner'', Fourth Edition, IEEE Press, Wiley. 2013.
2. Research Papers published in IEEE, ACM, Elsevier publishers, etc.

CS660 – MOBILE NETWORK SYSTEMS

Credits: 3

Objectives

- To impart the fundamentals of Mobile communication systems.
- To impart the significance of different layers in mobile system.

Unit-I Introduction

Introduction to wireless: mobile and cellular mobile systems -cellular mobile telephone systems. Analog and digital cellular systems: frequency reuse - co-channel interference.

Unit-II Medium Access Control (MAC)

MAC:SDMA –FDMA –TDMA –CDMA -Hand off sand dropped calls- initiation of handoff - power difference - mobile assisted cell - site and Intersystem handoff.

Unit-III Communication Systems

Mobile Telecommunication standards: GSM –DECT –TETRA -IMT-2000 –CTEO - satellite systems – GEO - LEOandMEO – and broadcast systems – Digital audio and video broadcasting - IEEE 802.11 – HIPERLAN - Bluetooth - Wireless ATM - WATM services.

Unit-IV Mobile Network Layer

Network support for mobile systems – Mobile IP- IP packet delivery- Agent discovery- tunneling and encapsulation, reverse tunneling, IPV6, DHCP.

Unit-V Mobile Transport Layer

Mobile transport and application layer protocol – Review of traditional TCP, fast re-transmit / fast recovery, transmission/timeout freezing, filesystems, WWW,WAP.

Outcome

- Ability to apply knowledge in application and protocol development.

Teaching and Evaluation guidelines

30% on Synthesis (Higher Order Thinking), and 30% on Application (Medium Order Thinking), and 40% on Conceptual Understanding (Lower Order Thinking)

Text Book

1. Jochen Sciller, "Mobile Communications ",Second Edition, Pearson Education India, 2014..

References

1. Theodore S. Rappaport, “Wireless Communications: Principles and Practice”, Second Edition, Pearson Education, 2014.
2. William C. Y Lee, "Mobile Cellular Telecommunications ",Second Edition, McGraw Hill International Editions, 2006.
3. Research Papers published in IEEE, ACM, and Elsevier publishers.

CS662 - NETWORK SECURITY

Credit: 3

Objectives

- To impart the network security, services, attacks, mechanisms, types of attacks on TCP/IP protocol suite.
- To impart network layer security protocols, Transport layer security protocols, Web security protocols.
- To impart the wireless network security threats.

Unit –I Introduction Overview

Network Security, Security services, attacks, Security Issues in TCP/IP suite- Sniffing, spoofing, buffer overflow, ARP poisoning, ICMP Exploits, IP address spoofing, IP Fragment attack, routing exploits, UDP exploits, TCP exploits.

Unit-II Authentication Algorithms and Protocols

Authentication: Requirements - Functions - Message Authentication Codes – Hashing: Functions - Security of Hash Functions and MACs - MD5 message Digest algorithm - Secure Hash Algorithm - RIPEMD - HMAC Digital Signatures, Authentication protocols: Kerberos - X.509.

Unit-III Network Security and Web Security Protocols

Network Security**:** IP Security - AH and ESP - SSL/TLS - SSH. Web Security: HTTPS - DNS Security - Electronic Mail Security (PGP, S/MIME).

Unit-IV Software Attacks and Security

Intruders - Viruses - Worms - Trojan horses - Distributed Denial-Of-Service (DDoS) - Honey nets and Honey pots. Security Systems: Firewalls – IDS.

Unit-V Wireless Security

Issues and threats in Wireless networks. Wireless LAN Security: WEP - WPA.

Outcomes:

- Ability to assess an appropriate mechanism for protecting the network.
- Ability to design a security solution for a given system or application.

Teaching and Evaluation Guidelines:

- 30% on Problems (Higher Order Thinking), and 30% on Comparisons and Statements (Medium Order Thinking), and 40% on Conceptual understanding (Lower Order Thinking).

Text Books

1. 1. W. Stallings, “Cryptography and Network Security: Principles and Practice”, Sixth Edition, Pearson; 6 edition,2013
2. Yang Xiao and Yi Pan, “Security in Distributed and Networking Systems”, World Scientific, 2007.

3. Aaron E. Earle, “Wireless Security Handbook”, First Edition, Auerbach publications, Taylor & Francis Group, 2005.

References

1. Atul Kahate, “Cryptography and Network Security”,Third Edition, Tata McGraw Hill, 2013.
2. Research Papers published in IEEE, ACM, and Elsevier publishers.

CS664 - MACHINE LEARNING TECHNIQUES
Credits : 3

Objectives

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques
- To study the various probability based learning techniques
- To understand graphical models of machine learning algorithms

Unit I Introduction

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Separability – Linear Regression.

Unit II Linear Models

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.

Unit III Tree and Probabilistic Models

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map.

Unit IV Dimensionality Reduction and Evolutionary Models

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process.

Unit V Graphical Models

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods.

Outcomes:

- Distinguish between, supervised, unsupervised and semi-supervised learning
- Apply the apt machine learning strategy for any given problem
- Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem
- Design systems that uses the appropriate graph models of machine learning
- Modify existing machine learning algorithms to improve classification efficiency

Teaching and Evaluation guidelines

- 50% on An Application (Higher Order Thinking), and 30% on Methods and Techniques (Medium Order Thinking), and 20% on Tool functions (Lower Order Thinking).

Text Books:

1. Stephen Marsland, "Machine Learning - An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Tom M Mitchell, "Machine Learning", First Edition, McGraw Hill Education, 2013.

References:

1. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press, 2012.
2. Jason Bell, "Machine learning - Hands on for Developers and Technical Professionals", First Edition, Wiley, 2014
3. Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation and Machine Learning Series)", Third Edition, MIT Press, 2014

CS666 - INFORMATION RETRIEVAL TECHNIQUES

Credits: 3
Objectives:

- To learn the concepts behind IR.
- To understand the operation of web search.
- To learn the algorithms related to text classification, indexing and searching.

Unit I Introduction
Information Retrieval – Early Developments – The IR Problem – The User‘s Task – Information versus Data Retrieval - The IR System – The Software Architecture of the IR System – The Retrieval and Ranking Processes - The Web – The e-Publishing Era – How the web changed Search – Practical Issues on the Web – How People Search – Search Interfaces Today – Visualization in Search Interfaces.

Unit II Modeling and Retrieval Evaluation
IR models – Classic Information Retrieval – Alternative Set Theoretic Models – Alternative Algebraic Models – Alternative Probabilistic Models – Other Models – Hypertext Models – Web based Models – Retrieval Evaluation – Cranfield Paradigm – Retrieval Metrics – Reference Collections – User-based Evaluation – Relevance Feedback and Query Expansion – Explicit Relevance Feedback – Clicks – Implicit Feedback Through Local Analysis – Global Analysis – Documents: Languages & Properties – Queries: Languages & Properties.

Unit III Text Classification, Indexing and Searching
A Characterization of Text Classification – Unsupervised Algorithms – Supervised Algorithms – Feature Selection or Dimensionality Reduction – Evaluation metrics – Organizing the classes – Indexing and Searching – Inverted Indexes –Signature Files – Suffix Trees & Suffix Arrays – Sequential Searching – Multi-dimensional Indexing.

Unit IV Web Retrieval and Web Crawling
The Web – Search Engine Architectures – Search Engine Ranking – Managing Web Data – Search Engine User Interaction – Browsing – Applications of a Web Crawler – Taxonomy – Architecture and Implementation – Scheduling Algorithms – Evaluation - Structured Text Retrieval.

Unit V Types of IR and Applications
Parallel and Distributed IR –Data Partitioning – Parallel IR – Cluster-based IR – Distributed IR - Multimedia Information Retrieval – Challenges – Content Based Image Retrieval – Audio and Music Retrieval – Retrieving and Browsing Video – Fusion Models – Segmentation –

Compression - Enterprise Search –Tasks – Architecture of Enterprise Search Systems – Enterprise Search Evaluation - Library Systems – Digital Libraries

Outcomes:

- To use an open source search engine framework and explore its capabilities
- To represent documents in different ways and discuss its effect on similarity Calculations and on search
- To design and implement an innovative feature in a search engine

Teaching and Evaluation guidelines

- 50% on An Application (Higher Order Thinking), and 30% on Methods and Techniques (Medium Order Thinking), and 20% on Tool functions (Lower Order Thinking).

Text Books:

1. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, "Modern Information Retrieval: The Concepts and Technology behind Search", Second Edition, ACM Press Books, 2011.
2. Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, "Information Retrieval: Implementing and Evaluating Search Engines", The MIT Press, 2010.

References:

1. C. Manning, P. Raghavan, and H. Schütze, "Introduction to Information Retrieval", Cambridge University Press, 2008.
2. Bruce Croft, Donald Metzler and Trevor Strohman,"Search Engines: Information Retrieval in Practice", First Edition, Addison Wesley, 2009.