Dept. of Computer Science and Engineering
University of Dhaka.
M.S. Course for 2017-18 to Present
(Research and Coursework)

List of Theoretical Courses

Course Code	Course Title	Credit
CSE 501	Advanced Algorithms	3.00
CSE 502	Network Routing and Switching	3.00
CSE 503	Network QoS	3.00
CSE 504	Graph Drawing	3.00
CSE 505	Mobile and Censor Networking	3.00
CSE 506	Optical Fiber Communications	3.00
CSE 507	Wireless Mesh Network	3.00
CSE 508	Advanced Computer Graphics	3.00
CSE 509	Computer Vision	3.00
CSE 510	Pattern Recognition	3.00
CSE 511	Image Processing	3.00
CSE 512	Computational Geometry	3.00
CSE 513	Advanced Database	3.00
CSE 514	Web Application Engineering	3.00
CSE 515	Enterprise Application Integration	3.00
CSE 516	Project Management	3.00
CSE 517	Knowledge Based System	3.00
CSE 518	Machine Learning and Data mining	3.00
CSE 519	Neural Networks	3.00
CSE 520	Information Security	3.00
CSE 521	Embedded System	3.00
CSE 522	Introduction to Bioinformatics	3.00
CSE 523	VLSI Layout Algorithm	3.00
CSE 524	Advanced Logic Design	3.00
CSE 525	Principles of GPS/GNSS Positioning	3.00

Course Code	Course Title	Credit
CSE 526	Mobile Computing	3.00
CSE 527	Graph Theory	3.00
CSE 528	Network Performance Analysis	3.00
CSE 529	Green Networking	3.00
CSE 530	Cloud Computing	3.00
CSE 531	Reversible Logic Synthesis	3.00
CSE 532	Decision Diagram for VLSI design	3.00
CSE 533	Modern Processor Design	3.00
CSE 534	IPv6 Deployment	3.00
CSE 535	Distributed Artificial Intelligence	3.00
CSE 536	Applied Game Theory and Mechanism Design	3.00
CSE 537	Text Mining	3.00
CSE 538	Mathematical Modeling and Optimization	3.00

Project

CSE 541	Project	6.00

Thesis

CSE 551	Thesis	18.00

Course content (Theoretical Courses)

CSE 501: Advanced Algorithms (3.0 Credits, 45 Lectures)

Asymptotic Analysis: Review of Asymptotic Analysis and Growth of Functions; Recurrence: Analyze the efficiency of algorithms using recurrences. Amortized Analysis – Analyze the efficiency of algorithms using amortized analysis, Binomial Heap, Fibonacci Heap, Splay Tree. String matching–KMP (Knuth Moris Pratt) string matching, Boyer Moore string matching, Suffix Tree. Dynamic Programming – Basics of dynamic programming, Top down vs. bottom up approach, Memoization, Sum of Subset, 0/1 Knapsack, Sequence Alignment, Edit Distance. Network Flow–The Maximum Flow Problem, Applications of Maximum Flow, Maxflow Mincut Theorem, Mincost Flow. Matching – Maximum Bipartite Matching, Weighted Bipartite Matching (Hungarian Method). Sorting - Lower bound for comparison based sorting, Non-comparison based sorting: Count sort, bucket sort, radix sort. NP and Computational Intractability - NP-Completeness Fundamentals, NP-Complete problems, P versus NP, co-NP, NP Hardness, A Class of problems beyond NP. Approximation Algorithm: Randomized Algorithm: Contention Resolution, Finding the Global Minimum Cut, A Randomized Approximation Algorithm for MAX 3-SAT, Randomized Divide & Conquer. Linear programming(LP): Formulating linear programs, Application of LP, Geometry of LP, simplex algorithm, Duality theory, Sensitivity analysis, Integer Linear Programming

CSE 502: Network Routing and Switching (3.0 Credits, 45 Lectures)

Internet Typologies: Autonomous system, PoP, vPoP, HUB/Super PoP, IXP(internet exchange point), IPv4 and IPv6: ICMP6, IPv6 packet format, Addressing, address classification, CIDR, IPv6 integration and transition, IPv6 in IPv4 tunneling, IPv4 to IPv6 migration, 6to4. Routing Basic, IPv4 and IPv6 Unicast routing (in detailed): RIP, OSPF, BGP, iBGP, eBGP etc protocol, message format, routing update, route lookup, route management. Multicast routing: IGMP, DVMRP, MOSPF, CBT, MBONE, PIM etc protocol, messaging, route management. Switching and advanced Routing: ATM, Optical routing, MPLS, MobileIP , NEMO. Routing for MANET and Adhoc Network: AODV, DVMRP etc. VPN, Security in routing, Case Study: CISCO IPv4 and IPv6 Unicast routing.

CSE 503: Network QoS (3.0 Credits, 45 Lectures)

QoS framework: Audio video compression techniques, End-System consideration, OS approaches, End-End QoS in Internet, Application layer adaptation, Real time protocols QoS Fundamentals: Trafic description, QoS Specification, signaling Resource classification, Resource reservation, Admission control, Traffic shaping, Traffic Policing, Queuing and Scheduling, Congestion control and buffer management. Packet Scheduling: FCFS, Priority queuing, GPS, Round Robin, Weighted round robin, Deficit round robin, weighted round robin, TCP/IP Queue Management: congestion control, AIMD, TCP reno/Tahoe/Vegas, RED, WRED QoS IntServ: Application classification, Admission control, Signaling Protocol(RSVP), Flow setup, Traffic Policing, IS-capable Router Component, LAN QoS and Intserv. RSVP: Features, Reservation Manager, Reservation Style, RSVP messages, RSVP message format, RSVP API, QoS DiffServ: Diffserv Architecture, PHB, PDB, Diffserv Router, Premium Service, Assured Service. Policy based QoS Management: Bandwidth Broker Policy Framework, Policy and RSVP, Internet2 and QBone etc, ATM QoS: IP ATM QoS integration and mapping MPLS: Diffserv over MPLS, GMPLS, QoS in Wireless network, IntServ over DiffServ, Case Study: Voice over IP, Video Conferencing, SIP, XMPP

CSE 504: Graph Drawing (3.0 Credits, 45 Lectures)

Introduction to graph drawing: historical background of graph drawing, drawing styles, properties of drawings, applications of graph drawing; Graph theoretic foundations; Straight line drawing: shift method, realizer method, compact grid drawing; Convex drawing: convex drawing and convex testing, convex grid drawing; Rectangular drawing: rectangular drawing and matching, Thomassen's theorem, linear algorithms for rectangular drawing; Box-rectangular drawing; Orthogonal drawing: orthogonal drawing and network flow, linear algorithms for orthogonal drawing; Octagonal drawing; Tree drawing.

CSE 505: Mobile and censor networking (3.0 Credits, 45 Lectures)

Introduction to Mobile Ad Hoc Networks and Wireless Sensor Networks: Differences with traditional networks, potential applications and case studies; MAC layer issues: IEEE 802.15.4, S-MAC, WiseMAC, TRAMA, Energy efficient MAC, Other existing MAC protocols for Sensor Networks; Network Layer Issues: Routing Protocol for Mobile Ad Hoc and Sensor Networks, Proactive and Reactive routing protocols, Energy Efficient Routing Protocols, AODV, DSR, DSDV, TORA, Routing Holes, Mobility Models, Transport Layer Issues: Problems of using TCP in sensor networks, Reasons of Congestion in sensor network, Rate Control Protocols, Back pressure based congestion control, Reliability concerned congestion control, Cross Layer Approaches; Connectivity and Coverage problems in ad hoc sensor networks, various security aspects of mobile ad hoc and sensor networks.

CSE 506: Optical Fiber Communications (3.0 Credits, 45 Lectures)

Introduction to optical fiber, History and importance of optical fiber, Properties of light, Electromagnetic waves, Maxwell,s equations, Propagation mode in a planer guide, LP modes, Multimode and single mode fibers, Different techniques of fiber fabrication. Losses in optical fiber: material absorption loss, linear scattering loss, nonlinear scattering loss, bending loss, coupling loss, Intermodal and intramodal dispersion, polarization mode dispersion. Fiber connectors and splices. Optical sources: requirements of sources, homostructure and heterostructure LEDs, working princuiple and properties of Laser diode, types of laser, optical transmitter. Optical detectors: responsivity and quantum efficiency of photodiodes, properties, noises and types of photodiodes, optical receiver. Requirements of transmitter and receiver in WDM networks, types of tunable lasers, optical amplifiers, SOA and FOA, EDFA and EBFA. Passive components: optical switches, wavelength converter, mux and demux, couplers, circulators, isolators, attenuator, optical filters. Optical network: basic principle of optical transmission, optical layer, protection and restoration methods. Terrestrial and undersea systems of fiber communications.

CSE 507: Wireless mesh network (3.0 Credits, 45 Lectures)

Introduction to wireless mesh networks, Network architecture, characteristics, application scenarios, critical design factors, Medium access control layer: Single-channel Single Radio MAC protocols, Multichannel Single radio MAC protocols, Multi radio MAC protocols, Channel assignment, Dynamic frequency selection, open research issues; Network Layer: Routing challenges, design principles, Topology discovery for routing , Routing metrics, categories of routing protocol, hop count based routing protocols, Link-level QoS based routing protocols, End-to-End QoS routing, Reliability aware routing, Multipath routing, Stability based routing, scalable routing, cross-layer Multichannel routing protocols, open research issues; Transport Layer: Challenges of a Transport Layer Protocol in Wireless Environments, Transport Layer Protocols for WMNs, Open research issues, Network Security: Typical attack scenarios, IEEE 802.11s; Network control and Management, Network Capacity, Cross-Layer Design, Standards on Wireless Mesh Networks.

CSE 508: Advanced Computer Graphics (3.0 Credits, 45 Lectures)

Light/object interaction. Geometric object representation; Polygonizing Algorithm: Marching Cubes Algorithm. Subdivision of Surfaces: Basic Ideas, Subdivision for Surfaces, The Subdivision Zoo, Caltech curve subdivision applets. Multi-resolution modeling, Multi-resolution analysis, Normal meshes, Mesh Simplification: Progressive Meshes, Streaming Meshes, Mesh Smoothing and Fairing, Laplacian Mesh Editing. Deformation modeling: Implicit Surfaces, Point-based Models. Computer animation and physically based modeling: Cloth Modeling and Animation. Texture and environment mapping: Photon Mapping. Ray tracing: Monte Carlo Path Tracing. Radiosity. Global illumination: Introduction to Global Illumination. Advanced real-time rendering: Image based rendering

CSE 509: Computer Vision (3.0 Credits, 45 Lectures)

Introduction: Human Vision, Computer Vision, and Robots Vision System, Sensing, Seeing, and perceiving, the role of Vision. Image formation: The physics of imaging. Representing, acquiring, and displaying images. Grayscale, color, noise, lens distortion, blurring, and filtering. Image processing, preprocessing and image correction. Binary image analysis, Enhancing features and correcting imperfections, image understanding, Fourier Transform. Computer Vision Paradigms: Pixels, lines, boundaries, regions, and object representations, "Low-level", "intermediate-level", and "high-level" vision. Image Analysis: Finding edges (low-level), Gradients, zero crossing detectors, line models. Finding and grouping lines (intermediate-level), Boundary tracing, line fitting, Hough transform, Finding and processing regions Finding "elementary regions" (low-level) Merging, splitting, and grouping regions (intermediate-level), Grouping and analyzing lines and regions (high-level). Feature Extraction/Analysis: Feature extraction, shape, histogram, color, spectral, texture, using CVIP tools, Feature analysis, feature vectors, distance /similarity measures, data preprocessing, Segmentation/ Morphological Filtering, texture. Stereo, and Motion: Optical Flow and FOE, motion Understanding. Pattern classification using computer vision Applications in medicine, industry, and survielance.

CSE 510: Pattern Recognition (3.0 Credits, 45 Lectures)

Introduction and General Pattern Recognition Concerns: Pattern Recognition, Classification and Description, feature extraction with examples, feature extraction from images, training and learning in PR system, pattern recognition approaches. Bayesian Decision Theory: Review of probability theory and some linear algebra, Bayesian Decision making; Bayesian networks, linear discriminants, separability, multi-class discrimination; quadratic classifiers. Bayesian estimation; Random vectors, expectation, correlation, covariance, linear transformations Decision theory, Likelihood ratio test Linear and quadratic discriminants, Fisher discriminants. Sufficient statistics, coping with missing or noisy features. Statistical Pattern Recognition: Introduction to statistical pattern recognition, The Gaussian and Class Dependence, Discriminant Functions, Kalman filtering and smoothing, Classifier performance, risk and Errors. Supervised Learning: Parametric Estimation and Supervise Learning, maximum likelihood Estimation approach, Bayesian parameter estimation approach, Non-parametric approaches, Parzen windows, K-nn Non-parametric estimation, Nearest Neighbor Rule, Mixture modeling, optimization by Expectation-Maximization. Un-supervised learning and Clustering: Formulation of Unsupervised learning Problems, Clustering for unsupervised learning and classification, vector quantization, K-means Feature extraction for representation and classification. Syntactic Pattern Recognition: Syntactic Pattern Recognition overview, Quantifying structure in pattern description and recognition, Grammar-Based approach and Applications, Elements of formal Grammars, Example of string generations as pattern description. Syntactic recognition via parsing and other grammars, Graphical approaches to syntactic pattern recognition. Classification: Template-based recognition, Eigen vector analysis, PCA Sequence analysis, HMMs, Viterbi algorithm, Baum-Welch algorithm, Maximum likelihood and Bayesian parameter estimation, optimization by gradient descent, SVM, Neural nets, Perceptron learning, Multi-layer Perceptrons, Neural networks for pattern recognition, Decision trees. Applications: Object detection and recognition, Biological object recognition, Tracking, Gesture recognition

CSE 511: Image Processing (3.0 Credits, 45 Lectures)

Digital Image Fundamentals: Visual perception and Light, Image Representation and Modeling, Sampling and Quantization, basic relationships between pixels. Image Enhancement: Image Transformation, Histogram Processing, Labeling, Different types of filters, Smoothing Frequency domain Filters, Sharpening Frequency domain Filters, Homomorphic filtering. Color Image Processing: Color Perception, Color coordinate system, Chromaticity Diagram, Color Transformation, Filtering Color images, Color-tone adjustment, Color-based Segmentation. Image Analysis and Segmentation: Line and Edge Detection, Edge linking and Boundary Detection, Region-based Segmentation, Segmentation by Morphological Watersheds, Motion-Based Segmentation. Morphological Image Processing: Dilation and Erosion, Opening and closing, Some Morphological algorithms. Image Restoration: A model of the image restoration process, noise models, periodic noise reduction, linear position-invariant Degradation, Minimum mean square error filtering. Image Compression: Image Compression Models, Error Free Compression, Lossy Compression, Image Compression Standards. Wavelets and Multi Resolution Processing: Multi-resolution Expansions, Wavelet Transforms in One-Dimensions and Two-Dimensions, Wavelet packet. Pattern Recognition: Statistical, Structural, Neural network, PCA, Knowledge-based and Hybrid techniques, Optical Character Recognition, Object Recognition. Applications: Robotic Vision, Medical Image Processing, Satellite Image Processing, etc.

CSE 512: Computational Geometry (3.0 Credits, 45 Lectures)

Searching and Geometric Data Structures: Balanced binary search trees, Priority-search trees, Range searching, Interval trees, Segment trees, Algorithms and complexity of fundamental geometric objects: Polygon triangulation and art gallery theorem, Polygon partitioning, Convex-hulls in 2-dimension and 3-dimension, Dynamic convex-hulls; Geometric intersection: Line segment intersection and the plane-sweep algorithm, Intersection of polygons; Proximity: Voronoi diagrams, Delunay triangulations, closest and furthest pair; Visualization: Hidden surface removal and binary space partition (BSP) trees; Graph Drawings: Drawings of rooted trees (Layering, Radial drawings, HV-Drawings, Recursive winding), Drawings of planar graphs (Straight-line drawings, Orthogonal drawings, Visibility drawings); Survey of recent developments in computational geometry.

CSE 513: Advanced Database (3.0 Credits, 45 Lectures)

Object Oriented Database; Data Model, Design, Languages; Object Relational Database: Complex data types, Querying with complex data types, Design; Distributed Database: Levels of distribution transparency, Translation of global queries to fragment queries, Optimization of access strategies, Management of distributed transactions, Concurrency control, Reliability, Administration; Parallel Database: Different types of parallelism, Design of parallel database; Multimedia Database SystemsBasic concepts, Design, Optimization of access strategies, Management of Multimedia Database Systems, Reliability; Database Wire-housing/Data mining: Basic Concepts and algorithms.

CSE 514: Web Application Engineering (3.0 Credits, 45 Lectures)

Introduction to Web and Web application, Web Essential: Client, Server and Protocols, HTTP request and Response Message, Web Application, CGI, Web server mode, logging. HTML/XHTML, CSS, w3c standard, XML, XML Schema, XML Tag, XML Structure, XML Namespace, XML processing, SAX, Document Object Model, XML Query, XSLT, Document transformation using XSLT, ServerSide Programming, Relation database overview, SQL, Database Design, Data Access Model, Object Relational Mapping, Design Pattern, Presentation Layer Design, Bussiness Layer Design, JSP and Servlet or PHP, JDBC, MVC model, Web tier, Command Design Pattern, Service Locator Pattern, Data Access Object Pattern, Persistent communication, Web Application Security: Policy, Network-level Security: SSL, Application-level Security. SQL-injection, Form modification, cross site scripting, Privacy: P3P, Policies, Procedures Access Control, Authorization and Laws. E-commerce Payment Systems. Web Application infrastructure: Case Study PHP or J2EE.

CSE 515: Enterprise Application Integration (3.0 Credits, 45 Lectures)

Approaches and issues in EAI: Design and develop data integration systems using XML, Design and develop Web service applications, integration area (e.g., Web 2.0), Identify other alternative technologies in the area Specifically (facts and knowledge), Architecture and communication patterns in enterprise systems, Middleware and conventional approaches to enterprise such as DCOM, CORBA, RMI, application integration, Data services and Service Oriented Architecture(SOA), SOA Layers, Application to application Communication Protocol: SOAP, REST, SOAP, SOAP-RPC and SOAP-Document, SOAP Encoding, SOAP-body, SOAP-fault, SOAP Binding and HTTP, Development of Web services, Web service Description Language(WSDL), Role of WSDL and main element of WSDL, WSDL: portType, Binding, Operation, Case Study: amazon and google web service, UDDI: Service Registry, Service Discovery, WSDL and UDDI Mapping, publishing UDDI, Implementing a web service with AXIS, Bottom-Up development Pattern, Top-Down Development Pattern, Client program development, BPM: Business process modeling and work-flow management system, Application Integration Models(B2B): Point-to-Poin, Bus, EAI Platform: Enterprise service hub/bus model, Workflow management system: static modeling, process modeling, Workflow concept: case, task process and routing, Petri Nets, BPEL: Web Service an Business process, Interacting with a Web Service, Web Service Coordination Protocol, Conversation amoung multiple web service, Web Service UML modeling: Activity, Web Service Composition, XLANG and WSFL, BPEL execution environment, BPEL process. BPEL Fault handling, REST: philosophy, Uniform Interface, REST Web Services, Resource Presentation Format, REST Complex Query, Building REST Web Services. XML-RPC, REST and SOAP, REST vs RPC, REST vs SOAP Protocol and Design Methodology, Data Service: XSLT and Xquery.

CSE 516: Project Management (3.0 Credits, 45 Lectures)

Introduction to project management: History of project management, the project management profession, project management software. The project management context and processes: A systems view of project management, project phases and the project life cycle, understanding organizations, suggested skills for a project manager, project management process groups, developing an information technology project management methodology. project integration management: project plan development, project plan development, project plan execution, integrated change control, project scope management: project initiation, strategic planning and project selection, scope planning and the scope statement, work breakdown structure, scope verification and scope change control, project time management: importance of project schedules, activity sequencing, activity duration estimation, schedule development, controlling changes to the project schedule, using software to assist in time management, problems of using project management software, project cost management: basic principles of cost management, resource planning, cost estimating, cost budgeting, cost control, using software to assist in cost management, project quality management: quality of information technology projects, modern quality management, quality planning, quality assurance, quality control, improving information system/technology project quality, project human resource management: keys to managing people, motivation theories, organizational planning, using software to assist in human resource management, project communication management: communication planning, information distribution, performance reporting, administrative closure, using software to assist in project communication, project risk management: risk management planning, common sources of risk on information information technology projects, risk identification, risk monitoring and control, using software to project risk management, project procurement management: procurement planning, solicitation planning, source selection, contract administration, contract close-out, initiating: developing the project charter, actions of the project manager and senior managers in project initiation, planning: developing the project plans, human resource and communication planning, quality risk, and communication planning, executing: providing project leadership, developing the core team, verifying project scope, assuring quality, disseminating information, controlling: schedule control, scope change control, quality control, performance and status reporting, managing resistance to change, closing: administrative closure.

CSE 517: Knowledge Based System (3.0 Credits, 45 Lectures)

Representation of Knowledge: Predicate logic, rules, Semantic Networks, Frames; Conceptual graphs, Scripts Fuzziness and uncertainty, Fuzzy logic, Statistical techniques for determining probability, Methodologies for developing knowledge based systems; The KBS Development Life Cycle: Knowledge acquisition, Prototyping, Implementation, Development environments; Meta-Knowledge, Search Techniques, Reasoning with uncertainity; Intelligent Database Systems: Decision Support System, OLAP, Data warehouse, Data Mining: rule mining, classification, clustering, regression. Intelligent Information Systems: Neural networks architectures- Hopfield network; Blackboard Architecture; Wrapper Architecture; Dependent Agent Architecture; Genetic algorithms-Rule induction, Decision trees/rule sets. Building an Expert System: Problem Selection, Development Methodology, Knowledge Acquisition, Pitfalls; Evaluation of Expert Systems: Test Cases, Refinement, Performance; Applications: Expert systems, Natural language processing, Machine vision and robotics, Data mining and intelligent business support

CSE 518: Machine Learning and Data mining (3.0 Credits, 45 Lectures)

Introduction to machine learning and data mining, Designing a learning system, perspective issues in machine learning, Concept of learning and the general to specific Ordering: induction learning hypothesis, Find-S, version space and candidate elimination algorithms, List-then-elimination algorithms, A biased hypothesis space, unbiased hypothesis space, decision tree, Artificial Neural networks, Multilayer networks and back propagation algorithms, Recurrent network, Evaluation hypothesis, Bayesian learning, Naive bays classifier, Gibbs algorithms, Bayesian belief Networks, EM algorithms, Computational learning theory, probability learning theory, sample complexity finite hypothesis space, sample complexity infinite hypothesis space, Mistake bound model of learning, Instance based learning, K-nearest neighbor learning, Genetic algorithms, Learning sets rules, Analytical learning, Combining inductive and Analytical learning, Reinforcement learning, SVM, Boasting, Clustering, training and testing, cross validation, prediction performance, Data mining tools

CSE 519: Neural Networks (3.0 Credits, 45 Lectures)

Structure and Function of a single neuron: Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, Difference between ANN and human brain, characteristics and applications of ANN, single layer network, Perceptron training algorithm, Linear reparability, Widrow & Hebb’s learning rule/Delta rule, ADALINE, MADALINE, AI v/s ANN. Introduction of MLP problem with linear activation function, different activation functions, sigmoidal, linear thresholding, hyperbolic tangent function etc, Error back propagation algorithm, derivation of EBPA, momentum, limitation, characteristics and application of EBPA, case-study: NETTALK, two dimensional pattern recognition. Bias and Variance. Under-Fitting and Over-Fitting. Counter propagation network, architecture, functioning in normal and training mode, characteristics of counter. Propagation network, Deterministic v/s statistical training, Boltzman training, Cauchy training, artificial specific heat method. Hopfield / Recurrent network, configuration, stability constraints, associative memory, characteristics, limitations and applications Hopfield v/s Boltzman machine. Adaptive Resonance Theory: Architecture, classification, Implementation and training. Optical neural network, advantages and disadvantages, vector matrix multiplies, electro-optical matrix multiplier, introduction to cognitron and neocognitron. Radial Basis Function Networks: Introduction, Algorithms, Applications; Self Organizing Maps: Fundamentals, Algorithms and Applications.

CSE 520: Information Security (3.0 Credits, 45 Lectures)

Introduction to information security: Security architecture, nature of information security risk, Principles of information security, security management process, information security policy, asset analysis, risk analysis. Internet protocol and security: Internet protocol and IP address, TCP/IP protocol suit, port number, www, e-mail, DNS etc. Threat: Types of threat – Vulnerability Exploitation, Denial of service, Spoofing, Eavesdropping, Password cracking, Malware(Viruses, Worm, Spyware, Rootkit, Bot, Botnet), Targeted attack, SPAM Messaging, Phishing Attack, Unintended Information disclosure: search Engine Hacking, peer to peer file sharing. Vulnerability(buffer overflow, stack overflow, heap overflow, sql injection, command injection,css/xcss): memory based, time and state based, string based, design based, ssl. TLS. Security technologies: Cryptography basics, Public key Infrastructure, Digital signature, Communication encryption, Authentication, Challenge and response, Firewall/Intrusion detection, intrusion prevention system, firewall deployment, anti-malware, Quarantine network, backup and restore, web application firewall, secure network system, penetration resting. Wireless security: threat on wireless LAN, countermeasures against threat, ESS-ID exposure, ANY connection, Vulnerability on MAC Address Authentication, Encryption with WEP, PSK mode, EAP. Incedent analysis: case study on system log files based on different protocols such as apache, pstfix, OpenSSH, apache-ssl, mysql, PostgressSQL, ftp, pop3, irc, proxy, Microsoft IIS, firewall. Forensics: network, harddrive. Network monitoring: iptraf, MRTG/RRDTool, wareshark, tcpdump/snoop, Case Study: CSIRT Activities

CSE 521: Embedded System (3.0 Credits, 45 Lectures)

Introduction to the Embedded Systems. Embedded System Design Specifications Embedded System Hardware and Hardware/Software Co-design. The 8051/8052 family of Microcontrollers. C programming for Microcontrollers. I/O ports Programming. Timer/Counter hardware and Its Device Driver. Serial communication interface and Its Device Driver. Interrupts Programming. Embedded Software Development Cycle and the Integrated Development Environment. Debugging Techniques for Embedded Software and the Role of Cross Simulators. Real World Interfacing Case Studies: LCD, Sensors, stepper motor, keyboard, PC. Design of Device Driver for Serial Devices. Concept of Finite State Machines and Examples - Stop Watch, Stepper Motor Control through PC. Remote Control of Systems using IR Remotes Used in Commercial TV Remote Control Modules. Simple Multi Drop Communication Networks with Examples. Simple Wireless Communication with Examples.

CSE 522: Introduction to Bioinformatics (3.0 Credits, 45 Lectures)

Essentials of Molecular biology: DNA, RNA and Protein, Watson and Crick Model of DNA, DNA replication, transcription, translation, splicing, Central dogma of molecular biology; DNA sequencing technology; Sequence Databases; Sequence Formats; Pairwise sequence alignment: local and global alignment, amino acid substitution scoring matrices; significance of the alignment, Multiple sequence alignment: progressive, iterative, statistical methods for multiple sequence alignment; local multiple alignment - sequence profiles and motifs, EM algorithm, Gibbs Algorithm; Hidden Markov Models: theory; training and applications to sequence alignment. Sequence database search: heuristic methods – FASTA, BLAST; Basic methods in molecular phylogeny: phylogenetic trees; distance matrix methods; maximum parsimony methods; maximum likelihood methods. RNA secondary structure basics: energy minimization, comparative sequence analysis, combined sequence and computational method; Gene Prediction: neural network, pattern discrimination functions and HMM; Promoter prediction: pattern driven, sequence driven algorithms; Proteins: protein classification, structure alignment and prediction; microarrays: design, data acquisition and analysis; gene network modeling; Systems biology.

CSE 523: VLSI Layout Algorithm (3.0 Credits, 45 Lectures)

VLSI design cycle, physical design cycle, design styles; Basic graph algorithms and computational geometry algorithms related to VLSI layout; Partitioning algorithms: group migration algorithms, simulated annealing and evaluation, performance driven partitioning; Floor planning and placement algorithms: constraint based floor planning, rectangular dualization and rectangular drawings, integer programming based floor planning, simulation based placement algorithms, partitioning based placement algorithms; Pin assignment algorithms; Routing algorithms: maze routing algorithms, line prob algorithms, shortest-path based and steiner tree based algorithms, river routing algorithms, orthogonal drawing based algorithms; Compaction algorithms: constraint-graph based compaction, virtual grid based compaction, hierarchical compaction; Algorithms for Multi-Chip Module (MCM) physical design automation.

CSE 524: Advanced Logic Design (3.0 Credits, 45 Lectures)

Functional decomposition and Symmetric Functions, Graph optimization problems and algorithms, Logic level synthesis and optimization, multi-level logic simplification, sequential logic optimization, Fault-Tolerance and Reliability: Error Detection and Correction. Hamming and CRC codes; two-dimensional (product) codes, Reed Muller expansions and their minimization, Synthesis and verification of Finite State Machine, Review of state machine design, Moore/Mealy machine, finite state machine word problems, Transformation from non-deterministic representations, Look up table (LUT), FPGA, Technology mapping; graph coloring, Choice of base function, creation of the subject graph, the DAG covering problem, delay optimization, Boolean matching, multilevel minimization, PLA reduction regular structure circuits, Synthesis of FSM-ASM chart representation and realization, Layout synthesis, Placement and routing, testing of VLSI, Testing of stuck-at Fault, testing of PLAs RAM, Asynchronous Design: Introduction to Hazard-Free Combinational Logic. Multiple input changes, Hazard free two level logic minimization, Multi-level logic, Design static and dynamic hazard free logic.

CSE 525: Principles of GPS/GNSS Positioning (3.0 Credits, 45 Lectures)

Introduction to GNSS, Introduction to reference systems, principles of range-based positioning, introduction to orbital motion, Introduction to Matlab & learning resources, Datum definitions & transformations, coordinates, height systems, map projections, height systems, map projections Visualisation of satellite orbits, introduction to GPS, GPS signals & measurements, positioning modes Principles of Least Squares estimation, Mathematical aspects of range-based positioning & LS, Factors affecting GPS/GNSS accuracy, from measurements to position, Differential GPS/GNSS, Introduction to GPS receivers, Introduction to GPS/GNSS, carrier phase-based positioning, Next generation GNSS, trends in technology & applications.

CSE 526: Mobile Computing (3.0 Credits, 45 Lectures)

Cellular Networks: Channel allocation, Multiple access, Location management, Handoffs. Wireless Networking: MAC protocols, Routing, Transport, Ad-hoc networking, Advantages and disadvantages of wireless networking. Applications: Mobility adaptations, Disconnected operations, Data broadcasting, Mobile agents. Security, Energy efficient computing, Impact of mobility on algorithms. Characteristics of radio propagation: Fading, Multipath propagation. Mobile network layer protocols such as mobile-IP, Dynamic Host Configuration Protocol (DHCP). Mobile transport layer protocols such as mobile-TCP, indirect-TCP. Wireless Application Protocol (WAP). Simplified mobile radio environment: propagation characteristics, signal loss, multipath fading, interference; Design countermeasures: design margins, diversity, coding, equalization, and error correction; Channel concept; Frequency division, time division, spread spectrum; Spectrum efficiency issues; Frequency reuse/cellular/microcellular concepts including sectorization and cell splitting; Cellular telephony as a case study in network support: hand-off, mobility, roaming, billing/ authorization/authentication; Design decisions in European GSM, U.S. Digital TDMA, and U.S. Digital CDMA from the systems perspective; Interplay of channel characteristics (e.g., power vs. bit error rate, multipath fading) and network protocol design; Media access methods: Aloha network/carrier sense methods, Karn's MACA for packet radio; Packet radio schemes; Survivable network design; Mobile IP proposal and variations; Cellular Digital Packet Data (CDPD) standard; Satellite systems: low-earth orbiting systems; Symmetric vs. asymmetric communications schemes; Broadcast and multicast communications in a wireless context; Direct Broadcast Satellite systems; Description of commercially available wireless local area networking products;

CSE 527: Graph Theory (3.0 Credits, 45 Lectures)

Fundamental concepts, varieties of graphs, path, cycles and components, degrees and distances, clique. Trees: Properties, spanning trees, forests, centroids, generation of trees and cycles, ent cycles and co-cycles. Connectivity: Vertex and edge connectivity, blocks, eccentricity, Menge′s Theorem. Traversability: Eulerian graphs, kuratowski′s theorem, embedding graphs on surfaces, genus, thickness and crossing number. Graph Coloring: Vertex coloring, edge coloring, chromatic number, five color theorem, four color conjecture, critical graph. Homomorphism Digraph: Different connectedness, oriented graphs-tournaments, network flows and related algorithms. Groups, polynomials and graph enumeration, matching and factorization, perfect graphs, Ramsey number and Ramsey theorem, forbidden graph theory, miscellaneous applications.

CSE 528: Network Performance Analysis (3.0 Credits, 45 Lectures)

Overview on probability theory, Poisson processes, Discrete-Time Markov Chain (DTMC), Continuous-Time Markov Chain (CTMC), Queuing Theory – Little’s law, M/M/1, M/M/m, M/G/1, G/M/1, G/M/m, G/G/1, Traffic Models – Poisson, On/Off, Markov, Video traffic, Web traffic, Backbone traffic, Multiple Access Techniques – Aloha, CSMA/CD, CSMA/CA, IEEE 802.11 DCF, Delay Analysis, Throughput Analysis, Performance analysis of transport and network layer protocols.

CSE 529: Green Networking (3.0 Credits, 45 Lectures)

Green networking is corresponding to the energy-efficient networking. This course explores current perspectives in power consumption for next generation wired and wireless networks, and examines power saving optimization techniques at the levels of the individual networking devices and of the network itself. Re-engineering, dynamic adaptation, sleeping/standby approaches, cooperative communications, energy-aware QoS schemes, transport, routing and MAC protocols are treated in some detail, in order to provide the methodological foundations of the future energy-aware networking.

CSE 530: Cloud Computing (3.0 Credits, 45 Lectures)

Defining cloud computing, Delivering services from the cloud, Adopting the Cloud, Key drivers of cloud computing solutions, Evaluating barriers to cloud computing, Exploiting Software as a Service (SaaS), Characterizing SaaS, Comparing service scenarios, Inspecting SaaS technologies, Delivering Platform as a Service (PaaS), Managing cloud storage, Deploying Infrastructure as a Service (IaaS), Accessing IaaS, Building a Business Case, Calculating the financial implications, Preserving business continuity, Migrating to the Cloud, Technical considerations, Planning the migration.

CSE 531: Reversible Logic Synthesis (3.0 Credits, 45 Lectures)

Theory of reversibility, Energy and Information loss, Popular Reversible logic gates, Garbage outputs, Delay, Quantum cost, Reversible Combinational Circuits: Decoder, Encoder, Multiplexer, Demultiplexer, Adder, BCD Adder, Carry Skip Adder, Reversible Sequential Circuits: Flip Flop, Register, Shift Register, Counter, RAM, Turing machine, Synthesis of Reversible Logic: Transformation based Synthesis, BDD based Synthesis, Fuzzy Reversible Circuit synthesis, Reversible Complex Circuits: PLA, PLD, CPLD, FPGA, Reversible Fault Tolerant Circuits: Fault Tolerant gates, Fault Tolerant Decoder, Fault Tolerant Multiplexer, Reversible Online Testable Circuits: On line testable gates, On line testable circuits, On line testable adders, On line testable Multiplexer, Ternary Reversible Circuits, Nanotechnology and its' impact, Quantum logic, Qubits, Quantum Circuits

CSE 532: Decision Diagram for VLSI Design (3.0 Credits, 45 Lectures)

Binary Decision Diagram; co-factors, Shannon expansions and their properties; binary decision trees; variable ordering, reduction rules and how they led to reduction, Evolution and Satisfiability, Minimization of Decision Diagrams Classical Methods: exchange of neighbor variables, exact minimization, heuristic Minimization, Reduced Ordered Binary Decision Diagram (ROBDD), canonicity of ROBDDs, If else then operator on ROBDDs, ROBDD implementation concepts, Solving 8 queens problem using ROBDD, Proof of correctness and equivalence of combinational Circuits using ROBDD, logical operations such as conjunctions, Disjunctions and Negation on ROBDD, Quantified Boolean Formula, Multi rooted BDD, BDD size bounds, dynamic variable re-ordering, SBDD, MTBDD, BDD for

Characteristic function, Manipulation of BDD using ITE algorithm, Reversible Decision Diagram, Applications of BDD in formal verification, fault tree analysis and Product Configuration, Shared Decision Diagram, Decision Diagram for Multi valued function.

CSE 533: Modern Processor Design (3.0 Credits, 45 Lectures)

The evolution of microprocessors, Instruction set processor design, Digital system design, Architecture, implementation and realization, Instruction set architecture, Dynamic-static interface, Processor performance equation, Processor performance optimizations, Performance evaluation method, Instruction level parallel processing, From scalar to superscalar, Limits of instruction level parallelism, Machines for instruction level parallelism, Pipelined design, Pipelining idealism, Instruction pipelining, Pipeline hazards, Minimizing pipeline stalls, Pipelined processor design, Commercial pipelined processors, RISC pipelined processors, CISC pipelined processors, Scalar pipelined processors, Deeply pipelined processors, Computer system overview, Latency and bandwidth, Components of a modern memory hierarchy, Temporal and spatial locality, Virtual memory systems, Memory hierarchy implementation, Input/output systems, Limitations of scalar pipelines, From scalar to superscalar pipelines, Parallel pipelines, Diversified pipelines, Dynamic pipelines, Superscalar pipeline overview, Instruction fetching, Instruction decoding, Instruction dispatching, Instruction execution.

CSE 534: IPV6 Deployment (3.0 Credits, 45 Lectures)

Introduction to IPv6, IPv6 Protocol Architecture, IPv6 Security Features, Mobile IP in IPv6, IPv6 Addressing and sub-netting, IPv6 Host configuration, Introduction to CISCO IOS, Case Study 1: IPv6 Deployment IP Address Plan, Case Study 2: IPv6 Deployment in IGP, Case Study 3: IPv6 Deployment in EGP, Internet Exchange Policy Overview and Configuration Requirement, Basic Internet Service Delivery using IPv6 Transport, IPv4 to IPv6 Transition Technologies, IPV6 Security.

CSE-535: Distributed Artificial Intelligence (3.0 Credits, 45 Hours Lecture)

Introduction: Introduction to Distributed Artificial Intelligence)DAI(, Historical background, Different domains of DAI. **Distributed Problem Solving:** Distributed constraint reasoning, Utility functions, Probabilistic and deterministic graphical models, Constraint graphical representations: Constraint network, DFS-tree, Junction tree, Factor graph. **Consistency-Enforcing Strategies:** Arc-consistency, Path-consistency and higher levels of i-consistency. Constraint propagation. **Constraint Reasoning Frameworks:** Distributed Constraint Satisfaction Problems)DCSPs(, Distributed Constraint Optimization Problems)DCOPs(and different families)i.e. optimal and approximate(of constraint reasoning algorithms: search-based optimal algorithms: ABT, ADOPT and OptAPO. Inference-based Optimal algorithms: DPOP, Action-GDL. Local search-based approximate algorithms: DSA, MGM and DBA. Inference-based approximate algorithms: Max-product, Max-Sum. **Multi-Agent Systems)MAS(:** Formulation of MAS, Values in MAS (Privacy, Safety, Security, Transparency, etc.), Agent-based Modelling, Coordination strategies, **Multi-Agent planning:** Automated planning, Privacy-preserving planning, Distributed planning and Centralized planning. **Sequential Decision Making:** Markov Decision Process)MDP(, Partially Observable Markov Decision Process)POMDP(and their variants.

CSE-536: Applied Game Theory and Mechanism Design (3.0 Credits, 45 Hours Lecture)

Introduction: Introduction to game theory, History, different families of game, strategies, payoffs, rationality, equilibrium **Normal-form games**: simultaneous-move games with pure and mixed strategies, zero-sum game, constant-sum game, rollback, dominance, best-response algorithms, Min-Max methods, Nash equilibrium, price of anarchy; **Extensive-form games** sequential-move games, game trees, strategy, centipede game, combining sequential and simultaneous moves, two-stage and multi-stage game, sub-game, sub-game perfection, rollback equilibrium; **Uncertainty and Information**: games with perfect and imperfect information (Bayesian game), complete and incomplete information game, cheap talk, conflicting interests, signaling game, Bayes-Nash equilibrium; **Repeated games**: finite and infinite repetition, grims strategy, tit-for-tat, asymmetric information, pooling and separation **Mechanism Design** reverse game theory, incentivecompatibility constraint, participation constraint, social choice and voting theory, social welfare, Groves-Clarke Mechanisms; **Auction**: types, auction rules and design, Dutch and English auctions, bidding strategy, Vickery Auctions.

CSE-537: Text Mining (3.0 Credits, 45 Hours Lecture)

Natural language processing: Basic techniques in natural language processing, including tokenziation, part-of-speech tagging, chunking, syntax parsing and named entity recognition. **Document representation**: How to represent the unstructured text documents with appropriate format and structure to support later automated text mining algorithms. **Text categorization**: Assigning a text document to one or more classes or categories using basic supervised text categorization algorithms, including Naive Bayes, k Nearest Neighbor (kNN) and Logistic Regression, Support Vector Machines and Decision Trees. **Text clustering**: Identifying the clustering structure of a corpus of text documents and assigning documents to the identified cluster(s) using two typical types of clustering algorithms, i.e., connectivity-based clustering (a.k.a., hierarchical clustering) and centroid-based clustering (e.g., k-means clustering). **Topic modeling**: General idea of topic modeling, two basic topic models, i.e., Probabilistic Latent Semantic Indexing (pLSI) and Latent Dirichlet Allocation (LDA), and their variants for different application scenarios, including classification, imagine annotation, collaborative filtering, and hierarchical topical structure modeling. **Document summarization**: Reducing a text document to a summary that retains the most important points of the original document. Extraction-based summarization methods. **Social media and network analysis**: Characteristic of social network: inter-connectivity, the PageRank algorithm. **Sentiment analysis**: It refers to the task of extracting subjective information in source materials. We will discuss several interesting problems in sentiment analysis, including sentiment polarity prediction, review mining, and aspect identification. **Text visualization**: Visual representations of abstract data to reinforce human cognition. Introduce mathematical and programming tools to visualize large collection of text documents.

CSE-538: Mathematical Modeling and Optimization

Linear Programming (LP) as a tool of Operational Research (OP). The history of LP and the contribution of G. Dantzig. Modelling a problem as an LP problem by defining the objective function, the set of linear constraints that determines its feasible solutions. Forms of an LP problem, Unique optimal solution and infinite many optimal solutions. Incompatible constraints, unbounded feasible solution set and unbounded variables; Mathematical Modeling: Linear, nonlinear, and integer programming models;Convex Analysis: Convex sets, polyhedral sets and polyhedral cones, Extreme points and extreme directions, Representation of polyhedral sets, Basic feasible solution and its relation with extreme points. Degenerated basic feasible solutions. The Extreme Point Theorem. Finding the optimal solution by the use of Linear Algebra; Linear Programming: Motivation of the simplex method and the revised simplex method, Farkas' lemma and the Karush-Kuhn-Tucker optimality conditions, Duality and sensitivity analysis, Interior point methods; The big M method and its application on various problems. The two phase method and its application on various problems. LP Problems with Unbounded variables. The Dual LP problem. Economic Interpretation of the Dual LP problem. Duality theorem. Dual Simplex method and its application on various problems. Computational Complexity Theory: Complexity issues, polynomial-time algorithms, Decision problems and classes NP and P; Network Optimization: Network simplex method, Matching and assignment problems, Min-cost, max-flow problems.