PROCEEDINGS OF THE COMMITTEE OF COURSES FOR FORMULATING COURSE CURRICULA OF MASTER OF SCIENCE/ MASTER OF ENGINEERING IN COMPUTER SCIENCE AND ENGINEERING

The committee of courses for formulating the course curricula of M.Sc./M. Engg in Computer Science and Engineering to be conducted by the Department of Computer Science and Engineering (CSE), Military Institute of Science and Technology (MIST) published vide Bangladesh University of Professional (BUP) letter number 23.12.0902.002.001.038.14(2088/HQ/Academic/G) dated 08 May 2014. The undersigned committee has worked out and finalized the detail course outline for the aforementioned M. Sc./ M. Engg Programme on 06 August 2014.

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MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY (MIST)

COURSE OUTLINE FOR MASTER DEGREE PROGRAMME IN COMPUTER SCIENCE AND ENGINEERING

Introduction

1. Computer Science and Engineering (CSE) is one of the leading and purposeful fields of engineering technology. Presently, a good number of students from various public and private universities/institutes successfully complete undergraduate programmes in this field of engineering. But scopes are limited to obtain postgraduate degree since most of the institutions at home do not run postgraduate programme. Since 2001, the department of Computer Science and Engineering (CSE) of MIST has been offering the undergraduate programme in this field. Over the past years, the department has attained sufficient strength and capability to run postgraduate programmes in this field of Engineering. MIST is determined to attain the cutting edge academic and research standard in the contemporary scientific world. The department of CSE, as being well-facilitated with all the modern and essential research aspects, is willing to launch the post-graduate program to open new dimension in the field of higher studies and research in Bangladesh.

2. On 22 May 2014, in the 45th meeting of Academic Council of MIST, it was decided that CSE department would start M.Sc. Engg/ M. Engg in CSE from October 2014 term. Accordingly, a committee of courses having 03 (three) expert professors from Bangladesh University of Engineering and Technology (BUET) and United International University (UIU) and in-house faculties from MIST was formed to design the course curricula of the said programme. In the designed curricula, maximum courses are included providing wider opportunities for the students in selecting courses and research area. Courses of following fields are included:

a. Algorithm
b. Software Engineering
c. Computer Architecture
d. Database Management
e. Computer Networking, Multimedia theory and Information Security
f. Logic Design
g. Artificial Intelligence
h. Image Processing
i. Special Studies

Scope

3. The proceedings of the committee of courses include the following:

   a. General Overview of Master Degree Programme in CSE.

   b. List of Course Codes and Course Titles.

   c. Detail Contents of M.Sc. Engg /M. Engg Courses.

4. **General Overview of Master Degree Programme**. All enrolled students for the M.Sc. Programme shall have to complete minimum 36 credit hours that will include 18 credit hours of theory courses and 18 credit hours of thesis. For M. Engg Programme, the students shall have to complete 30 credit hours of theory and 6 credit hours of thesis/project. Students of both the programmes need to earn minimum CGPA of 2.75 in the theory courses and complete the thesis/project satisfactorily under the supervision of a designated supervisor within the stipulated time duration. All the theory courses will be of 3 (three) credit hours i.e. three hours of engagement in a week with a total of 14 (fourteen) weeks in a semester. Students may enroll as full time or part time. For full time, a student needs to take minimum 12 (twelve) credits to maximum 15 (fifteen) credits including thesis work in any semester. A part time student can take 3 (three) to 9 (nine) credits including thesis work in any semester. For the degree of M.Sc. Engg a student has to take a minimum of 6 (six) courses from different groups. For the degree of M. Engg a student has to take a minimum of 10 (ten) courses. The topic of the thesis (for M. Sc. Engg degree) / project (for M. Engg degree) must be related to the group of the courses.

5. **List of Masters/Postgraduate Courses.** The postgraduate theory courses are arranged as: Algorithm (CSE 6101-6108), Software Engineering (CSE 6201-6204), Computer Architecture (CSE6301-6302), Database Management (CSE 6401-6402), Computer Networking, Multimedia theory and Information Security (CSE 6501-6509), Logic Design (CSE 6601-6602), Artificial Intelligence (CSE 6701-6707), Image Processing (CSE 6801-6806) and Special Studies (CSE 6900).

a. Algorithm

CSE6101	Graph Theory
CSE6102	Computational Geometry
CSE6103	VLSI Layout Algorithms
CSE6104	Graph Drawing
CSE6105	Bioinformatics Algorithms
CSE6106	Combinatorial Optimization
CSE6107	Advanced Algorithms

CSE6108 Advanced Algorithmic Graph Theory

b. Software Engineering

CSE6201 Software Project Management
CSE6202 Software Quality Assurance
CSE6203 Information System Management
CSE6204 Software Testing

c. Computer Architecture

CSE6301 Computer Organization and Design
CSE6302 Advanced Microprocessor

d. Database Management

CSE6401 Advanced Database Systems
CSE6402 High Dimensional Data Management

e. Computer Networking, Multimedia theory and Information Security

CSE6501 Distributed Computing Systems
CSE6502 Multimedia Systems
CSE6503 Computer Graphics and Animation
CSE6504 Elements of Cryptography
CSE6505 Wireless Resource Management
CSE6506 Distributed Search Techniques
CSE6507 Wireless Ad Hoc Networks
CSE6508 Wireless Sensor Networks
CSE6509 Network Security

f. Logic Design

CSE 6601 Computer Arithmetic
CSE 6602 Advanced Logic Design

g. Artificial Intelligence

CSE6701 Advanced Artificial Intelligence
CSE6702 Advanced Syntactic Pattern Recognition

CSE6703 Speech Recognition
CSE6704 Data Mining
CSE6705 Machine Translation
CSE6706 Text-to-Speech Synthesis
CSE 6707 Semantic Web

h. Image Processing

CSE6801 Neural Networks
CSE6802 Mathematical Programming
CSE6803 Fuzzy Systems
CSE6804 Meta-Heuristics
CSE6805 Advanced Digital Image Processing
CSE6806 Image Retrieval

i. Special Studies

CSE6900 Special Topics Related to Computer Science and Engineering

6. **Detail Contents of Master/Postgraduate Courses**.

CSE 6000: Thesis

(for PhD: 45 Credits, for M.Sc. Engg.:18 Credits) / Project (for M. Engg: 6 Credits)

a. Algorithm Division

CSE6101: Graph Theory

Prerequisite: None

3.0 Credits

Introduction, fundamental concepts, trees, spanning trees in graphs, distance in graphs, Eulerian graphs, digraphs, matching and factors, cuts and connectivity, k-connected graphs, network flow problems, graph coloring: vertex coloring and edge coloring, line graphs, Hamiltonian cycles, planar graphs, perfect graphs.

CSE6102: Computational Geometry

Prerequisite: None

3.0 Credits

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.

CSE6103: VLSI Layout Algorithms

Prerequisite: None

3.0 Credits

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.

CSE6104: Graph Drawing

Prerequisite: None

3.0 Credits

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.

CSE6105: Bioinformatics Algorithms

Prerequisite: None

3.0 Credits

Introduction; Molecular biology basics: DNA, RNA, genes, and proteins; Restriction mapping algorithm; Motif in DNA sequences, motif finding algorithms; Genome rearrangements, sorting by reversals and breakpoints; DNA sequence alignments; Gene prediction; Space-efficient sequence alignments, sub-quadratic alignment; DNA sequencing, genome sequencing, protein sequencing, spectrum graphs; Combinatorial pattern matching: Exact pattern matching, heuristic similarity search algorithms, approximate string matching, BLAST, FASTA; Clustering: Microarrays, hierarchical clustering, K-means clustering, corrupted cliques problem, CAST clustering algorithm; Evolutionary trees.

CSE6106: Combinatorial Optimization

Prerequisite: None

3.0 Credits

Introduction to Optimization; Linear Programming: Different forms, Simplex Method, Primal-Dual theory; Max-Flow: The Max-Flow-Min-Cut Theorem, Ford-Fulkerson Labeling Algorithm, Dijkstra's Algorithm, The Floyd-Warshall Algorithm; Some

Network Flow Algorithms: The Minimum Cost Network Flow Method, Transportation Problem; Capacitated Transportation Problem, Assignment Problem; Integer Linear Programming; Relaxation; Cutting-Plane Algorithm; Branch and Bound Technique; Dynamic Programming; NP-Completeness; TSP and Heuristics; Approximation.

CSE6107: Advanced Algorithms

Prerequisite: None

3.0 Credits

Randomized Algorithms: Las Vegas and Monte Carlo Algorithms; Randomized Data Structures: skip Lists; Amortized Analysis: different methods, applications in Fibonacci Heaps; Lower Bounds: decision trees, information theoretic lower bounds, adversary arguments; Approximation Algorithms: approximation schemes, hardness of approximation; Fixed Parameter Tractability: parameterized Complexity, techniques of designing fixed parameter algorithms, examples; online algorithms: competitive analysis, online paging problem, k-server problem; external memory algorithms; Advanced Data Structures: Linear and Non-linear Methods

CSE6108: Advanced Algorithmic Graph Theory

Prerequisite: None

3.0 Credits

Vertex Orderings: st-Numbering and Canonical Orderings; Graph Decompositions and Their Algorithmic Applications: ear decomposition, canonical decomposition, tree decomposition, path width and tree width, PQ-tree, SPQR-tree, split decomposition, recursively decomposable graphs, clique separator decomposition; Graph Representations: implicit representations, intersection and containment representations; graph classes defined by forbidden subgraphs; graph classes defined by elimination schemes; classes of graphs with bounded treewidth and their algorithmic implications; characterization, construction and recognition algorithms for some special classes of graphs.

b. Software Engineering

CSE6201: Software Project Management

Prerequisite: None

3.0 Credits

Foundations of software project management; organization structure and staffing; motivation, authority and influence; conflict management; proposal preparation; a large engineering software system management; client management; managing software project teams; project planning and scheduling; risk management; configuration management; pricing estimation and cost control; quality assurance and accreditation; factors affecting software quality; software quality assurance plans; business context and legal issues for software projects; software measurement: testing, upgrading and maintenance; network systems; and international project management.

CSE6202: Software Quality Assurance

Prerequisite: None

3.0 Credits

Definition and concept of software quality assurance (SQA); quality models; specification of quality requirements; product development & delivery issues; software development processes & maturity; software quality management process: total quality management, improvement cycle, SQA planning & management, organizing the SQA effort; software verification & validation; typical software development errors; Fagan inspections; software audit; software testing: testing objectives & testing fundamentals, testing theory, coverage criteria, equivalence class testing, value-based testing, decision table, syntax & state transition testing, statement & path testing, branch & condition testing, data flow testing, thread-based testing, integration & integration testing, system testing; testing in object-oriented systems; test tools & test automation; test management; problem reporting & corrective action.

CSE6203: Information System Management

Prerequisite: None

3.0 Credits

Information systems management: importance of information systems (IS) management, IS management's leadership role, strategic uses of IT, IS planning; managing essential technologies: distributed systems, managing telecommunications, managing information resources, and managing operations; managing system development: technologies for developing systems and management issues in system development; systems for supporting knowledge work: supporting decision making, collaboration, and knowledge works; acquisition of hardware, software, networks, and services: request for proposal, acquisition methods (buy, rent, or lease), software acquisition, and analysis of alternatives; people and technology: the challenges ahead.

CSE6204: Software Testing

Prerequisite: None

3.0 Credits

Objectives of software testing, test process, testing and development, test case, test execution, test harness, testing and debugging, test adequacy, control flow graph, errors, faults and failures, types of testing; Test generation from requirements: equivalence partitioning, boundary value analysis, category partitioning, fault model for predicates, Boolean operator (BOR), Boolean and relational operator (BRO), and Boolean and relational expression (BRE) methods, limitations of test generation from requirements; Test adequacy assessment: adequacy criteria, control flow based criteria, data flow based criteria, mutation based criteria, adequacy as a stopping criterion, adequacy as a tool for test enhancement; GUI testing, security testing, random testing, combinatorial testing; Testing tools: Open source and commercial software testing tools.

c. Computer Architecture

CSE6301: Computer Organization and Design

Prerequisite: None

3.0 Credits

Classification and addressing modes, operands and operations for media and signal processing, instructions for control flow, encoding an instruction set; pipelined and superscalar processors, data hazards, dynamic scheduling, branch prediction, hardware based speculation, thread level parallelism; ILP with software approaches: compiler techniques, static branch prediction, static multiple issue, advanced compiler support for ILP. basic techniques of integer arithmetic, floating-point arithmetic, speeding up integer addition; speeding up integer multiplication and division; memory technology, raids, organization for improving performance, virtual memory and protection, cache organization, reducing cache miss rate and penalty; busses, performance measures, designing i/o system, reliability, dependability and availability; symmetric shared memory architectures, cache coherence protocols, distributed shared memory architectures, synchronization, models for memory consistency, multithreading. Interconnection networks: practical issues, network on chip, designing cluster; advanced RISC, CISC and embedded processors architectures.

CSE6302: Advanced Microprocessor

Prerequisite: None

3.0 Credits

Review of different microprocessors: 80486, 68040, V70, Gmicro processors; Comparing the architectures: RISC and CISC; Instruction set of machines: SPARC, INTEL, and MIPS; Study of microprocessors: Pentium II, Alpha 21064, MIS 6400, PA-RISC; Math coprocessors and microprocessors.

d. Database Management Division

CSE6401: Advanced Database Systems

Prerequisite: None

3.0 Credits

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.

CSE6402: High Dimensional Data Management

Prerequisite: None

3.0 Credits

Spatial database systems; spatial data types; indexing and querying spatial data; spatial networks; temporal database systems; moving object data management systems; moving object indexing techniques; query processing on moving object data; multidimensional indexing methods; similarity search; dimension reduction methods; time series data; indexing techniques for massive time series data; state-of-the-art systems for managing high dimensional data; emerging issues in high-dimensional data management systems.

e. Computer Networking, Multimedia theory and Information Security

CSE6501: Distributed Computing Systems

Prerequisite: None

3.0 Credits

Distributed object systems, retrieving and caching of distributed information, distributed data replication and sharing, performance issues, algorithms for deadlock detection;

concurrency control and synchronization in distributed system, models for distributed computation, networking facilities and resource control and management methods in network and distributed operating systems; collaborative applications, wide area network computing, web based commerce, agent systems and market based computing.

CSE6502: Multimedia Systems

Prerequisite: None

3.0 Credits

Overview to multimedia systems, multimedia storage, data compression techniques for audio and video, synchronization, multimedia networking and protocols; QoS principles, video streams on ATM, mobile multimedia communications, operating system support for multimedia, hypermedia system, standards for multimedia, multimedia database and multimedia applications.

CSE6503: Computer Graphics and Animation

Prerequisite: None

3.0 Credits

Advanced Graphic Techniques: graphics basics, three dimensional drawings, geometric forms and models, hidden surfaces, fractals; Advanced rendering Techniques: shadow generation techniques, texture and environment mapping techniques, procedural texture mapping and modeling, ray tracing, Radiosity methods, global illumination models, volume rendering techniques; Advanced Animation: animation articulated structures, soft object animation, procedural animation.

CSE6504: Elements of Cryptography

Prerequisite: None

3.0 Credits

Classical Cryptography: introduction to simple cryptosystems, cryptanalysis; Shannon's Theory: perfect secrecy, entropy, product cryptosystems; data encryption standard: description of des, differential cryptanalysis; RSA System and Factoring: Public-key cryptography, RSA cryptosystem, attacks on RSA, factoring algorithms; Other Public-

key cryptosystems: ElGamal cryptosystem and discrete logs, Merkle-Hellman Knapsack System; Signature Schemes: ElGamal signature schemes, Digital signature standard, Fail-stop signatures; Hash Functions: Signatures and Hash functions, Collision-free Hash functions, Birthday attack; Key Distribution and Key Agreement: Key redistributions, Kerboros, Diffie-Hellman key exchange; Identification Schemes: Schnorr identification scheme, Okamoto identification schemes; Authentication Codes: Computing deception probabilities, Combinatorial bounds, Entropy bounds; Secret Sharing Schemes: Shamir threshold scheme, Access structure and general secret sharing; Pseudo-random Number Generation: Indistinguishable probability distribution, probabilistic encryption; Zero-knowledge proofs: Interactive proof systems, computational Zero-knowledge proofs.

CSE6505: Wireless Resource Management

Prerequisite: None

3.0 Credits

Resource management architecture: evolution and components of QoS and cross-layer architecture for bandwidth management; tri-band and smart antenna; handoff management; mobility prediction; resource management and connection admission control; bandwidth allocation and scheduling: real-time guaranteed and fair real-time scheduling; inter-domain radio resource management; high performance broadband architecture; wireless truthful computing; resource allocation of Spatio-temporal division multiple access control; resource management schemes for connectivity: Piconet and scatternet; energy efficient MAC layer protocols for wireless ad-hoc networks; routing and resource discovery for wireless ad-hoc networks: QoS based routing, topology management, efficient resource discovery, hybrid routing protocols, and localization; energy efficient broadcasting and multicasting algorithms; power-conserving broadcasting and multicasting algorithms; scopes of increasing wireless resources, research and future developments.

CSE6506: Distributed Search Techniques

Prerequisite: None

3.0 Credits

Large-scale distributed systems: properties and examples; search requirements in service discovery, peer-to-peer content sharing and distributed XML databases; unstructured techniques: intelligent flooding, hint-based routing, etc.; basic structured techniques: Chord, CAN, Tapestry, Kademlia, etc.; advanced structured techniques: pSearch, Squid, SkipNet, etc.; Signature search techniques using Bloom filters; Distributed Pattern Matching (DPM) problem and its applications; distributed crawling and indexing techniques.

CSE6507: Wireless Ad Hoc Networks

Prerequisite: None

3.0 Credits

Introduction: applications and motivations; broadcasting protocols: algorithmic aspect, optimization techniques, power-efficient broadcasting; routing protocols: DSDV, AODV, DSR, position based routing protocols, load balancing techniques, multi-path routing; medium access control protocols: reservation-based MAC protocols, Bluetooth technology, IEEE 802.11 based MAC protocols; channel propagation models; topology control protocols; power aware protocol design; cross layer design principles; mobility awareness; fairness and security issues: attacks and preventions; stimulating cooperation: self policing schemes, economic incentive based schemes; other state-of-the-art relevant topics.

CSE6508: Wireless Sensor Networks

Prerequisite: None

3.0 Credits

Introduction: applications; Localization and tracking: tracking multiple objects; Medium Access Control: S-MAC, IEEE 802.15.4 and ZigBee; Geographic and energy-aware routing; Attribute-Based Routing: directed diffusion, rumor routing, geographic hash tables; Infrastructure establishment: topology control, clustering, time synchronization; Sensor tasking and control: task-driven sensing, information-based sensor tasking, joint routing and information aggregation; Sensor network databases: challenges, querying the physical environment, in-network aggregation, data indices and range queries, distributed

hierarchical aggregation; Sensor network platforms and tools: sensor node hardware, sensor network programming challenges; Other state-of-the-art related topics.

CSE6509: Network Security

Prerequisite: None

3.0 Credits

Network security policies, strategies and guidelines; Network security assessments and matrices; Different attacks: Denial of Service attack (DoS), Distributed Denial of Service (DDoS) attack, eavesdropping, IP spoofing, Sybil attack, Blackhole attack, Grayhole attack, Man-in-the-middle attack, passwords-based offline attacks; Network security threats and attackers: intruders, malicious software, viruses and spy-ware; Security standards: DES, RSA, DHA, Digital Signature Algorithm (DSA), SHA, AES; Security at Transport layer: Secure Socket Layer (SSL) and Transport Layer Security (TLS); Security on Network layer: IPSec; Network security applications: AAA standards, e-mail securities, PGP, S/MIME; PKI smart cards; Sandboxing; Firewalls and Proxy server; Security for wireless network protocols: WEP, WPA, TKIP, EAP, LEAP; security protocols for ad-hoc network; security protocols for sensor network; security for communication protocols; security for operating system and mobile agents; security for e-commerce; security for LAN and WAN; switching and routing security; other state-of-the-art related topics.

f. Logic Design

CSE 6601: Computer Arithmetic

Prerequisite: None

3.0 Credits

Integer arithmetic, floating point arithmetic; single precision and double precision; interrupt handling high-speed adders; standard and recorded multipliers, booth's multiplier, canonical and multi bit scanning multipliers, array multipliers; high radix non-restoring division, SKT division, Robertson division, convergence division and cellular array dividers; floating point processors; binary squares and square roots, evaluation of

trigonometric functions and polynomials, Chen convergence computation, cord1c computations, logarithmic number system (LNS) processor.

CSE6602: Advanced Logic Design

Prerequisite: None

3.0 Credits

Functional decomposition and symmetric functions; linear sequential machines; Reed-Muller expansions and their minimizations; EXOR based logic design; self-timed circuits; asynchronous design techniques; digital logic circuit testing and testable design: testing of combinational and sequential logic circuits, design for testability and built-in self test; digital logic simulation.

g. Artificial Intelligence

CSE6701: Advanced Artificial Intelligence

Prerequisite: None

3.0 Credits

Introduction, advanced search techniques in AI, knowledge based system design, advanced plan generating systems, Bayesian network and probabilistic reasoning; learning in neural belief networks, practical natural language processing, computer vision, introduction to robotics.

CSE6702: Advanced Syntactic Pattern Recognition

Prerequisite: None

3.0 Credits

Introduction to formal languages, string languages for pattern description, higher dimensional pattern grammars, syntax analysis as a recognition procedure, stochastic languages; error-correcting parsing for string languages, error-correcting tree automata, cluster analysis for syntactic patterns, grammatical inference for syntactic pattern recognition, application shape analysis of wave forms and contours, syntactic approach to texture analysis.

CSE6703: Speech Recognition

Prerequisite: None

3.0 Credits

Introduction, Speech signal: production, perception and characterization, Signal processing and analysis; Pattern comparison techniques: distortion measures, spectral-distortion measures, time alignment and normalization; Recognition system design and implementation: source-coding, template training, performance analysis; Connected word models: two level DP, level building algorithm, one-pass algorithm; Continuous speech recognition: sub word units, statistical modeling, context-dependent units; Task oriented models.

CSE6704: Data Mining

Prerequisite: None

3.0 Credits

Introduction; data warehousing and OLAP technology for data mining; data preprocessing; data mining primitives, languages and systems; descriptive data mining: characterization and comparison; association analysis; classification and prediction; cluster analysis; mining complex types of data; applications and trends in data mining.

CSE6705: Machine Translation

Prerequisite: None

3.0 Credits

Theoretical problems: definition, context dependency, interpretation and translation; engineering problems of machine translation: maintainability, tunability, modularity, and efficiency; Linguistics-based MT: compositionality and isomorphism, declarative frameworks, constraint-based formalisms; Knowledge-based MT: translation and understanding, design of interlinguas, the conceptual lexicon; Statistics-based MT: E-M algorithms, alignment of bilingual corpora, translation templates; Example-based MT: similarity measures, levels of comparison; treatment of context dependency: knowledge-based transfer, sublanguage-based mt, translation units.

CSE6706: Text-to-Speech Synthesis

Prerequisite: None

3.0 Credits

Introduction and definition, composition and production of speech; human hearing, acoustics and phonetics; Text parsing and processing: grammars and lexicons, segmentation, transducers; Morphological and contextual analysis; Phonetization: phonemes, modules and systems; Intonation and prosody: levels, acoustic, perceptual and linguistic models, prosodic parsing; Techniques: architectures, formalisms, databases, rule based, formant, concatenative, linear predictive, and stochastic synthesis.

CSE6707: Semantic Web

Prerequisite: None

3.0 Credits

Semantic web: general overview, motivation, models, technologies, resource annotation; Resource Description Language (RDF): syntax, data structures, formal semantics; Web Ontology Language (OWL): semantics, standards, logics; Ontology: formats, rules, queries, Simple Protocol and RDF Query Language (SPARQL); Ontology engineering and applications.

h. Image Processing Division

CSE6801: Neural Networks

Prerequisite: None

3.0 Credits

Fundamentals of neural networks; back propagation and related training algorithms; Hebbian learning; Cohonen-Grossberg learning; the bam and the Hopfield memory; simulated annealing; different types of neural networks: counter propagation, probabilistic, radial basis function, generalized regression, etc; adaptive resonance theory; dynamic systems and neural control; the Boltzmann machine; self-organizing maps; spatiotemporal pattern classification, the recognition; practical aspects of neural networks.

CSE6802: Mathematical Programming

Prerequisite: None

3.0 Credits

Basic concept of mathematical programming, concepts of linear and quadratic programming, convexity, convex sets and convex functions, concept of integer programming; some examples of integer programming problems, linear programming techniques, graphical solution of linear programming problems, simplex method, dual simplex method, different integer programming techniques, revised simplex method.

CSE6803: Fuzzy Systems

Prerequisite: None

3.0 Credits

Basic Concepts of fuzzy set theory; fuzzy numbers; aggregation operations of fuzzy sets; the theory of approximate reasoning; introduction to fuzzy logic control; fuzzy system models and developments; fuzzy logic controllers; defuzzification methods; linguistic descriptions and their analytical forms; the flexible structure of fuzzy systems; practical aspects of neural networks.

CSE6804: Meta-Heuristics

Prerequisite: None

3.0 Credits

Heuristics and meta-heuristic: notation, motivations, applications; Representations: vectors, graphs, trees, lists, rule sets; Single-state methods: hill-climbing, global optimization algorithms, simulated annealing, Tabu search, iterated local search, guided local search, reactive local search, greedy randomized adaptive search procedures; Nature inspired methods: evolution strategies, genetic algorithms, particle swarm optimization, ant colony optimization, bee colony optimization, artificial immune systems; Hybrid methods; Parallel methods: multiple threads, island models, master-slave fitness assessment, spatially embedded models; Multiobjective optimization; Performance evaluation.

CSE6805: Advanced Digital Image Processing

Prerequisite: None

3.0 Credits

Image sampling and quantization; image smoothing, sharpening and contrast enhancement in spatial and frequency domains: basic gray level transformation, histogram processing, image subtraction, image averaging, Gaussian and Laplacian filters in spatial and frequency domains, convolution theorem; Image de-noising: noise models, noise reduction by spatial and frequency domain filters, mean filter, adaptive filter, bandpass and band reject filters, notch filter, inverse filter, minimum mean square error filter; Multi-resolution image processing: wavelet transform in one and two dimensions, tree structured wavelet transform, pyramid structured wavelet transform, curvelet transform; Morphological image processing: erosion, dilation, opening, closing, hole filling, connected components, thinning, skeletons, extension of morphological operations to gray scale images; Image segmentation: thresholding, region based segmentation, contour based segmentation, graph based segmentation; Color image processing: color models and transformations, edge detection and segmentation in color images, color image compression; digital image security; image content feature extraction, representation and image retrieval; concept learning and object recognition.

CSE6806: Image Retrieval

Prerequisite: None

3.0 Credits

Color models and their properties; Color feature extraction: color histogram, color coherence vector, color correlogram, dominant color descriptor, scalable color descriptor, color structure descriptor, color naming system; Texture feature extraction: moment based texture features, gray level co-occurrence matrix, features based on Gabor filter, wavelet and curvelet transforms, simultaneous autoregressive model, fractal dimension, edge detection and edge histogram; Shape feature extraction: image segmentation, contour representation by chain codes, Fourier descriptors, and curvature scale space, region descriptors; local and global features; Distance measures; Performance metrics;

Databases; Tradition metadata based image retrieval; Content based image retrieval (CBIR) using low level color, texture and shape features; Issues in CBIR; relevance feedback in image retrieval; image understanding using support vector machines, neural networks, decision tree, Bayesian theorem, and ontology; Semantic image retrieval; Web image retrieval.

i. Special Studies Division

CSE6900: Special Topics Related to Computer Science and Engineering

Prerequisite: None

3.0 Credits

Syllabus should be approved by BPGS prior to the commencement of the term. In each term only one such course title under this course number can be offered. Furthermore one student can take such course only once.