

Wired network security; IDS Fundamental; Generic architecture, Host based and Network based IDSs; DM in NIDS development: supervised, semi-supervised and unsupervised NIDSs Signature/Rule based NIDS

Anomaly based NIDS development Performance evaluation metrics for NIDS

Wireless network security; Development of security applications

Privacy preserving data clustering; privacy preserving association mining

#### References:

1. Cryptography and Network Security by Atul Kahate, Tata McGraw-Hill, 2007
2. Cryptography and Network Security by B. A. Forouzan, McGraw-Hill Companies, 2009
3. Data Mining and Knowledge Discovery - <http://www.kluweronline.com/issn/1384-5810>

CS 538	Computational Geometry	3-0-0	3
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#### COURSE CONTENT

Geometric and Algorithm Basics: Fundamentals of Euclidean and Affine Geometry, Convexity; Basic concepts of Algorithms and its complexity, correctness proofs of algorithms; Paradigms of computational geometric algorithms; Degeneracies in Computational Geometry.

Convex Hulls Planar convex hulls definition, deterministic, randomized, output-sensitive and dynamic algorithms; applications of convex hull.

Intersection: Plane sweep algorithm for line segment intersection.

Geometric searching: Segment tree, Interval tree and Priority search tree; Point location query; Range searching -- Kd tree, range tree, fractional cascading; Proximity queries -- Nearest neighbor, closest pair; persistent data structure (if possible)

Triangulation and Partitioning: Polygon triangulation -- existence and algorithms, Art Gallery Theorem.

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Voronoi Diagram and Delaunay Triangulation: Voronoi diagram, Delaunay triangulation and their dual relations; algorithms for computing Voronoi diagram and Delaunay triangulation. Duality and Arrangement: Duality relation between points and lines; Arrangements and their applications.

Basics of Combinatorial Geometry: Unit distance problem, Point line incidences.

Text Book:

1. M. de Berg, O. Cheong, M. van Kreveld, and M. Overmars. Computational Geometry: Algorithms and Applications. Springer-Verlag, 3rd revised edition, 2008.

Reference Books:

1. Preparata and Shamos, Computational Geometry - an introduction, Springer-Verlag (1985, revised ed., 1991).
2. J. O' Rourke, Computational Geometry in C, Cambridge University Press, second edition, 1998.
3. Jean-Daniel Boissonnat, Mariette Yvinec, Algorithmic Geometry, Cambridge University Press, 1998.

CO 503	Fuzzy Logic and Neural Networks	3 - 0 - 0	3
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## COURSE CONTENT

Overview of Crisp Sets and Fuzzy Sets:

Basic concepts of crisp sets and fuzzy sets, Types of fuzzy sets, Operation on fuzzy sets.

Fuzzy relations and fuzzy logic:

Crisp vs fuzzy relations, binary relations, equivalence relations, tolerance relations, composition of relations, fuzzy relational equations, fuzzy measure and possibility theory, classical logic and multivalued logic, fuzzy propositions and approximate reasoning.

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Introduction to neural networks:

Biological and Artificial neurons, Learning in ANNs, Perceptrons – classification and linear separability, XOR problem, Network architectures, Multilayer feed forward networks and recurrent networks, Generalized delta rule.

Multilayer networks:

Back propagation (BP) network, BP training algorithm, Radial basis function (RBF) networks, Applications of BP and RBF networks.

Recurrent networks and unsupervised learning, Hopfield network - energy; stability; capacity; Application to optimization problems, Counter back propagation network, Boltzmann machine, Kohonen's self organizing feature maps, Adaptive resonance theory.

Associative memory:

Matrix associative memory, Auto associative memories, hetero associative memories, Bi-directional associative memory, applications of associative memories.

Fuzzy Systems and Neuro fuzzy systems:

Relevance of Integration between fuzzy sets and neural network, Fuzzy neural network, Neuro fuzzy systems, Fuzzy associative memories.

Application of Fuzzy sets and Neural networks:

Application in pattern recognition, Image processing and computer vision, Application in control: Fuzzy controllers, neuro controllers and fuzzy neuro controllers, applications in expert systems and decision making systems, application in real world computing.

Text books:

1. S. Haykin, Neural Networks: A Comprehensive Foundation, Prentice Hall.
2. Limin Fu, Neural Networks in computer intelligence, McGraw hill Intl.

Reference Books:

3. T Ross, Fuzzy logic with Engineering applications.,
4. G Klir, B Yuan, Fuzzy sets and fuzzy logic : Theory and application, PHI.

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Discourse- Reference resolution, constraints on co-reference, algorithm for pronoun resolution, text coherence, discourse structure.

Applications of NLP- Spell-checking, Summarization

Information Retrieval- Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries.

Machine Translation– Overview.

Textbook:

1. Daniel Jurafsky and James H Martin. *Speech and Language Processing, 2e*, Pearson Education, 2009

Reference Books:

2. James A.. *Natural language Understanding 2e*, Pearson Education, 1994
3. Bharati A., Sangal R., Chaitanya V.. *Natural language processing: a Paninian perspective*, PHI, 2000
4. Siddiqui T., Tiwary U. S. *Natural language processing and Information retrieval*, OUP, 2008

CS 610	Bioinformatics	3-0-0	3
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## COURSE CONTENT

Evolution and inheritance. Concept of gene, genetic material and genome. Chemistry of nucleic acids - structure and chemical composition of DNA and RNA. Concept of cell-cycle and its regulation. Replication of genome, molecular basis of genome evolution. Molecular biology of gene functions (transcription and translation. Concepts of transcriptome, proteome and metabolome. Genomics (genome projects, concepts of structural and functional genomics). Databases, DNA sequence analysis, protein sequence analysis. Introduction to Neurobiology, Signal Transduction. Computational tools and techniques for Bioinformatics.

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Books/References:

1. Genes VII by Benjamin Lewin.
2. Proteins, Structure and Molecular Properties by Thomas E. Creighton.
3. Bio-physical Chemistry Part I: The Conformation of Biological Molecules by Cantor and Schimmel.
4. Principles of Bio-Chemistry by Albert L. Lehninger, David L. Nelson and Michael M. Cox. 5. Genetics by T. A. Brown.
6. Molecular Cell Biology by David Baltimore.
7. Introduction to Bioinformatics Arthur M. Lesk, Oxford University Press
8. Fundamental Concepts of Bioinformatics Krane and Raymer, Pearson Education
9. Bioinformatics (Sequence and Genome Analysis) David W. Mount, Cold Spring Harbour Laboratory Press

CS 725	Knowledge Representation and Reasoning	4-0-0	4
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COURSE CONTENT

Review of First-order Logic: Expressing knowledge, Resolution. Horn clauses. Procedural representations. Production systems.

Review of logical foundations of knowledge representation including key properties of formal systems (such as soundness, completeness, expressiveness and tractability). Principles of Logic Programming.

Representing and reasoning about time and actions and physical changes (e.g., interval calculus, event calculus). Representing space and physical situations (topology, orientation, physical objects).



Concept of Data Warehouse, Differences between Operational Databases and Data Warehouse, Multi-dimensional Data Model, Schemas for Multi-dimensional Databases, Data Cube Representations, Data Warehouse Architecture, OLTP vs OLAP, Efficient Query Processing in data Warehouses, Indexing of OLAP data, Materialization concept;

Data Mining

Data Clustering: Partitioning, Hierarchical, Density-based, Grid Based and Model Based Methods;

Classification & Prediction: Decision Tree Techniques, Back-Propagation Method, Bayesian Method

Association Rule Mining Techniques: Frequent Itemset Generation, Apriori, Horizontal Method, Sampling Approach, Hashing Approach; Dynamic Association Rule Mining;

Mining of Complex Types of Data: Mining of Spatial Databases, Multimedia Databases, Time-series and sequence Data, Text Databases, WWW Data;

Books/References:

1. Jiawei Han and Micheline Kamber, 'Data Mining: Concepts and Techniques', Morgan Kaufmann, India
2. A K Pujari, 'Data Mining Techniques', University Press, India
3. Han, Manilla and Smyth, 'Principles of Data Mining', PHI, India

IT 507	Computer Security & Cryptography	3-0-0	3
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## COURSE CONTENT

Introduction to Cryptography, Mathematical Foundation of Cryptography : Information Theory, Complexity Theory, Number Theory, Probability Theory;

Secret Key Cryptosystem : Stream and Block Ciphers; Pseudo-random pattern generators, LFSR based stream ciphers, other stream ciphers; Correlation attacks and other relevant attacks for stream ciphers; DES and Its Security, other Block Ciphers; Differential Cryptanalysis, Attacks on Block Ciphers;

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One-Way Hash Functions and Data Integrity: Snefru, MD4, MD5, SHA, HAVAL;  
Cryptanalysis of hash functions;

Public Key Cryptography: Mathematical Foundation, RSA, Security Analysis of RSA

Key Establishment Protocols: Symmetric key based and Asymmetric Key based  
protocols, KERBEROS, EKE, DH-EKE, PAKE, etc; Secret Sharing;

Digital Signature Schemes: RSA and other related signature schemes, Possible Attacks,  
DSA and other related signature schemes;

Books/References:

1. Manazes, Oorschot and Vanstone, Handbook of Applied Cryptography, CRC Press
2. B Schnier, Applied Cryptography, PHI

CS 606	Computer Architecture and Parallel Processing	3-0-0	3
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## COURSE CONTENT

Definitions of Computer Architecture - Abstract Architecture & Concrete Architecture.

Concepts in Parallel Processing - Available Parallelism and Utilized Parallelism.  
Parallel Programming Models – PRAM, Shared Variable, Message Passing, Data  
Parallel.

Classification of Computer Architectures – Flynn’s Classification – Classification of  
Parallel Architectures.

Instruction Level Parallel (ILP) Processors – Pipelined, VLIW, Super Scalar Processors  
– Instruction Dependencies, their Effect on Performance and Techniques to overcome  
them.

Basic Concepts and Techniques in Vector, Systolic and Dataflow architectures.  
Multiprocessor Architectures – Synchronization and Cache Coherence Issues.

Multicomputer Architectures – Interconnection Networks, Routing and Data  
Communication Algorithms.

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