

Rajiv Gandhi Proudyogiki Vishwavidyalaya Bhopal

M.Tech (Artificial Intelligence & Data Science)

Third Semester Syllabus

MTAD-301 (A) Image Processing & Computer Vision

UNIT 1

Digital Image Formation and low-level processing: Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc. Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

UNIT 2

Depth estimation and Multi-camera views, Multiple View Geometry Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

UNIT 3

Feature Extraction Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

UNIT 4

Image Segmentation Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

Pattern Analysis Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

UNIT 5

Motion Analysis Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

Shape from X Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

Reference Books:

1. Digital Image Processing using MATLAB, By: Rafael C. Gonzalez, Richard Eugene Woods, 2nd Edition, Tata McGraw-Hill Education 2010
2. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
3. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.

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Third Semester Syllabus

MTAD-301 (B) Modern Information Retrieval

UNIT 1

Introduction to Information Retrieval: The nature of unstructured and semi-structured text. Inverted index and Boolean queries.

UNIT 2

Text Indexing, Storage and Compression: Text encoding: tokenization, stemming, stop words, phrases, index optimization. Index compression: lexicon compression and postings, lists compression. Gap encoding, gamma codes, Zipf's Law. Index construction. Postings size estimation, merge sort, dynamic indexing, positional indexes, n-gram indexes, real-world issues.

UNIT 3

Retrieval Models: Boolean, vector space, TFIDF, Okapi, probabilistic, language modeling, latent semantic indexing. Vector space scoring. The cosine measure. Efficiency considerations. Document length normalization. Relevance feedback and query expansion. Rocchio.

UNIT 4

Performance Evaluation: Evaluating search engines. User happiness, precision, recall, F-measure. Creating test collections: kappa measure, interjudge agreement.

Text Categorization and Filtering: Introduction to text classification. Naive Bayes models. Spam filtering. Vector space classification using hyperplanes; centroids; k Nearest Neighbors. Support vector machine classifiers. Kernel functions. Boosting.

UNIT 5

Text Clustering: Clustering versus classification. Partitioning methods. k-means clustering. Mixture of Gaussians model. Hierarchical agglomerative clustering. Clustering terms using documents.

Reference Books:

1. Manning, Raghavan and Schutze, Introduction to Information Retrieval, Cambridge University Press.
2. Baeza-Yates and Ribeiro-Neto, Modern Information Retrieval, Addison-Wesley.
3. Soumen Charabarti, Mining the Web, Morgan-Kaufmann.
4. Survey by Ed Greengrass available in the Internet.

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Third Semester Syllabus

MTAD-301 (C) Information Security

UNIT-1

Passwords, security questions, challenge-response, Cryptographic hash functions, Biometrics, Phishing

UNIT-2

Web security model, Web authentication and session management, Cross-site request forgery, SQL injection, cross-site scripting, Logic flaws in Web applications, Clickjacking

UNIT-3

Online tracking, Symmetric encryption, Kerberos, Memory corruption attacks and defenses, Viruses and rootkits.

UNIT-4

Spam, Attacks on TCP/IP, DNS, BGP. Denial of service, Worms and botnets, Advance Persistent Threats

UNIT-5

Firewall and intrusion detection, Public Key Cryptography, SSL and certificates, Anonymity networks, Side channel attacks: acoustics and reflections Security Engineering by Anderson Network Security (2nd edition) by Kaufman, Perlman, and Speciner -- required textbook!

Reference Books:

1. The Art of Intrusion by Mitnick and Simon
2. Network Security Essentials by Stallings
3. Secure Programming for Unix and Linux HOWTO by Wheeler
4. The Shellcoder's Handbook by Koziol et al.

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MTAD-301 (D) IOT (Internet of Things)

UNIT-1

Introduction to IoT Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models and APIs IoT and M2M, Difference between IoT and M2M, Software define Network.

UNIT-2

Network and Communication aspects: Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment, Node discovery, Data aggregation and Dissemination

UNIT-3

Challenges in IoT Design: challenges, Development challenges, Security challenges, Other Challenges Domain specific applications: IoT Home automation, Industry applications, Surveillance applications, Other IoT applications

UNIT-4

Developing IoTs: Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python

UNIT-5

PRIVACY PRESERVATION AND TRUST MODELS FOR IOT : Concerns in data dissemination – Lightweight and robust schemes for Privacy protection – Trust and Trust models for IoT – self-organizing Things - Preventing unauthorized access.

CLOUD SECURITY FOR IOT : Cloud services and IoT – offerings related to IoT from cloud service providers – Cloud IoT security controls – An enterprise IoT cloud security architecture – New directions in cloud enabled IoT computing.

Reference Books:

1. Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van Duren
2. Securing the Internet of Things Elsevier
3. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations

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Third Semester Syllabus

MTAD-302 (A) PATTERN RECOGNITION

UNIT-1

Pattern recognition fundamentals: Basic concepts of pattern recognition, fundamental problems in pattern recognition system, design concepts and methodologies, example of automatic pattern recognition systems, a simple automatic pattern recognition model.

UNIT-2

Bayesian decision theory: Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, Discrete features, Missing and noisy features, Bayesian networks (Graphical models) and inferencing.

UNIT-3

Maximum-likelihood and Bayesian parameter estimation: Maximum-Likelihood estimation: Gaussian case, Maximum a Posteriori estimation, Bayesian estimation: Gaussian case, Problems of dimensionality, Dimensionality reduction: Fisher discriminant analysis, PCA ExpectationMaximization method: Missing features

UNIT-4

Sequential Models: State Space, Hidden Markov models, Dynamic Bayesian, Non-parametric techniques for density estimation: Parzen-window method, K-Nearest Neighbour method Linear discriminant functions: Gradient descent procedures, Perceptron criterion function, Minimum-squared-error procedures, Ho-Kashyap procedures, Support vector machines

UNIT-5

Unsupervised learning and clustering: Unsupervised maximum-likelihood estimates, Unsupervised Bayesian learning, Criterion functions for clustering, Algorithms for clustering: Kmeans, Hierarchical and other methods, Cluster validation, Low-dimensional representation and multidimensional scaling (MDS).

Reference Books:

1. Pattern Recognition principles: Julius T. Tou and Rafael C. Gonzalez, Addison –Wesley.
2. Pattern recognition and machine learning, Christopher M. Bishop, Springer 2006.

3. A probabilistic theory of pattern recognition, Luc Devroye, László Györfi, Gábor Lugosi, Springer, 1996.
4. Pattern classification, Richard O. Duda, Peter E. Hart and David G. Stork, Wiley, 2001.
5. Pattern Classification, R.O.Duda, P.E.Hart and D.G.Stork, John Wiley

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Third Semester Syllabus

MTAD-302 (B) Bio-Informatics Computing

UNIT-1

Introduction to bioinformatics, Proteomics, Strategies for Protein Separation, Secondary structure and Tertiary structure, Strategies for Protein Identification, Quantitation, Structural Proteomics, Protein Chips, Methods of Protein Engineering.

UNIT- 2

Introduction to Molecular biology, Molecular Dynamics, Monte Carlo and Molecular Dynamics in Various Ensembles. System biology, biological sequences, patterns in biological sequences, genetic, genetic alterations and genomics, Engineering of Macromolecules.

UNIT-3

DNA, RNA, Application of Recombinant DNA Technology. DNA re-association kinetics, repetitive and unique sequences, kinetics and sequence complexities, DNA polymorphism, nucleotides, DNA sequences, DNA engineering.

UNIT-4

Biological database, DNA and protein database, DNA Data Bank of Japan (DDBJ), DHCP database.

UNIT-5

Applications of Bioinformatics in molecular medicine, personalized medicine, preventative medicine, gene therapy, agriculture, animal, waste cleanup etc. case studies.

Reference Books:

1. Bryan Bergeron M.D., Bioinformatics Computing, Pearson publication.
2. Hancock J M, Bioinformatics and Computational Biology, Second Edition, Wiley publication.
3. David Mount, Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, Second Edition.
4. Vince Buffalo, Bioinformatics Data Skills, O'Reilly publication.

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MTAD-302 (C) Social Network Analysis

UNIT-1

Introduction to Social Media and Social Networks, Social Media: New Technologies of Collaboration, Social Network Analysis: Measuring, Mapping, and Modeling Collections of Connections

UNIT-2

Getting Started with NodeXL, Layout, Visual Design, and Labeling, Calculating and Visualizing Network Metrics, Preparing Data and Filtering, Clustering and Grouping

UNIT-3

Email: The Lifeblood of Modern Communication, Thread Networks: Mapping Message Boards and Email Lists, Twitter: Conversation, Entertainment, and Information, All in One Network, WWW Hyperlink Networks

UNIT-4

Visualizing and Interpreting Facebook Networks, Photos: Linking People, Photos, and Tags, YouTube: Contrasting Patterns of Content, Interaction, and Prominence, Wiki Networks: Connections of Creativity and Collaboration

UNIT-5

Social Media Network Analysis Case Studies: Email, YouTube, Facebook, Twitter, Photos, WWW, WhatsApp.

Reference Books:

1. Derek Hansen Ben Shneiderman Marc Smith: Analyzing Social Media Networks with NodeXL, Elsevier, 1th edition. 2010
2. David Easley and Jon Kleinberg, Networks, Crowds, and Markets: Reasoning About a Highly Connected World., Cambridge University Press, 2010.
3. Mark Newman, Networks: An Introduction., Oxford University Press, 2010.
4. Avinash Kaushik., Web Analytics 2.0: The Art of Online Accounta-bility, Sybex, 2009.

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MTAD-302 (D) Mathematical Modeling & Simulation

UNIT 1

Discrete optimization models – Linear optimization, geometric and algebraic solutions, integer programs and combinatorial optimization, binary decisions

UNIT 2

Network models – Graphs and networks, network flows, assignment problems, graph coloring, vertex covers, local search algorithms

Discrete probabilistic models – Finite discrete time Markov chains and stationary distribution, component and system reliability

UNIT 3

System Dynamics & Probability concepts in Simulation: Exponential growth and decay models, logistic curves, Generalization of growth models, System dynamics diagrams, Multi segment models, Representation of Time Delays. Discrete and Continuous probability functions, Continuous Uniformly Distributed Random Numbers, Generation of a Random numbers, Generating Discrete distributions, Non-Uniform Continuously Distributed Random Numbers, Rejection Method.

UNIT 4

Simulation of Queueing Systems and Discrete System Simulation: Poisson arrival patterns, Exponential distribution, Service times, Normal Distribution Queueing Disciplines, Simulation of single and two server queues. Application of queueing theory in computer system Discrete Events, Generation of arrival patterns, Simulation programming tasks, Gathering statistics, Measuring occupancy and Utilization, Recording Distributions and Transit times.

UNIT 5

Introduction to Simulation languages and Analysis of Simulation output: GPSS: Action times, Succession of events, Choice of paths, Conditional transfers, program control statements, SIMSCRIPT: Organization of SIMSCRIPT Program, Names & Labels, SIMSCRIPT statements. Estimation methods, Relication of Runs, Batch Means, Regenerative techniques, Time Series Analysis, Spectral Analysis and Autoregressive Processes.

Reference Books:

1. Giordano, Fox, Horton, A First Course in Mathematical Modeling, 5th edition, Cengage.
2. Gordon G., System simulation, Prentice Hall.
3. Seila, Simulation Modeling, Cengage Learning
4. Law ., Simulation Modeling And Analysis, McGraw Hill
5. Deo, System Simulation with Digital Computer, PHI
6. Harrington, Simulation Modeling methods, McGraw Hill
7. Severance, " System Modeling & Simulation, Willey Pub