Faculty of Engineering & Technology
Department of Computer Science de Engineering
Pre – Ph.D (CSE)
NEURAL NETWORKS

COURSE OUTCOMES:
At the end of the course, the students will develop ability to

1. Differentiate neural network architectures and techniques for enhancing model performance.
2. Apply optimization algorithms and hyper parameter tuning to improve deep neural networks.
3. Implement data augmentation techniques and design Convolutional Neural Networks for image processing.
4. Utilize advanced CNN techniques for object detection, segmentation, and transfer learning.
5. Explore and apply RNNs, GANs, and deep reinforcement learning for sequential and generative tasks.

UNIT I:

Introduction to Neural Networks, Neural network architectures.
Neural network basics: Neural Networks vs Conventional Computing, Applications and limitations of Neural Network.
Feed forward Neural Network, Back propagation algorithm, Over fitting & Under fitting, Regularization, Dropout.

UNIT II:

Deep neural network optimization: How Learning differs from Pure Optimization, challenges in Neural network.
Algorithms: Stochastic Gradient Descent, momentum, RMSprop, Adam, Loss functions, Batch normalization, Hyper parameter Tuning.

UNIT III:

Data imbalance Problem, Data Augmentation: Cropping, Rotation, Color augmentation. **Convolutional Neural Networks:** convolution, striding, padding, pooling, 1x1 convolution.**CNN architectures** - LeNet5, ALEXNET, VGG16, ResNet50, ImageNet, Efficient Net, XceptionNet.

UNIT IV:

CNN Applications, Transfer Learning, Image classification, face detection, Object detection, Evaluation Measure, two stage, single stage detector, Image Segmentation, Semantic Segmentation, Evaluation Measure: Dice, IoU/Jaccard score

UNIT V:

RNN, Backpropagation through Time, LSTM, GRU, Auto Encoders, Seq2Seq, Attention mechanism types, Generative Adversarial Network, GL Applications: Image generation, font generation, video generation, anime face/celebrity face generation, Deep Reinforcement Learning, Markov decision Processing.

TEXT BOOKS:

1.Introduction to Deep Learning (The MIT Press) by Eugene Charniak
2.Ian Good fellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.

REFERENCE BOOKS:

1.Francois Chollet, Deep Learning with Python, 1/e, Manning Publications Company, 2017
2.Aston Zhang, Zack C. Lipton, Mu Li and Alex J. Smola, Dive into Deep Learning (1st ed.), Corwin, 2019. ISBN 978-1544361376.

Faculty of Engineering & Technology
Department of Computer Science de Engineering
Pre – Ph.D (CSE)
PRINCIPLES OF NETWORK SECURITY

UNIT I:

Introduction to Network Security: Attacks, services, Security. A model of Inter network Security. Block and Stream Ciphers: RC2, GOST, CAST, BLOW FISH, SAFEER, RC5, NEWDES, CRAB, Theory of Block Cipher design.
Key Management: Key Exchange, Key lengths, Generating Keys, Transferring, Verification, Updating, Storing, Backup, Compromised, Lifetime of, Destroying Keys, Public key Management.

UNIT II:

Cryptographic Protocols: Authentication, Formal Analysis of Authentication and key Exchange Protocols, Multiple & Public Key Cryptography, Secret Splitting & Sharing Secure elections, Secure multiparty, Communication, Digital Cash.

UNIT III:

Digital Signature Algorithms: Digital Signature, DSA, DSA variants, Discrete Lagorithm, One – Schnorr – Shamir digital Signatures,
Mails: Electronic Mail & IO Security good Privacy, SIMIME,
IP Security: Architecture, Authentication Header, Encapsulating Security, Pay load Key Management Issues.

UNIT IV:

Web Security: Web Security requirements, Secure Sockets Layer and Transport Layer Security, Secure Electronic Transaction. Digital Certificates, Certificate Authorities and Public Key Infrastructure.

UNIT V:

Viruses and Threats: Intruders, Viruses, Worms and Firewalls Intruders, Viruses and Related Threats, Firewall Design Principles, Trusted Systems.

REFERENCE BOOKS:

1.Applied Cryptography, 7/e, Bruce SCHNEIER John Wiley & Sons Inc.
2.Cryptography and Network Security, William Stallings, PHI.
3.Introduction to cryptography with coding Theory, 7/e, Wade Trappe, C. Washington, PEA.
4.Web Security, Privacy and Commerce, Simson Garfinkel, Gene Spafford, 2/e, O'REILLY, 2002.
5.Cryptography and Information Security, V.K. Pachghare, PHI.
6.Cryptography and Network Security, Forouzan, TMH, 2007.
7.Cryptography and Network Security, 2/e, Kahate, TMH.
8.Modern Cryptography, Wenbo Mao, PEA

Faculty of Engineering & Technology
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Pre – Ph.D (CSE)
MACHINE LEARNING

Course Outcomes:

1. Identify and analyse the different types of machine learning systems and their associated challenges.
2. Apply various supervised learning techniques to solve regression and classification problems.
3. Implement ensemble methods and support vector machines for advanced classification and regression tasks.
4. Utilize clustering techniques for data segmentation, pre-processing, and semi-supervised learning.
5. Apply dimensionality reduction techniques to manage high-dimensional data effectively.

UNIT I:

Introduction to Machine Learning, Types of Machine Learning Systems, Main Challenges of Machine Learning

Statistical Learning: Introduction to Statistical Learning, Supervised and Unsupervised learning, Training and Test Loss, Trade-offs in Statistical Learning, Estimating Risk Statistics, Sampling Distribution of an Estimator, Empirical Risk Minimization.

UNIT II:

Supervised Learning Techniques:
Basic Methods: Distance-based Methods, Nearest Neighbours, Decision Trees, Naive Bayes, **Linear Models:** Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines
Binary Classification: Multiclass/Structured Outputs, MNIST, Ranking.

UNIT III:

Ensemble Learning and Random Forests: Introduction to Ensemble Learning, Voting Classifiers, Bagging and Pasting, Random Forests, Boosting, Stacking.

Support Vector Machine: Linear SVM Classification, Nonlinear SVM Classification, SVM Regression,
Naïve Bayes Classifiers

UNIT IV:

Unsupervised Learning Techniques: Clustering, K-Means and Its Limits, Using Clustering for Image Segmentation, Using Clustering for Pre-processing, Using Clustering for Semi-Supervised Learning, DBSCAN, Gaussian Mixtures

UNIT V:

Dimensionality Reduction: The Curse of Dimensionality, Main Approaches for Dimensionality Reduction, Principal Component Analysis (PCA), Using Scikit-Learn for Dimensionality Reduction, Randomized PCA, Kernel PCA

Textbooks:

1. Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Ethem Alpaydin, —Introduction to Machine Learning (Adaptive Computation and Machine Learning) The MIT Press 2004.
3. Stephen Marsland, —Machine Learning: An Algorithmic Perspective, CRC Press, 2009.

Reference books:

1. Machine Learning, Tom M. Mitchell, McGraw Hill education
2. Machine Learning,Saikat Dutt, Subramanian Chandramouli, First Edition, Pearson

Faculty of Engineering & Technology
Department of Computer Science de Engineering
Pre – Ph.D (CSE)
DIGITAL IMAGE PROCESSING

UNIT I:

Introduction to digital image processing: Motivation & Perspective, Applications, Components of Image Processing System, Fundamentals Steps in Image Processing, Different types of images, Visual perception, Image sensing and Acquisition, Quantization, Sampling, color image, processing, Revision of Mathematical concepts for image processing

UNIT II:

Image Transforms: Two dimensional orthogonal and unitary transforms – Separable Unitary transforms, Basis images, Dimensionality of Image Transforms, Discrete linear orthogonal transforms - DFT, WHT, KLT and DCT, Quantization of Transform coefficients, Transform Coding of Color images.

UNIT III:

Image restoration and reconstruction: Models of image degradation, noise models, Spatial and Frequency domain-based approaches for image restoration, Inverse filtering, Wiener Filtering, Median filtering, Bayesian denoising., Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations.

Image Enhancement: Spatial domain techniques, Image Enhancement by histogram Modification-Histogram Equalization, Histogram Specification, Spatial Operations - Unsharp masking and crispening, Bit-plane slicing, Power law transformation,

UNIT IV:

Image Compression: Spatial and Temporal redundancy, Basic image compression models, compression standards, basic compression methods: Lossless and Lossy compression, Huffman coding, Arithmetic Coding, Run-length coding, Block transform coding, Predictive coding, Shanon-Fano Coding, Bit Plane Coding

Edge detection: Gradient and Laplacian based edge detection, Diffusion based edge detection: Isotropic and anisotropic diffusion

UNIT V:

Image segmentation: Image Segmentation – Discontinuity based and region-based approaches, Morphological image processing techniques – Dilation, Erosion, Opening, and Closing, Thresholding, region-based Morphological Watersheds, Bayesian based image segmentation.

Color Image Processing: Color Fundamentals, Color Models, Color transformation, smoothing, sharpening and edge detection in color images.

TEXT BOOKS:

1. Gonzalez Rafael C. and Woods Richard E., Digital Image Processing, New Delhi: Prentice–Hall of India.
2. William K. Pratt, "Digital Image Processing," 4th edition, Wiley-Interscience, 2007

REFERENCE BOOKS:

1. A.K.Jain "Fundamental of digital image processing", Prentice-Hall
2. R.C.Gonzalez,R.E.Wood "Digital image processing using MATLAB", Pearson Education
3. M. Sonka, V. Hlavac, R. Boyle," Image processing analysis and machine vision" Chapman & Hall

Faculty of Engineering & Technology
Department of Computer Science de Engineering
Pre – Ph.D (CSE)
DATA MINING AND DATA WAREHOUSING

UNIT I:

Introduction: Why Data Mining, What is Data mining, Basic Data Mining Tasks, Kinds of Data, Kinds of Patterns, Technologies Are Used, Kinds of Applications adopted, Dota Mining Issues, Data Mining Metrics, Data Mining from a Database perspective. **Preprocessing Techniques:** Data Cleaning, Integration, Transformation, Reduction, Similarity Measures
Data Warehousing And On-Line Analytical Processing: Data Warehouse basic concepts, Data Warehouse Modeling - Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, Data Generalization by Attribute-Oriented Induction

UNIT II:

Descriptive Data Mining: Concept Description - Generalized Characterization, Summarized Characterization, Analytical Characterization, Class Comparison, Descriptive Statistical Measures
Predictive Mining: What is predicative mining, classification- preparing data, criteria for comparing algorithms. **Association Rules**: Basic algorithms, Parallel and distributed algorithms, Incremental rules, Advanced association rule techniques, Measuring the quality of rules

UNIT III:

Classification: Statistical-Based algorithms, Distance-Based algorithms, Decision Tree-Based algorithms, Neural Network-Based algorithms, Rule-Based algorithms and Other Classification Methods. **Clustering:** Similarity and distance measures, Hierarchical algorithms, Partitioned algorithms, Clustering large databases, Clustering with categorical attributes, Clustering Graph and Network Data.

UNIT IV:

Data Mining Applications: Biological Data Analysis, E-commerce, Information Retrieval, Marketing and Sales, Health care and Medicine, Banking and finance, Intrusion detection, Image processing and speech processing, Social network Analysis.

UNIT V:

Web Mining: Introduction, web mining, Web Content and Web Structure Mining, web usage mining, Web Mining Overview, Search Engines, Search Engine Optimization, Web Usage Mining (Web Analytics), Web Analytics Maturity Model and Web Analytics Tools.
Text Mining : Text Mining Concepts and Definitions, unstructured text, episode rule discovery for texts, hierarchy of categories, text clustering, Text Mining Applications, Text Mining Process, Text Mining Tools.

SUGGESTED TEXT / REFERENCE BOOKS:

1. Jiawei Han, Micheline Kambler, "Data Mining Concepts and Techniques" Morgan Kaufmann Publishers, ISBN-81-7867-023-2, 2002.
2. M. H. Dunham, "Data Mining: Introductory and Advanced Topics", 1st edition, Pearson Education, 2001.

3. Sam Anahory, Dennis Murray, "Data Warehousing in the real world", Low Price Edition, Pearson Education, ISBN-81-7808-387-6, 2003,
4. C.S.R. Prabhu, "Data Warehousing Concepts, Techniques, Products and Applications". Second Edition, Prentice-Hall of India, ISBN - 81-203-2068-9, 2002.
5. Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, "Introduction to Data Mining", Pearson Education.
6. Hongbo Du, "Data mining Techniques and Applications", Cengage India Publishing.
7. Arun K Pujari, "Data Mining Techniques", 3rd Edition, Universities Press.
8. T.V Sveresh Kumar, B. Esware Reddy, Jagadish S Kalimani, "Data Mining Principles & Applications", Elsevier.
9. Ramesh Sharda, Dursun Delen, Efraim Turban, BUSINESS INTELLIGENCE AND ANALYTICS: SYSTEMS FOR DECISION SUPPORT, Pearson Education

Faculty of Engineering & Technology
Department of Computer Science de Engineering
Pre – Ph.D (CSE)
ARTIFICIAL INTELLIGENCE

UNIT-I:

Introduction to artificial intelligence: Introduction, Problem solving: state-space search and control strategies: Introduction, general problem solving, characteristics of problem, AI problem solving as state space search, exhaustive searches, and heuristic search techniques.

UNIT-II:

Knowledge Representation: Introduction, approaches to knowledge representation propositional logic, proportional logic, natural deduction, semantic nets, frames, conceptual dependency theory, script structure.

UNIT-III:

Representation of Knowledge with Rules: Production System, Forward versus Backward chaining, Rule Matching and chain control, Non-Monotonic reasoning, Truth maintenance systems, Uncertain Reasoning: Probability theory: Introduction, probability theory, Bayes theorem, Bayesian belief networks, certainty factor theory, Dempster-Shafer theory, Statistical Inference.

UNIT-IV:

Problem reduction and game playing: Introduction to problem reduction, AO* algorithm, Game Playing: Adversial search, Games, minimax, algorithm, optimal decisions in multiplayer games, Alpha-Beta pruning, Evaluation functions, cutting of search.

UNIT-V:

Planning: Overview, Blocks world as example, components of planning system, Goal stack planning, Nonlinear planning, Hierarchical planning, Reactive Systems Expert Systems: Representing and using Domain knowledge, examples of expert systems, Expert system Architectures, Components, Building an expert system, Expert system shells.

TEXT BOOKS:

1.Artificial intelligence, A modern Approach, 2nded, Stuart Russel, Peter Norvig, Prentice Hall
2.Artificial Intelligence- 3 rd Edition, Rich, Kevin Knight, Shiv Shankar B Nair, TMH
3.Introduction To Artificial Intelligence And Expert Systems, 1st Edition, Patterson, Pearson India, 2015.

REFERENCE BOOKS:

1.Artificial intelligence, structures and Strategies for Complex problem solving, 5th Edition, George F Lugar, PEA.
2. Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer, 2017.
3. Artificial Intelligence, Saroj Kaushik, 1st Edition, CENGAGE Learning, 2011