Technocrats Institute of Technology, Bhopal
M.Tech (Computer Science and Engineering)
First Semester Syllabus

MCSE-101 ADVANCED DATA STRUCTURES AND ALGORITHM

UNIT 1

INTRODUCTION: Basic concepts of OOPs – Templates – Algorithm Analysis – ADT - List (Singly, Doubly and Circular) Implementation - Array, Pointer, Cursor Implementation.

UNIT 2

BASIC DATA STRUCTURES: Stacks and Queues – ADT, Implementation and Applications - Trees – General, Binary, Binary Search, Expression Search, AVL, Splay, B -Trees – Implementations - Tree Traversals.

UNIT 3

ADVANCED DATA STRUCTURES: Set – Implementation – Basic operations on set – Priority Queue – Implementation - Graphs – Directed Graphs – Shortest Path Problem - Undirected Graph - Spanning Trees – Graph Traversals.

UNIT 4

MEMORY MANAGEMENT : Issues - Managing Equal Sized Blocks - Garbage Collection Algorithms for Equal Sized Blocks - Storage Allocation for Objects with Mixed Sizes - Buddy Systems - Storage Compaction.

UNIT 5

SEARCHING, SORTING AND DESIGN TECHNIQUES: Searching Techniques, Sorting – Internal Sorting – Bubble Sort, Insertion Sort, Quick Sort, Heap Sort, Bin Sort, Radix Sort – External Sorting – Merge Sort, Multiway Merge Sort, Polyphase Sorting - Design Techniques - Divide and Conquer - Dynamic Programming - Greedy Algorithm – Backtracking - Local Search Algorithms.

Reference Books :

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Pearson P

2. Aho, Hopcroft, Ullman, “Data Structures and Algorithms”, Pearson Education P

3. Drozdek, Data Structures and algorithm in Jawa, Cengage (Thomson)

4. Gilberg, Data structures Using C++, Cengage

3. Horowitz, Sahni, Rajasekaran, “Computer Algorithms”, Galgotia,

4. Tanenbaum A.S., Langram Y, Augestien M.J., ”Data Structures using C & C++”,Prentice

Hall of India, 2002

MCSE-102 MACHINE LEARNING TECHNIQUES

UNIT 1

Introduction to machine learning (ML): Basics of ML, History of ML , Evolution of ML, ML Models, Learning and testing models, ML Algorithm and Convergence, ML Techniques , Types of ML, supervised and unsupervised learning, classification and clustering, Applications of ML, Bias-Variance tradeoff.

UNIT 2

Neural Networks : McCulloch Pitts Neuron models, Activation Functions, Loss Functions, perception, Gradient Descent, Multilayer neural networks: back-propagation, back propagation calculus, Initialization, Training rules, issues in back -propagation, Bayesian Learning, Competitive learning and self -organization map .

UNIT 3

Support Vector Machines(SVM): SVM Formulation, Interpretation & Analysis, hard and soft margin, Hinge loss, SVM dual, SVM tuning parameters, SVM Kernels, twin SVM.

UNIT 4

Clustering: K-Means Clustering, Mean Shift Clustering, Aagglomerative clustering, Association Rule Mining, Partition Clustering, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density -based Clustering, Gaussian Mixture Models, and Expectation Maximization. Parameters estimations – MLE, MAP.

UNIT 5

Learning Theory: Probably Approximately Correct (PAC) Model, PAC Learnability, Agnostic PAC Learning, Theoretical analysis of machine learning problems and algorithms, Generalization error bounds, VC Mode l, ML Tools.

Recommended Books:

1. Tom Mitchell, Machine Learning, McGraw -Hill, 1997.
2. Leonard Kaufman and P. J. Rousseau. Finding group s in data: An introduction to cluster analysis, Wiley, 2005.
3. Nello Cristianini and John Shawe -Taylor , An Introduction to Support Vector Machines ,Cambridge University Press , 2000.
4. Bernhard Schölkopf and Alexander J. Smola , Learning with Kernels , MIT Press, 2002.
5. Shai Shalev -Shwartz and Shai Ben -David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press., 2014.

MCSE-103(A) DEEP LEARNING

Course Contents:

Unit-1

History of Deep Learning, Deep Learning Success Stories, review of Neuron model, activation functions, Perceptron Learning, Multilayer Perceptrons (MLPs), Feedforward Neural Networks, Backpropagation, weight initialization methods, Batch Normalization, Representation Learning, GPU implementation, Decomposition – PCA and SVD.

Unit -2

Deep Feedforward Neural Networks, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, Adam, RMSProp, Auto -encoder , Regularization in auto-encoders, De-noising auto -encoders, Sparse auto -encoders, Contractive auto-encoders, Variational auto -encoder, Auto -encoders relationship with PCA, Dataset augmentation.

Unit -3

Introduction to Convolutional neural Networks (CNN) and its architectures, CCN terminologies: ReLu activation function, Stride, padding, pooling, convolutions operations, Convolutional kernels, types of layers: Convolutional, pooling, fully connected, Visualizing CNN, CNN examples: LeNet, AlexNet, ZF -Net, VGGNet, GoogLeNet, ResNet, RCNNetc. Deep Dream, Deep Art. Regularization: Dropout, drop Connect , unit pruning, stochastic pooling, artificial data, injecting noise in input, early stopping, Limit Number of parameters, Weight decay etc.

Unit -4

Introduction to Deep Recurrent Neural Networks and its architectures, Backpropagation Through Time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, Gated Recurrent Units (GRUs), Long Short Term Memory (LSTM), Solving the vanishing gradient problem with LSTMs, Encoding and decoding in RNN net work, Attention Mechanism, Attention over images, Hierarchical Attention, Directed Graphical Models.

Unit -5

Introduction to Deep Generative Models, Restricted Boltzmann Machines (RBMs), Gibbs Sampling for training RBMs, Deep belief networks , Markov Networks, Markov Chains, Autoregressive Models: NADE, MADE, Pixel RNN, Generative Adversarial Networks (GANs), Applications of Deep Learning in Object detection, speech/ image recognition, video analysis, NLP, medical science etc.

Recommended Books:

1. Ian Goodfellow , Yoshua Bengio and Aaron Courville; Deep Learning, MIT Press, 2017.

2. Chris Bishop; Pattern Recognition and Machine Learning, Springer publication, 2006

3. Aurelien Geon, “Hands -On Machine Learning with Scikit -Learn and Tensorflow: Concepts, Tools, and Technique s to Build Intelligent Systems”, First Edition, O'Reilly publication, 2017.

4. Francois Chollet, "Deep Learning with Python", First Edition, Manning Publications, 2018.

5. Andreas Muller, "Introduction to Machine Learning with Python: A Guide for Data Scientists ", First edition, O'Reilly Edition, 2016.

MCSE-103(B) NATURAL LANGUAGE PROCESSING

UNIT-I

Introduction to NLP: Different Data Models such as Boolean Model, Vector model, Probabilistic Model, comparison of classical models. Introduction to alternative algebraic models such as Latent Semantic Indexing etc.

UNIT-II

Probabilistic language modeling and its applications. The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. Markov models. Estimating the probability of a word, and smoothing. Generative models of language.

UNIT-III

Part of Speech Tagging and Sequence Labeling: Lexical syntax. Hidden Markov Models Forward and Viterbi algorithms and EM training.

UNIT-IV

Syntactic parsing: Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs).

UNIT-V

Semantic Analysis: Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labeling and Semantic Parsing.

TEXT BOOKS RECOMMENDED:

1. Daniel Jurafsky & James H. Martin, Speech and Language Processing, Perason publication, 2018.
2. Manning and Schutze "Foundations of Statistical Natural Language Processing", MIT Press,2009

REFERENCE BOOKS:

1. Dipanjan Sarkar, Text Analytics with Python (Apress/Springer, 2016)
2. Handbook of Natural Language Processing, Second Edition—Nitin Indurkhya, Fred J Damerau.

MCSE-103(C) BIG DATA

UNIT 1

Introduction to Big data, Big data characteristics, Types of big data, Traditional versus Big data, Evolution of Big data, challenges with Big Data, Technologies available for Big Data, Infrastructure for Big data, Use of Data Analytics, Desired properties of Big Data system.

UNIT 2

Introduction to Hadoop, Core Hadoop components, Hadoop Eco system, Hive Physical Architecture, Hadoop limitations, RDBMS Versus Hadoop, Hadoop Distributed File system, Processing Data with Hadoop, Mapreduce Programming, Managing Resources and Application with Hadoop YARN, Apache Spark.

UNIT 3

Introduction to Hive, Hive Architecture, Hive Data types, Hive, Hive Query Language, Introduction to Pig, Anatomy of Pig, Pig on Hadoop, Use Case for Pig, ETL Processing, Data types in Pig running Pig, Execution model of Pig, Operators, Evalfunction, Data types of Pig.

UNIT 4

Introduction to NoSQL, NoSQL Business Drivers, NoSQL Data architectural patterns, Variations of NOSQL architectural patterns using NoSQL to Manage Big Data.

UNIT 5

Mining social Network Graphs: Introduction Applications of social Network mining, Social Networks as a Graph, Types of social Networks, Clustering of social Graphs Direct Discovery of communities in a social graph.

TEXT BOOKS RECOMMENDED:

1. Radha Shankarmani, M. Vijay lakshmi, "Big Data Analytics", Wiley, Second edition

2. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley, First edition

REFERENCE BOOKS:

1. KaiHwang, Geoffrey C., Fox. Jack, J. Dongarra, “Distributed and Cloud Computing”, Elsevier, First edition
2. Michael Minelli, Michele Chambers, Ambiga Dhiraj, “Big Data Big Analytics”, Wiley

MCSE-104(A) 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 application.

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

MCSE-104(B) Cloud Computing

UNIT 1

Cloud Computing Fundamentals-Definition, Evolution, Essential characteristics, Cloud Deployment Models, Cloud Service Models, Benefits, Cloud Architecture, Virtualization in Cloud, Cloud Data Centre, SLA, Cloud Applications.

UNIT 2

Cloud Security Challenges, Cloud Information Security Objectives, Cloud Security Services, Secure Cloud Software Requirements, Cloud Security Policy Implementation, Infrastructure Security, Data Security and Storage, Privacy in Cloud.

UNIT 3

Threats and Vulnerabilities to Infrastructure, Data, and Access Control; Risk Management and Risk Assessment in Cloud, Cloud Service Provider Risks, Virtualization Security Management in the Cloud, Trusted Cloud Computing, Identity Management and Access Control.

UNIT 4

Cloud Computing and Business Continuity Planning/Disaster Recovery, Cloud Audit and Compliance: Internal Policy Compliance, Regulatory/External Compliance, Cloud Security Alliance.

UNIT 5

Standards for Security: SAML OAuth, OpenID, SSL/TLS, Encrypting Data and Key Management, Creating a Cloud Security Strategy, The Future of Security in Cloud Computing.

REFERENCES

1. Ronald L. Krutz, Russell Dean Vines, "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010.
2. Tim Mather, SubraKumaraswamy, and ShahedLatif, " Cloud Security and Privacy",

MCSE-104(C) Block chain Technology

Unit I

Introduction: Overview of Block chain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, Public vs Private Block chain, Understanding Crypto currency to Block chain, Permissioned Model of Block chain, Overview of Security aspects of Block chain; Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic crypto currency.

Unit II

Understanding Block chain with Crypto currency: Bitcoin and Block chain: Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay.

Working with Consensus in Bitcoin**:** Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – basic introduction, HashCash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

Unit III

Understanding Block chain for Enterprises: Permissioned Block chain: Permissioned model and use cases, Design issues for Permissioned block chains, Execute contracts, State machine replication, Overview of Consensus models for permissioned block chain- Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport-Shostak-Pease BFT Algorithm, BFT over Asynchronous systems.

Unit IV

Enterprise application of Block chain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Block chain, Block chain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, and Identity on Block chain.

Unit V

Block chain application development: Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda.

REFERENCES

1. Melanie Swan, “Block Chain: Blueprint for a New Economy”, O’Reilly, 2015

2. Josh Thompsons, “Block Chain: The Block Chain for Beginners- Guide to Block chain Technology and Leveraging Block Chain Programming”

3. Daniel Drescher, “Block Chain Basics”, Apress; 1st edition, 2017

4. Anshul Kaushik, “Block Chain and Crypto Currencies”, Khanna Publishing House, Delhi.

5. Imran Bashir, “Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Packt Publishing

6. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Block Chain”, Packt Publishing.

7. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O’Dowd, Venkatraman Ramakrishna, “Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer”, Import, 2018.

MCSE 105 Research Methodology and IPR

UNIT 1

INTRODUCTION TO RESEARCH METHODS

Definition and Objective of Research, Various steps in Scientific Research, Types of Research, Criteria forGood Research, Defining Research Problem, Research Design , Case Study Collection of Primary and Secondary Data, Collection Methods: Observation, Interview, Questionnaires, Schedules,

UNIT 2

SAMPLING DESIGN AND HYPOTHESIS TESTING

steps in Sampling Design, Types of Sample Designs, Measurements and Scaling Techniques - Testing ofhypotheses concerning means (one mean and difference between two means -one tailed and two tailedtests), concerning variance – one tailed Chi-square test.

UNIT 3

INTERPRETATION AND REPORT WRITING

Techniques of Interpretation, Precaution in Interpretation, Layout of Research Report, Types of Reports, Oral Presentation, Mechanics of Writing Research Report

UNIT 4

INTRODUCTION TO INTELLECTUAL PROPERTY

Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights, Innovations and Inventions trade related intellectual property rights.

UNIT 5

TRADE MARKS, COPY RIGHTS AND PATENTS

Purpose and function of trade marks, acquisition of trade mark rights, trade mark registration processes,trademark claims –trademark Litigations- International trademark law

Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the workpublicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

Text/References Books:

1. C.R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques, New Age International Publishers.

2. Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents, and TradeSecrets”, Delmar Cengage Learning.

3. PrabuddhaGanguli, “Intellectual Property Rights: Unleashing the Knowledge Economy”, Tata McGraw Hill Education.

4. Panneerselvam, R., Research Methodology, Prentice-Hall of India, New Delhi,.

5. Ranjith Kumar, Research Methodology – A step by step Guide for Begineers, Sage publisher.

6. D Llewelyn & T Aplin W Cornish, “Intellectual Property: Patents, Copyright, Trade Marks and AlliedRights”, Sweet and Maxwell, .

7. AnanthPadmanabhan, “Intellectual Property Rights-Infringement and Remedies”, Lexis Nexis,

8. Ramakrishna B and Anil Kumar H.S, “Fundamentals of Intellectual Property Rights: For Students,Industrialist and Patent Lawyers”, Notion Press.

9. M.Ashok Kumar and Mohd.IqbalAli :”Intellectual Property Rights” Serials Pub.