INVERTIS
UNIVERSITY BAREILLY

Established by Govt. of U.P. u/s 2F of UGC Act, 1956 vide U.P. Act 22 of 2010.

STUDY AND EVALUATION SCHEME
(With effective from academic session 2023-2024)
B. Tech. in Computer Science & Engineering with
specialization in Artificial Intelligence
YEAR III, SEMESTER V

Sl. No.	Category	Course Code	Course Title/ Subjects	Hours per week			Evaluation Scheme		Total	Credits
				L	T	P	CA	EE		
THEORY										
1	Professional Core	BCSAI 501	Ethics in Computer Science	3	0	0	25	50	75	3
2	Professional Core	BCSAI 502	Prolog Programming	3	0	0	25	50	75	3
3	Professional Core	BCSAI 503	Signal & Image Processing	3	0	0	25	50	75	3
4	Professional Core	BCSAI 504	Data Mining & ML	3	0	0	25	50	75	3
5	Professional Core	BCSAI 505	Formal Language & Automata	3	0	0	25	50	75	3
6	Professional Elective	BCSAI 506, BCSAI 507, BCSAI 508	Elective-I	2	0	0	15	35	50	2
7	Engineering Science Course	IIOT5	Machine Learning for IIOT	4	0	0	30	70	100	4
PRACTICALS AND PROJECTS										
7	Engineering Science Course	BCSAI 509	Data Mining & ML using Python Lab	0	0	4	15	35	50	2
8	Engineering Science Course	BCSAI 510	Signal & Image Processing Lab	0	0	4	15	35	50	2
9	Engineering Science Course	BCSAI 511	Prolog Programming Lab	0	0	4	15	35	50	2
10	Skill Enhancement	BCSAI 512	Anandam –I (Happiness Curriculum)	0	0	1	10	15	25	1

				TOTAL	21	0	13	225	475	700	**28**

L-Lecture, T- Tutorial , P- Practical ,CA- Continuous Assessment, EE- End Semester Examination

COURSE CODE	Elective – I
BCSAI 506	Information Security
BCSAI 507	Database Security
BCSAI 508	Business Intelligence

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Sl. No.	Category	Course Code	Course Title/ Subjects	Hours per week			Evaluation Scheme		Total	Credits
				L	T	P	CA	EE		
THEORY										
1	Professional Core	BCSAI 601	Big Data Analytics	3	0	0	25	50	75	3
2	Professional Core	BCSAI 602	Compiler Design	3	0	0	25	50	75	3
3	Professional Core	BCSAI 603	Advanced Machine Learning	3	0	0	25	50	75	3
4	Professional Core	BCSAI 604	Natural Language Processing	3	0	0	25	50	75	3
5	Professional Core	BCSAI 605	Graphical Model	3	0	0	25	50	75	3
6	Professional Elective	BCSAI 606, BCSAI 607, BCSAI 608	Elective-II	2	0	0	15	35	50	2
7	Engineering Science Course	IIOT6	Artificial Intelligence for IIOT	4	0	0	30	70	100	4
PRACTICALS AND PROJECTS										
7	Engineering Science Course	BCSAI 609	Digital Electronics Lab	0	0	4	15	35	50	2
8	Engineering Science Course	BCSAI 610	Computer Aided Graphics & Drafting (Lab)	0	0	4	15	35	50	2
9	Skill Enhancement	BCSAI 611	Business & Technical Communication (Lab)	0	0	4	15	35	50	2

| 10 | Skill Enhancement | BCSAI 612 | Anandam-II(Happiness Curriculum) | 0 | 0 | 1 | 10 | 15 | 25 | 1 |
| | | | **TOTAL** | **21** | **0** | **13** | 225 | 475 | 700 | **28** |

L-Lecture, T- Tutorial , P- Practical ,CA- Continuous Assessment, EE- End Semester Examination

Course code	Elective – II
BCSAI 606	Blockchain
BCSAI 607	Internet of Things
BCSAI 608	Management information system

BCSAI 501: ETHICS IN COMPUTER SCIENCE

3L + 0T + 0P + 3C   **MM 100**

Unit 1: An overview of Ethics

Ethics in business world, Ethics in IT, Ethics for IT professionals and IT users, IT professionals, Ethical behavior, IT professional malpractices, IT users.

Unit 2: Computer and Internet Crime

IT security incidents: Increasing Complexity Increases Vulnerability, Higher Computer user Expectations, Expanding and changing systems. Introduces new risks, Increased Reliance on Commercial Software with known Vulnerabilities, Types of Exploits, Perpetrators, Reducing Vulnerabilities, Risk Assessment, Establishing a Security Policy, Educating Employees, contractors and part-time Workers, Prevention, Detection, Response.

Unit 3: Privacy

The right of Privacy, Recent History of Privacy Protection, Key Privacy and Anonymity issues, Governmental Electronic Surveillance, Data Encryption, Identity Theft, Consumer Profiling, Treating Consumer Data Responsibility, Workplace Monitoring, Advanced surveillance Technology, Defamation, Freedom of Expression: Key issues, Controlling Access to Information on the Internet, Anonymity, National, Security Letters, Defamation and Hate Speech.

Unit 4: Intellectual Property

Copyrights, Patents, Trade Secret Laws, Key Intellectual Property Issues, Plagiarism, Reverse Engineering, Open Source Code, Competitive Intelligence, Cyber squatting, Software Development, Strategies to Engineer Quality Software, The Importance of Software Quality, Software Development Process, Capability Maturity Model Integration for Software, Key Issues in Software Development, Development of Safety-Critical Systems, Quality Management Standards.

Unit 5: Ethics of IT Organization

Need for Nontraditional Workers, Contingent Workers H-IB Workers, Whistle-blowing, Protection for Whistle-Blowers, Dealing with Whistle-Blowing Situation.

Text/ Reference Books:

1. Deborah G.Johnson,"Computer Ethics",3/e Pearson Education.
2. Sara Baase, "A Gift of Fire: Social, Legal and Ethical Issues, for Computing and the Internet," PHI Publications.
3. Richard A.Spinello, "Case study in Information Technology Ethics", second Edition PHI Publications.
4. Duncan Lanford "Internet Ethics".
5. D. Micah Hester and Paul J. Ford "Computer and Ethics in the Cyber age".

BCSAI 502: PROLOG PROGRAMMING

3L + 0T + 0P + 3C **MM 100**

Unit 1: An overview of Prolog

An overview of Prolog, components of a Prolog program, syntax of Prolog, meaning of a Prolog program, Clauses, Programs and Queries

Unit 2: Working with Lists, Numbers and Operators

Notation, Head and Tail, Some Built-in Predicates for List Manipulation, working with numbers:The is-Operator for Arithmetic Evaluation, Predefined Arithmetic Functions and Relations, workimg with operators: Precedence and Associativity, Declaring Operators with op/3.

Unit 3: Backtracking, Cuts and Negation

Backtracking and Cuts: Backtracking Revisited, Problems with Backtracking, Introducing Cuts, Problems with Cuts, Negation as Failure: The Closed World Assumption, Horn Formulas and Resolution.

Unit 4: Logic Foundations of Prolog

Translation of Prolog Clauses into Formulas ,Horn Formulas and Resolution.

Unit 5: Recursive Programming

Induction in Mathematics, The Recursion Principle ,What Problems to Solve Debugging .

Text Books:

1. PROLOG Programming for Artificial Intelligence Bratko I., Addison-Wesley, Reading, MA, 1986

Reference Books:

1. Programming in Prolog , Clocksin W.F. & Mellish C.S., Springer-Verlag, Berlin, 1981, A good introduction to programming in PROLOG
2. Foundations of Logic Programming, Lloyd J.W., Springer-Verlag, Berlin, 1984, Logic programming is a theory behind the PROLOG. You can find introduction to this topis here.

BCSAI 503: SIGNAL AND IMAGE PROCESSING

3L + 0T + 0P + 3C   **MM 100**

Unit 1: Introduction

Fundamental steps in DIP, elements of DIP, Simple image model, sampling & quantization, basic relationships between pixels, colour image model.

Unit 2: Image Transforms

One-dimensional & two-dimensional DFT, cosine, sine, Hadamard, Haar, and Slant & KL transforms. Image Enhancement: Introduction, point operations, histogram modelling, spatial operations, Transform operations.

Unit 3: Image Restoration

Introduction, image observation models, Inverse & Wiener filtering, difference between enhancement & restoration Restoration-spatial filtering, Noise reduction in frequency domain.

Unit 4: Image Compression

Introduction, Pixel coding, Predictive coding, Transform coding, Inter-frame coding

Unit 5: Image Segmentation

Introduction, Spatial feature extraction, Transforms features, Edge detection, Boundary extraction, Segmentation techniques.

Text/Reference Books:

1. Digital Image Processing Using MATLAB, Gonzalez, Woods and Eddins, Gatesmark Publishing
2. Applications of Pattern Recognition, Fu, K.S., CRC Press
3. Digital Image Restoration, Andrews, H.C. Hunt, B.R., Prentice Hall, Englewood Cliffs.
4. Applications of Digital Signal Processing, Oppenheim, A.V., Prentice Hall Englewood Cliffs.
5. Digital Image Processing, Gonzalez, R.C. & Wintz, P.A., Reading, Addison-Wesley.

BCSAI 504: DATA MINING AND ML

3L + 0T + 0P + 3C   **MM 100**

Unit 1: Introduction to Machine Learning and Data Mining

Introduction to modern data analysis, Machine Learning, supervised and unsupervised learning, Data mining definition and motivation, data mining functionalities Concept of interesting patterns, Data mining tasks, current trends, major issues and ethics in data mining, Data Mining and Knowledge Discovery in Databases.

Unit 2: Statistical Concepts & Linear Regression:

Probability Distributions, Statistical Inferences, Level of Significance, Type I and Type II Error, One Sample, Paired Samples, Independent Samples T Tests, One Way ANOVA, Chi-Square Test. Linear Regression, Scatter Plot, Correlations, R Square and Adjusted R Square, Testing of Slope, Standard Error of Estimate.

Unit 3: Logistic Regression & Decision Trees

Logit Function, Odds versus Probabilities, Nagelkerke R Square, Classification Matrix, Cut-Offs, ROC Curve. Classification & Regression Trees, Information Gain, Gain Ratio, Gini Index, Mean Squared Error, Pruning of Tree, Bagging, Random Forest, Adaptive Boosting, XG Boosting, Model Overfitting.

Unit 4: kNN& Naïve Bayes Classifiers, Association Rules Mining and Cluster Analysis

kNN as a lazy learner, Similarity Quantification, Appropriate k, Rescaling Data. Probabilistic Learning, Joint Probability, Conditional Probability, Laplace Estimator. Market Basket Analysis, Support, Confidence, Lift, Association Rules. Clustering Methods, Dendogram, Profiling of Cluster, Cluster Evaluation.

Unit 5: Dimensionality Reduction, Support Vector Machines and Text Mining

Principal Component Analysis, Eigen Values & Eigen Vectors, Singular Value Decomposition. Decision Boundaries for Support Vector Machine, Hyperplanes, Linear & Non-Linear Cases, Kernel Function, Kernel Trick, Kernel Hilbert Space, Model Evaluation. Text Data, Sentiment Analysis, Word Clouds, Term Frequency, Tokeniing.

Text Books:

1. Mitchell (2013). Machine Learning. McGraw Hill.
2. Han, Jiawei and Kamber, Micheline. (2012). Data Mining: Concepts and Techniques. Morgan Kaufman Publishers.
3. Tang, P.N., Steinback, M. and Kumar, V. (2014). Introduction to Data Mining. Pearson.

Reference Books:

1. Myatt, Glenn and Johnson, Wayne. (2009). Making Sense of Data II. Wiley.
2. Kassambara. (2017). Practical Guide to Cluster Analysis in R. STHDA
3. Silge& Robinson. (2017). Text Mining With R. SPD.

BCSAI 505: FORMAL LANGUAGE AND AUTOMATA

3L + 0T + 0P + 3C   **MM 100**

Unit 1: Finite Automata & Regular Expression

Basic Concepts of finite state system, Deterministic and non-deterministic finite automation and designing regular expressions, relationship between regular expression & Finite automata minimization of finite automation mealy & Moore Machines.

Unit 2: Regular Sets Of Regular Grammars

Basic Definition of Formal Language and Grammars, Regular Sets and Regular Grammars, closure proportion of regular sets, Pumping lemma for regular sets, decision Algorithms for regular sets, Myhell_Nerod Theory & Organization of Finite Automata.

Unit 3: Context Free Languages& Pushdown Automata

Context Free Grammars – Derivations and Languages – Relationship between derivation and derivation trees – ambiguity – simplification of CEG – Greiback Normal form – Chomsky normal forms – Problems related to CNF and GNF Pushdown Automata: Definitions – Moves – Instantaneous descriptions – Deterministic pushdown automata – Pushdown automata and CFL - pumping lemma for CFL - Applications of pumping Lemma.

Unit 4: Turing Machines

Turing machines – Computable Languages and functions – Turing Machine constructions – Storage in finite control – multiple tracks – checking of symbols – subroutines – two way infinite tape. Undecidability: Properties of recursive and Recursively enumerable languages – Universal Turing Machines as an undecidable problem – Universal Languages – Rice's Theorems.

Unit 5: Linear Bounded Automata Context Sensitive Language

Chomsky Hierarchy of Languages and automata, Basic Definition& descriptions of Theory & Organization of Linear bounded Automata Properties of context-sensitive languages.

Text/Reference Books:

1. Hopcroft, Ullman, "Introduction to Automata Theory, Language and Computation",Nerosa Publishing House
2. K.L.P. Mishra and N.Chandrasekaran, "Theory of Computer Science (Automata,Languages and Computation)", PHI
3. Martin J. C., "Introduction to Languages and Theory of Computations", TMH
4. Hopcroft, Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education
5. Papadimitrou, C. and Lewis, C.L., "Elements of the Theory of Computation", PHI

BCSAI 509: DATA MINING AND ML USING PYTHON LAB

0L + 0T + 4P + 2C   **MM 100**

List of Experiments:

1. Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets
2. Demonstrate performing classification on data sets
3. Demonstrate performing clustering on data sets
4. Demonstrate performing Regression on data sets
5. Write a program to implement the naïve Bayesian classifier for a sample data set.
6. Write a program to construct a Bayesian network considering any data set.
7. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.
8. Implement K-means on .CSV file using python.
9. Implementing Logistic Regression in Python for classification

BCSAI 510: SIGNAL AND IMAGE PROCESSING LAB

0L + 0T + 4P + 2C   **MM 100**

List of Experiments:

1. To study the Image Processing concept.

2. To obtain histogram equalization image.

3. To Implement smoothing or averaging filter in spatial domain.

4. Program for opening and closing of the image.

5. To fill the region of interest for the image.

6. Program for edge detection algorithm.

7. Program of sharpen image using gradient mask.

8. Program for morphological operation: erosion and dilation

9. Program for DCT/IDCT computation.

BCSAI 511: PROLOG PROGRAMMING LAB

0L + 0T + 4P + 2C   **MM 100**

List of Experiments:

1. Write a prolog program to calculate the sum of two numbers.

2. Write a prolog program to find the maximum of two numbers.

3. Write a prolog program to calculate the factorial of a given number.

4. Write a prolog program to calculate the nth Fibonacci number.

5. Write a prolog program, insert_nth(item, n, into_list, result) that asserts that result is the list into_list with item inserted as the n'th element into every list at all levels.

6. Write a Prolog program to remove the Nth item from a list.

8. Write a Prolog program to implement append for two lists.

9. Write a Prolog program to implement palindrome(List).

10. Write a Prolog program to implement max(X,Y,Max) so that Max is the greater of two numbers X and Y.

11. Write a Prolog program to implement maxlist(List,Max) so that Max is the greatest number in the list of numbers List.

12. Write a Prolog program to implement sumlist(List,Sum) so that Sum is the sum of a given list of numbers List.

13. Write a Prolog program to implement two predicates evenlength(List) and oddlength(List) so that they are true if their argument is a list of even or odd length respectively.

14. Write a Prolog program to implement reverse(List,ReversedList) that reverses lists.

15. Write a Prolog program to implement maxlist(List,Max) so that Max is the greatest number in the list of numbers List using cut predicate.

BCSAI 512: ANANDAM-I HAPPINESS CURRICULUM

0L + 0T + 1P + 1C   **MM 100**

List of Experiments:

1. Strategies for Happiness : Loving Yourself (Self-motivation, Self-worth, Self-respect, Self-care, and Self-purpose)
2. Appreciate Your Life
3. Finding Your Passion (a Vision Board, and an Inspirational Toolkit)
4. Practicing Your Creativity

Semester V   **B.Tech(AI)**

BCSAI 506: INFORMATION SECURITY

2L + 0T + 0P + 2C   **MM 100**

Unit 1: Introduction to Information Security

Overview of Information security, Threats, Type of Vulnerabilities and Risk, Business Requirements, Information Security Definitions – Security Policies – Tier 1 (origination Level), Tier 2 (Functional Level), Tier 3 (Application or Device Level), Procedures, Standards, Guidance. Role of Governance in Information Security, Develop a Risk Management Program, Risk Management Process, Best Practices for IT Governance, Case study.

Unit 2: Information Asset Classification

Classification of Information, Information Assets – Owner, Custodian, User, Information Classification in terms of Secret, Confidential, Private and Public, Declassification. Retention and Disposal of Information Assets. Provide Authorization for Access – Owner, Custodian and User, Case study.

Unit 3 : Access Control

User Identity and Access Management- Account Authorization, Access and Privilege Management, System and Network Access Control. Operating Systems Access Controls, Monitoring Systems Access Controls, Intrusion Detection System, Event logging, Cryptography. Physical Security: Identify Assets to be Protected, Perimeter Security, Firewalls, Prevention and Detection Systems, Safe Disposal of Physical Assets. Email Security: PGP, MIME, IP Security: IP security overview, Case study.

Unit4: Introduction to Cryptography

Introduction to Advanced Cryptography and Cryptanalysis, Classical Encryption Techniques – Substitution Techniques, Transposition Techniques, Permutation Method. Advanced Encryption Techniques and Security Issues – RC4, One-time Pad, RSA, DES, Triple DES, AES and Diffie Hellman, Case study.

Unit 5: Conventional Encryption

Confidentiality using conventional encryption – Placement of Encryption, Traffic Confidentiality, Key Distribution and Random Number Generation. Key management – Generating Keys, Nonlinear Keyspaces, Transferring Keys, Verifying Keys, Using Keys, Updating Keys, Storing keys, Backup keys, Compromised Keys, Lifetime of Keys, Destroying Keys and Public-Key Management, Case study.

Text Book/Reference books:

1. Mark Stamp's Information Security: Principles and Practice (WIND) Paperback – 2009 by Deven N. Shah, Wiley (2009)
2. Cryptography and Information Security by V. K. Pachghare, Prentice-Hall of India Pvt.Ltd; 2nd Revised edition edition (30 March 2015)
3. Information Security Risk Analysis - Thomas R. Peltier, Third Edition, Pub: Auerbach, 2012
4. Cryptography and Network Security Principles and Practices, by William Stallings, Pearson Education; Seventh edition (30 June 2017)

BCSAI 507: DATABASE SECURITY

2L + 0T + 0P + 2C   **MM 100**

Unit 1: Security Architecture & Operating System Security Fundamentals

Security Architecture: Introduction-Information Systems- Database Management Systems-Information Security Architecture- Database Security–Asset Types and value-Security Methods. Operating System Security Fundamentals: Introduction-Operating System Overview-Security Environment – Components-Authentication Methods-User Administration-Password PoliciesVulnerabilities-E-mail Security

Unit 2 : Administration Of Users & Profiles,Password Policies, Privileges And Roles

Administration of Users: Introduction-Authentication-Creating Users, SQL Server User-Removing, Modifying Users-Default, Remote Users-Database Links-Linked Servers-Remote Servers-Practices for Administrators and Managers-Best Practices Profiles, Password Policies, Privileges and Roles: Introduction-Defining and Using Profiles-Designing and Implementing Password Policies-Granting and Revoking User Privileges-Creating, Assigning and Revoking User Roles-Best Practices

Unit 3: Database Application Security Models & Virtual Private Databases

Database Application Security Models: Introduction-Types of Users-Security Models- Application Types-Application Security Models-Data Encryption Virtual Private Databases: Introduction-Overview of VPD-Implementation of VPD using Views, Application Context in Oracle-Implementing Oracle VPD- Viewing VPD Policies and Application contexts using Data Dictionary, Policy Manager Implementing Row and Column level Security with SQL Server

Unit 4: Auditing Database Activities

 Auditing Database Activities: Using Oracle Database Activities-Creating DLL Triggers with OracleAuditing Database Activities with Oracle-Auditing Server Activity with SQL Server 2000-Security and Auditing Project Case Study.

Unit 5: Privacy Preserving Data Mining Techniques

 Privacy Preserving Data Mining Techniques: Introduction- Privacy Preserving Data Mining AlgorithmsGeneral Survey-Randomization Methods-Group Based Anonymization-Distributed Privacy Preserving Data Mining-Curse of Dimensionality-Application of Privacy Preserving Data Mining

Text/Reference Books:

1. Hassan A. Afyouni, "Database Security and Auditing", Third Edition, Cengage Learning,2009
2. 2.Charu C. Aggarwal, Philip S Yu, "Privacy Preserving Data Mining": Models and Algorithms, Kluwer Academic Publishers, 2008
3. Ron Ben Natan, "Implementing Database Security and Auditing", Elsevier Digital Press,2005.
1. http://charuaggarwal.net/toc.pdf

BCSAI 508: BUSINESS INTELLIGENCE

2L + 0T + 0P + 2C **MM 100**

Course Objective:

- To understand information Systems with comprehensive and in-depth knowledge of Business Intelligence
- To provide expose to students about the frontiers of BI-intensive BIG data computing and information systems

Unit 1: Introduction to Business Intelligence

Introduction to OLTP and OLAP, BI Definitions & Concepts, Business Applications of BI, BI Framework, Role of Data Warehousing in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities.

Unit 2: Basics of Data Integration (Extraction Transformation Loading)

Concepts of data integration need and advantages of using data integration, introduction to common data integration approaches, introduction to ETL, Introduction to data quality, data profiling concepts and applications.

Unit 3: Introduction to Multi-Dimensional Data Modeling

Introduction to data and dimension modeling, multidimensional data model, ER Modeling vs. multi-dimensional modeling, concepts of dimensions, facts, cubes, attribute, hierarchies, star and snowflake schema, introduction to business metrics and KPIs, creating cubes using SSAS.

Unit 4: Basics of Enterprise Reporting

Introduction to enterprise reporting, concepts of dashboards, balanced scorecards, and overall architecture.

Unit 5: Data Mining Functionalities

Association rules mining, Mining Association rules from single level, multilevel transaction databases, Classification and prediction, Decision tree induction, Bayesian classification, k-nearest neighbor classification, Cluster analysis, Types of data in clustering, categorization of clustering methods.

Text/ ReferenceBooks:

1. R N Prasad, Seema Acharya: Fundamentals of Business Analytics, Wiley India, First Edition, 2011
2. J.Han and M. Kamber: Data Mining: Concepts and Techniques By Morgan Kaufman publishers, Harcourt India pvt. Ltd. Latest Edition
3. David Loshin: Business Intelligence: The Savvy Manager's Guide., Latest Edition By Knowledge Enterprise.
4. Larissa Terpeluk Moss, Shaku Atre: Business Intelligence roadmap by Addison Weseley
5. Cindi Howson: Successful Business Intelligence: Secrets to making Killer BI Applications by Tata McGraw Hill
6. Mike Biere: Business intelligence for the enterprise by Addison Weseley, Ausgust 2010

BCSAI 601: BIG DATA ANALYTICS

3L + 0T + 0P + 3C   **MM 100**

Unit 1: Introduction to Big Data

Introduction to Big Data, Characteristics of Data, and Big Data ,Evolution of Big Data, Definition of Big Data, Challenges with big data, Why Big data? Complexity of Big Data, Big Data Processing Architectures, Big Data Technologies, Data Warehouse, Traditional Business Intelligence versus Big Data. State of Practice in Analytics, Key roles for New Big Data Ecosystems, Big Data Analytics, Introduction to big data analytics, Classification of Analytics, Challenges of Big Data, Importance of Big Data, Big Data Technologies, Data Science, Responsibilities, Soft state eventual consistency, Data Analytics Life Cycle.

Unit 2: Analytical Theory and Methods

Analytical Theory and Methods: Clustering and Associated Algorithms, Association Rules, Apriori Algorithm, Candidate Rules, Applications of Association Rules, Validation and Testing, Diagnostics, Regression, Linear Regression, Logistic Regression, Additional Regression Models

Unit 3: Advanced Analytics Technology And Tools

Analytics for Unstructured Data, Use Cases, MapReduce, Apache Hadoop, The Hadoop Ecosystem, Pig, Hive, Hbase, Mahouth, NoSQL, SQL Essentials Joins, Set Operations, Grouping Extensions, In-Database Text Analysis, Advanced SQL, Window Functions, Userdefined Functions and Aggregates, Ordered Aggregates, MADlib

Unit 4: Hadoop Distributed File System Architecture

HDFS Architecture, HDFS Concepts, Blocks NameNode, Secondary NameNode, DataNode, HDFS Federation, HDFS High Availability, Basic File System Operations, Data Flow, Anatomy of File Read, Anatomy of File Write, Anatomy of a MapReduce Job Run

Unit 5: Processing Your Data With Mapreduce

Getting to know MapReduce, MapReduce Execution Pipeline, Runtime Coordination and Task Management, MapReduce Application, Hadoop Word Count Implementation

Text /Reference Books

1. Data Warehousing in the Age of Big Data by Krish Krishnan, Morgan Kaufmann.
2. A.Ohri, "R for Business Analytics", Springer, 2012.
3. Big Data Analytics with R and Hadoop by Vignesh Prajapati
4. Principles of Big Data Preparing, Sharing, and Analyzing Complex Information, 1st Edition, by J Berman, published by Morgan Kaufmann
5. "Big Data Analytics - From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph" By David Loshin, Morgan Kaufmann

BCSAI 602: COMPILER DESIGN

3L + 0T + 0P + 3C   **MM 100**

Unit 1: Overview Of Compilation - The structure of a compiler and applications of compiler technology; Lexical analysis - The role of a lexical analyzer, specification of tokens, recognition of tokens, hand-written lexical analyzers, LEX, examples of LEX programs.

Introduction to syntax analysis -Role of a parser, use of context-free grammars (CFG) in the specification of the syntax of programming languages, techniques for writing grammars for programming languages (removal left recursion, etc.), non- context-free constructs in programming languages, parse trees and ambiguity, examples of programming language grammars.

Unit 2: Top-Down Parsing - FIRST & FOLLOW sets, LL(1) conditions, predictive parsing, recursive descent parsing, error recovery. LR-parsing - Handle pruning, shift-reduce parsing, viable prefixes, valid items, LR (0) automaton, LR-parsing algorithm, SLR(1), LR(1), and LALR(1) parsing. YACC, error recovery with YACC and examples of YACC specifications. Syntax-directed definitions (attribute grammars)-Synthesized and inherited attributes, examples of SDDs, evaluation orders for attributes of an SDD, dependency graphs. S-attributed and L-attributed SDDs and their implementation using LR-parsers and recursive- descent parsers respectively.

Unit 3: Semantic Analysis - Symbol tables and their data structures. Representation of "scope". Semantic analysis of expressions, assignment, and control-flow statements, declarations of variables and functions, function calls, etc., using S- and L-attributed SDDs (treatment of arrays and structures included). Semantic error recovery.

Unit 4: Intermediate Code Generation - Different intermediate representations –quadruples, triples, trees, flow graphs, SSA forms, and their uses. Translation of expressions (including array references with subscripts) and assignment statements. Translation of control-flow statements – it- then-else, while-do, and switch. Short-circuit code and control-flow translation of Boolean expressions. Back patching. Examples to illustrate intermediate code generation for all constructs.

Unit 5: Run-Time Environments - Stack allocation of space and activation records. Access to non-local data on the stack in the case of procedures with and without nesting of procedures.

Introduction to machine code generation and optimization- Simple machine code generation, examples of machine-independent code optimizations.

Text / Reference Books:
1. Compilers: Principles, Techniques, and Tools , by A.V. Aho, Monica Lam, Ravi Sethi, and J.D. Ullman, (2nd ed.), Addison-Wesley, 2007 (main text book, referred to as ALSU in lab assignments).
2. K.D. Cooper, and Linda Torczon, Engineering a Compiler, Morgan Kaufmann, 2004.
3. K.C. Louden, Compiler Construction: Principles and Practice, Cengage Learning, 1997.
4. D. Brown, J. Levine, and T. Mason, LEX and YACC, O"Reilly Media, 1992.

BCSAI 603: ADVANCED MACHINE LEARNING

3L + 0T + 0P + 3C   **MM 100**

Unit 1: Introduction

Bayesian Machine Learning: Machine Learning Paradigms, types of machine learning approaches, delineating between supervised and unsupervised learning, and between discriminative and generative approaches.

Unit 2: Bayesian Modelling

Bayesian Modelling: assumptions and processes of constructing a Bayesian model, dependency relationships in Bayesian models,graphical models and probabilistic programming.

Unit 3: Bayesian Inference

Bayesian Inference: approaches for estimating Bayesian posteriors, marginal likelihoods, and expectations. Monte Carlo sampling, Markov chain Monte Carlo (MCMC) sampling and variational inference.

Unit 4: Natural Language Processing:

Challenge of Natural Language Processing (NLP), Embeddings : methods to create embeddings, disadvantages and advantages, Classification and neural networks: classification task, tasks arises in NLP problems, Language models.

Unit 5: Deep Learning

Motivation for deep learning, basic supervised classification task, optimizing logistic classifier using gradient descent, stochastic gradient descent, momentum, and adaptive sub-gradient method.

Text and Reference Books:

1. Jeff Heaton, Deep Learning and Neural Networks, Heaton Research Inc, 2015.
2. Ethem Alpaydin, Introduction to Machine Learning, Second Edition
3. Stephen Marsland, Machine Learning: An Algorithmic Perspective.
4. Tom Mitchell, Machine Learning

BCSAI 604: NATURAL LANGUAGE PROCESSING

3L + 0T + 0P + 3C   **MM 100**

Unit 1: Overview And Morphology

Introduction, Models -and Algorithms , Regular Expressions Basic Regular Expression Patterns, Finite State Automata Morphology, Inflectional Morphology, Derivational Morphology, Finite-State Morphological Parsing , Porter Stemmer

Unit 2: Word Level And Syntactic Analysis

N-grams Models of Syntax, Counting Words, Unsmoothed N-grams, Smoothing, Back off Deleted Interpolation, Entropy , English Word Classes , Tag sets for English, Part of Speech Tagging, Rule Based Part of Speech Tagging, Stochastic Part of Speech Tagging, Transformation-Based Tagging

Unit 3: Context Free Grammars

Context Free Grammars for English Syntax, Context- Free Rules and Trees, Sentence- Level Constructions, Agreement, Sub Categorization, Parsing, Top-down, Early Parsing, feature Structures Probabilistic Context, Free Grammars

Unit 4: Semantic Analysis

Representing Meaning, Meaning Structure of Language, First Order Predicate Calculus, Representing Linguistically Relevant Concepts –Syntax, Driven Semantic Analysis, Semantic Attachments, Syntax, Driven Analyzer, Robust Analysis, Lexemes and Their Senses, Internal Structure, Word Sense Disambiguation, Information Retrieval

Unit 5: Language Generation And Discourse Analysis

Discourse -Reference Resolution , Text Coherence, Discourse Structure, Coherence, Dialog and Conversational Agents , Dialog Acts, Interpretation, Conversational Agents, Machine Translation Transfer Metaphor, Interlingua, Statistical Approaches

Text /Reference Books:
1. Daniel Jurafsky and James H Martin,"Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition, 2008.

2. C. Manning and H. Schutze, "Foundations of Statistical Natural Language Processing", MIT Press. Cambridge, MA:,1999

3. James Allen, Bejamin/cummings, "Natural Language Understanding", 2nd edition, 1995

BCSAI 605: GRAPHICAL MODEL

3L + 0T + 0P + 3C **MM 100**

Unit 1: Fundamentals

Fundamentals of Probability Theory - Views of Probability, Random Variables and Joint Distributions, Conditional Probability, Conditional Independence, Expectation and Variance, Probability Distributions - Conjugate Priors, Introduction to Exponential Family; Fundamentals of Graph Theory - Paths, Cliques, Subgraphs, Cycles and Loops.

Unit 2: Graphical Models: Introduction

Directed Models (Bayesian Network), Undirected Models (Markov Random Fields), Dynamic Models (Hidden Markov Model & Kalman Filters) and Factor Graph; Conditional Independence (Bayes Ball Theorem and D-separation), Markov Blanket, Factorization (Hammersley-Clifford Theorem), Equivalence (I-Maps & Perfect Maps); Factor Graphs - Representation, Relation to Bayesian Network and Markov Random Field.

Unit 3: Inference in graphical models

Exact Inference - Variable Elimination, Elimination Orderings, Relation to Dynamic Programming, Dealing with Evidence, Forward-Backward Algorithm, Viterbi Algorithm; Junction Tree Algorithm; Belief Propagation (Sum Product); Approximate Inference - Variational Methods (Mean Field, Kikuchi & Bethe Approximation), Expectation Propagation, Gaussian Belief Propagation;

Unit 4:MAP Inference - Max-Product, Graph Cuts, Linear Programming Relaxations to MAP (Tree-Reweighted Belief Propagation, MPLP); Sampling - Markov Chain Monte Carlo, Metropolis Hastings, Gibbs (Collapsing & Blocking), Particle filtering.

Unit 5: Learning in Graphical Models

Parameter Estimation - Expectation Maximization, Maximum Likelihood Estimation, Maximum Entropy, Pseudolikelihood, Bayesian Estimation, Conditional Likelihood, Structured Prediction; Learning with Approximate Inference; Learning with Latent Variables; Structure Learning, Structure Search, L1 priors.

Text / Reference Books:
1. Jensen, F. V. and Nielsen, T. D. (2002). Bayesian Networks and Decision Graphs. Information Science and Statistics. Springer, 2nd edition.
2. Kevin P. Murphy (2013) Machine Learning: A Probabilistic Perspective. 4th Printing. MIT Press.
3. Barber, D. (2011). Bayesian Reasoning and Machine Learning. Cambridge University Press, 1st edition.
4. Bishop, C. M. (2011). Pattern Recognition and Machine Learning (Information Science and Statistics). Springer, 2nd printing.
5. Wainwright, M. and Jordan, M. (2008). Graphical Models, Exponential Families, and Variational Inference. Foundations and Trends in Machine Learning.

Semester VI   **B. Tech CSE (AI)**

BCSAI 609: BIG DATA ANALYTICS LAB

0L + 0T + 4P + 2C   **MM 100**

List of Experiments:

1. To draw and explain Hadoop Architecture and Ecosystem with the help of a case study using WorkCount example.

2. To understand the overall programming architecture using Map Reduce API

3. Implement word count / frequency programs using MapReduce

4. To implement the following file management tasks in Hadoop System (HDFS): Adding files and directories, Retrieving files, Deleting files

5. To perform NoSQL database

6. To study and implement basic functions and commands in R Programming.

7. Implement Linear and Logistic Regression

8. Develop Map Reduce Work Application

9. Creating the HDFS tables and loading them in Hive and learn joining of tables in Hive

10. Visualize data using any plotting framework

BCSAI610: ADVANCED MACHINE LEARNING LAB

0L + 0T + 4P + 2C   **MM 100**

List of Experiments

1. Implement and demonstrate the FIND-S Algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test datasets.
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

BCSAI 611: NATURAL LANGUAGE PROCESSING LAB

0L + 0T + 4P + 2C   **MM 100**

List of Experiments

1. Overview of NLP

2. NLP Toolkit

3. Installation of NLPTK

4. Determination of Statistical Word frequency

5. Handling Stop words

6. Use of NLTK Tokenize text

7. Non-English Tokenize

8. Synonym Processing

BCSAI 612 : Anandam-II Happiness Curriculum

0L + 0T + 1P + 1C   **MM 100**

List of Experiments:

1. A Healthy Life-style
2. The Power of Resilience
3. Getting Out of Your Comfort Zone
4. Creating More Time and Capacity Your Life to Increase Productivity

BCSAI 606: BLOCKCHAIN

2L + 0T + 0P + 2C   **MM 100**

Unit 1:Introduction to Cryptography

Introduction to Advanced Cryptography and Cryptanalysis, Classical Encryption Techniques – Substitution Techniques, Transposition Techniques, Permutation Method. Advanced Encryption Techniques and Security Issues – RC4, One-time Pad, RSA, DES, Triple DES, AES and Diffie Hellman, Case study.

Unit 2: Conventional Encryption

Confidentiality using conventional encryption – Placement of Encryption, Traffic Confidentiality, Key Distribution and Random Number Generation.

Unit 3: Key management – Generating Keys, Nonlinear Keyspaces, Transferring Keys, Verifying Keys, Using Keys, Updating Keys, Storing keys, Backup keys, Compromised Keys, Lifetime of Keys, Destroying Keys and Public-Key Management, Case study.

Unit 4: Introduction to Blockchain and Crypto-currency Basics

What is Blockchain, Blockchain Technology and Mechanisms, Challenges, Centralized Servers and Trusted Third Party, Shift from gold standard to flat currency to Hash cash/Digital, Trust less System, Transactions and Blocks, Digital Signatures

Discussion on Bitcoin and Ethereum, Significance, Security, The Bitcoin Mining Network, Mining Developments, Decentralization and Hard Forks, Ethereum Eco-System

Unit 5: Working of Blockchain and Hyper Ledger

Technology behind Blockchain-Consensus Building, Proof of Work, Byzantine Generals. Distributed Consensus, Cryptography, Hashing, Data Integrity, Public vs. Private Key Cryptography, Merkle Trees. Crypto-currency and Mining, Proof of Work vs. Stake, Business Model.
What is Hyper Ledger, Distributed Ledger Technology, Hyper Ledger Fabric and Composer, Assets, Chaincode and Ledger/Transactions, Permission Network, Member Services, Nodes and Channels, Development Machine Specifications and IDE.

Text/ Reference Books:

1. Imran Bashir. (2018). Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts explained, Import.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder. (2016). Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction. Princeton University Press.
3. Alex Tapscott and Don Tapscott. (2016). Blockchain Revolution: How the Technology behind Bitcoin Is Changing Money, Business, and the World, Portfolio.
4. Dr. Gavin Wood. (2014) Ethereum: A Secure Decentralized Transaction Ledger. Yellow Paper.
5. Chris Dannen. (2017). Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain Programming for Beginners. Apress.
6. William Mougayar, VitalikButerin. (2016). The Business Blockchain: Promise, Practice and Application of the Next Internet Technology. Wiley.

BCSAI 607: INTERNET OF THINGS

2L + 0T + 0P + 2C   **MM 100**

Unit 1: Introduction to IoT

Defining IoT, Characteristics, Physical Design, Logical Design, Functional Blocks, Communication Models and APIs, Computer Networks, Internet of Everything (IOE), Distributed Computing, Industrial Automation, Understanding IT and OT Convergence, Evolution of IIoT, Machine to Machine Communication, Difference between IoT and M2M, Software Define Network.

Unit 2: Concept of Data, Information, Knowledge and Wisdom

Knowledge Discovery Process, DIKW Pyramid and Relevance with IoT, Microcontrollers, Cost, Performance and Power Consumption, Commercial Microcontroller Based Development Boards, Selection Criteria and Trade-Offs.

Unit 3: Network and Communication Aspects

Wireless Medium Access Issues, Mac Protocol Survey, Survey-Routing Protocols, Sensor Deployment Basics & Node Discovery, Data, Aggregation & Dissemination. Sensor Node Architecture, WSN/M2M Communication Technologies, Bluetooth, Zigbee, Wifi. Cellular Communication and LpWAN (Lora and LoraWAN Technologies), Topologies, Applications.

Unit 4: Design and Development of IoT Systems

IoT Reference Architectures, Standardization Initiatives and Interoperability Issues. IoT Design Considerations, Architecture (Devices, Networks and Cloud). Network, Communication Technologies and Protocols, Smart Asset Management: Connectivity, Visibility, Analytics and Alerts.

Unit 5: Domain Specific Applications of IoT and its Challenges

Home Automation, Industry Applications, Surveillance Applications, Other IoT Applications, Design Issues and Challenges in IoT, Security, Development, Deployment, Usage. Security Standards, Vulnerabilities, Attack Surfaces, Hardware and Software Solutions, Open Source Initiatives.

Text/ Reference Books:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle. (2014). From Machine-To-Machine to the Internet of Things: Introduction to a New Age of Intelligence. Academic Press.
2. Francis Dacosta. (2013). Rethinking the Internet of Things: A Scalable Approach to Connecting Everything. Apress.
3. Vijay Madisetti and ArshdeepBahga. (2014). Internet of Things: A Hands-On-Approach. Orient Blackswan.
4. Adrian Mcewen, HakinCassimally. (2015). Designing the Internet of Things. Wiley.
5. Peter Waher. (2018). Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3. Packt
6. Rolf H. Weber, Romana Weber. (2010). Internet of Things: Legal Perspectives. Springer.

BCSAI 608: MANAGEMENT INFORMATION SYSTEM

2L + 0T + 0P + 2C   **MM 100**

Unit 1: Managing Information Systems in Organization

Introduction, Defination, Need of MIS, Managing in the Internet Era, Managing Information Systems in Organization-the IT interaction model, Challenges for the manager-what information to build?-how much to spend on information systems?-what level of capabilities should be created with information systems?-how centralized should the services be?-what security levels are required?-what is technology road map for the organization?

Unit 2: Data and Information

Introduction, data and information- measuring data, information as a resource, information in organizational functions, types of information technology, types of information systems- transaction processing systems-management information systems

Unit 3: Decision making and communication

Introduction, Decision making with MIS-Tactical decisions-operational decisions-strategic decisions, communication in organizations- types of communication- examples of communications in organizations-decision making with communication technology, Decision Support Systems: Introduction, Understanding DSS- MIS and DSS-Decision making-types of decisions, Analytics and Business Intelligence- BI techniques

Unit 4: SCM, CRAM and International Systems

Introduction, Supply Chain Management Systems, Customer Relationships Management Systems, Challenges of Enterprise Systems Implementations- Managing the implementation, International Information Systems-Outsourcing and off-shoring

Unit 5: Managing Social Media

Introduction, Social Dynamics of the Internet, Services of the Internet- Blogs-Social Networks, Technology of the Internet- Twitter-Rating-Tagging/folksonomies, Social issues-Media impact- Collaboration-Emergence of order, Social Networks in the Enterprise Managing IT Function: Introduction, Challenges of Managing the IT function- Modern IT environment-Centralization versus Decentralization-IT security-Technology selection, Vendor Management- vendor selection-vendor contracts and service levels-Ongoing relationship management- vendor retention or termination

Text/ ReferenceBooks:

1. Management Information Systems, Jawadekar, Tata McGraw Hill
3. Management Information Systems, Davis and Olson, Tata McGraw Hill
4. Analysis and Design of Information Systems, Rajaraman, Prentice Hall
5. Decision Support Systems and Intelligent Systems, Turban and Aronson, Pearson Education Asia
6. Management Information Systems, Schulthesis, Tata McGraw Hill
7. Management Information Systems - Sadagopan, Prentice Hall