Integrated M. Sc. Programme
in
Computer Science

Artificial Intelligence and Machine Learning

Mahatma Gandhi University, Kottayam

THIRD SEMESTER ONWARDS.

SEMESTER - III

Sl. No.	Course Code	Title	Hrs/ Week	Credits	Total Hours
1	ICSA3CR1	Advanced Computation Techniques (T)	4	4	72
2	ICSC3CR2	Programming in Python (T)	3	3	54
3	ICSC3CR3	R Programming and Mathematics for Artificial Intelligence (T)	4	3	72
4	ICSC3CR4	Computer Organization and Architecture (T)	4	4	72
5	ICSA3CM5	Digital Electronics (T)	4	4	72
6	ICSA3CP6	Software Lab III: Python and R Programming (L)	6	2	108
		Total	25	20	450

Course Title: Advanced Computation Techniques

Course Code: ICSA3CR1
Total Credits: 4

Course Objectives

Upon successful completion of this course, students should be able to:

- Illustrate the representation of tree structure and basic operations on it.
- Describe fundamental concepts of file as a data structures.
- Gain the needed expertise in designing normalized databases.
- Attain fundamental concepts of concurrent transactions and database security.
- Understand the storage techniques and accessing data from databases.

Module 1:

Trees: Introduction, Tree Terminology, Binary Trees-Strictly Binary Tree, Complete Binary Tree, Extended Binary Tree, Binary Tree Representation- Array and Linked List representation, creation of Binary Tree, Operations on Binary Trees, Traversal of Binary Tree-Inorder, Preorder and Post order traversals, Technique of Conversion of an expression into Binary Tree, Binary Search Tree- Insertion of a node, Searching for Node, Deletion of a Node. (16 Hrs.)

Module 2:

Files: Introduction, Terminology, File Organization, File Operations- Creation of a Fie, Reading of a File, Updation of a File, Insertion in the file, Deletion from the File, Sequential Files- Structure, Operations, Disadvantages, Areas of Use, Indexed Sequential File- Structure of Indexed Sequential File, Direct File Organization, Multiple Key Access- Multilist Organization, Inverted-List Organization. (16 Hrs.)

Module 3:

Relational Database design: features of good relational database design. Un-normalized relations, insertion deletion updation anomalies, normalized relations, first, second , third and BCNF normal forms, functional dependency, non-loss decomposition of relations, Concept of multivalued dependency, Basic concept of object oriented DBMS, databases connectivity. (16 Hrs.)

Module 4:

Transaction Management and Concurrent transactions: properties of transactions, benefits of concurrent transactions, schedules and locking principles, problems and solution of concurrent transactions, Database security and authorizations , Grant and Revoke , triggers and its need, system crashes and recovery, concept of logs . (12 Hrs.)

Module 5:

Overview of Storage and Indexing: Data on External Storage, storage of databases and access methods, Indexing and data retrieval, types of indexes - Clustered Indexes, Primary and Secondary Indexes, Index data Structures - Hash Based Indexing, Tree based Indexing, Comparison of File Organizations. (12 Hrs.)

Book of Study

1. G.S Baluja, Data Structures through C++ (A Practical Approach), Danapat Rai & Co.
2. Fundamentals of Database systems 7th edition: Elmasri & Navathe : Pearson Education.
3. Database Management Systems by Raghu Ramakrishnan, Johannes Gehrke 3rd. Edition, July 2014, McGraw Hill Education.

References

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures, Galgotia publications.
2. An introduction to database systems C.J Date 8th edition. Pearson education

Course Title: Programming in Python

Course Code: ICSC3CR2

Total Credits: 3

Course objectives

After completing this course, the student will

- understand basic knowledge in Python programming.
- learn how to design and program Python applications.
- acquire object-oriented skills in Python.
- able to work with python standard library.

Module 1:

Programming Environment and Python Basics: Getting Started with Python Programming - Running code in the interactive shell, Editing, Saving, and Running a script. Using editors - IDLE, Jupyter. Basic coding skills – Writing simple programs. (10 Hrs.)

Module 2:

Building Python Programs: Data types, variables, operators. Control statements – branching controls, simple if, if - else, if - elif -else; looping, while, for. Functions - defining, calling, returning values, functions with default arguments, recursive functions, nested functions and lamda functions. Strings - operation, string functions. Work with dates and times. (10 Hrs.)

Module 3:

Containers: Lists - Basic list Operations and functions, List of lists, Slicing, Searching and sorting list, List comprehension. Work with tuples and Sets. Dictionaries - Dictionary functions, dictionary literals, adding and removing keys, accessing and replacing values, traversing dictionaries, reverse lookup. (10 Hrs.)

Module 4:

Object Oriented Programming: Design with classes, Inheritance – multi-level and multiple inheritance. Exceptions - Handle a single exception, handle multiple exceptions. Introduction to file I/O - Reading and writing text files, Manipulating binary files. More concepts: Decorators, generators and iterators. (12 Hrs.)

Module 5:

Scientific Python: NumPy - Basics, Creating arrays, Arithmetic, Slicing, Matrix Operations, Random Numbers.. Plotting and visualization. Matplotlib - Basic plot, Ticks, Labels, and Legends. Pandas: operations on CSV files. Reading, Manipulating, and Processing Data. Python GUIs and event handling using tkinter. (12 Hrs.)

Book of Study

1. Kenneth A Lambert., Fundamentals of Python: First Programs, 2/e, Cengage Publishing,2016
2. Jeeva Jose, P Sojan Lal, Introduction to Computing and Problem solving with Python, Khanna Book Publishing, 2016
3. Wes McKinney, Python for Data Analysis, 2/e, Shroff / O'Reilly Publishers, 2017

Reference Books:

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2/e, Schroff, 2016
2. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016
3. David M.Baezly, Python Essential Reference. Addison-Wesley Professional; 4/e, 2009.

Course Title: R Programming and Mathematics for Artificial Intelligence

Course Code: ICSC3CR3

Total Credits: 3

Course Outcome

- On completion first two units of the course, students will be able to use R language for programming purposes

- The remaining three units will enable the student to become confident in the mathematical portions needed in the field of artificial intelligence.
- The lab sessions for the paper is so designed to make the student an expert in R to solve problems in mathematics.

Module 1:

R Programming -Fundamentals, installation and use of software, data editing, use of R as a calculator, functions and assignments, arguments, scope, logic and statements in R, logical equivalence, Sets with R: Cardinality, Equality, Empty set, Subset, ,Union, Intersection, Complement, Cross product and Algebraic properties. (12 Hrs.)

Module 2:

R Programming - Exploring and cleaning data for analysis, Data organization, Arrays, and Matrices, Basics of Arrays in R, Matrix operations, Advanced Matrix operations, Additional Matrix facilities, Lists and Data frames. Mapping models to Machine Learning, Evaluating and Validating models, Probability distributions in R, Statistical models in R, Building, linear models, Generalized linear models, Nonlinear least squares and maximum likelihood models. (14 Hrs.)

Module 3:

Sets, Operations on sets, Venn Diagrams, Multi Sets, Binary Relations, Equivalence Relations, Ordering Relations, Operations on Relations, Partial Orders. Statements and Notation, Connectives, Quantified Propositions, Logical Inferences, Methods of Proof of an Implication, First Order Logic and other Methods of Proof, Rules of Inference for Quantified Propositions, Proof by Mathematical Induction. (15 Hrs.)

Module 4:

Linear Algebra – System of Linear equations, Solving System of Linear equations, Linear Independence, Vectors, Scalars, Addition, Scalar multiplication, dot product, vector projection, cosine similarity. Support Vector Machines, Implementation using Python, Classification using Support Vector Machines. (15 Hrs.)

Module 5:

Matrices, determinants, inverse of matrix. System of equations, Linear transformation - rank and nullity, Consistency, and Inconsistency of linear system of equations, rank nullity theorem, Echelon form of a matrix and Row reduced echelon form of matrix. Correlation coefficient, Eigen values and Eigen vectors. Principle Component analysis (PCA) – Concepts and properties. Dimensionality reduction with PCA. (16 Hrs.)

Book of Study

1. N Matloaff ,“The art of R Programming”, No Starch Press, Inc, 2011, Ist edition,ISBN-10: 1-59327-384-3, ISBN-13: 978-1-59327-384-2.
2. William B. Claster, “Mathematics and Programming for Machine Learning with R: From the Ground Up” CRC Press; 1st edition (27 October 2020), ISBN: 9780367507855.
3. For Maths

4. Kenneth H. Rosen, “Discrete Mathematics And Its Applications”, 7th Ed,McGrawHill, 2012.
5. Erwin Kreyszig, “Advanced Engineering Mathematics”, Wiley India, 9th Edition 2011.

References

1. Nina Zumel, John Mount, Jeremy Howard, Rachel Thomas, “Practical Data Science With R”, Manning Publications, Year: 2020, ISBN: 1617295876, 9781617295874.
2. “Mathematics for Data Science and Machine Learning using R” by Eduonix, September 2019, Packt Publishing, ISBN: 9781839210945.
3. Mark Gardener, “Beginning R: The Statistical Programming Language”, ISBN: 978-1-118-16430-3 May 2012.

Web References

1. https://cran.r-project.org/doc/contrib/Verzani-SimpleR.pdf

Course Title: Computer Organization and Architecture

Course Code: ICSC3CR4

Total Credits: 4

Course objective

Upon successful completion of this course, students should be able to:

- Describe the fundamental organization of a computer system
- Explain addressing modes, instruction formats and program control statements
- Analyze the organization and performance of system memory hierarchy
- Describe basic concept of parallel computing.
- Describe fundamentals concepts of pipeline and vector processing

Module 1:

Introduction: Functional units of a computer, Basic operational concepts, Bus structure, Memory locations and addresses, Instructions and instruction sequencing, Instruction execution. Instruction Formats, Addressing Modes. (16 Hrs.)

Module 2:

Central Processing Unit: General Register Organization, Stack Organization, Instruction Formats, Instruction Classification, Addressing modes. (14 Hrs.)

Module 3:

Memory: Memory Hierarchy, RAM, ROM, Cache Memories, Virtual memory. (12 Hrs.)

Module 4:

Pipeline and Vector Processing: Parallel Processing, Architectural classification scheme-SISD, SIMD, MISD, MIMD, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processor. (16 Hrs.)

Module 5:

Multi Processors: Characteristics of Multiprocessors, Interconnection Structures, Interprocessor arbitration, Interprocessor communication and synchronization, Cache Coherence. (14 Hrs.)

Book of Study

1. Computer Organization, V. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, 5th Edition, McGraw Hill Education.
2. Computer System Architecture, M. Morris Mano, Third Edition, Pearson/PHI.

References

1. Computer Organization and Architecture – William Stallings, Sixth Edition, Pearson/PHI.
2. Computer Architecture and Parallel Processing, Kai Hwang and F. A. Briggs, McGraw Hills
3. Computer Architecture & Organization– John P Hayes, Mc Graw Hill.
4. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition, Pearson/PHI.

Course Title: Digital Electronics

Course Code: ICSA3CM5

Total Credits: 4

Course Outcome

After completion of the course the students will be able to:

- Explain number systems, describe binary and hexadecimal arithmetic and Discuss on logic gates.
- Analyse Boolean expressions using logic gates, Discuss Boolean algebra and Minimize SOP and POS expressions using Karnaugh map.
- Illustrate and explain various combinational logic circuits
- Explain various sequential logic circuits, Design various Up and down counters and describe various shift registers and shift register counters.

Module 1:

Review of number systems: Decimal Numbers, Binary numbers, Decimal to binary and binary to decimal conversions, Conversion of hexadecimal numbers to binary and decimal number system, Introduction to digital electronics: digital and analog systems, binary digits, logic levels, Binary Arithmetic, 1’s and 2’s complement of binary numbers, Signed numbers, Arithmetic operations with signed numbers, Arithmetic operation of hexadecimal numbers (addition and subtraction) Binary coded decimal, 8421 BCD code, BCD addition, Digital codes: Gray code, ASCII and EBCDIC codes. (14 Hrs.)

Chapter 2 (Pages 16 to 47 and 51 to 60) of Text book 1.

Module 2:

Logic Gates: AND, OR, NOT, XOR, XNOR, NAND (Definition, Symbols, Truth Tables and Operation, gate propagation delay time, fan-in and fan-out). Basic combinational logic circuits, Implementing combinational logic, Universal property of NAND and NOR gates, Combinational

logic using NAND and NOR gates, Realization of basic gates using NAND and NOR gates. (12 Hrs.)
Chapter 3 (Pages 78 to 103) and Chapter 5 Pages 172 to 185 of Text book 1.

Module 3:

Boolean algebra Boolean variables, operations and functions, Boolean Postulates, Boolean Theorems, De-Morgan's theorems, Boolean analysis of logic circuits, simplification using Boolean algebra, standard forms of Boolean expression, Boolean expressions and truth tables. The Karnaugh Map, Karnaugh SOP and POS minimization. (15 Hrs.)
Chapter 4 (Pages 4.5 to 4.42) of Text book 2.

Module 4:

Basic overview of logic functions, Introduction to combinational circuits: Basic adders (adders and subtractors), parallel binary adders, ripple carry and look ahead carry adders, magnitude comparators, decoders, encoders, code converters: binary to Gray and Gray to binary converters, multiplexers (Data selectors), De-multiplexer, parity generators/ checkers.
Introduction to sequential circuits: Latches, flip flops: RS flip flop using NAND/ NOR gates, Clocked RS, D, JK and T flip flops, Edge triggered flip flops, Master-slave JK flip flop, basic flip flop applications. (16 Hrs.)
Chapter 6 (Pages 202 to 251) and Chapter 7 (Pages 266 to 287) of Text book 1.

Module 5:

Basic shift register functions. Serial in- Parallel out shift registers, Parallel in -Serial out shift registers, Serial in- Serial out shift registers, Parallel in Parallel out shift registers, Bidirectional shift registers Shift register counters.
Types of counters- asynchronous and synchronous counters, design of asynchronous and synchronous counters, up/down counters, decade counters, cascaded counters, applications of counters. (15 Hrs.)
Chapter 8 (Pages 305 to 336) and Chapter 9 (Pages 354 to 374) of Text book 1.

Book of Study

1. Digital Fundamentals- Floyd and Jain, Eighth Edition
2. B. RAM, "Computer Fundamentals: Architecture and Organization", Fourth Edition, New age international (P) Limited.

Course Title Software Lab III: Python and R Programming

Course Code: ICSA3CP6
Total Credits: 2

I. Programming in Python- Lab. (54 Hrs.)

1. Programs using conditional Branching and looping
2. Programs using functions and strings
3. Programs using Lists, Dictionaries, tuples and sets.
4. Program for traversing dictionaries

5. Programs using class, Inheritance and Exceptions.
6. Programs using files.
7. Arrays and Matrix using NumPy.
8. Plotting and Visualization using Matplotlib (Line, bar chart, pie chart etc..).
9. Data manipulations (data series and data frames) using Pandas
10. Simple programs using GUI

II. Programming using R language- Lab. (54 Hrs.)

1. R Program to add two vectors. The program covers:
   a. R Vector b. R Operators
2. Find sum, mean and product of vector in r using built-in functions. The program covers:
   a. R Variables and Constants b. R Functions
3. R program to print the Fibonacci sequence by taking input from the user. The program covers:
   a. R if…else Statement b. R while loop
4. R program to find the factors of a number. The program covers:
   a. R Functions
   b. R for Loop
5. Calculator Application in R. The program covers:
   a. Using with and without R objects on console
   b. Using mathematical functions on console
6. Reading and writing different types of datasets
   a. Reading different types of data sets (.txt, .csv) from web and disk and writing in file in specific disk location.
   b. reading Excel data sheet in R.
   c. reading XML dataset in R
7. Solve this system using R:

Compute the inverse of the resultant matrix, Compute the determinant matrix, Compute the Eigenvalues/eigenvector. $x1 + x2 = 2$ $-x1 + x2 = 4$

8. Solve the system of linear equations using R.
   $5x + y = 15$, $10x + 3y = 9$
9. Write an R program to access the element at 3rd column and 2nd row, only the 3rd row and only the 4th column of a given matrix.
10. Descriptive statistics in R
    a. Write an R script to find basic descriptive statistics using summary, str, quartile function on mtcars& cars datasets.
    b. Write an R script to find subset of dataset by using subset (), aggregate () functions on iris dataset.

SEMESTER - IV

Si. No.	Course Code	Title	Hrs/ Week	Credits	Total Hours
1	IEN4CC01	English II-English Language Skills for Academic Purposes (T)	5	4	90
2	ICSA4CM2	Microprocessors (T)	4	3	72
3	ICSC4CR3	Data Mining (T)	4	4	72
4	ICSC4CR4	Software Engineering (T)	4	3	72
5	ICSC4CR5	Basics of Artificial Intelligence (T)	4	3	72
6	ICSA4CMP6	Complementary Lab: Digital Electronics Lab (L)	2	2	36
7	ICSA4CP7	Software lab IV (L)	2	1	36
		Total	25	20	450

- Syllabus of English II –As Approved by BoS of English

Course Title: Microprocessors

Course Code: ICSA4CM2
Total Credits: 3

Course Objective

At the end of the course, a student will be able to

- Assess and solve basic binary math operations using the microprocessor and explain the 8086 microprocessors internal architecture and its operation.
- Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the microprocessor 8086.
- Discuss operations of 8087, 8089, 8255 etc.
- Get an idea of advanced processors.

Module 1: Introduction to Microprocessor.

Overview of binary, hexadecimal and BCD arithmetic, Introduction to microprocessors, Microprocessor Evolution, Overview of microcomputer structure and operation. Introduction to computer programming languages and Assembly language programming. Introduction to16-bit Processors – 8086/8088. *refer text book 1 and 3* (5 Hrs.)

Module 2: 8086 Architecture

Pins and signal descriptions of 8086 processor, Introduction to Maximum and Minimum mode operation, 8086 Architecture, Register organization of 8086, Physical Memory organization,

Addressing Modes. 8086, General Bus operation, read machine cycle, Write machine cycle, Memory and I/O Mapping, 8086 interrupts, interrupt Types, Introduction to Stack, Stack Structure of 8086, Timer/counter. *refer text book 1 and 3* (14 Hrs.)

Module 3: Instruction set and programming of 8086

16 hours Machine language instruction formats, 8086 instruction set, Assembler directives, Machine level programming/coding steps, Use of MASM (Microsoft Macro Assembler)/ TASM (Turbo Assembler), Assembly language programming examples (arithmetic, logical, stack and delay subroutines). Software Development with Interrupts, Introduction to Subroutines, Recursion, MACROS. *refer text book 1*. (16 Hrs.)

Module 4: Peripherals and interfacing

Numeric Processer 8087-Architecture and registers, I/O Processor 8089-Architecture, Memory Interfacing, RAM interfacing, Interfacing I/O ports, Programmable peripheral. Interface 8255, Modes of operation of 8255. *refer text book 1* (13 Hrs.)

Module 5: Advanced Architecture

80286, 80386, 80586(Pentium) processors- System Architecture and salient features (Detailed study not needed). Introduction to Single Board Computers- Arduino, Raspberry Pi- Features *refer text book 1 and 3*. (6 Hrs.)

Book of Study

1. Advanced microprocessor and Peripherals - A.K.Ray and K.M.Bhurchandi, TMH, 2000
2. Micro Processors & Interfacing – Douglas V. Hall, 2007.
3. O'Reilly Raspberry Pi Cookbook- Simon Monk, O'Reilly.

References

1. The Intel Microprocessor, Architecture, Programming and Interfacing - Barry B. Brey, 6e, Pearson Education / PHI, 2003.
2. Microcomputer systems-The 8086 / 8088 Family – Y.C. Liu and A. Gibson, 2nd edition, PHI -2003.
3. The 8086 Microprocessor: Programming & Interfacing the PC – Kenneth J Ayala, CENGAGE Learning, 2011.

Course Title: Data Mining

Course Code: ICSC4CR3

Total Credits: 4

Course Objectives

- To identify the scope and essentiality of Mining
- To analyse data, choose relevant models and algorithms for respective applications. To develop research interest towards advances in data mining.
- To introduce the basic concepts and techniques of Data mining

Module 1:

Introduction: What is Data mining? Data Mining Tasks, KDD process, Major issues in Data Mining, Data objects and Attribute types- Nominal, Binary, Ordinal and Numeric attributes, Measuring the central tendency- Mean, Median and Mode. Data Warehouse. (12 hrs)

Module 2:

Data Pre-processing: Needs of Pre-processing the Data, Data Cleaning- Missing Values, Noisy Data, Data Cleaning as a Process. Data Integration- Redundancy and correlation analysis, Data Reduction- Attribute Subset Selection, Dimensionality Reduction, Numerosity Reduction, PCA. Data Transformation strategies, Data transformation by Data Structure, Discretization by Binning, Histogram Analysis (14 hrs)

Module 3:

Association Analysis- Frequent patterns, Basic terminology in association analysis- Binary representation, Itemset and support count, Association Rule, Support and Confidence, Frequent Item set generation- The Apriori Algorithm, Generating Association Rules from Frequent Itemsets, FP Growth algorithm, From Association Analysis to Correlation Analysis. (14 hrs)

Module 4:

Classification- Basic concepts, General approach to classification, Nearest neighbor models, Cross validation and re-sampling methods- kfold cross validation, Boot strapping, Measuring classifier performance- Precision, recall, ROC curves. Bayes Theorem, Bayesian classifier, Decision Trees- Entropy, Information Gain, Tree construction, ID3, Issues in Decision Tree learning- Avoiding Over-fitting, Reduced Error Pruning, The problem of Missing Attributes, Gain Ratio, Classification by Regression (CART) (16 hrs)

Module 5:

Cluster Analysis: Introduction, Basic Clustering methods- Partitioning methods- k-Means and k-Medoid. Hierarchical Methods - Agglomerative and Divisive Hierarchical Clustering. Density Based Methods - DBSCAN, OPTICS. Grid Based- STING, CLIQUE, Outlier Analysis- what are outliers, Types of outliers, Outlier detection methods - Statistical Distribution-based Outlier Detection, Distance-Based Outlier Detection. Mining other kinds of data – Mining spatial data, mining multimedia data, mining text data, mining web data. (16 hrs)

Book of Study

1.Jiawei Han & Micheline Kamber , Data Mining, Concepts and Techniques, , 3rd Edition.

2.Pang Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining, Pearson India Education Services.

References

1. Arun K Pujari, Data Mining Techniques, , University Press

2. Sam Anahory & Dennis Murray, Data Warehousing in the Real World, Pearson Education, Asia.

3. Paulraj Ponnaiah, Data Warehousing Fundamentals,Wiley Student Edition

Course Title: Software Engineering

Course Code: ICSC4CR4
Total Credits: 3

Course Objectives

Upon the completion of the course, students should be able to

- Recognize the importance of basic processes in software Development life cycle.
- Understand the various activities associated with different models and their significance.
- To provide better understanding about the basic concepts of Software Engineering
- Familiarize the requirements in engineering and systematic approach in classical software design and development techniques.
- Familiarize with various software testing techniques and tools.
- Perceive the importance of Software Maintenance

Module 1:
Introduction: Evolution, Types of software development products; Software life cycle models: A few basic concepts, Waterfall model and its extension, Agile development models, Spiral model, Comparison of different life cycle models (14 hrs)

Module 2:
Software Project Management, Project Planning, Metrics for project size estimations, Project Estimation Techniques, Basic COCOMO model, Scheduling, Organization structure, Team structure , Staffing, Risk Management, Software Requirements Analysis and Specification: Requirements gathering and analysis, Software Requirements Specification(SRS) (14 hrs)

Module 3:
Software Design: overview of the design process, How to characterize a good software design, Cohesion and Coupling, Layered arrangements of modules, Approaches to software design, Function oriented design: Overview of SA/SD Methodology, Structured analysis, Developing the DFD model of a system, Structured Design, User Interface design: Characteristics of a good user interface, Basic concepts, Types of user interfaces (14 hrs)

Module 4:
Coding and Testing: Coding, Code review, Software documentation, Testing, Unit testing, Black box testing, white box testing: Basic concepts, Debugging Integration testing, system testing, Software Reliability and quality management: Software reliability, Software quality (14 hrs)

Module 5:
Software maintenance: Characteristics of software maintenance, Software reverse engineering, Software process models, Estimation of maintenance cost, Software Reuse: Basic issues in any Reuse Program, A Reuse approach, Reuse at Organization level , Emerging Trends: Client Server Software, Client Server architectures, CORBA, Service Oriented Architecture (SOA), Software as a Service (SaaS). (16 hrs)

Book of Study

1. Fundamentals of Software Engineering, Fifth Edition by Rajib Mall, PHI Learning Pvt. Ltd., February 2019.

References

1. Software Engineering 10th Edition by Ian Sommerville, PEARSON INDIA, October 2018.
2. Software Engineering – a Practitioner's approach Seventh Edition by Roger S Presman, 7th edition, McGraw Hill. 2017.

Course Title: Basics of Artificial Intelligence

Course Code: ICSC4CR5

Total Credits: 3

Course Objectives

Upon successful completion of this course students should be able to:

- Explain the basics of AI.
- Identify appropriate AI methods to solve a given problem.
- Will be able understand the concept of differentiation and its applications
- Should have sound knowledge in the field of probability and correlation and regression

Module 1:

Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics - Specialized productions system- Problem solving methods – Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction – Related algorithms, Measure of performance and analysis of search algorithms. (14 Hrs.)

Module 2:

Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge. Game playing. (14 Hrs.)

Module 3:

Differentiation, Limits and continuity rules of differentiation, Derivatives, Scalar derivatives, Partial derivatives, Differentiation of univariate functions, Partial differentiation and gradients, Gradient of vector valued function. Gradient of matrices. Optimization using gradient functions, constrained optimization, and Lagrange multipliers. Convex optimization. Back propagation in neural networks, implementation and application. (15 Hrs.)

Module 4:

Generating Functions of Sequences, Calculating Coefficients of Generating Functions, Recurrence Relations, Solving Recurrence Relations by Substitution and Generating Functions,

The Method of Characteristic Roots, Solutions of Inhomogeneous Recurrence Relations, Complexity calculations of prominent algorithms. (15 Hrs.)

Module 5:

Probability, basics, Conditional Probability, Bayes Theorem, Distributions - Binomial, Poisson, normal distributions, and related problems. Descriptive Statistics, Regression, and correlation, Bayesian classification, implementation, applications. (14 Hrs.)

Books of Study

1. Artificial Intelligence, Deepak Khemani, Tata Mc Graw Hill Education.
2. Kenneth H. Rosen, “Discrete Mathematics And Its Applications”, 7th Ed,McGrawHill, 2012.
3. Erwin Kreyszig, “Advanced Engineering Mathematics”, Wiley India, 9th Edition 2011.
4. Walpole, R. E., Myers, R. H., Myers S L & Keying Ye, ‘Probability and Statistics for Engineers and Scientists’. 8th ed, Pearson Education, 2007.

Course Title: Complementary Lab: Digital Electronics Lab

Course Code ICSA4CMP6
Total Credits: 2

Course Objective

At the end of the course, a student will be able to

- Analyse assembly language programs using appropriate assembler.
- Construct a maintainable assembly language program for an algorithm.

Assembly Language Programming (MP 8086 based)

1. Simple Arithmetic Calculations
2. Conditional statements
3. Control statements
4. Loop and arrays
5. Character strings
6. Subroutines and Stack Operations

(Minimum two programs from each section, total 20 programs to be carried out compulsorily to appear for external examination)

Sample List of Programs

Write Assembly Language Program using 8086

1. Data transfer using direct and indirect addressing
2. Block data transfer from one section of memory to another section of memory
3. Addition and subtraction of two unsigned numbers.
4. 16 bit addition.
5. Multiplication of two numbers.
6. Multiplication by shift rotate and add method.

7. Division of two numbers.
8. Checking specific bits in a number.
9. Finding the number of negative numbers in a dataset.
10. Finding largest number in a dataset.
11. Finding smallest number in a dataset
12. Sorting in ascending order.
13. Sorting in descending order.
14. BCD addition and subtraction.
15. BCD to HEX conversion
16. Finding the square of a given number.
17. Checking parity of a given number.
18. Square of a number
19. Find the Square from the hexadecimal look uptable
20. Hexa decimal to ASCII conversion
21. ASCII to Hexa decimal conversion
22. Occurrence of a number in a dataset
23. Binay to BCD conversion
24. BCD to binary conversion
25. Factorial of a number
26. Moving a string from one location to another
27. Checking of password
28. Check for palindrome

Course Title: Software lab IV

Course Code: ICSA4CP7

Total Credits: 1

Software Lab IV- Data Mining Implementation using Python & R

1. Implement Apriori algorithm for frequent item set generation using Python.
2. Implementation of Classification in Python using
    a. KNN
    b. Decision Tree
3. Implementation of Clustering in Python using
    a. K-means
    b. K-medoid
4. Implementation of Correlation and Covariance analysis using R
    a. Find the correlation matrix
    b. Plot the correlation plot on dataset and visualize an overview of relationships among data on iris dataset.
    c. Analysis of covariance: Variance (ANOVA), if data have categorical variables on iris data.

SEMESTER - V

Si. No.	Course Code	Title	Hrs./ Week	Credits	Total Hours
1	ICSC5CR1	Principles of Machine Learning (T)	3	4	54
2	ICSC5CR2	Web Application Development Using PHP (T)	4	3	72
3	ICSC5CR3	Programming in Java (T)	4	3	72
4	ICSC5CR4	IT and Environment (T)	3	4	54
5	ICSA5PR5	Project Minor - Phase I	3	-	54
6	ICSA5CP6	Software Lab V: Java and PHP (L)	8	3	144
		Total	25	17	450

Course Title: Principles of Machine Learning

Course Code: ICSC5CR1
Total Credits: 4

Course Objectives

On completion of the course, the student should have:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To understand the supervised learning techniques such as Linear Regression, Logistic Regression, Support Vector Machine, Naïve Bayes Classifier.
- To understand the biological neural network and to model equivalent neuron models.

Module 1:

Introduction to Machine Learning – Machine learning basics, Types of machine learning, Applications of Machine Learning, Basic types of data in Machine learning, Data pre-processing, Predictive Vs Descriptive models, training a model, training versus testing, cross validation, overfitting & underfitting, Bias variance tradeoff, error measures, evaluating performance of a model. Introduction to feature engineering, ML tools in Python. (12 Hrs.)

Module 2:

Linear Regression – Problem formulation, Parameter Estimation, Bayesian Linear Regression, Multiple linear regression, fitting simple linear and multiple linear regression equations with examples, regularization techniques, case study and implementation. (10 Hrs.)

Module 3:

Logistic Regression - Interpreting Parameters in Logistic Regression, Inference for Logistic Regression, Logistic Models with Categorical Predictors, Multiple Logistic Regression, Fitting Logistic Regression Models and its implementation using real life examples. (10 Hrs.)

Module 4:

Support Vector Machine (SVM) Algorithm, Types of SVM, Hyperplane and Support Vectors, Working of SVM Applications of SVM; Naïve Bayes Classifier Algorithm, Bayes' Theorem, Types of Naïve Bayes Model, Working of Naïve Bayes' Classifier, Applications of Naïve Bayes Classifier (10 Hrs.)

Module 5:

Artificial Neural Network (ANN): Features, structure and working of Biological Neural Network (BNN), Comparison of BNN and ANN, History of neural network research, characteristics of neural networks, terminology, Applications of ANN, models of neuron McCulloch-Pitts model, Perceptron, Basic learning laws, Topology of neural network architecture. Backpropagation networks (BPN), Architecture of feed forward network, single layer ANN, multilayer perceptron, back propagation learning, input-hidden and output layer computation, backpropagation algorithm, selection of tuning, parameters in BPN, learning. (12 Hrs.)

Books of Study

1. Machine Learning, Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Person, 2020.
2. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, “Mathematics for Machine Learning”, 2020.
3. Aurelien Geron, “Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow” Powered by Jupyter, published by O’Reilly Media.
4. Artificial neural network, B. Yegnanarayana - PHI Publication.
5. Neural networks, Fuzzy logic and Genetic Algorithms; S. Raj Sekaran and Vijayalakshmi Pari

Course Title: Web Application Development Using PHP

Course Code: ICSC5CR2
Total Credits: 3

Course Objectives

Upon successful completion of this course, students should be able to:

- Develop web applications using Php and MySQL database.
- Use java scripts and jQuery in client side
- Use CSS concepts in Webpage designing

Module 1:

Introduction to PHP- Structure of PHP-Comments, Basic Syntax, Variables, Variable Assignment, Variable Typing, Constants, Predefined Constants, echo vs print Command, Functions, Variable Scope.

Expressions and Control Flow in PHP- Expressions, Conditionals- if Statement, else Statement, elseif Statement, switch Statement? Operator, Looping- while Loops, do...while Loops, for Loops, break, continue Statement.
PHP Functions and Objects- PHP Functions- Defining a Function, Returning a Value, Returning an Array, Passing Arguments by Reference, Returning Global Variables, Including and Requiring Files, PHP Objects- Declaring a Class, Creating an Object, Accessing Objects, Cloning Objects, Constructors, Destructors, Writing Methods, Declaring Properties, Declaring Constants, Property and Method Scope, Static Methods, Static Properties, Inheritance. (16 Hrs)

Module 2:

PHP Arrays -Basic Access- Numerically Indexed Arrays, Associative Arrays, Assignment Using the array Keyword, foreach Loop, Multidimensional Arrays, Array Functions .Accessing MySQL Using PHP -Connecting to a MySQL Database, $_POST Array, create, insert, delete, update, select operations in MySQL database using PHP, Form Handling - Building Forms - Retrieving Submitted Data, Default Values, Input Types, HTML5 Enhancements- autocomplete Attribute, autofocus Attribute, placeholder Attribute, required Attribute, Override Attributes, width and height Attributes, min and max Attributes, step Attribute, form Attribute, list Attribute, color Input Type, number and range Input Types, Date and Time Pickers. (14 Hrs)

Module 3:

Exploring JavaScript - JavaScript and HTML Text- Using Scripts Within a Document Head, Including JavaScript Files, Using Comments, Semicolons, Variables- String Variables, Numeric Variables, Arrays, Variable Typing, Functions, Global Variables, Local Variables, Document Object Model document.write, console.log, alert, Writing into Elements, with Statement, onerror, Using try...catch, Conditionals, Loops.
JavaScript Functions, Objects, and Arrays - JavaScript Functions- Defining a Function, Returning a Value, Returning an Array, JavaScript Objects- Declaring a Class, Creating an Object, Accessing Objects, prototype Keyword, JavaScript Arrays- Numeric Arrays, Associative Arrays, Multidimensional Arrays, Array Methods, Asynchronous Communication - XMLHttpRequest, Sending XML Requests. (14 Hrs)

Module 4:

Introduction to CSS - Importing a Stylesheet, Importing CSS from Within, Embedded Style Settings, Using IDs, Using Classes, Using Semicolons, CSS Rules- Multiple Assignments, Using Comments, Style Types- Default Styles, User Styles, External Stylesheets, Internal Styles, Inline Styles, CSS Selectors- Type Selector, Descendant Selector, Child Selector, ID Selector, Class Selector, Attribute Selector, Universal Selector, Selecting by Group, CSS Cascade-Stylesheet Creators, Stylesheet Methods, Stylesheet Selectors, Measurements, Fonts and Typography- font-family, font-style, font-size, font-weight, Managing Text Styles- Decoration, Spacing, Alignment, Transformation, Indenting, CSS Colors- Short Color Strings, Gradients, Positioning Elements- Absolute Positioning, Relative Positioning, Fixed Positioning, Pseudoclasses, Box Model and Layout- Setting Margins, Applying Borders, Adjusting Padding, Object Contents. (14 Hrs)

Module 5:

Introduction to jQuery- Including jQuery, jQuery Syntax, Avoiding Library Conflicts, Selectors, css Method, Element Selector, ID Selector, Class Selector, Combining Selectors, Handling Events, Event Functions and Properties- blur and focus Events, click and dblclick Events, keypress Event, mousemove Event, Other Mouse Events, Alternative Mouse Methods, submit Event, Special Effects, Hiding and Showing, toggle Method, Fading In and Out, Sliding Elements Up and Down, Manipulating the DOM- text vs html Methods, val and attr Methods, Adding and Removing Elements, Dynamically Applying Classes, Modifying Dimensions, DOM Traversal- Parent Elements, Child Elements, Sibling Elements, Selecting the Next and Previous Elements, Traversing jQuery Selections, is Method, Using jQuery Without Selectors- $.each Method, $.map Method, Asynchronous Communication. (14 Hrs)

Book of Study

1. Learning PHP, MySQL & JavaScript, Robin Nixon 5th Edition, O'Reilly

References

1. Learn PHP 7: Object-Oriented Modular Programming using HTML5, CSS3, JavaScript, XML, JSON, and MySQL- Steve Prettyman , Apress

2. PHP, MySQL, JavaScript & HTML5 All-in-One For Dummies - Steve Suehring and Janet Valade, Wiley

3. Beginning JavaScript with DOM Scripting and Ajax From Novice to Professional , Christian Heilmann, Apress

4. Beginning jQuery: From the Basics of jQuery to Writing your Own Plug-ins- Jack Franklin Russ Ferguson, Second Edition, Apress

5. Sams Teach Yourself HTML, CSS & JavaScript Web Publishing in One Hour a Day, Seventh Edition

Course Title: Programming in Java

Course Code: ICSC5CR3

Total Credits: 3

Course Objectives

- To familiarize basic concepts of OO programming.
- To understand the concept of constructors, packages and multithreading.
- To inculcate concepts of GUI programming using swing.
- To be able to create applets and implement database connectivity.

Module 1:

Concepts of Object-oriented programming, Benefits of OOP, Features of java. Java environment, java tokens, Constant, variables, data types, operators, Control Statements-branching statements, looping statements, jump statements, labeled loops. (10 hrs.)

Module 2:

Defining a Class, Fields declaration, Method declaration, Creating object, Accessing class members, method overloading, Constructors, constructor overloading, super keyword, static Members, Inheritance, overriding methods, dynamic method dispatch, final(variables, methods and classes), abstract methods and classes, interfaces, visibility control. (10 hrs.)

Module 3:

Arrays- One dimensional arrays, declaration, creation, initialization of arrays, two dimensional arrays, String class. Packages: - java API packages overview (lang, util, io, awt, swing, applet), user defined packages-creating packages, using packages Exception Handling Techniques-try-catch-throw-throws-finally -Multithreading- creation of multithreaded program-Thread class Runnable interface, Thread life cycle. (12 hrs.)

Module 4:

Event Handling-Delegation Event Model-Event Classes-Sources of Events-Event Listeners-Event classes- Swing- architecture, components of swing- JLabel, JButton, JCheckBox, JRadioButton, JList, JComboBox, JTextField, JText Area, JPanel, JFrame, Layout Managers (Flow Layout, Grid Layout, Card Layout, Border Layout, Box Layout, Null Layout). (10 hrs.)

Module 5:

Applet Fundamentals -applet tag, applet life cycle, passing parameters to applets. Working with graphics -Line, Rectangle, Oval, Arc, color setting. JDBC architecture- JDBC connection, JDBCstatement object, JDBC drivers. (10 hrs.)

Book of Study

1. E. Balagurusamy- Programming with Java , Third Edition, McGraw Hill Companies.
2. K. Somasundaram - PROGRAMMING IN JAVA2, First Edition, Jaico Publishing House.

References

1. Patrick Naughton - Java2 The Complete Reference, Seventh Edition:
2. Cay S Horstmann & Gary Cornell - Core Java Volume 1- Fundamentals, Eighth edition.
3. Java 6 Programming Black Book 2007 Edition, Dreamtech press.

Course Title: IT and Environment

Course Code: ICSC5CR4

Total Credits: 4

Course Objectives

- To understand the importance of internet and use of IT in teaching and learning.
- To identify, formulate and solve environmental problems by utilizing the concept of environmental studies.
- To create awareness among people about protection of wild life & forests.
- To understand the impact of e-waste and use of green computing.
- Understanding of environmental policies and regulations.
- To aware with human rights.

Module 1: Introduction to Internet and Environment:
Internet- Internet as a knowledge repository, academic search techniques, creating cyber presence. Academic websites. Multidisciplinary nature of environmental studies -Definition, scope and importance, Need for public awareness. (10 Hrs.)
Module 2: Impact of IT in E-Learning:
Introduction to use of IT in teaching and learning, Learning Management System, Moodle, Edmodo, etc. Academic services– A note on INFLIBNET, NPTEL, NICNET. (10 Hrs.)
Module 3: IT and Society:
IT & Society- issues and concerns- digital divide, IT & development, the free software movement. IT industry: new opportunities and new threats, software piracy, cyber ethics, cybercrime, cyber threats, cyber security, privacy issues, cyber laws, cyber addictions, information overload, health issues guidelines for proper usage of computers, internet and mobile phones. Impact of IT on language & culture. (10 Hrs.)
Module 4: E-waste and Green Computing:
E-waste- Problems- Solutions-Impact of e-waste in living beings and environment- a study on e-waste management in India. Green computing, definition, meaning, scope. Green computing in India. (10 Hrs.)
Module 5: Human Rights:
An Introduction to Human Rights, Meaning, concept and development –History of Human Rights- Different Generations of Human Rights- Universality of Human Rights- Basic International Human Rights Documents - UDHR ,ICCPR,ICESCR.-Value dimensions of Human Rights
Human Rights and United Nations : Human Rights co-ordination within UN system- Role of UN secretariat The Economic and Social Council- The Commission Human Rights-The Security Council and Human rights The Committee on the Elimination of Racial Discrimination- The Committee on the Elimination of Discrimination Against Women- the Committee on Economic, Social and Cultural Rights- The Human Rights Committee- Critical Appraisal of UN Human Rights Regime.
Human Rights National Perspective : Human Rights in Indian Constitution – Fundamental Rights- The Constitutional Context of Human Rights-directive Principles of State Policy and Human Rights- Human Rights of Women- children –minorities- Prisoners- Science Technology and Human Rights- National Human Rights Commission- State Human Rights Commission- Human Rights Awareness in Education. (14 Hrs.)
Case Study:
The students need to view the film “Samaksham”, a film on environment produced by Mahatma Gandhi University Creations and submit a compulsory assignment reviewing film. The review is considered for internal mark assessment.

References

1. K.L. James, The Internet: A User's Guide 2nd Revised edition, PHI publication.

2. Bharucha Erach, Text Book of Environmental Studies for undergraduate Courses. University Press, IInd Edition 2013 (TB)
(https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf).
3. Barkha and U Rama Mohan, Cyber Law & Crimes, 3rd Edition, Asia Law House.
4. Rakesh Johri, E-waste: Implications, regulations, and management in India and current global best practices, Teri publications.
5. Alan Evans, Kendall Martin, Mary Anne Poatsy, Technology in Action, Pearson.

Course Title Project Minor - Phase I

Course Code ICSA5PR5

General guidelines for Phase I and II

Each student needs to undertake a project work to implement various phases of Software Development. The project work is divided into two phases, Phase I in 5th and Phase II in the 6th Semester

The Phase I includes Problem identification and statement, system study and system design. For this he/she needs to identify a problem which is not yet automated. Analyze the Manual System existing there and suggest a framework of software befitting the problem. In the fifth semester (Phase I), system must be developed showing the data flow and needed DFD's and Database design. Evaluation of Project-Phase I will be internal for which the student needs to submit a spiral bound report of their work and appear before a team of faculty members formed by the head of the Department. The team should comprise of the Project Guide and two other Faculty members from the Department.

The Phase II of the project work in the Sixth semester is purely meant for development of software implementing the project identified and designed in Phase I. Student needs to develop a software using any of the Language or Package they have studied in their syllabus. Usage of any other language/package needs to get approved by the Committee/ Project Guide/HoD of the Department No student should be allowed to change the project work in Phase II and they need to develop the software for the work they identified in phase1. The internal mark for the Project work is to be awarded based on the student's performance in Phase I and II (50 percent Weightage for both the semesters). The Sixth semester project evaluation will be of External Nature along with its internal component. Students have to submit a hard bounded report for the evaluation.

Course Title: Software Lab V-Java and PHP

Course Code: ICSA5CP6

Total Credits: 3

I. Advanced Java Programming: Lab

Basic Concepts and File Handling

1. Inheritance, Polymorphism

2. Constructors
3. Interface
4. Package
5. One Dimensional and Two-Dimensional Array Manipulation
6. String Handling (Character Extraction, String Comparison, Searching String, Modifying a String, String Copy)
7. Exception (Built-in and User Defined)
8. Thread (Using Runnable Interface and Thread Class)
9. File management (File reading, Writing, Appending and Content Replacing)

II. Web Application Development Using PHP: Lab

Develop programs for implementing the following concepts

1. Expressions and Control Flow in PHP.
2. PHP Functions -Returning a Value, Returning an Array, Passing Arguments by Reference, Returning Global Variables
3. Constructors, Destructors, Inheritance
4. PHP Arrays - Numerically Indexed Arrays, Associative Arrays, foreach Loop, Multidimensional Arrays.
5. MySQL Database - create, insert, delete, update, select operations using HTML form
6. HTML5 Enhancements- autocomplete Attribute, autofocus Attribute, placeholder Attribute, required Attribute, Override Attributes, width and height Attributes, min and max Attributes, step Attribute, form Attribute, list Attribute, colour Input Type, number and range Input Types, Date and Time Pickers
7. JavaScript - Conditionals, Loops, Functions, Objects, and Arrays
8. Asynchronous Communication - XMLHttpRequest, Sending XML Requests,
9. CSS Selectors- Type Selector, Descendant Selector, Child Selector, ID Selector, Class Selector, Attribute Selector, Universal Selector, Selecting by Group.
10. CSS- Fonts and Typography- font-family, font-style, font-size, font-weight, Managing Text Styles- Decoration, Spacing, Alignment, Transformation, Indenting.
11. CSS Colors- Short Color Strings, Gradients
12. Positioning Elements- Absolute Positioning, Relative Positioning, Fixed Positioning.
13. Pseudoclasses,
14. Setting Margins, Applying Borders, Adjusting Padding.
15. JQuery- Selectors, css Method, Element Selector, ID Selector, Class Selector, Combining Selectors
16. JQuery event handling
17. Special Effects, Hiding and Showing, toggle Method, Fading In and Out, Sliding Elements Up and Down.
18. Manipulating the DOM
19. Using jQuery Without Selectors- $.each Method, $.map Method
20. Asynchronous Communication.

SEMESTER - VI

Si. No.	Course Code	Title	Hrs/ Week	Credits	Total Hours
1	ICSC6CR1	Linux and Shell Programming (T)	3	3	54
2	ICSC6CR2	Computer Networks (T)	4	4	72
3	ICSA6CR3	Advanced Machine Learning Techniques (T)	4	4	72
4	ICSC6EA1/2/3	Elective 1 [Bunch A] (T)	3	3	54
5	ICSA6PR4	Project Minor Phase II (L)	7	4	126
6	ICSA6CP5	Software Lab VI : Machine Learning Techniques (L)	4	2	72
		Total	25	20	450

Course Title: Linux and Shell Programming

Course Code: ICSC6CR1
Total Credits: 3

Course objective

Upon completion of the course, students will be able to:

- gain working knowledge in Linux environment.
- get a clear view on Linux file system
- understand process scheduling in Linux.
- facilities for user creation and management and basics of shell programming.

Module 1:

Open Source Software : Free software foundation, Freedoms in free software, GNU project, Introduction and development of Linux, , advantages of Linux, Hardware requirement, Installing Linux, Linux File System overview, Linux Architecture, Boot Process, Kernel, shell - the user interface, GUI and CLI commands, Usage of input-output redirection (>, >> etc.), Basic Commands in Linux – creating directories, changing directories, listing directory contents, file related commands (create and edit text files, renaming, copying, deleting), Introduction to Shells, Different shells and their features, Online manuals in Linux, the Man command. (10 Hrs.)

Module 2:

The Linux File system: Partitioning the disk, Disk command, Important files and directories in Linux, the hierarchical file system. The root directory / and its important sub directories /bin, /etc, /dev /lib, /boot /home. /mnt, /tmp, /user. Navigating through the file system. Absolute and

relative pathnames. The disk related commands, df, du, creating new partitions in Linux, deleting a partition, mounting and unmounting file systems , file types, file related commands Find, touch, cat etc. searching for a pattern, concept of wild cards and regular expressions , grep, egrep commands. (10 Hrs.)

Module 3:

Process Management in Linux The Concept and properties of Processes, Creating processes, the Parent processes and child processes, PID's and its relevance, Killing processes and sending signals to a process (kill, killall, xkill), How to start and monitor processes, Identify CPU/memory intensive processes, adjust process priority, Processor scheduling in Linux. The Batch command, The at Command, nohup command, File processing commands, wc, cut, paste, sort , Mathematical Commands expr and factor. Different editors in Linux, Consol based editors and GUI based editors and comparison of basic features (Vi, ed, emacs, gEdit etc..). (12 Hrs.)

Module 4:

Users and Group Management, useradd, usermod, userdel, groupadd, groupmod, groupdel. Adding a New User Account, User Private Groups, Modifying / Deleting User Accounts, Group Administration, Password Aging Policies, Switching Accounts, passwd command, logging in as Super user, Networked Users and communication, Authentication, Configuration, Default File Permissions, Changing file ownership (chown), Changing file group ownership (chgrp), Permissions on files, Permissions on directories, How permissions are applied, Changing permissions (chmod), Access Control Lists (ACLs). (10 Hrs.)

Module 5:

Shell Programming: The role of shells in the Linux environment, : The bash shell, Shell commands, Other standard shells, Write a simple shell script to welcome users, Comments in a script ,Setting up permissions on a script, debug and Execute a script, Variables in shell, The export statement, Unset shell and environment variables, Getting User Input Via Keyboard , Bash variable existence check, Customize the bash shell environments: Recalling command history, Path name expansion, Create and use aliases, The tilde expansion, Startup scripts-(Using aliases, Changing bash prompt, Setting shell options , Setting system wide shell options), Commonly Used Commands and Utilities (ls,rm,cat etc),Developing shell scripts for adding a User, Changing Password of users etc. (10 Hrs.)

Book of Study

1. A Practical Guide to Linux Commands, Editors, and Shell Programming, 4th Edition, by Mark
G. Sobell, Matthew Helme, Prentice Hall, 2018. ISBN: 978-0-13-477460-2.
2. The redhat Linux Bible: Christopher Negus: Wiley Dreamtech India
3. Unix Shell Programming: Yeshwant kanetkar. BPB publications.

Course Title: Computer Networks

Course Code: ICSC6CR2
Total Credits: 4

Course Objectives

Upon completion of this course, the students will be able to:

- Understand the concepts of signals and OSI layer functions.
- Discuss the process of Multiplexing, switching and difference between guided and unguided media in networks.
- Describe, analyze various data link layer protocols.
- Describe and analyze various network, and transport layer protocols.
- Have a basic knowledge of the use of cryptography and network security.

Module 1:

Introduction to Networks, Data and signals-analog and digital, periodic analog signals, digital signals, bit rate, baud rate, bandwidth. Transmission impairments- attenuation, distortion and noise. Data communication protocols and standards, Network models - OSI model-layers and their functions. TCP/IP protocol suite. (14 Hrs.)

Module 2:

Bandwidth utilization Multiplexing: FDM, TDM, spread spectrum. Transmission Media- guided media and unguided media. Switching: message, Circuit and packet switched networks, datagram networks, virtual- circuit networks.(12 Hrs.)

Module 3:

Data link layer: Error Detection and Correction, Framing, flow and error control, Protocols - Noiseless channels (Simplest, Stop and Wait) and Noisy channels (Stop and Wait and Piggy Backing). Multiple Access Protocols. Random Access-ALOHA, CSMA. Wired LANs- IEEE standards, wireless LANs-Bluetooth, Cellular Telephony (16 Hrs.)

Module 4:

Network layer and Transport layer: Repeaters, Bridges, Gateways and routers. Logical addressing – IPV4 and IPV6 addressing, Internet protocol - IPV4 and IPV6. Connectionless and Connection Oriented Services: UDP and TCP. Congestion Control, Quality of Service. (16 Hrs.)

Module 5:

Application layer: HTTP, FTP, SMTP, DNS. Network security: Common Threats- Firewalls (advantages and disadvantages), Cryptography. (14 Hrs.)

Book of Study

1. B. A. Forouzan - Data communication and Networking, Fourth edition-,TMH
2. Andrew S Tanenbaum - Computer Networks, Fourth Edition, Prentice Hall of India.

Course Title: Advanced Machine Learning Techniques

Course Code: ICSA6CR3
Total Credits: 4

Course Objectives:

- To be able to apply machine learning algorithms to solve problems of moderate complexity.
- Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
- To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.
- Be able to design and implement various machine learning algorithms in a range of real-world applications.
- Have an understanding of the strengths and weaknesses of many popular machine learning approaches.

Module 1

Data Structure for machine learning, normalization, min-max scaling, standardization scaling, importance of machine learning, issues in machine learning, machine learning for anomaly detection, recommender systems, adversarial machine learning, entropy in machine learning, mathematical formula for entropy, large scale machine learning.

Module 2

Dimensionality reduction, curse of dimensionality, feature selection, Principal Component Analysis (PCA), principal component, Working of PCA, Linear Discriminant Analysis (LDA), generalized discriminant analysis, forward selection, score comparison, missing value ratio, factor analysis, advantages and disadvantages of dimensionality reduction. Data augmentation, numerical data augmentation, image augmentation.

Module 3

Random forest algorithm, working, applications and advantages of random forest, decision tree vs random forest, Ensemble learning, Bagging vs Boosting, Gradient boosting algorithm, working, AdaBoosting algorithm, working, Xtreme gradient descent algorithm (XgBoost), working.

Model-based clustering, fuzzy clustering, fuzzy c-means algorithm, expectation-maximization clustering using GMM, applications of clustering.

Module 4

Confusion matrix, calculations using confusion matrix, precision, recall, F1-score, need for confusion matrix. Overfitting, avoid the overfitting in model. Underfitting, avoid the overfitting in model. Regularization, techniques of regularization, L1 regularization, L2 regularization,

dropout regularization. Cross-validation, methods used for cross-validation, leave one out cross-validation, k-fold cross-validation, stratified k-fold cross-validation.

Module 5

Epoch, batch, iteration. Cost Function, use of cost function, types of cost function, regression cost function, binary classification cost functions, multi-class classification cost function. Model parameter and hyperparameter in machine learning, hyperparameter tuning. Gradient descent in machine learning, types of gradient descent: batch gradient descent, stochastic gradient descent, and mini-batch gradient descent. Deployment, deploy a machine learning model using streamlit library.

Books of Study

1. Yaser Abu Mostafa, Malik Magdon-Ismail, and Hsuan-Tien Lin; "Learning from Data: A Short Course"; AMLBook Publishers.
2. Machine Learning, Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Person, 2020.
3. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, “Mathematics for Machine Learning”, 2020.
4. Aurelien Geron, “Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow” Powered by Jupyter, published by O’Reilly Media.

Course Title: Project Minor - Phase II

Course Code: ICSA6PR4
Total Credits: 4

General guidelines for Phase I and II

Each student needs to undertake a project work to implement various phases of Software Development. The project work is divided into two phases, Phase I in 5th and Phase II in the 6th Semester

The Phase I includes Problem identification and statement, system study and system design. For this he/she needs to identify a problem which is not yet automated. Analyze the Manual System existing there and suggest a framework of software befitting the problem. In the fifth semester (Phase I), system must be developed showing the data flow and needed DFD’s and Database design. Evaluation of Project-Phase I will be internal for which the student needs to submit a spiral bound report of their work and appear before a team of faculty members formed by the head of the Department. The team should comprise of the Project Guide and two other Faculty members from the Department.

The Phase II of the project work in the Sixth semester is purely meant for development of software implementing the project identified and designed in Phase I. Student needs to develop a software using any of the Language or Package they have studied in their syllabus. Usage of any other language/package needs to get approved by the Committee/ Project Guide/HoD of the

Department No student should be allowed to change the project work in Phase II and they need to develop the software for the work they identified in phase1. The internal mark for the Project work is to be awarded based on the student's performance in Phase I and II (50 percent Weightage for both the semesters). The Sixth semester project evaluation will be of External Nature along with its internal component. Students have to submit a hard bounded report for the evaluation.

Course Title: Software Lab VI -Machine Learning Techniques

Course Code ICSA6CP5
Total Credits: 2

The lab based on the following topics:

1. Linear Regression
2. Logistic Regression
3. Support Vector Machine (SVM) Algorithm
4. Naïve Bayes Classifier Algorithm
5. Dimensionality reduction
6. Principal Component Analysis
7. Random forest algorithm,
8. Gradient boosting algorithm
9. AdaBoosting algorithm
10. Xtreme gradient descent algorithm
11. Confusion matrix
12. Precision, Recall, and F1-score
13. Hyperparameter tuning
14. Deploy a machine learning model using streamlit library

SEMESTER – VII

Si. No.	Course Code	Title	Hrs/ Week	Credits	Total Hours
1	ICSC7CR1	Computational Mathematics (T)	4	4	72
2	ICSA7CR2	Applied Statistics for Data Analytics (T)	4	4	72
3	ICSA7CR3	Advanced Python Programming (T)	4	4	72
4	ICSA7CR4	Data Science and Analytics (T)	4	3	72
5	ICSA7CP5	Software Lab VII: Advanced Python Programming (L)	5	3	90
6	ICSA7CP6	Software Lab VIII: Statistical Programming and Data Analytics using R (L)	4	2	72
		Total	25	20	450

Course Title: Computational Mathematics

Course Code: ICSC7CR1

Total Credits: 4

Course Objectives:

Upon successful completion of this course, students should be able:

- To Understand set relations and functions, Use of Permutation and Combination for
- arranging objects.
- To do Predicate and Propositional Calculus for Precise reasoning.
- To Gain the methods of fuzzy logic, use the fuzzy set theory, and recognize fuzzy
- logic membership function, Understand Fuzzification and Defuzzification.
- To understand different concepts in automata theory and formal languages and
- determine solution to simple automata problems.
- To recognize real-world problems that are amenable to mathematical analysis, and
- formulate mathematical models of such problems

Module 1:

Sets, Relations and Functions: Set Operations, Representation and Properties of Relations, Equivalence Relations, Partially Ordering, Functions, Domain and Range, Types of Functions.
Counting and Mathematical Induction: Basics of Counting, Pigeonhole Principle, Permutations and Combinations, Inclusion- Exclusion Principle, Mathematical Induction.

Module 2:

Mathematical Logic: Propositional Calculus: Statements and notations, Connectives: negation, conjunction, disjunction, statement formulas and truth tables, conditional and biconditional, Well-formed formulas, tautologies, equivalence of formulas, tautological implication. Normal forms: Disjunctive and conjunctive normal forms.

Predicate calculus: Predicates, statement functions, variables and quantifiers, predicate formulas, free & bound variables, universe of discourse.

Module 3:

Fuzzy Logic: - Fuzzy Set Theory: - Fuzzy Versus Crisp – Crisp sets – Operations on Crisp Sets, Properties of Crisp Sets, Fuzzy Sets, Basic Fuzzy Set Operations, Properties of Fuzzy Sets – Crisp Relations, Operations on Crisp Relations - Fuzzy Relations –Operations on Fuzzy Relations, Properties, Membership Functions, Fuzzification, Defuzzification Methods.

Module 4:

Theory of Automata: Definition, Description of finite automata, Transition system and its properties, Acceptability of a string by a finite automaton, NFA, Equivalence of DFA and NFA, Minimization of finite automata, Construction of minimum automaton.

Regular sets and Regular grammars: Regular expressions, identities for regular expressions, finite automata and regular expressions, transition system containing ^-moves, conversion of nondeterministic systems to deterministic systems, Algebraic method using Arden‘s theorem, Construction of finite automata equivalent to a regular expression.

Module 5:

Languages and grammars: Basic definition and example, Definition of a grammar, derivation and the language generated by a grammar, Chomsky classification of languages, Context free languages and derivation trees

References

1. J.P. Tremblay & R Manohar- Discrete Mathematical Structures with Applications to Computer Science, McGraw Hill.
2. K.L.P Mishra & N. Chandrasekaran -Theory of Computer Science (Automata, Languages and Computation), Prentice hall of India.
3. George J Klir& Bo Yuan- Fuzzy sets and Fuzzy logic Theory and applications, Prentice Hall of India.
4. Fuzzy Set Theory, Fuzzy Logic & Their Applications; Dr A K Bhargava- S Chand Publications.
5. Discrete Mathematics and Its Applications; Kenneth H. Rosen and Kamala Krithivasan- McGraw-Hill Publishers.

Course Title: Applied Statistics for Data Analytics

Course Code: ICSA7CR2

Total Credits: 4

Course Objectives:

Upon successful completion of this course, students should be able:

- To Collect and present data objectively using R.
- To Study different approaches of probability.
- To Find the probability distribution function, expectation, variance and moments of

- random variables.
- To Study and solve Statistical inference by different estimation approaches using R.
- To Understand and solve Hypothesis testing using R.

Module 1:

Introduction to Statistics - probability: Introduction, collection of data, measurers of central tendency and dispersion Definitions of probability, Random variable, Types of random variables, probability mass function, density function, Distribution function, conditional probability, producing various descriptive statistical measures using R.

Module 2:

Probability Distributions: Discrete Distributions - Bernoulli, Binomial, Geometric, Poisson, Power series family of distributions, Continuous Distributions -Rectangular, Exponential, Weibull, Beta, Gamma, Pareto, Normal, Lognormal, Cauchy, Laplace, Logistic– Definition, mgf, moments, quantiles, properties. Computing probabilities in R, Graphical representation of various probability distributions using R.

Module 3:

Statistical inference-Estimation: Introduction to Inference, Point and interval estimation - maximum likelihood estimation, least square estimation, confidence interval for a mean, variance and proportion, Finding ML estimates and least square estimates using R, constructing confidence interval using R.

Module 4:

Statistical inference-Testing of hypothesis: Hypothesis testing, Hypothesis testing procedure, large sample test for mean and proportion, small sample tests, paired test, chi-square test of goodness of fit, Test of independence, Yates correction, large and small sample tests using R

References

1.Grolemund G., Hands-on programming with R: write your own functions and simulations, O' Reilly Media Inc., 2014.

2.James G., Witten D., Hastie T., & Tibshirani R, An introduction to statistical learning: with Applications in R, Springer, 2013.

3.Peng R. D, Exploratory data analysis with R, Lulu.Com, 2012

4.Peng R. D, R programming for data science, Leanpub, 2016.

5.Crawley M. J., The R book, John Wiley & Sons, 2012.

6. Johnson N.L, Kotz S. and Balakrishnan N. (1991) Continuous Univariate distributions I & II, Wiley.

7 Johnson N.L, Kotz S. and Kemp A.W. (1992) Univariate discrete distributions, Wiley.

8.Gupta S. C., & Kapoor V. K., Fundamental of Mathematical Statistics, Sultan Chand & Sons, 2018.

9. Rohatgi V.K. and Saleh M. (2015) An introduction to probability and statistics, Third edition, Wiley.

Course Title: Advanced Python Programming

Course Code: ICSA7CR3
Total Credits: 4

Course Objectives

Upon successful completion of this course, students should be able:

- To learn about some Python functionality and techniques that are commonly used.
- To understand and use functionality of various Python libraries for different scientific and mathematical tasks.
- To gain basic insight of implementation of advanced concepts and use of various libraries for applying Machine Learning for problem solving.
- To acquire knowledge about the frameworks in Python.
- To analyze large data sets in Python.

Module 1:

Introduction: Review of Important Python Concepts, Overview of Advanced techniques in Python: Lambdas, Filter and map, is and id, Decorators, Iterators and Generators, Garbage Collector, environment, Exception handling, Interop module, Pickle, Marshal, Networking Concepts, Process and Threads, Sockets, Regular Expression, Heuristic search techniques.

Module 2:

Scientific and Numerical Computing with Python: Introduction to Scientific and Numerical computing, Introduction to various modules used for Scientific and Numerical programming: NumPy, SciPy, Scikit-Learn, MatplotLib and Keras & Pandas, Introduction of Internal Statistics, overview of common approaches to multivariate statistics.

Module 3:

Introduction to Processing of Data Sets: Overview of various Data sets, Data handling Techniques: using Structured and unstructured Files, Excel and SQL Files. Data Preprocessing and Data Analysis using Pandas and Seaborn, Data Visualization, Exploring duplicate data and missing data, Data fitting concepts, Introduction to collection modules, counter, data storage offline.

Module 4:

Introduction to Frameworks used with Python – TensorFlow: Concept of Computational Graph and Nodes Virtual Environment and Anaconda, Installing TensorFlow with GPU support on a Linux System, TF Datatypes, Placeholders, TF Variables, TF Session, Softmax, One Hot Encoding, Dropout, building hidden layers, Batching, Stochastic Gradient Descent, Building an Optimizer, Training and displaying outcome, Overview of various python frameworks.

Module 5:

Implementation of Machine Learning concepts in Python: Introduction to Machine Learning Approaches, Overview of ML tasks: Supervised Learnings: Classifications, Regression.

Unsupervised Learnings: Clustering, Semi-supervised Learning, Reinforcement Learning, Basics of implementation of Machine Learning modules using Python.

References

1. Rao N.R., “Core Python Programming”, Dreamtech Publication India
2. Sarker M.O.F., “Python Network Programming Cookbook”, Packt Publication
3. Sebastian Raschka, “Python Machine Learning”, Packt Publication
4. Willi Richert, “Building Machine Learning Systems with Python”, Packt publication
5. Fredrik Lundh, “Python Standard Library”, O’Reilly Publications
6. Halterman R.,” Fundamentals of Python Programming”, Southern Adventist University
7. Guttag J.V., “Introduction to Computation and Programming Using Python”, Prentice Hall India
8. Chun W., “Core Python Programming”, Prentice Hall India

Course Title: Data Science and Analytics

Course Code: ICSA7CR4

Total Credits: 3

Course Objectives:

Upon successful completion of this course, students should be able:

To Understand basics of Data Analytics and managing different types of Data

To manage data using SPSS.

To explore applied data analytics using R.

To understand and use the Data visualization techniques.

To explore various Data science applications.

Module 1:

Introduction to Data Science, Data Science Terminology- Big data- Business Intelligence-data Analytics-Data Wrangling-Algorithm- Machine Learning and Web Analytics. Methods of Data depository, Type of Data- Un Structured Data-Semi Structured Data-Meta Data- - structured Data. Data Science process, Data Science Project Life Cycle, Popular Data Science Tool Kit.

Module 2:

Data Management Using SPSS: Data Management Planning-Data Management Plan-Data Collection and Management-API-Exploring Data-Model Building-Storage Management.

Module 3:

Data Analysis Using R, Applied Statistical Techniques, Type of Statistical Data, Big Data Analytics, Data Collection for Sampling and Distribution, Probability, Frequency Distribution, Population and Parameters, Central Tendency, Measure of Central Tendency, Problem of Estimation, Normal Distribution Curve.

Module 4:

Data Visualization: Importance of Data Visualization, Conventional Data Visualization Techniques, Retinal Variable, Mapping variable to Encoding.

Module 5:

Visualization Tools, Tool for Big Data Visualization, Visualizing Big Data, Pre atentive Attributes, Application of Data Science, Recent Trend in Data Science.

Book of Study

1. V K Jain, “Data Science and Analytics” Khanna Book Publishing Co. P Ltd.

Course Title: Software Lab VII: Advanced Python Programming

Course Code: ICSA7CP5

Total Credits: 3

Course Objectives

Upon successful completion of this course, students should be able to:

- Infer the supported data structures like lists, dictionaries and tuples in python and
- apply exception handling.
- Develop Module and Package in python.
- Make use of Pandas and Numpy Libraries.
- Use Tensor flow to do Advanced Python Programming.
- Apply different types of machine learning algorithms.

Course Content

Python functions, Boolean expressions, selection structure, iteration structure, Working with lists, work with a list of lists, work with tuples, work with dates and times.

Programming with dictionaries I/O and Error Handling in Python: Introduction Data Streams, Creating Your Own Data Streams, Access Modes, Writing Data to a File, Reading Data from a File, Additional File Methods, Handling IO Exceptions, Errors, Run Time Errors, the Exception Model, Exception Hierarchy, Handling Multiple Exceptions, Working with Directories. Implementation of Computational Graph and Nodes Virtual Environment and Anaconda. Implement Machine Learning algorthims: Usage of Numpy for numerical Data, Usage of Pandas for Data Analysis, Matplotlib for Python plotting, Seaborn for Statical plots, interactive Dynamic visualizations, SciKit for Machine learning. Unsupervised Clustering Algorithms using Python. Supervised Machine learning methods such as Decision tree, SVM etc. using Python

Course Title: Software Lab VIII: Statistical Programming and Data Analytics using R

Course Code: ICSA7CP6

Total Credits: 2

Course Objectives

Upon successful completion of this course, students should be able to:

- Manipulate data within R and to create simple graphs and charts used in introductory Statistics
- Perform and interpret different distribution using R
- Carry out hypothesis testing and calculate confidence intervals; Perform linear regression models for data analysis

Course Content

- Introduction to R Programming
- Getting Used to R: Describing Data , Viewing and Manipulating Data , Plotting Data, Reading in Your Own Data
- Visualizing Data using SPSS: Tables, charts and plots. Visualizing Measures of Central Tendency, Variation, and Shape. Box plots, Pareto diagrams. How to find the mean median standard deviation and quantiles of a set of observations. Students may experiment with real as well as artificial data sets.
- Exploring R Programming: Generate and Visualize Discrete and continuous distributions using the statistical environment. Demonstration of CDF and PDF uniform and normal, binomial Poisson distributions. Students are expected to generate artificial data using and explore various distribution and its properties. Various parameter changes may be studied.
- Probability Distributions in R, Matching a Density to Data, More about Making Histograms, Binomial Distribution, Plots of density and distribution functions. Normal approximation to the Binomial distribution. Building Confidence in Confidence Intervals, Populations Versus Samples, Large Sample Confidence Intervals, Simulating Data Sets
- Perform Tests of Hypotheses using R: How to perform tests of hypotheses about the mean when the variance is known. How to compute the p-value. Explore the connection between the critical region, the test statistic, and the p-value,
- Correlation: How to calculate the correlation between two variables. How to make scatter plots. Use the scatter plot to investigate the relationship between two variables, Estimating a Linear Relationship, A Statistical Model for a Linear Relationship, Least Squares Estimates

TEXTBOOKS:

1. Maria Dolores Ugarte , Ana F. Militino , Alan T. Arnholt “Probability and Statistics with R” 2nd Edition on, CRC Press, 2016.
2. P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)

SEMESTER – VIII

Si. No.	Course Code	Title	Hrs/ Week	Credits	Total Hours
1	ICSA8EB1/2	Elective 2 [Bunch B] (T)	4	4	72
2	ICSC8CR1	Advanced Deep Learning Techniques (T)	4	4	72
3	ICSA8CR2	Digital Image Processing (T)	4	4	72
4	ICSA8EC1/2	Elective 3 [Bunch C] (T)	4	4	72
5	ICSA8CP3	Software Lab IX: DIP using Python (L)	5	2	90
6	ICSA8CP4	Software Lab X: Deep Learning Lab using R /Python (L)	4	2	72
		Total	25	20	450

Course Title: Advanced Deep Learning Techniques

Course Code: ICSC8CR1

Total Credits: 4

Course Objectives

1. To understand the theoretical foundations, algorithms and methodologies of Neural Network
2. To design and develop an application using specific deep learning models
3. To provide the practical knowledge in handling and analyzing real world applications

Module 1: Deep Learning Architectures

Machine Learning and Deep Learning, Representation Learning, Width and Depth of Neural Networks, Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Auto Encoders, Deep Learning Applications. (14 Hrs.)

Module 2: Convolutional Neural Networks

Architectural Overview, Motivation, Layers, Filters, Parameter sharing, Regularization, Popular CNN Architectures: ResNet, AlexNet – Applications. (14 Hrs.)

Module 3: Transfer Learning

Transfer learning Techniques, Working, Approaches in Transfer Learning, Variants of CNN: DenseNet, PixelNet. (14 Hrs.)

Module 4: Sequence Modelling – Recurrent and Recursive Nets.

Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short-Term Memory Networks. Auto Encoders: Under complete Auto encoder, Regularized Auto encoder, stochastic Encoders and Decoders, Contractive Encoders. (16 Hrs.)

Module 5: LSTM, GRU

Image Segmentation, Image classification, Object Detection, Automatic Image Captioning, Image generation with Generative Adversarial Networks, LSTM as a classifier Model, Attention Models for Computer Vision. (14 Hrs.)

References

1. Ian Goodfellow, YoshuaBengio and Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
3. Umberto Michelucci “Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks” Apress, 2018.
4. Deep learning - Heaton, J. Ian goodfellow, yoshua bengio, and aaron courville, The MIT Press, First Edition

Course Title: Digital Image Processing

Course Code: ICSA8CR2
Total Credits: 4

Course Objectives:

- To introduce image fundamentals and discuss basic transformation functions for image enhancement in spatial and frequency domain.
- To introduce noise models and discuss image restoration process.
- To understand various image compression and image segmentation methods.

Module 1:

Fundamentals of Image Processing –Definition of Image, Digital Image and Digital Image Processing, Examples of fields that use Digital Image Processing, Fundamental steps in image processing, Components of Image Processing system, Elements of Visual perception, Image sensing and acquisition, Image sampling and quantization, Relationships between pixels– Color image fundamentals – Color Models-RGB, CMY, HSI

Module 2:

Image Enhancement in spatial domain – Basic Intensity transformation functions – Image Negatives, Log Transformations, Power Law Transformations, Piecewise Linear Transformations, Histogram processing, Enhancement using arithmetic, logic operations-Image Subtraction and Image averaging – Fundamentals of spatial filtering ,Smoothing spatial Filters.

Module 3:

Image Enhancement in Frequency domain – Introduction to Fourier transform: 1- D, 2 –D DFT and its Inverse Transform, Properties of 2-D DFT, Image Smoothing and Sharpening using Frequency Domain Filters- Ideal, Butterworth and Gaussian filters and Homomorphic filtering.

Module 4:

Image restoration and Compression: A Model of Image degradation and restoration process – Noise models-Gaussian Noise, Rayleigh Noise, Gamma Noise, Exponential Noise, Impulse Noise, Restoration using Mean Filters, Order Statistics filters, Adaptive filters. Compression-Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG.

Module 5:

Image Segmentation –Fundamentals, Edge Detection-Gradient operator, Marr-Hildreth edge detector, canny edge detector, Thresholding- Global Thresholding using Otus's method, Variable Thresholding, Region based segmentation – Region growing, Region splitting and merging, Segmentation using morphological watersheds.

References

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson, Third Edition, 2014.
2. Kenneth R. Castleman, Digital Image Processing Pearson, 2006.
3. Anil K Jain, Fundamentals of Digital Image Processing, Prentice Hall, Fourth Edition,1989.
4. William K. Pratt, Digital Image Processing, John Wiley, Fourth Edition, New York, 2002.
5. Milan Sonka et al, Image processing, analysis and machine vision Brookes/Cole, Vikas Publishing House, Fourth edition, 2007.

Course Title: Software Lab IX: DIP using Python

Course Code: ICSA8CP3
Total Credits: 2

Digital image processing using Python

The lab based on the following topics:

1. Open an image file and show, convert a colour image to grayscale and store. split the image in to its red, green, and blue components using OpenCV and display them
2. Perform basic graylevel intensity transformations
3. Plot histogram of an image, perform histogram equialization
4. Implement smoothing and sharpening spatial filters.
5. Perform image Subtraction and Image averaging
6. Perform Fourier transform and its inverse transform
7. Perform image smoothing and sharpening using Frequency Domain Filters
8. Add and remove noise from image using different noise model.
9. Implement edge detection.
10. Implement Thresholding.
11. Show segmented image

Course Title: Software Lab X: Deep Learning Lab using R /Python

Course Code: ICSA8CP4
Total Credits: 2

Deep Learning Lab using R /Python

The lab based on the following topics:

1. Neural Networks Design
2. Fully Connected Neural Networks
3. TensorFlow
4. Word2Vec
5. Convolutional Neural Networks & Data Pipelines
6. Visualization, Style Transfer & Save and Load Models
7. Seq2Seq Learning for Machine Translation
8. Image Caption
9. Q-learning
10. Autoencoders
11. ResNet
12. AlexNet
13. Long Short-Term Memory Networks

SEMESTER – IX

Si. No.	Course Code	Title	Hrs./ Week	Credits	Total Hours
1	ICSA9ED1/2	Elective 4 [Bunch D] (T)	4	4	72
2	ICSA9CR1	Advanced Concepts in AI (T)	4	3	72
3	ICSA9CR2	Natural Language Processing (T)	4	4	72
4	ICSC9EE1/2	Elective 5 [Bunch E] (T)	4	4	72
5	ICSA9CP3	Software Lab XI: NLP Lab using R/ Python (L)	4	2	72
6	ICSA9PR4	Case study and Minor project (L)	5	3	90
		Total	25	20	450

Course Title: Advanced Concepts in AI

Course Code: ICSA9CR1
Total Credits: 3

Course Objectives

On completion of this course

- Learner can develop an understanding of modern concepts in AI and where they can be used.
- Learner can design, implement and apply novel AI techniques based on emerging real-world requirements.

Module 1:

Making Simple Decision: Combining Beliefs and desires under uncertainty. The basis of Utility Theory, Utility Functions. Multi attribute utility Functions, Decision Networks. The Value of Information. Decision – Theoretic Expert Systems. sequential decision problems, Partially Observable MDPs, Game Theory.

Module 2:

Reinforcement Learning: Introduction, Terms, Features, Passive RL, Active RL, Generalization in RL, Policy Search, Making decisions: Utility theory, utility functions, decision networks, sequential decision problems,

Module 3:

Probabilistic Reasoning over time: Time and uncertainty , Inference: filtering, prediction, smoothing , Hidden Markov models , Kalman filters (a brief mention)

Module 4:

Knowledge Representation: Representation for states and Goals, Representation for states and Goals, Ontological engineering, Situation Calculus, semantic networks, description logic, The internet shopping world: A Knowledge Engineering example.

Module 5:

Planning: Planning with state space search, Types of state space Search: Forward and Backward, Partial-Order Planning, Algorithm, Planning Graphs, Planning with Propositional Logic, hierarchical task network planning, non-deterministic domains, conditional planning, continuous planning, multi-agent planning.

References

1. E. RICH, K. KNIGHT, S. B. NAIR (2017), Artificial Intelligence, McGraw Hill Education, 3rd
2. Edition t Book 1. S. RUSSEL, P. NORVIG (2009), Artificial Intelligence: A Modern Approach, Pearson, 3rd Edition

Course Title: Natural Language Processing

Course Code: ICSA9CR2
Total Credits: 4

Course Objectives

1. To create real-world problem-solving ability using NLP
2. To map the appropriate processing technique to a problem and implement the technique
3. To propose extension of existing NLP techniques for solving a range of problems.

Module 1:

Introduction to Natural Language Processing-History of NLP, Text Analytics and NLP, Various Steps in NLP, Kick Starting an NLP project.

Types of Data-Structured, Semi Structured and Unstructured Data, Categorization of Data Based on Content

Module 2:

Basic Feature Extraction Methods-Cleaning Text Data-Tokenization, Feature Extraction from Texts, Feature Engineering.

Developing a Text Classifier- Removing Correlated Features, Dimensionality Reduction, Evaluating the Performance of a Model, Building Pipelines for NLP Projects.

Module 3:

Language Processing and Python-Computing with Language, Lists, Simple Statistics, Making Decisions and Taking Control, Automatic Language Understanding, Limitations of NLP.

Module 4:

Natural Language Understanding, Propositional Logic, First Order Logic, Language Challenge

Module 5:

Natural Language Processing for Chatbots-spaCy, Features of Spacy, SpaCy Models, Fundamental Methods of NLP for Building Chatbots, Dependency Parsing, Named Entity Recognition, Regular Expressions.

References

1. Sohom Ghosh, Dwight Gunning," Natural Language Processing Fundamentals", Packt Publishing.
2. Steven Bird, Ewan Klein, Edward Lopper, "Natural Language Processing with Python", O'Reilly, First Edition.
3. Sumit Raj, "Building Chatbots with Python Using Natural Language Processing and Machine Learning", Apress
4. www.nltk.org

Course Title: Software Lab XI: NLP Lab using R/ Python

Course Code: ICSA9CP3
Total Credits: 2

The candidate needs to submit a Lab Record, duly signed by the teacher in charge and Head of the Department, (minimum of 10 Programs), failing which he/she will not be allowed to attend the external software lab examination. The Lab record should be hard-binded with the name of college and the emblem of the college depicted on the first page and should be properly indexed.

- Preprocessing of text (Tokenization, Filtration, Script Validation, Stop Word Removal, Stemming)
- Morphological Analysis
- N-gram model
- POS tagging
- Chunking
- Named Entity Recognition
- Virtual Lab on Word Generator and Word Analysis
- Morphology
- N-Grams
- N-Grams Smoothing
- Building POS Tagger
- Building Chunker

Course Title: Case Study and Minor project

Course Code: ICSA9PR4
Total Credits: 3

Minor Project aims at giving students hands-on experience in applying the programming knowledge in R to develop a real application for AI / ML based on the case study conducted by the student on a real-world scenario. Students must take up individual projects. Evaluation of the project is external. The case study has to be presented in the project report, and submitted in hard bound format for evaluation.

The students will work on multiple case studies and projects from different domain specified by guide allotted to him. This course aims at discussing the key principles of knowledge discovery process through various case studies arising from different application areas. The students are expected to learn the main steps to traverse when they face new data analytics problems. With each case study, the tools for cleaning, processing and altering the data shall be visited. A particular attention shall be given to data inspection, feature reduction and model selection. Each case study will be completed by a thorough discussion and interpretation of the results.

SEMESTER – X

Si. No.	Course Code	Title	Hrs./ Week	Credits	Total Hours
1	ICSAXPR1	Major Project (L)	25	16	450
2	ICSAXVV2	Comprehensive Viva Voce (L)		4	
		Total	25	20	450

Course Title: Major Project

Course Code: ICSAXPR1
Total Credits: 16

Major Project aims at giving students industrial exposure, with an internship. Students must take up individual projects. The student projects should be guided by the inhouse faculty and mentored by the industrial expert. Real world problems has to be taken into consideration while selecting the project. Evaluation of the project is external.

Industry or research internship should include partial/complete project implementation. Student should be allocated to the inhouse faculty / research guide in 7th semester itself and same guide should be continued for the: Industry Internship/ In house Research Project. Otherwise, the preferences/choices of the domain should be taken from the students. The guide needs to be allocated based on the preference/choices. The research project should be assigned to students. In case of Industry Internship, the assigned guide from college has to monitor and evaluate the progress of the student. The student has to exhibit the continuous progress through regular reporting and presentations and proper documentation. The continuous assessment of the progress needs to be documented unambiguously.

Course Title: Comprehensive Viva Voce

Course Code: ICSAXVV2
Total Credits: 4

The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Computer Science acquired over 5 years of study in the integrated program . The viva shall normally cover the subjects taught in all the semesters of Programme. In doing so, the main objective of this course is to prepare the students to face interview both in the academic and the industrial sector.

Integrated MSc Computer Science

Artificial Intelligence and Machine Learning

ELECTIVES

Bunch A	
ICSC6EA1	Cloud Computing
ICSC6EA2	Full Stack Programming Techniques
ICSC6EA3	Predictive Analytics
Bunch B	
ICSA8EB1	Soft Computing Techniques
ICSA8EB2	Mobile Application Development
Bunch C	
ICSA8EC1	Computer Vision
ICSA8EC2	Augmented and Virtual Reality
Bunch D	
ICSA9ED1	Robotics,
ICSA9ED2	IoT Analytics
Bunch E	
ICSC9EE1	Block Chain Technology
ICSC9EE2	Big Data Analytics

Electives: Bunch A

1. ICSC6EA1: Cloud Computing
2. ICSC6EA2: Full Stack Programming Techniques
3. ICSC6EA3: Predictive Analytics

Course Title: Cloud Computing

Course Code: ICSC6EA1
Total Credits: 3

Course Objectives

Cloud computing has evolved as a very important computing model, which enables information, software, and shared resources to be provisioned over the network as services in an on-demand manner. On completion of this course provides an insight into what is cloud computing and the various services cloud is capable.

Module 1:

Introduction to Computing Paradigms, High-Performance Computing, Parallel Computing., Distributed Computing, Cluster Computing, Grid Computing, Cloud Computing., Biocomputing, Mobile Computing, Quantum Computing, Optical Computing. Nanocomputing.

Introduction: Benefits and Limitations-Cloud Architecture – Storage – Services –Service Providers - Types of Cloud Service Development – Services and Tools

Module 2:

Collaborating on Contact Management - Collaborating on Project Management- Collaborating on Word Processing, Spreadsheet, Presentations, Databases- Sharing Files and Photographs

Module 3:

Cloud Virtualization Technology – Virtualization Defined – Virtualization Benefits – Server Virtualization– Virtualization for x86 Architecture – Hypervisor Management Software – Logical Partitioning – VIO Server – Virtual Infrastructure Requirements

Module 4:

Deep Dive: Cloud Virtualization –Introduction - Storage Virtualization–Storage Area Networks– Network Attached Storage – Cloud Server Virtualization – Virtualized Data Center

Module 5:

Industrial platforms and new developments - Amazon web services: Compute services - Storage services- Communication services - Additional services - Google AppEngine: Architecture and core concepts - Application life cycle - Cost model Microsoft Azure: Azure core concepts - SQL Azure - Windows Azure platform appliance

References

1. Essentials of cloud Computing: K.Chandrasekhran , CRC press, 2014
2. Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley, 2011.

3.Cloud Computing: Insights into New Era Infrastructure, Dr. Kumar Saurabh (2011). , Wiley India,
4. Mastering Cloud Computing Foundations and Applications Programming, Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi (2013).
5. Cloud Computing: Fundamentals, Industry Approach and Trends, Rishabh Sharma (2014),Wiley India edition.

Course Title: Full-Stack Programming Techniques

Course Code: ICSC6EA2
Total Credits: 3

Course Objectives

Learner can:

- Identify Structure and implementation of HTML/CSS.
- Apply intermediate and advanced web development practices.
- Implement basic JavaScript.
- Create visualizations in accordance with UI/UX theories.
- Develop a fully functioning website and deploy on a web server.

Module 1: HTML and CSS

Introduction to HTML, Browsers and HTML, Editor's Offline and Online, Tags, Attribute and Elements, Doctype Element, Comments, Headings, Paragraphs, and Formatting Text, Lists and Links, Images and Tables.

Introduction CSS, Applying CSS to HTML, Selectors, Properties and Values, CSS Colors and Backgrounds, CSS Box Model, CSS Margins, Padding, and Borders, CSS Text and Font Properties, CSS General Topics.

Module 2: JavaScript

Introduction to JavaScript, Applying JavaScript (internal and external), Understanding JS Syntax, Introduction to Document and Window Object, Variables and Operators, Data Types and Num Type Conversion, Math and String Manipulation, Objects and Arrays, Date and Time, Conditional Statements, Switch Case, Looping in JS, Functions.

Module 3: ReactJS

Introduction to ReactJS, Templating using JSX, Components, State and Props, Lifecycle of Components, Rendering List and Portals, Error Handling, Routers, Redux and Redux Saga, Immutable.js, Service Side Rendering, Unit Testing, Webpack.

Module 4: NodeJS

Node js Overview, Basics and Setup, Console, Command Utilities, Modules, Concepts, Events, Node js with Express js, Database Access.

Module 5: MongoDB

SQL and NoSql Concepts, Create and Manage MongoDB, Migration of Data into MongoDB, MongoDB with PHP, MongoDB with NodeJS, Services Offered by MongoDB, Connect MongoDB with Python.

References

1. The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer; Chris Northwood- Apress publications.
2. Full Stack Development with MongoDB; Manu Sharma-bpb publications.
3. Modern Full-Stack Development:Using TypeScript, React, Node.js, Webpack, and Docker; Frank W. Zammetti- Apress publications.
4. Mastering Html, Css & Javascript Web Publishing; Laura Lemay, Rafe Colburn, Jennifer Kyrnin- -bpb publications.

Course Title: Predictive Analytics

Course Code: ICSC6EA3

Total Credits: 3

Course Objectives

After completing this class, the student will develop the following competencies.

- Competency in Predictive Analytics Methods.
- Competency in Predictive Analytics Tools.
- Competency in the Predictive Analytics Cycle

Module 1:

Introduction: - Prediction Versus Interpretation, Key Ingredients of Predictive Models, Predictive Modeling Process. Data Pre-processing: - Data Transformations for Individual Predictors- Centering and Scaling, Transformations to Resolve Skewness, Data Transformations for Multiple Predictors- Transformations to Resolve Outliers, Data Reduction and Feature Extraction, Removing Predictors- Predictor Correlations, Adding Predictors, Binning Predictors.

Module 2:

Over-Fitting and Model Tuning-The Problem of Over-Fitting Model Tuning, Data Splitting, Resampling Techniques. Regression Models- Quantitative Measures of Performance, Linear Regression- Partial Least Squares, Penalized Models, Nonlinear Regression Models - Neural Networks, K-Nearest Neighbors.

Module 3:

Forecasting and time series analysis: Introduction to Decision Trees, Chi- Square Automatic Interaction Detectors (CHAID), Classification and Regression Tree (CART), Analysis of Unstructured data, Naive Bayes algorithm. Classification Models: - Introduction of Classification Models - Discriminant Analysis and Other Linear Classification Models - Nonlinear Classification Model -Naïve Bayes - Support Vector Machines.

Module 4:

Introduction to Feature Selection -Consequences of Using Non-informative Predictors, Approaches for Reducing the Number of Predictors-Factors That Can Affect Model Performance- Measurement Error in the Outcome, Measurement Error in the Predictors.

Module 5:

Predicting Cognitive Impairment Predicting Caravan Policy Ownership, The Effect of Class Imbalance- Sampling Methods-Cost-Sensitive Training-Job Scheduling-Case Studies –Real world scenario where forecasting and Time series analysis.

Books of Study

1. Kuhn, Max, Kjell Johnson. “Applied predictive modeling”. Springer, 2018.
2. Montgomery “Applied statistics and probability for engineers” Third edition.

References

1. Siegel, Eric. “Predictive analytics”: The power to predict who will click, buy, lie, or die. John Wiley & Sons, 2013.
2. Abbott, Dean. “Applied predictive analytics”: Principles and techniques for the professional data analyst. John Wiley & Sons, 2014.
3. Miner, Gary, “Practical text mining and statistical analysis for non-structured text data applications”. Academic Press, 2012.

Electives: Bunch B

1. ICSA8EB1: Soft Computing Techniques
2. ICSA8EB2: Mobile Application Development

Course Title: Soft Computing Techniques

Course Code: ICSA8EB1
Total Credits: 4

Course Objectives

- To learn soft computing techniques and their applications.
- To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
- To understand the Artificial neural network and its applications.
- To apply soft computing techniques to solve problems.
- Understand the genetic algorithm concepts and their applications.

Module 1:

Concept of computing systems, Soft computing versus Hard computing, Characteristics of Soft computing, Some applications of Soft computing techniques.

Artificial Neural Networks, Evolutionary Programming, Swarm Intelligent Systems, Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta-Perceptron Network, Adaline Network, Madaline Network.

Module 2:

Back propagation Neural Networks - Kohonen Neural Network, Learning Vector Quantization, Hamming Neural Network, Hopfield Neural Network- Bi-directional Associative Memory, Adaptive Resonance Theory Neural Networks- Support Vector Machines, Spike Neuron Models.

Module 3:

Genetic Algorithm: Basic Concepts, Working Principles, Encoding, Fitness Function, Reproduction, Inheritance Operators, Selection, Cross Over, Mutation Operator, Bit-wise Operators, Convergence of Genetic Algorithm, Stopping Criteria. Applications.

Module 4:

Fuzzy Logic, Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations, Membership Functions, Defuzzification, Fuzzy Arithmetic and Fuzzy Measures, Fuzzy Rule Base and Approximate Reasoning, Introduction to Fuzzy Decision Making.

Module 5:

Hybrid Systems, Neural Networks, Fuzzy Logic and Genetic, GA Based Weight Determination, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BP, Inference by Fuzzy BP, Fuzzy ArtMap: A Brief Introduction, Soft Computing Tools, GA in Fuzzy Logic Controller Design, Fuzzy Logic Controller.

References

1. N. K. Sinha and M. M. Gupta, Soft Computing & Intelligent Systems: Theory & Applications-Academic Press /Elsevier. 2009.
2. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
3. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd., 2nd Edition, 2011.
4. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017.
5. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, —Neuro-Fuzzy and Soft Computing‖, Prentice-Hall of India, 2002.

Course Title: Mobile Application Development

Course Code: ICSA8EB2
Total Credits: 4

Course Objectives

- Course provides overview of how to integrate mobile technology and applications.
- Course focuses on developing multiplatform mobile applications using the Web skills.

- Get exposed to technology and business trends impacting mobile applications.
- Able to build mobile applications targeting multiple platforms with a single codebase.
- Able to explore features of the Ionic framework to build hybrid mobile applications.

Module 1:

Introduction-Mobile vs. Desktop devices -App Store, Google Play, Windows Store -Development environments-PhoneGAP- Native vs. web applications – Mobile Connectivity Evolution.

Introduction to CSS3. HTML5-Full-Stack Web Development: - Hybrid Mobile App Development: Ionic and AngularJS, node.JS- Task scheduling, Middleware-Energy aware resource allocation.

Module 2:

Mobile Architectures: Android, iOS and Windows-Underlying OS (Darwin vs. Linux vs. Win 8) - Kernel structure and native level programming –Runtime More Ionic CSS and JavaS

Module 3:

Advanced Features-Popups, Popovers, Action Sheets, Loading and Gestures.

Angular ui-router and Resolve-Using Local Storage (Sqlite,iosDB,)-Databases- mongoDB, MySQL-Ionic Adding Platforms-Building and Deploying the App- Hybrid Mobile Development and IBM BlueMix .

Module 4:

Resource sharing-Loud speakers, Microphones-Image Sensors, Displays- (Augmented Reality(AR)-Web and AR-User interface-Mobile A Revaluation of A R-standardization-GPS-Accelerometer - Camera –Mobile malware -Device protections)-Cordova and ngCordova, Camera Plugin.

Module 5:

Mobile Security -Mobile app vulnerability detection and security Mobile threat landscape-advanced Threats. Different level of security, Security issues- - Mobile security solution targeted attacks-mobile malware –device protection

References

1. Brian Fling," Mobile Design and Development" O'Reilly Media, 2009.
2. Maximiliano Firtman "Programming the Mobile Web", O'Reilly Media, 2010.
3. Valentino Lee, Heather Schneider, and Robbie Schell, "Mobile Applications: Architecture, Design, and Development", PrenticeHall,2004.
4. Rajiv Ramnath, Roger Crawfis, and Paolo Sivilotti, "Android SDK3 for Dummies", Wiley 2011.
5. Christian Crumlish and Erin Malone Designing Social Interfaces, O'Reilly Media, 2009.

Electives: Bunch C

1. ICSA8EC1: Computer Vision
2. ICSA8EC2: Augmented and Virtual Reality

Course Title: Computer Vision

Course Code ICSA8EC1
Total Credits: 4

Course Objectives

- Learner learns the basics of computer vision as well as become proficient in Deep learning methods for computer vision.
- Learn the usage and implications of various Computer Vision techniques in real-world scenarios, Design and implement basic applications of Computer Vision.

Module 1:
Introduction: Computer Vision, Image formation, Geometric primitives and transformations, Photometric image formation. Application of Computer Vision.

Module 2:
Image processing: Point operators, Linear filtering, More neighborhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations, Global optimization

Module 3:
Feature detection and matching: Feature detectors, Descriptors, Matching and Tracking. Edge Detection and Linking.

Module 4:
Segmentation: Key point Extraction, Region Segmentation, Active Contours, Split and merge, mean shift and mode finding.

Module 5:
Review of Deep Learning, Multi-layer Perceptron, Backpropagation, Deep Learning based Segmentation and Recognition, Introduction to CNNs; DL-based Object detection (e.g. Mask-RCNN), Semantic Segmentation, Convolutional Neural Network (CNN) based approaches to visual recognition.

References

1. R. Szeliski, (2010), Computer Vision: Algorithms and Applications, Springer-Verlag London.
2. R. Hartley, A. Zisserman (2004), Multiple View Geometry in Computer Vision, Cambridge University Press, 2nd Edition.

Course Title: Augmented and Virtual Reality

Course Code: ICSA8EC2
Total Credits: 4

Course Objectives

- Explore the research issues in Augmented Reality and Virtual Reality (AR &VR).
- Make them know the basic concept and framework of virtual reality.
- On completion of this course: Familiar with technology frame work of AR, VR and Mixed Reality.
- Data visualization and analytics in VR.

Module 1:

Introduction of Virtual Reality: Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality.

Augmented and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality method.

Module 2:

Multiple Models of Input and Output Interface in Virtual Reality: Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output -- Visual /Auditory / Haptic Devices.

Module 3:

Visual Computation in Virtual Reality: Fundamentals of Computer Graphics. Software and Hardware Technology on Stereoscopic Display. Advanced Techniques in CG: Management of Large-Scale Environments & Real Time Rendering.

Module 4:

Interactive Techniques in Virtual Reality: Body Track, Hand Gesture, 3D Manus, Object Grasp. Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR. X3D Standard; Vega, MultiGen, Virtools etc.

Module 5:

Application of VR in Digital Entertainment: VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR.
Data Analytics and Visualization in Augmented and Virtual Reality.

References

1. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.
2. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
3. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications.

Electives: Bunch D

1. ICSA9ED1: Robotics
2. ICSA9ED2: IoT Analytics

Course Title: Robotics

Course Code: ICSA9ED1
Total Credits : 4

Course Objectives

To impart knowledge about industrial robots for their control and design.
On completion of this course, the students will be able to Perform kinematic and dynamic analyses with simulation. Able to Select a robotic system or Data driven Robotic for a given application.

Module 1:

Introduction to Robotics, Types and components of a robot, Classification of robots, closed-loop and open loop control systems. Kinematics systems; Definition of mechanisms and manipulators, social issues and safety.

Module 2:

Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Jacobian, Singularity, and Statics.
Dynamic Modelling: Equations of motion: Euler-Lagrange formulation.

Module 3:

Sensors and Vision System: Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc. Introduction to Cameras, Camera calibration, Geometry of Image formation, Transformations. Vision applications in robotics.

Module 4:

Basics of Robotic control: Transfer functions, Control laws, Non-linear and advanced controls. Robot Actuation Systems: Electric, Hydraulic and Pneumatic, Transmission Components. Control Hardware and Interfacing, Programming for Robot Applications.

Module 5:

Introduction to Data Driven Robotics: Vision for Robots -Mid-Level Visual State Estimation-Direct Perception-Active and Interactive Perception, Learning-Based Control-Predictive Models and Forward Dynamics Models-Model-Based Reinforcement Learning and Visual Servoing-Model-Free Reinforcement Learning and Sim-to-Real Transfer, Learning from Demonstrations: Self-Supervised Image Representations- Unstructured Full-Scene Representations- Object and Key point-Structured Representations.

References

1. Saha, S.K., “Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.

2. Ghosal, A., “Robotics”, Oxford, New Delhi, 2006.
3. Niku Saeed B., “Introduction to Robotics: Analysis, Systems, Applications”, PHI, New Delhi.
4. Mittal R.K. and Nagrath I.J., “Robotics and Control”, Tata McGraw Hill.
5. Mukherjee S., “Robotics and Automation”, Khanna Publishing House, Delhi

Course Title: IOT Analytics

Course Code: ICSA9ED2
Total Credits: 4

Course Objectives

Course deals basic concepts for IOT Analytics, collection of data for IOT, Integration of IOT with Cloud, Big Data Environments.

On successful completion course, students will be able to examine concepts of cloud based IOT, Big data and IOT in various domains. Able to apply techniques and strategies for data collection.

Module 1:

Introduction to IoT, applications, IoT architectures, introduction to analytics, IoT analytics challenges. IOT Data and Big Data, IOT Cloud and Big Data Integration, Cloud based IOT platform Data Analytics for IOT, Data Collection, software Platform-. VAZIUP and Ikaas.

Module 2:

IoT devices, Networking basics, IoT networking connectivity protocols, IoT networking data messaging protocols, analyzing data to infer protocol and device characteristics.

IOT Analytics for the Cloud -Building elastic analytics – elastic analytics concepts – designing for scale – Cloud security and analytics-AWS overview - AWS key. services for IOT analytics. Decouple key components.

Module 3:

Designing data processing for analytics, Applying big data technology to storage.

Exploring IoT Data: Exploring and visualizing data, Techniques to understand data quality, Basic time series analysis, Statistical analysis.

Strategies and Techniques in Data collection: Designing data processing for analytics – Applying big data to storage – Apache Spark for IOT data processing.

Module 4:

Data Science for IoT Analytics: Introduction to Machine Learning, Feature engineering with IoT data, Validation methods, Understanding the bias–variance tradeoff, Use cases for deep learning with IoT data.

Module 5:

Strategies to Organize Data for Analytics: Linked Analytical Datasets, Managing data lakes, data retention strategy for IOT data. Economics of IOT data – Cloud computing and open source – cost considerations – Revenue – Predictive maintenance.

References

1. Building blocks for IOT Analytics. Internet-of-Things Analytics. John Soldatos (Editor). River Publisher Series in Signal Image and Speech Processing.
2. Analytics for the Internet of Things (IoT), Minteer, Andrew, Packt Publishing Ltd.
3. Big-Data Analytics for Cloud, IoT and Cognitive Computing, Kai Hwang, Min Chen, Wiley.

Electives: Bunch E

1. ICSC9EE1: Blockchain Technology
2. ICSC9EE2: Big Data Analytics

Course Title: Blockchain Technology

Course Code: ICSC9EE1

Total Credits: 4

Course Objectives

- Explain the working of Blockchain Technology.
- Integrating Blockchain technology to real world scenarios.
- Ability to understand what and why of Blockchain.
- Explore various components of Blockchain and its use.
- Learners can create their own Blockchain network application.

Module 1:

Introduction to Block chain Technology, the growth of blockchain technology, Block Chain as a distributed system, the history of blockchain and Bitcoin, Blockchain defined, Generic elements of Blockchain, How Blockchain works, Benefits and limitations of blockchain, Tiers, Feature and Types. consensus mechanism, Type of consensus mechanism, Consensus in blockchain.

Module 2:

Introduction To Cryptocurrency: Bitcoin – Bitcoin Platform, Bitcoin Architectures - Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations. Ethereum concept and Ethereum classic.

Module 3:

Consensus Protocols and Security Issues Trust Essentials: Decentralized Systems, Consensus Protocols: Proof-of-Work (PoW), Proof-of-Stake (PoS), Delegated Proof-of-Stake (DPoS), Proof-of-Burn (PoB), Byzantine Fault Tolerance (BFT), Practical Byzantine Fault Tolerance (PBFT), Proof-of-Activity (PoA), Proof of Elapsed Time (PoET). Blockchain Security Threats, Challenges and Issues.

Module 4:

Enterprise Blockchain Platforms, Enterprise Blockchain Platform: Hyperledger, Hyperledger Architecture, Membership, Blockchain, Transaction, Chaincode, Hyperledger Fabric, Features of Hyperledger, Fabric Demo.

Module 5:

Blockchain Applications: Building on the Blockchain, Smart Contract and Ethereum Platform Introduction Ethereum, Architecture, Smart Contracts, Elements of Smart Contracts, Ethereum Operations, Incentive Model, Transactions in Ethereum, Introduction Solidity

References

1. A. Bahga, V. Madisetti (2017), Blockchain Applications: A Hands-On Approach, VPT.
2. M. Swan (2015), Blockchain: Blueprint for a New Economy, O'Reilly Media.
3. R. Wattenhofer (2016), The Science of the Blockchain, CreateSpace Independent Publishing Platform.
4. I. BASHIR (2017), Mastering blockchain, Packt Publishing Ltd.

Course Title: Big Data Analytics

Course Code: ICSC9EE2
Total Credits: 4

Course Objectives

- To explore the fundamental concepts of big data analytics.
- To learn to analyze the big data using intelligent techniques.
- To understand the various search methods and visualization techniques.
- To learn to use various techniques for mining data stream.
- To understand the applications using HDFS and Map Reduce Concepts
- To learn Hadoop ecosystem.

Module 1:

Understanding Big Data-Concepts and Terminologies. Big Data Characteristics-Volume, Velocity, Variety, Veracity, Value. Different types of data-structured, unstructured, semi structured, metadata. Business Motivations and Drivers for Big Data Adoption. Big Data Analytics Life Cycle.

Module 2:

Big Data Processing Concepts-Parallel Data Processing, Distributed Data Processing, Hadoop, Processing Workloads, Cluster, Processing in Batch Mode.

Hadoop Fundamentals-Introduction, Core Components, HDFS Daemons, Map Reduce Daemons, Resource Allocation with YARN, Workflow of MapReduce Job, HDFS High-Availability Daemons, Benefits and Challenges of HDFS.

File Sizes, Block Sizes, and Block Abstraction in HDFS, Data Replication, Data Locality, Network Topology, Network Bandwidth, and Rack Placement Policy

Module 3:

HDFS and MapReduce- Hadoop Distributed File System, MapReduce Framework, Hadoop Cluster Environment.

Map Reduce-Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Module 4:

Hadoop EcoSystem

Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.

Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.

Hbase: HBasics, Concepts, Clients, Example, Hbase Versus RDBMS.

Module 5:

Data Analytics Lifecycle. Review of Basic Data Analytic Methods Using R-Introduction to R, Exploratory Data Analysis, Statistical Methods for Evaluation

Advanced Analytics-Technology and Tools: In-Database Analytics-SQL essentials,In-Database Text Analysis, Advanced SQL

References

1. Thomas Erl,Wajid Khattak,Paul Buhler “Big Data Fundamentals: Concepts, Drivers & Techniques”, Prentice Hall.

2. Deepak Vohra, “Practical Hadoop Ecosystem”, Apress.

3. Tom White “Hadoop the Definitive Guide”, O’Reilly.

4. EMC Education Services. “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley Publishing.