Basaveshwar Engineering College, Bagalkote
Department of Artificial Intelligence and Machine Learning Engineering
Scheme of Teaching and Evaluation
(Academic Year 2020 – 2021 admitted)

III Semester BE

Sl. No	SUBJECT CODE	SUBJECT	CREDITS	HOURS/ WEEK			EXAMINATION MARKS		
				L	T	P	CIE	SEE	TOTAL
1.	UMA391C	Numerical Techniques and Integral Transforms	3	3	--	--	50	50	100
2.	UAI302C	Data Structures and Applications	4	4	--	--	50	50	100
3.	UAI303C	Embedded Systems	4	4	--	--	50	50	100
4.	UAI304C	Computer Organization	4	4	--	--	50	50	100
5.	UAI305C	AI and its Applications	3	3	--	--	50	50	100
6.	UAI306L	Problem Solving with Python Lab.	2	--	2	4	50	50	100
7.	UAI307L	Data Structures Lab.	1	--	--	2	50	50	100
8.	UAI308L	Embedded Systems Lab.	1	--	--	2	50	50	100
9.	UBT133M	Environmental Studies *	0	2	--	0	50	50	100
10.	UMA330M	Bridge course Mathematics – I *	0	3	--	0	50	50	100
		Total	**22**	**23**	**2**	**8**	**500**	**500**	**1000**

***Mandatory Subjects (For lateral entry (Diploma quota) students only)**

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IV Semester BE

Sl. No	SUBJECT CODE	SUBJECT	CREDITS	HOURS/ WEEK			EXAMINATION MARKS		
				L	T	P	CIE	SEE	TOTAL
1.	UMA491C	Statistics and Probability Distributions	3	3	--	--	50	50	100
2.	UAI402C	Design and Analysis of Algorithms	4	3	2	--	50	50	100
3.	UAI403C	Operating Systems	4	4	--	--	50	50	100
4.	UAI404C	Introduction to Data Science	3	3	--	--	50	50	100
5.	UAI405C	OOPS with Java Programming	3	3	--	--	50	50	100
6.	UHS001N	Fundamentals of Quantitative Aptitude And Soft Skills	1	1	--	--	50	50	100
7.	UAI406L	Design and Analysis of Algorithms Lab	1	--	--	2	50	50	100
8.	UAI407L	Data Science Lab	1	--	--	2	50	50	100
9.	UHS004M	Universal Human Values - II	--	3	--	--	--	--	--
10.	UMA430M	Bridge Course Maths - II*	--	3	--	--	50	50	100
11.	UHS226M	Constitution of India*	--	2	--	--	50	50	100
12.	UHS488C	Samskruthika Kannada**	1	2	--	--	50	50	100
	UHS489C	Balake Kannada***							
Total			**21**	**27**	**2**	**4**	550	550	1100

***For lateral entry (Diploma) students only**
****Students who have studied Kannada at primary level**
***** Students who have not studied Kannada at primary level**

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V Semester BE

Sl. No	SUBJECT CODE	SUBJECT	CREDITS	HOURS/ WEEK			EXAMINATION MARKS		
				L	T	P	CIE	SEE	TOTAL
1.	UAI501C	Principles of AI	3	3	--	--	50	50	50
2.	UAI502C	Machine Learning Algorithms	3	3	--	--	50	50	50
3.	UAI503C	Database Management Systems	3	3	--	--	50	50	50
4.	UAI504E	Computer Graphics with OpenGL	3	3	--	--	50	50	50
5.	UAI505X	Open Elective-I	3	3	--	--	50	50	50
6.	UHS002N	Fundamentals of Quantitative Aptitude And Soft Skills	1	2	--	--	50	50	50
7.	UAI506L	AI and Machine Learning Lab	1	--	--	3	50	50	50
8.	UAI507L	Database Lab	1	--	--	3	50	50	50
9.	UAI508L	Robotics Lab	2	--	2	2	50	50	50
Total			**21**	**17**	**2**	**8**	**450**	**450**	**900**

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VI Semester BE

Sl. No	SUBJECT CODE	SUBJECT	CREDITS	HOURS/ WEEK			EXAMINATION MARKS		
				L	T	P	CIE	SEE	TOTAL
1.	UAI601C	Advanced AI and ML	3	3	--	--	50	50	100
2.	UAI602C	Cloud Computing	3	3	--	--	50	50	100
3.	UAI603C	Computer Networks	3	3	--	--	50	50	100
4.	UAI604E	Natural Language Processing	3	3	--	--	50	50	100
5.	UAI605E	Cyber Security	3	3	--	--	50	50	100
6.	UAI606X	Open Elective – B	3	3	--	--	50	50	100
7.	UAI607L	Advanced AI and ML Lab	1	--	--	3	50	50	100
8.	UAI608L	Web Programming Lab	2	--	2	2	50	50	100
9.	UHS003N	Career Planning & Professional skills	1	2	--	--	50	50	100
10.	UAI610P	Mini Project	2	--	--	3	50	50	100
		Total	**24**	**20**	**2**	**8**	**500**	**500**	**1000**

UMA391C	Numerical Techniques and Integral Transforms	Credits:03
Hrs/Week : 03		CIE Marks:50
Total Hours:40		SEE Marks:50

UNIT - I	10 Hrs
Numerical analysis - I: Introduction to root finding problems, Bisection Method, Newton-Raphson method. Finite differences, forward and backward difference operators (no derivations on relations between operators) Newton-Gregory forward and backward interpolation formulae. (Without proof), Lagrange's and Newton's divided difference interpolation formulae (without proof).	
UNIT – II	**10 Hrs**
Numerical analysis - II: Numerical differentiation using Newton's forward and backward formulae problems. Trapezoidal rule, Simpson's one third rule, Simpson's three eighth rule and Weddle's rule (no derivation of any formulae) problems. Euler's and Modified Euler's method, Runge-Kutta 4^{th} order method.	
UNIT - III	**10 Hrs**
Fourier series: Periodic functions, Conditions for Fourier series expansions, Fourier series expansion of continuous and functions having finite number of discontinuities, even and odd functions. Half-range series, practical harmonic analysis.	
UNIT - IV	**10 Hrs**
Fourier transforms and z-transforms: Infinite Fourier transforms and inverse Fourier transforms- simple properties, Fourier sine and Fourier cosine transforms, Inverse Fourier sine and cosine transforms. Z-transforms-definition, standard forms, linearity property, damping rule, shifting rule-problems.	

Text Books:

1) Steven C. Chapra & Raymond P Canale, Numerical Methods for Engineers.
2) Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi.
3) H. K. Das, Advanced Engineering Mathematics, S. Chand & company Ltd. Ram Nagar, New Delhi.
4) E Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.

UAI302C	Data Structures and Applications	Credits: 04
Hrs/Week : 04		CIE Marks:50
Total Hrs: 52		SEE Marks:50

UNIT - I	13 Hrs
Introduction to Data Structures: Basic Concepts: Abstract data type: Atomic and composite data, Data type, Data structure, Abstract data type, Model for an abstract data type: ADT operations, ADT data structures, Pointer to void. **Pointer to Function**: Defining pointers to functions, Using pointers to functions. **Stacks**: **Basic stack operations**: Push, Pop, Stack top. **Stack linked list**: Implementation, Data structure, Stack head, Stack data node, Stack algorithms, Create Stack, Push Stack, Stack top, Empty Stack, Full Stack, Stack count, Destroy Stack, **C language implementation**: Insert data, Push Stack, Print Stack, Pop character. **Stack ADT**: Data structure, ADT implementations, Stack structure, Create stack, Push stack, Pop stack, Stack top, Empty stack, Stack count, Destroy stack. **Stack applications**: Reversing data, Reverse a list, Convert decimal to binary, Infix to postfix transformation, Evaluating postfix expressions, Stack implementation using array.	
UNIT – II	**13 Hrs**
Queues: **Queue Operations**: Enqueue, Dequeue, Queue front, Queue rear, Queue example. **Queue Linked list design**: Data structure, Queue head, Queue data node, Queue algorithms, Create queue, Enqueue, Dequeue, Retrieving queue data, Empty queue, Full queue, Queue count, Destroy queue. **Queue ADT**: Queue structure, Queue ADT algorithms, Queue Implementation using array, Queue Applications. **Sorting:** Selection, Insertion, exchange and quick sorts. **Searching**: Sequential, binary search, hashed list searches.	
UNIT - III	**13 Hrs**
General Linear lists: Basic operations, Insertion, Deletion, Retrieval, Traversal. **Implementation:** Data structure, Head node, Data node, Algorithms, Create list, Insert node, Delete node, List search, Retrieve node, Empty list, Full list, List count, Traverse list, Destroy list. **List ADT**: ADT functions, Create list, Add node, Internal insertion function, Remove node, Internal delete function, Search list, Internal search function, Retrieve node, Empty list, Full list, List count, Traverse, Destroy list. **Circular linked lists and Doubly linked lists**: Create list, add node, delete node, retrieve node, search list.	
UNIT - IV	**13 Hrs**
Non-Linear lists: Trees: Basic tree concepts: Terminology, User representation, **Binary trees**: Properties, Height of binary trees, Balance, Complete and Nearly complete binary trees, **Binary tree traversals:** Depth-first traversals, Breadth-first traversals, **Expression Trees**: Infix traversal, Postfix traversal, Prefix traversal, **Huffman code, General trees, Binary search trees**: Basic concepts, **BST operations**: Traversals, Searches, Insertion Find the smallest and largest node, BST search, Insertion, Deletion, **Binary search tree ADT**, Data structure, Head and node structure, Algorithms, Create a BST, Insert a BST, Internal insert function, Delete a BST, Internal delete function, Retrieve a BST, Internal retrieve function, Traverse a BST, Internal traverse function, Empty a BST, Full BST, BST count, Destroy a BST, Internal destroy function. **Graphs: Basic concepts**, **Operations**: Insert vertex, Delete vertex, Add edge, Delete edge, Find vertex, **Graph storage structures**: Adjacency matrix, Adjacency list.	
Text Book: 1) Behrouz A. Forouzan and Richard F. Gilberg, 2nd Edition, Cengage Learning Publisher, 2005. **Data Structure A Pseudocode Approach with C**, (Chapter 1(1.2,1.3,1.5), 2,3,4 (4.1-4.4), 5, 6(6.1-6.3), 7(7.1-7.3), 11(11.1-11.3),12(12.2-12.4) 13(13.1-13.3) Appendix F.	

Reference Books:

1) Data Structures Using C, Aaron M. Tenanbaum, Yedidyah Langsam, Moshe J Augenstein Pearson Education.
2) Data Structures and Program Design in C, Robert Kruse, Bruce Leung, C. L. Tondo, Shashi Mogalla, 2nd Edition, Pearson Education.
3) Data Structures with C, Seymour Lipschutz, Schaum's outlines, MGH Education.
4) Data Structures Through C,Yeshwant Kanetkar , BPB publications.

Course outcomes:

1. Summarize linear and nonlinear data structures concepts, searching and sorting techniques.
2. Analyze and implement different data structures, searching and sorting techniques.
3. Compare and contrast different types of data structures and searching and sorting methods.
4. Develop solutions for the given problem by using relevant data structure

UAI303C	Embedded Systems	Credits: 04
Hrs/Week: 04		CIE Marks:50
Total Hrs: 52		SEE Marks:50

UNIT - I	13 Hrs

Boolean Algebra: Definition of Boolean algebra, Boolean algebra theorems, A two-valued Boolean algebra, Boolean formulas and functions, Canonical Formulas, Manipulations of Boolean formulas. Gates and Combinational networks: Incomplete Boolean functions and Don't care conditions, Additional Boolean operations and Gates. Simplification of Boolean Expressions: K-maps and The Quine-McCluskey method.

Logic Design with MSI Components, Flip- Flops, Counters: Binary adders and subtractors, Decimal adders, Comparators, Decoders, Multiplexers. The basic Bi-stable element, Latches, Master-Slave flip-flops (Pulse-Triggered flip-flops), Edge triggered flip-flops, Characteristic equations, Registers, Counters, Design of synchronous counters.

UNIT – II	13 Hrs

The 8051 Microcontrollers, Assembly Language Programming: Microcontrollers and Embedded systems, Overview of the 8051 family, Inside the 8051, Introduction to 8051 Assembly programming, Assembling and running an 8051 program, the program counter and ROM space in the 8051, 8051 data types and directives, 8051 flag bits and PSW register, 8051 register banks and stack, pin description of the 8051.

Jump, Loop and Call Instructions, I/O Port Programming: Loop and Jump instructions, Call instructions, Time delay for various 8051 chips, 8051 I/O programming, I/O bit manipulation programming.

UNIT - III	13 Hrs

8051 Addressing Modes, Arithmetic, Logic Instructions and Programs: Immediate and register addressing modes, Accessing memory using various addressing modes, Bit addresses for I/O and RAM, Extra 128-byte-on-chip RAM in 8052. Arithmetic instructions, Signed number concepts and arithmetic operations, Logic and compare instructions, Rotate instruction and data serialization, BCD, ASCII, and other application programs.

UNIT - IV	13 Hrs

8051 Programming in C, Pin description of 8051: Data types and time delay in 8051 C, I/O programming in 8051 C, Logic operations in 8051 C, Data conversion programs in 8051 C, Accessing code ROM space in 8051 C, Data serialization using 8051 C.

8051 Timer Programming in Assembly and C: Programming 8051 timers, counter programming, Programming timer 0 and 1 in 8051 C.

Interrupts Programming in Assembly and C: 8051 interrupts, Programming timer interrupts, Programming external hardware interrupts, Programming the serial communication interrupt, Interrupt priority in the 8051/52, Interrupt programming in C. **MOTOR Control:** DC and Stepper Motors.

Text Books:

1) Donald D. Givone, Digital Principles and Design, McGraw Hill Edition 2002.
2) Muhammed Ali Mazidi, Janice Gillispie Mazidi and Rolin D. Mckinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Pearson 2nd Edition, 2011.

Reference Books:

1) Leach and Malvino, Digital Principles and Applications, TMH, New Delhi, 2002.
2) Yarbrough J. M, Digital logic- Applications and Design, Thomson Learning, New Delhi, 2001.
3) Kenneth J. Ayala, The 8051 Microcontroller Architecture, Programming and Applications, 2nd Edition, Penram International, 1996.
4) Uma Rao and Andhe Pallavi, The 8051 Microcontroller Architecture, Programming and Applications, Pearson Education Sanguine.
5) V. Udayshankar, M. S. Mallikarjunaswamy, 8051 Microcontroller: Hardware, Software and Applications, McGrawHill, New Delhi.

Course outcomes:

1. Comprehend the difference between microprocessor and microcontroller architectures.
2. Simulate, analyze and develop basic programs using assembly and C language.
3. Demonstrate the use of Timers, Counters, Interrupts through programs.
4. Demonstrate the use of serial ports through programs for developing basic communication systems.
5. Analyze a problem and formulate appropriate computing solution for microcontroller based embedded applications.

UAI304C	Computer Organization	Credits: 04
Hrs/Week:04		CIE Marks: 50
Total Hrs:52		SEE Marks:50

UNIT - I	10 Hrs
Basic structure of computers: Computer types, Functional Units, Basic operational concepts, Bus structures. **Machine instructions and programs:** Numbers, Arithmetic operations and characters, Memory locations and addresses, Memory operations, Instructions and instruction sequencing, Addressing modes, Assembly language, assembler directives, number notation, Stacks and Queues, Subroutines, Encoding of machine instructions.	
UNIT – II	**10 Hrs**
Input/output organization: Accessing I/O devices, Interrupts-Interrupt hardware, Enabling and Disabling Interrupts, Handling multiple devices, controlling device requests, Exceptions, Direct memory access-bus Arbitrations, Buses-Asynchronous bus and Synchronous bus, Interface Circuits-Parallel port and serial port, Standard I/O Interfaces-Peripheral component interconnect Bus, SCSI bus, USB.	
UNIT - III	**10 Hrs**
The memory system: Some Basic concepts, Semiconductor RAM memories, Read only memories, speed, size, and cost, cache memories. **Arithmetic Unit:** Addition and subtraction of signed numbers, Design of fast adders, Multiplication of positive numbers, Signed operand multiplication, Fast multiplication. Integer Division, Floating point numbers and operations- IEEE standard for Floating point numbers, Arithmetic operations on Floating point numbers. Implementing Floating point operations.	
UNIT - IV	**10 Hrs**
Basic Processing Unit: Some fundamental concepts, Execution of complete instruction, Hardwired Control, Micro programmed control, Micro instructions. **Pipelining:** basic concepts, role of cache memory, pipeline performance. **Large computer systems**: forms of parallel processing, array processor, the structure of general purpose and multiprocessors. **Performance:** Processor Clock, Basic performance equation, pipelining and superscalar operations, Clock rate, Instruction set, compiler, performance measurement.	
Text Books: 1) Hamacher, Zvonko Vranesic, Safwat Zaky, 2002, Computer Organization, 5th Edition, MGH. (1.1-1.4, 2.1-2.5, 2.6.1, 2.6.3, 2.8-2.9, 2.12, 4.1, 4.2, 4.2.1-4.2.5, 4.4, 4.4.1, 4.5, 4.5.1-4.5.2, 4.6, 4.7, 5.1-5.5, 5.5.1, 6.1-6.7, 7.1-7.5, 7.5.1, 8.1, 8.1.1, 8.1.2, 12.1-12.3, 1.6)	
Reference Book: 1) J.P. Hayes, 1998, Computer Architecture and Organization, 3rd Edition, MGH. 2) William Stallings, 2007, Computer Organization and Architecture, 7th Edition, PHI.	

Course outcomes:

1. Describe the fundamental organization of a digital computer.
2. Explain the functional units and components of a computer.
3. Explain various addressing modes, instruction formats and program control statements and write assembly-level programs using simple machine instructions.
4. Distinguish the organization of various parts of a system memory hierarchy.
5. Describe fundamental concepts of pipelining and parallel processing.

UAI305C	AI and its Applications	Credits: 03
Hrs/Week:03		CIE Marks:50
Total Hrs: 40		SEE Marks:50

UNIT - I	10 Hrs

Introducing AI: Defining the Term AI, Discerning intelligence, Discovering four ways to define AI, Understanding the history of AI, Starting with symbolic logic at Dartmouth, Continuing with expert systems, Overcoming the AI winters, Considering AI uses, Avoiding AI Hype, Connecting AI to the underlying computer.

Defining the role of data: Finding data ubiquitous in this age, Understanding Moore's implications, Using data everywhere, Putting algorithms into action.

Considering the use of algorithms: Understanding the role of algorithms, Understanding what algorithm means, starting from planning and branching, Playing adversarial games, Using local search and heuristics, Discovering the learning machine, Leveraging expert systems, Introducing machine learning, Touching new heights.

Pioneering specialized hardware: Relying on standard hardware, Understanding the standard hardware, Describing standard hardware deficiencies, Using GPUs, Considering the Von Neumann bottleneck, Defining the GPU, Considering why GPUs work well, Creating a specialized processing environment, Increasing hardware capabilities, Adding specialized sensors, Devising methods to interact with the environment.

UNIT – II	10 Hrs

Seeing AI uses in computer applications: Introducing common application types, Using AI in typical applications, Realizing AI's wide range of fields, Considering the Chinese Room argument, Seeing how AI makes applications friendlier, Performing corrections automatically, Considering the kinds of corrections, Seeing the benefits of automatic corrections, Understanding why automated corrections don't work, Making suggestions, Getting suggestions based on past actions, Getting suggestions based on groups, Obtaining the wrong suggestions, Considering AI-based errors.

Using AI to address medical needs: Implementing portable patient monitoring, Wearing helpful monitors, Relying on critical wearable monitors, Using movable monitors, Making humans more capable, Using games for therapy, Considering the use of exoskeletons, Addressing special needs, Considering the software-based solutions, Relying on hardware augmentation, Seeing AI in prosthetics, Completing analysis in new ways, Devising new surgical techniques, Making surgical suggestions, Assisting a surgeon, Replacing the surgeon with monitoring, Performing tasks using automation, Working with medical records, Predicting the future, Making procedures safer, Creating better medications, Combining robots and medical professionals.

Relying on AI to improve human interaction: Developing new ways to communicate, Creating new alphabets, Automating language translation, Incorporating body language, Exchanging ideas, Creating connections, Augmenting communication, Defining trends, Using multimedia, Embellishing human sensory perception, Shifting data spectrum, Augmenting human senses.

UNIT - III	10 Hrs

Performing data analysis for AI: Defining data analysis, Understanding why analysis is important, Reconsidering the value of data, Defining machine learning, Understanding how machine learning works. Understanding the benefits of machine learning, Being useful; being mundane, Specifying the limits of machine learning, Considering how to learn from data, supervised learning, Unsupervised learning, Reinforcement learning.

Employing machine learning in AI: Taking many different roads to learning, Discovering five main approaches to AI learning, Delving into the three most promising AI learning, approaches, Awaiting the next breakthrough, Exploring the truth in probabilities, Determining what probabilities can do, Considering prior knowledge, Envisioning the world as a graph, Growing trees that can classify, Predicting outcomes by splitting data, Making decisions based on trees, Pruning overgrown trees.

Developing robots and flying with drones: Defining robot roles, Overcoming the sci-fi view of robots, Knowing why it's hard to be a humanoid, Working with robots, Assembling a basic robot, Considering the components, Sensing the world, Controlling a robot, Acknowledging the state of the art, Flying unmanned to missions, Meeting the quad-copter, Defining uses for drones, Seeing drones in non-military roles, Powering up drones using AI, Understanding regulatory issues.

UNIT - IV	**10 Hrs**

Understanding the Non starter Application: Using AI where it won't work, Defining the limits of AI, Applying AI incorrectly, Entering a world of unrealistic expectations, Considering the effects of AI winters, Understanding the AI winter, Defining the causes of the AI winter, Rebuilding expectations with new goals, Creating solutions in search of a problem, Defining a gizmo, Avoiding the infomercial, Understanding when humans do it better, Looking for the simple solution.

Seeing AI in space: Observing the universe, Seeing clearly for the first time, Finding new places to go, Considering the evolution of the universe, Creating new scientific principles, Performing space mining, Harvesting water, Obtaining rare earths and other metals, Finding new elements, Enhancing communication, Exploring new places, Starting with the probe, Relying on robotic missions, Adding the human element, Building structures in space, Taking your first space vacation, Performing scientific investigation, Industrializing space, Using space for storage.

Adding new human occupations: Living and working in space, Creating cities in hostile environments, Building cities in the ocean, Creating space-based habitats, Constructing moon-based resources, Making humans more efficient, Fixing problems on a planetary scale, Contemplating how the world works, Locating potential sources of problems, Defining potential solutions, Seeing the effects of the solutions, Trying again.

Text Books:

1) John Paul Mueller and Luca Massaron, Artificial Intelligence for Dummies, John Wiley and Sons, 2018.

Reference Books:

1) Utpal Chakraborthy, Artificial Intelligence for all, BPB Publications, Feb. 2020.
2) Praphat Kumar, Artificial Intelligence, BPB Publications, Jan. 2019.
3) Nils J. Nilsson, The Quest for Artificial Intelligence: A History of Idea and Achievements, Stanford University, Camridge University Press, 2010.
4) Bernard Marr, Artificial Intelligence: How 50 Successful Companies used Artificial Intelligence to solve Problems, Wiley Publications, 2019.

Course outcomes:

1. Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.
2. Demonstrate proficiency in usage of hardware and software platforms for AI based applications.
3. Demonstrate awareness and understanding of various applications of AI techniques.
4. Demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implication

UAI402C	DESIGN AND ANALYSIS OF ALGORITHMS	Credits: 04
L:T:P:3:2:0		CIE Marks:50
Total Hours/Week : 40/5		SEE Marks:50

UNIT - I	(10+6 hours)
Introduction: Notion of Algorithm, Fundamentals of Algorithmic Problem Solving, Important Problem Types, Fundamental Data Structures. **Fundamentals of the Analysis of Algorithm Efficiency:** Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms, Example – Fibonacci Numbers. **Brute Force:** Selection Sort and Bubble Sort, Sequential Search and Brute-Force String Matching, Exhaustive Search.	
UNIT – II	**(10+6 hours)**
Divide and Conquer: Merge sort, Quick sort, Binary Search, Binary Tree Traversals and Related Properties, Multiplication of Large Integers and Strassen's Matrix Multiplication. **Decrease and Conquer**: Insertion Sort, Depth First Search, Breadth First Search, Topological Sorting, Algorithms for Generating Combinatorial Objects.	
UNIT - III	**(10+6 hours)**
Transform and Conquer: Presorting, Balanced Search Trees, Heaps and Heapsort, Problem Reduction. **Space and Time Tradeoffs:** Sorting by Counting, Input Enhancement in String Matching, Hashing, B-Trees. **Dynamic Programming:** Computing a Binomial Coefficient, Warshall's and Floyd's Algorithms, Optimal Binary Search Trees. The Knapsack Problem and Memory Functions.	
UNIT - IV	**(10+6 hours)**
Greedy Technique: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees. **Limitations of Algorithm Power:** Lower-Bound Arguments, Decision Trees, Problems Coping with the Limitations of Algorithm Power: Backtracking, Branch-and-Bound.	
Text Books: 1) "Introduction to The Design & Analysis of Algorithms", Anany Levitin, Pearson Education, 3rd Edition, 2017	
Reference books: **1)** "Introduction to Algorithms", Stein, PHI, 2nd Edition, **2)** "Computer Algorithms", Horowitz E., Sahni S., Rajasekaran S., Galgotia Publications, 2001	

Course Outcomes:

1. Explain the notion of algorithm, asymptotic notations.
2. Design and analyze recursive and non-recursive algorithms.
3. Design and analyze algorithms using divide and conquer.
4. Design and analyze algorithms using dynamic programming and greedy approaches.
5. Design and analyze algorithms using backtracking, branch and bound.

UAI403C	OPERATING SYSTEMS	Credits: 04
L:T:P:4:0:0		CIE Marks:50
Total Hours/Week :52/4		SEE Marks:50

UNIT - I	13 Hrs
Introduction to operating systems, types and services: **Role of Operating systems:** user view, system view: Types of OS, Batch Systems; Multiprogramming; Time Sharing; Distributed & Real time OS, Operating System structure; Operating System operations; Operating System Services; User - Operating System interface; System calls; Types of system calls; System programs; Operating System design and implementation; Operating System structure; Virtual machines. **Process management:** Process concept; Concepts of process: Process status, Process description, Process model, Operations on processes	
UNIT – II	**13 Hrs**
Process management, threads and process synchronization **Process Scheduling:** Basic concepts; scheduling criteria; Scheduling algorithms; Multiple-Processor scheduling, Interprocess communication. **Threads**: concepts, Multi-Threaded Programming: Overview; Multithreading models; Thread Libraries; Threading issues. Thread scheduling. **Synchronization:** The Critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors.	
UNIT - III	**13 Hrs**
Deadlocks and memory management **Deadlocks:** Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock. **Memory Management Strategies:** Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation. Virtual Memory Management: Background; Demand paging; Page replacement; Allocation of frames.	
UNIT - IV	**13 Hrs**
File system: concepts and implementation, secondary storage structures **File system:** File System: File concept; Access methods; Directory structure; File system mounting; File sharing; Protection. Implementing File System: File system structure; File system implementation; Directory implementation; Allocation methods; Free space management. Protection: Goals, principles and domain of protection, Access Matrix, Disk management and other issues**:** Disk management: Disk Structure and Scheduling.	
Text Books: 1) Abraham Silberschatz, Peter Baer Galvin , Greg Gagne: Operating System 7th edition, Addison Wesley	
Reference books: 1. D.M Dhamdhere: Operating systems - A concept based Approach, 2nd Edition, Tata McGraw- Hill, 2002.	

Course Outcomes: At the end of the course the student should be able to

1. Explain the core structure and different services provided by Operating System at different levels
2. Apply the concepts of process scheduling algorithms and synchronization techniques in solving real time problems
3. Exhibit the knowledge of memory management techniques
4. Exhibit the knowledge of secondary storage management techniques and security solutions

UAI404C	Introduction to Data Science	Credits:03
L:T:P:3:0:0		CIE Marks:50
Total Hours/Week : 40/3		SEE Marks:50

UNIT - I	10 Hrs
Introduction: Data Science. Applications of data science. Data science related to other field. Relationship between data science and Information science. Computational thinking. Skills for data science. Tools for data science. Issues of Ethics, Bias, and Privacy in Data Science. **Data**: Introduction, Data types: Structured Data, Unstructured Data, Challenges with Unstructured Data. Data Collections: Open Data, Social Media Data, Multimodal Data, Data Storage and Presentation. **Data Pre-processing**: Data Cleaning, Data Integration, Data Transformation, Data Reduction, Data Discretization.	
UNIT – II	**10 Hrs**
Techniques: Introduction, Data Analysis and Data Analytics, Descriptive Analysis**:** Variables, frequency Distribution, Measures of Centrality, Dispersion of a Distribution Diagnostic Analytics**:** Correlations, Predictive Analytics, Prescriptive Analytics, Exploratory Analysis, Mechanistic Analysis, Regression. **Tools for data science:** Introduction, Getting Access to R, Getting Started with R**:** Basics, Control Structures, Functions, Importing Data, Graphics and Data Visualization: Installing ggplot2, Loading the Data, Plotting the Data, Statistics and Machine Learning**:** Basic Statistics, Regression, Classification, Clustering.	
UNIT - III	**10 Hrs**
Machine learning for data science: Machine Learning Introduction and Regression: Introduction, Machine Learning, Regression, Gradient Descent. Unsupervised learning**:** Introduction, Agglomerative Clustering, Introduction to Reinforcement Learning.	
UNIT - IV	**10 Hrs**
Applications, Evaluation, and Methods: Hands-On with Solving Data Problems: Introduction, Collecting and Analyzing Twitter Data, Collecting and Analyzing YouTube Data , Analyzing Yelp Reviews and Ratings. **Data Collection, Experimentation, and Evaluation: Data Collection Methods**: Surveys, Survey Question Types, Survey Audience, Survey Services, Analyzing Survey Data, Pros and Cons of Surveys, Interviews and Focus Groups, Why Do an Interview? Why Focus Groups? Interview or Focus Group Procedure, Analyzing Interview Data , Pros and Cons of Interviews and Focus Groups, Log and Diary Data, User Studies in Lab and Field, Picking Data Collection and Analysis Methods**:** Introduction to Quantitative Methods, Introduction to Qualitative Methods, Mixed Method Studies. Evaluation: Comparing Models, Training–Testing and A/B Testing, Cross-Validation.	
Text Books: 1) A hands on introduction to Data Science, Chirag Shah, Cambridge University Press, 2020.	

Reference books:

1) **"**Data Science from Scratch", Joel Grus, O'Rielly Publications, 2015.
2) **"** Introduction to Data Science", Laura Igual and Santi Segui, Springer International Publications, 2017

Course Outcomes:

1. Identify and asses the needs of an organization for data science task
2. Collect, manage and use data to examine, analyze and interpret data
3. Apply statistical and ML algorithms to effectively generate useful information from structural and un structured data
4. Design, build and evaluate models that can be used to make predictions in real world phenomena
5. Communicate data science related information effectively in various formats to appropriate audience

UAI405C	OOPS with Java Programming	Credits:03
L:T:P:3:0:0		CIE Marks:50
Total Hours/Week: 40/3		SEE Marks:50

UNIT - I	10 Hrs
Java Programming Fundamentals: Object Oriented programming features. **History and evolution of Java**: Java's lineage, byte code, Java Buzzwords**,** An overview of Java, Data Types, Variables and Arrays, Operators, Control Statements. **Introducing Classes:** Class Fundamentals, Declaring Objects, Introducing Methods, Constructors, this keyword, garbage collection, method overloading.	
UNIT – II	**10 Hrs**
Inheritance: Inheritance Basics, Using Super, Creating a Multilevel Hierarchy, Method overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance. **String Handling:** The string constructors, string length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String. **Packages and Interfaces:** Packages, Access Protection.	
UNIT - III	**10 Hrs**
Importing packages and Interfaces. **Exception Handling:** Exception-Handling Fundamentals-Exception Classes, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch clauses, Nested try Statements, throw and finally statements. **Multithreaded Programming:** The Java Thread Model, The Main Thread , Creating a thread Creating Multiple Threads, Using is Alive( ) and join() , Thread Priorities , Synchronization , Suspending, Resuming and Stopping Threads.	
UNIT - IV	**10 Hrs**
Files: The Stream Classes, Byte streams, Character Streams, Serialization and Console Class. **Co** Collections Overview, The Collection Interfaces: The collection Interface, The List Interface, The Interface, The Queue Interface and The De queue Interface. The Collection Classes (Array List, List).	
Text Books: 1) 1. Java The Complete Reference,- Herbert Schildt 9th Edition, MGH Education	
Reference books: 1) Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill. 2) Core Java Volume 1- Fundamentals, Cay S Horstmann ,Gary Cornell, 8th Edition Pearson Education. 3) Programming with Java, E Balagurusamy,6th Edition, MGH.	

Course Outcomes:

1. Explain the syntax and semantics of java programming language and basic concepts of Object Oriented Programming (OOP).
2. Identify classes, objects, members of a class and relationships among them needed for a specific problem.
3. Develop reusable programs using the concepts of inheritance, polymorphism, string and packages.
4. Apply the concepts of importing packages and interface, multithreading and exception handling to develop efficient and error free codes.
5. Develop interactive programs using file and collections.

Course Outcomes	Programme Outcomes												PSO	PSO	PSO
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1										3		
CO2	3	3	3										3		
CO3	3	3	3										3		
CO4	3	3	3										3		
CO5	3	3	3										3		

UAI501C	Principles of AI	Credits:03
L:T:P:3:0:0		CIE Marks:50
Total Hours/Week: 40/03		SEE Marks:50

UNIT - I	10 Hrs
Introduction: What is AI? Foundations and History of AI. **Intelligent Agents:** Agents and environment, Concept of Rationality, The nature of environment, The structure of agents.	
UNIT – II	**10 Hrs**
Problem solving: Problem solving agents, Example problems, Searching for Solutions, Uninformed Search. **Strategies:** Breadth First search, Depth First Search, Iterative deepening depth first search.	
UNIT - III	**10 Hrs**
Informed Search Strategies: Heuristic functions, Greedy best first search, A*search. Heuristic Functions. **Logical Agents:** Knowledge–based agents, The Wumpus world, Logic, Propositional logic, Reasoning patterns in Propositional Logic. **First Order Logic:** Representation Revisited, Syntax and Semantics of First Order logic, Using First Order logic.	
UNIT - IV	**10 Hrs**
Inference in First Order Logic: Propositional Versus First Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution. **Uncertain Knowledge and Reasoning:** Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference using Full Joint Distributions, Independence, Baye's Rule and its use. Wumpus World Revisited.	

Text Books:

1) 1. Stuart J. Russell and Peter Norvig , Artificial Intelligence, 3rd Edition, Pearson, 2015.

Reference Books:

1) Elaine Rich, Kevin Knight, Artificial Intelligence, 3rd edition, Tata McGraw Hill, 2013.

2) George F Lugar, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011.

Course Outcomes:

1. Apply knowledge of agent architecture, searching and reasoning techniques for different applications.
2. Analyze Searching and Inferencing Techniques.
3. Develop knowledge base sentences using propositional logic and first order logic
4. Demonstrating agents, searching and inferencing

Course Outcomes	Programme Outcomes												PSO 1	PSO 2	PSO 3
	1	2	3	4	5	6	7	8	9	10	11	12			
CO1	2	2	2										2	3	
CO2		3											2	3	
CO3			3										2	3	
CO4			2	2	2								2	3	

UAI502C	Machine Learning Algorithms	Credits:03
L:T:P:3:0:0		CIE Marks: 50
Total Hours/Week: 40/03		SEE Marks: 50

UNIT - I	10 Hrs
Introduction: Introduction to Machine Learning, Examples of Machine Learning Applications. Well posed learning problems, Designing Learning System, Perspectives and issues in Machine Learning. **Decision Tree Learning**: Introduction, Decision tree representation, Appropriate problems for decision tree learning, the basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Inductive Bias in decision tree learning, Issues in decision tree learning	
UNIT – II	**10 Hrs**
Artificial Neural Networks (ANN): Introduction, Neural Network Representations, Appropriate Problems For Neural Network Learning, Perceptron, Multilayer Networks And The Back propagation Algorithm, Remarks On The Back propagation Algorithm, An Illustrative Example: Face Recognition. **Hypothesis and Performance Evaluation**: Basic Performance Criterion, Precision and recall, Other ways to measure Performance, Estimating Hypothesis Accuracy, Basics of Sampling Theory, General approach for deriving confidence intervals, difference in error of two hypothesis, comparing learning algorithms.	
UNIT - III	**10 Hrs**
Bayesian learning: Introduction, Bay's theorem, Maximum likelihood and least squared hypothesis, Maximum likelihood hypothesis for predicting probabilities, Minimum Description length principle, Bay's optimal classifier, Gibbs algorithm, Naive Bay's Classifier. An Example: Classify Text. **Instance Based Learning**: Introduction, k-Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis function, and case based reasoning.	
UNIT - IV	**10 Hrs**
Dimensionality Reduction: Introduction, Subset Selection, Principal Components Analysis, Factor Analysis, Multi dimensional scaling, Linear discreminant analysis, isomap, Locally Linear Embedding. **Clustering**: Introduction, Mixture Densities, K-means Clustering, Expectation Maximization Algorithm, Mixture Latent Variable models, Supervised learning after clustering, Hierarchical clustering, Choosing the number of clusters	
Text Books: 1) Tom Mitchell, Machine Learning, McGraw- Hill Publications, 2nd Edition, 2013. 2) Ethem Alpaydin, Introduction to Machine Learning, MIT press, Cambridge, Massachusetts, London, 2nd Edition, 2010.	
Reference Books: 1) Trevor Hastie. Robert Tipeshirani, Jerome Fredman, Elements of Statistical Learning, Springer, 2nd Edition, 2010. 2) Luis Pedro Coelho and Willi Richart, Building Machine Learning Systems with Python, PACKT Publication, 2nd Edition, 2013.	
Course Outcomes: 1. Define machine learning and types of learning algorithms 2. Explain various machine learning algorithms. 3. Apply machine learning algorithm to solve problems of moderate complexity. 4. Analyze performance of algorithms by varying some parameters. 5. To formulate machine learning model for the simple problem.	

Course Outcomes	Programme Outcomes												PSO 1	PSO 2	PSO 3
	1	2	3	4	5	6	7	8	9	10	11	12			
CO1	3												2	2	
CO2	2												3	3	
CO3		2	3		2								3	3	
CO4			2		2								2	3	
CO5					3								2	2	2

UAI503C	Database Management Systems L:T:P:3:0:0	03-Credits
Hrs/Week: 03		CIE Marks:50
Total Hours:40		SEE Marks:50

UNIT - I	10 Hrs

Introduction to Databases: Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications. **Overview of Database Languages and Architectures:** Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment. Conceptual Data Modelling using Entities and Relationships: Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, examples, Specialization and Generalization.

UNIT – II	10 Hrs

Relational Model: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations. **Relational Algebra:** Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra. Mapping Conceptual Design into a Logical Design: Relational Database Design using ER-to-Relational mapping. SQL: SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL.

UNIT - III	10 Hrs

SQL: Advances Queries: More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL.Normalization: Database Design Theory-Introduction to Normalization using Functional and Multivalued

Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Normalization Algorithms: Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decompositions, Algorithms for Relational Database Schema Design, Nulls, Dangling tuples, and alternate Relational Designs, Further discussion of Multivalued dependencies and 4NF, Other dependencies and Normal Forms.

UNIT - IV	10 Hrs

Transaction Processing: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL.

Concurrency Control in Databases: Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering, Multiversion Concurrency control techniques, Validation Concurrency control techniques, Granularity of Data items and Multiple Granularity Locking.

Text Books:

1) Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.

Reference books:

1) Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill
2) SilberschatzKorth and Sudharshan, Database System Concepts, 6th Edition, Mc-GrawHill, 2013.
3) Coronel, Morris, and Rob, Database Principles Fundamentals of Design, Implementation and Management, Cengage Learning 2012.

Course Outcomes:

1) Provide a strong foundation in database concepts, technology, and practice.
2) Practice SQL programming through a variety of database problems.
3) Demonstrate the use of concurrency and transactions in database.
4) Design and build database applications for real world problems.

Course Outcomes	Programme Outcomes												PSO 1	PSO 2	PSO 3
	1	2	3	4	5	6	7	8	9	10	11	12			
CO1	2	3	1										3		
CO2	2	3	3										3		
CO3	2	2	3										3		
CO4	3	3	3										3		

UAI504E	Computer Graphics with Open GL	Credits:03
L:T:P:3:0:0		CIE Marks:50
Total Hours/Week: 40/03		SEE Marks:50

UNIT - I	10 Hrs

Overview of Graphics Systems: Video Display Devices, Raster-Scan Displays, Graphics Workstations and Viewing Systems, Introduction to OpenGL, **Graphics Output Primitives:** Coordinate Reference Frames, Specifying A Two-Dimensional World-Coordinate Reference Frame in OpenGL, OpenGL Point Functions, OpenGL Line Functions, Line Drawing Algorithms: DDA, Bresenham's Line-Drawing Algorithm, OpenGL Curve Functions, Circle Generating Algorithms: Midpoint Circle Algorithm. **Attributes of Graphics Primitives**: OpenGL State Variables, Color and Grayscale, OpenGL Color Functions, OpenGL Point-Attribute Functions, OpenGL Line-Attribute Functions.

UNIT – II	10 Hrs

Fill-Area primitives, OpenGL Polygon Fill-Area Functions, OpenGL Vertex Arrays, Pixel-Array Primitives, OpenGL Pixel-Array Functions, Character Primitives, OpenGL Character Functions, OpenGL Display Lists, OpenGL Display-Window Reshape Function.

Interactive Input Methods and Graphical User Interfaces: Graphical Input Data, Logical Classification of Input Devices, Input Functions for Graphical Data, Interactive Picture-Construction Techniques, OpenGL Interactive Input-Device Functions, OpenGL Menu Functions, Designing a Graphical User Interface.

UNIT - III	10 Hrs

Geometric Transformations-1: Basic Two-Dimensional Geometric Transformations, Matrix Representations and Homogeneous Coordinates, Inverse Transformations, Two-Dimensional Composite Transformations, Other Two-Dimensional Transformations, Raster Methods for Geometric Transformations, OpenGL Raster Transformations, Transformations between Two-Dimensional Coordinate Systems.

Geometric Transformations-2: Geometric Transformations in Three-Dimensional Space, Three-Dimensional Translation, Three-Dimensional Rotation, Three-Dimensional Scaling, Composite Three Dimensional Transformations, Other Three Dimensional Transformations, Transformations between Three Dimensional Coordinate Systems, Affine Transformations, OpenGL Geometric Transformations Functions.

UNIT - IV	10 Hrs

Two-Dimensional Viewing: The Two-Dimensional Viewing Pipeline, The clipping Window, Normalization and Viewport Transformations, OpenGL Two-Dimensional Viewing Functions, Clipping Algorithms, Two-Dimensional Point Clipping, Two-Dimensional Line Clipping: Cohen-Sutherland line Clipping, Polygon Fill-Area Clipping: Sutherlan-Hodgman Polygon Clipping, Curve Clipping, Text Clipping.

Viewing: Classical and Computer Viewing, Viewing with a Computer, Positioning of the Camera, Simple Projections, Projections in OpenGL, Hidden-Surface Removal, Interactive Mesh Displays, Parallel-Projection Matrices, Perspective-Projection Matrices, Projections and Shadows.

Text Books:

1) Computer Graphics with OpenGL, Donald Hearn and Pauline Baker, Pearson Education, 3rd Edition, 2004.

2) 2. Interactive Computer Graphics A Top-Down Approach using OpenGL, Edward Angel Addison-Wesley, 5th Edition, 2008.

Reference books:

1. Computer Graphics using OpenGL, F.S.Hill Jr. Pearson Education, 2nd Edition, 2001.
2. Computer Graphics, James D. Foley, Andries Van Dam, Steven K Feiner, John F. Hughes, Addison-Wesley, 1997.

Course Outcomes:

1. Explain the fundamental concepts of computer graphics.
2. Implement the graphics algorithms to draw geometric primitives using OpenGL.
3. Develop an interactive 2D and 3D graphics applications.
4. Demonstrate 2D viewing and clipping algorithms.
5. Construct the graphical model with lighting and shading patterns.

Course Outcomes	Programme Outcomes												PSO 1	PSO 2	PSO 3
	1	2	3	4	5	6	7	8	9	10	11	12			
CO1	3	3	1	3			2						1		
CO2	3	3	1	3			2						1		
CO3	3	3		3			2						1		
CO4	3	3		3			2						1		
CO5	3	3		3			2						1		

UAI601C	Advanced AI and ML	Credits:03
L:T:P:3:0:0		CIE Marks:50
Total Hours/Week:40/03		SEE Marks:50

UNIT - I	10 Hrs

Support Vector Machine (SVM): Basic terms, how does SVM works? Types of SVM, mathematical intuition behind support vector machine, SVM kernel functions, applications of SVM, advantages and disadvantages of SVMs, differences between logistic regression and SVM, v-SVM.

Advanced clustering techniques: Introduction to clustering, applications of clustering, density based clustering algorithms, density reachability and density connectivity. *DBSCAN clustering:* types of points after the DBSCAN clustering is completed, algorithmic steps for DBSCAN clustering, the complexity of DBSCAN. *BIRCH algorithm:* stages of BIRCH algorithm, algorithm and cluster features, parameters of BIRCH, advantages of BIRCH. Differences between: DBSCAN and K-means, BIRTH and K-means.

Implementation of: SVM, DBSCAN, BIRCH algorithms using python.

e-Resources:

- https://www.analyticsvidhya.com/blog/2021/10/support-vector-machinessvm-a-complete-guide-for-beginners/
- https://stackabuse.com/implementing-svm-and-kernel-svm-with-pythons-scikit-learn/
- Radial Basis Function (RBF) Kernel: The Go-To Kernel | by Sushanth Sreenivasa | Towards Data Science
- https://www.kdnuggets.com/2020/04/dbscan-clustering-algorithm-machine-learning.html#:~:text=low%20point%20density.-,Density%2DBased%20Spatial%20Clustering%20of%20Applications%20with%20Noise%20(DBSCAN),is%20containing%20noise%20and%20outliers.
- https://www.freecodecamp.org/news/8-clustering-algorithms-in-machine-learning-that-all-data-scientists-should-know/
- https://www.javatpoint.com/birch-in-data-mining

UNIT – II	10 Hrs

Ensemble techniques: Definition, ensemble learning approaches. *Bagging techniques:* Random forest, differences between decision tree and random forest, example for random forest, features of random forest. *Boosting techniques:* Working processes of boosting, Gradient boosting-elements, algorithm. AdaBoosting, XGBoost, differences between bagging and boosting techniques.

Recommendation system: *Content based technique:* working processes, advantages and disadvantages. *Collaborative based technique:* working process, advantages and disadvantages. *Hybrid based techniques:* working process and advantages and disadvantages. Applications of recommendation system.

Implementation of: Random Forest, Content based and Collaborative based techniques using python.

e-Resources:

- https://www.pluralsight.com/guides/ensemble-methods:-bagging-versus-boosting
- https://www.wallstreetmojo.com/gradient-boosting/
- https://www.mygreatlearning.com/blog/random-forest-algorithm/
- Ensemble Learning Methods: Bagging, Boosting and Stacking (analyticsvidhya.com)
- https://www.geeksforgeeks.org/recommendation-system-in-python/
- https://www.nvidia.com/en-us/glossary/data-science/recommendation-

system/#:~:text=A%20recommendation%20system%20is%20an,demographic%20information%2C%20and%20other%20factors.

- https://towardsdatascience.com/introduction-to-recommender-systems-6c66cf15ada
- https://www.analyticsvidhya.com/blog/2021/07/recommendation-system-understanding-the-basic-concepts/
- https://www.iteratorshq.com/blog/an-introduction-recommender-systems-9-easy-examples/

UNIT - III	10 Hrs

Introducing Neural Networks: Deep Learning at a glance: How deep learning works, differences between Machine Learning (ML) and Deep Learning (DL), Convolution Neural Network (CNN) architecture, illustration of different operations in CNN model(convolution, padding, flattening),advantages and disadvantage of CNN model, building an CNN, types of pre-defined CNN models:- VGG, AlexNet, LeNet, ResNet and GoogleNet.

A brief introduction to TensorFlow and Keras: Differences between Keras and TensorFlow, advantages and disadvantage of Keras and TensorFlow.

Implementation of CNN: using keras and TensorFlow.

e-Resources:

- https://www.tensorflow.org/tutorials/images/cnn
- https://medium.com/analytics-vidhya/cnns-architectures-lenet-alexnet-vgg-googlenet-resnet-and-more-666091488df5
- https://www.javatpoint.com/machine-learning-vs-deep-learning
- https://www.geeksforgeeks.org/cnn-introduction-to-pooling-layer/
- https://www.ibm.com/in-en/topics/convolutional-neural-networks#:~:text=The%20convolutional%20layer%20is%20the%20core%20building%20block%20of%20a,matrix%20of%20pixels%20in%203D.
- https://www.analyticsvidhya.com/blog/2021/06/building-a-convolutional-neural-network-using-tensorflow-keras/

UNIT - IV	10 Hrs

Knowledge Representation: Techniques of knowledge representation, Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning systems for categories, the internet shopping world.

Quantifying Uncertainty: Probabilistic reasoning in Artificial intelligence, Bayes' theorem in Artificial intelligence, Application of Bayes' theorem in Artificial intelligence, Bayesian Belief Network in artificial intelligence

e-Resources:

- https://www.javatpoint.com/ai-techniques-of-knowledge-representation
- https://mitu.co.in/wp-content/uploads/2022/01/5.-Knowledge-Representation-in-AI.pdf
- https://www.uio.no/studier/emner/matnat/ifi/nedlagte-emner/INF5390/v14/forelesninger/inf5390-07-knowledge-representation.pdf
- https://pages.mtu.edu/~nilufer/classes/cs5811/2016-fall/lecture-slides/cs5811-ch13-quantifying-uncertainty.pdf
- Valen, J., Balki, I., Mendez, M. et al. Quantifying uncertainty in machine learning classifiers for medical imaging. Int J CARS 17, 711–718 (2022). https://doi.org/10.1007/s11548-022-02578-3

Text Books:

1. Giuseppe Bonaccorso, “Machine Learning Algorithms”, Second Edition, ISBN:978-1- 78934-799-9, Packet Publishing Ltd., Birmingham,UK.
2. Peter Norvig and Stuart J. Russell, “Artificial Intelligence: A Modern Approach”, third edition, ISBN:978-93-325-4351-5, pearson , 2021.(Chapter 12 and Chapter 13)

Reference books:

1. Tom Mitchel, "Machine Learning ", International Edition 1997, McGraw Hill Education.

e-Resources and other Digital Material:

1. https://onlinecourses.nptel.ac.in/noc21_cs24/preview
2. https://onlinecourses.nptel.ac.in/noc20_cs62/preview

Course Outcomes:

1. **Apply** and **Analyze** various algorithms for SVM, and Clustering techniques.
2. **Analyze** and **Apply** basic concepts of ensemble, and recommendation systems.
3. **Understand** and **Apply** the basic concepts of CNN using Tensor Flow and Keras
4. **Understand** and **Contrast** the concept of Knowledge Representation and Quantifying Uncertainty.
5. **Apply** and **Analyze** machine learning algorithms on given data and interpret the results obtained.

Course Outcomes	Programme Outcomes												PSO	PSO	PSO
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	3	3	1							1	2	3	1
CO2	1	2	3	2	1							1	2	3	1
CO3	1	2	3	2	1							1	2	3	1
CO4	2	2	3	2	1							1	2	3	1
CO5	2	2	3	3	2							1	2	3	1

UAI602C	Cloud Computing	Credits:03
L:T:P:3:0:0		CIE Marks:50
Total Hours/Week:40/03		SEE Marks:50

UNIT - I	10 Hrs
System Models and Enabling Technologies: Scalable Computing towards Massive Parallelism; System Models for Distributed and Cloud Computing - Clusters of Cooperative Computers, Grid Computing Infrastructures, Peer-to-Peer Network Families, Cloud Computing over the Internet; Parallel and Distributed Programming Models. **Computer Clusters**: Clustering for massive parallelism – Trend, Design objectives, Issues; Clusters and MPP architectures; Design Principles – SSI features.	
UNIT – II	**10 Hrs**
Cloud platform architecture over virtualized data centers: Cloud computing and service models; data center design and interconnection networks; architecture design of compute and storage clouds; Public cloud platforms (GAE, AWS and Azure); inter cloud resource management.	
UNIT - III	**10 Hrs**
Cloud security and trust management: Cloud Programming and Software Environments: Features of Cloud and Grid Platforms; Parallel and Distributed Programming Paradigms - Parallel Computing and Programming Paradigms., MapReduce, Twister, and Iterative MapReduce, Hadoop Library from Apache.	
UNIT - IV	**10 Hrs**
Programming Support of Google App Engine, Programming Amazon AWS and Microsoft Azure: G Emerging cloud software environments, Enabling technologies for Internet of Things	

Reference books:

1) Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, Distributed & Cloud Computing, Morgan Kaufmann / ELSEVIER Publishers, 2012
2) Dinakar Sitaram, Geeta Manjunath, Moving to the cloud, SYNGRESS/ ELSEVIER, 2012

Course Outcomes:

1. To explain various computing paradigms and system models for massive computing.
2. To describe service models, design of data centres and various cloud platforms.
3. To analyze data flow in parallel and distributed programming models and apply them to solve problems on distributed systems.
4. To describe public cloud platforms, emerging cloud software environments and enabling technologies for internet of things.

CO id	Course Outcomes	IS –PO -1	IS –PO-2	IS –PO-3	IS -PO-4	IS -PO-5	IS -PO-6	IS -PO-7	IS -PO-8	IS -PO-9	IS -PO_10	IS -PO_11	IS -PO_12
1	To explain various computing paradigms and system models for massive computing			2	2	3							
2	To describe service models, design of data centres and various cloud platforms			2	2	3							
3	To analyze data flow in parallel and distributed programming models and apply them to solve problems on distributed systems			3	3	3	1	1	2				

4	To describe public cloud platforms, emerging cloud software environments and enabling technologies for internet of things.			2	2	3							

UAI603C	Computer Networks	Credits:03
L:T:P:3:0:0		CIE Marks:50
Total Hours/Week:40/03		SEE Marks:50

UNIT - I	10 Hrs
Introduction to Network and Communication: Definition, **Network topology:** Mesh (advantages and disadvantages), Star (advantages and disadvantages), Ring (advantages and disadvantages). **Types of Networks based on size:** LAN, WAN, MAN. **Classes of transmission media:** Guided (wired)-Twisted pair cable, Coaxial cable, Fiber-optic cable. Unguided (wireless)-Free space. **Propagation modes:** *Switching (switched networks)*- Circuit switched networks, Packed switched network-datagram circuit network, virtual circuit network, message switched network. **OSI (Open System Interconnection):** Seven layers, how data is referred to in the OSI model? Interaction between layers in the OSI model, advantages of OSI model, differences between OSI and TCP/IP models. Port number, port range groups. **IP address:** Types of IP addresses- IPv4, IPv6, IP address format, classes of IP address. **Protocols and Standards:** The key elements of a protocol, Standard Creation committees.	
e-Resources: • https://datacommandnet.blogspot.com/p/protocols-and-standards.html • https://www.javatpoint.com/ip-address-format-and-table • https://data-flair.training/blogs/osi-model-in-computer-network/ • https://www.geeksforgeeks.org/how-communication-happens-using-osi-model/ • https://www.geeksforgeeks.org/difference-between-ip-address-and-port-number/ • https://www.studytonight.com/computer-networks/protocols-and-standards • https://www.geeksforgeeks.org/difference-between-ip-address-and-port-number/ • https://www.javatpoint.com/ip-address-format-and-table	
UNIT – II	**10 Hrs**
Data link layer: Data link layer services and flow control techniques. Design issues. *Framing:* Character count, Flag bytes with byte stuffing, Starting and ending flags, with bit stuffing. *Elementary data link protocols:* Utopian simplex protocol-, a simplex stop and wait protocol for an error-free channel. *Noisy channel*: *Sliding Window protocols:* Stop-and-Wait Automatic Repeat Request, Go-Back-N Automatic Repeat Request. *Controlled Access Protocols:* Reservation, Polling, Token Passing. *Error Detection:* Simple Parity check, Two-dimensional Parity check, Checksum, Cyclic redundancy check.	
e-Resources: • https://www.tutorialspoint.com/what-is-byte-stuffing-in-computer-networks • https://www.geeksforgeeks.org/stop-and-wait-arq/ • https://www.javatpoint.com/go-back-n-arq	
UNIT - III	**10 Hrs**
Network Layer: Services, *Routing algorithms*- The Optimality Principal, Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing, Hierarchical routing, Congestion Control Algorithms. **Transport layer:** Services, advantage and disadvantages, responsibility of transport layer, Elements of Transport Protocols, Congestion control. The Internet Transport Protocols (TCP) and User Datagram Protocol (UDP), differences between TCP and UDP and features of network layer.	
e-Resources: • https://citizenchoice.in/course/computer-networks-theory/Chapter%204/2-process-to-process-delivery • https://www.geeksforgeeks.org/transport-layer-responsibilities/ • https://www.tutorialspoint.com/what-are-the-elements-of-transport-protocol • https://www.geeksforgeeks.org/differences-between-tcp-and-udp/	

UNIT - IV	10 Hrs

The application Layer: Functions of application layer, Application layer services, protocols. *DNS (Domain Name System):* Domain Name Space, Distribution of Name Space, DNS in the internet, resolution, applications of DNS. *Electronic mail:* Components of Email System. E-Mail Protocol-SMTP (Simple Mail Transfer Protocol), POP (Post Office Protocol), IMAP (Internet Mail Access Protocol). Architecture of WWW, *Web Documents:* static, dynamic, and active Static. **Network Security:** Goals of Network Security, Security Services, Types of Network Security and classification of Security Attacks.

e-Resources:

- https://www.geeksforgeeks.org/computer-security-and-its-challenges/
- https://www.tutorialspoint.com/internet_technologies/e_mail_protocols.htm
- https://www.javatpoint.com/computer-network-application-layer

Text Books:

1) 1. Andrew S Tanenbaum, David. J. Wetherall, "Computer Networks", Pearson Education, 5th Edition,

Reference books:

1) Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill, Fourth Edition
2) Kurose and Ross, Computer Networking- A Top-Down approach,
3) Pearson, 5th edition

e-Resources and other Digital Material:

1. https://www.digimat.in/nptel/courses/video/106105183/L01.html

Course Outcomes:

1. **Understand** and **Contrast** the concept of computer network concepts with it types, topologies, transmission media, layered protocols and standards, network models, port and IP address and **discuss** the functionalities of each layer in these models.
2. **Discuss** and **Analyze** flow control and error control mechanisms and apply them using standard data link layer protocols.
3. **Analyze** and **apply** various routing algorithms to find shortest paths for packet delivery. **Explain** the details of Transport Layer Protocols (UDP, TCP) and suggest appropriate pro able/unreliable communication.
4. **Analyze** the features and operations of various application layer protocols such as HTTP, DNS, SMTP, need of network security.

Course Outcomes	Programme Outcomes												PSO	PSO	PSO
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2				1							1	2		1
CO2	2				1							1	2		1
CO3	2				1							1	2		1
CO4	2				1							1	2		1

UAI604E	Natural Language Processing	Credits:03
L:T:P:3:0:0		CIE Marks:50
Total Hours/Week: 40/03		SEE Marks:50

UNIT - I	10 Hrs
Introduction to NLP, Empirical Laws, Text Processing, Spelling Correction: Edit Distance, Weighted Edit Distance, Other Variations, Noisy Channel Model for Spelling Correction, N-Gram Language Models, Evaluation of Language Models, Basic Smoothing, Computational Morphology, Finite - State Methods for Morphology.	
UNIT – II	**10 Hrs**
Introduction to POS Tagging, Hidden Markov Models for POS Tagging, Viterbi Decoding for HMM, Parameter Learning, Syntax – Introduction, Syntax – Parsing, Syntax - CKY, PCFGs, Introduction to PCFGs - Inside-Outside Probabilities, Dependency Grammars and Parsing – Introduction, Transition Based Parsing : Formulation and learning.	
UNIT - III	**10 Hrs**
Distributional Semantics – Introduction, Distributional Models of Semantics, Distributional Semantics : Applications, Structured Models, Word Embeddings Lexical Semantics ,Lexical Semantics – Word net Word Sense Disambiguation ,Novel Word Sense detection, Topic Models : Introduction, Latent Dirichlet Allocation : Formulation, Gibbs Sampling for LDA, Applications.	
UNIT - IV	**10 Hrs**
Entity Linking, Information Extraction – Introduction, Relation Extraction, Distant Supervision, Text Summarization – LEXRANK, Optimization Based Approaches for Summarization, Summarization Evaluation, Text Classification, Sentiment Analysis – Introduction, Sentiment Analysis - Affective Lexicons, Learning Affective Lexicons, Computing with Affective Lexicons, Aspect – Based Sentiment Analysis.	

Text Books:

1) Dan Jurafsky and James Martin. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition. Prentice Hall, Second Edition, 2009. Some draft chapters of the third edition are available online: https://web.stanford.edu/~jurafsky/slp3/
2) Chris Manning and Hinrich Schütze. Foundations of Statistical Natural Language Processing. MIT Press, Cambridge, MA: May 1999

Course Outcomes:

1. Extract information from text automatically using concepts and methods from natural language processing (NLP) including stemming, n-grams, POS tagging, and parsing
2. Analyze the syntax, and semantic using computational methods
3. Apply statistical and machine learning algorithms to natural language processing
4. Design NLP-based applications using NLP tools

UAI605E	Cyber Security	Credits:03
L:T:P:3:0:0		CIE Marks:50
Total Hours/Week:40/03		SEE Marks:50

UNIT - I	10 Hrs
Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000. **Cyber offenses:** How Criminals Plan Them: Introduction, How Criminals Plan the Attacks,	
UNIT – II	**10 Hrs**
Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes. Bot nets: The Fuel for Cybercrime, Attack Vector. Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares.	
UNIT - III	**10 Hrs**
Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, Attacks on Wireless Networks. **Understanding the people on the scene:** Introduction, understanding cyber criminals, understanding cyber victims, understanding cyber investigators.	
UNIT - IV	**10 Hrs**
Understanding Cybercrime Prevention: Understanding Network Security Concepts, Understanding Basic Cryptography Concepts, Making the Most of Hardware and Software Security. **Cybercrime Detection Techniques:** Security Auditing and Log: Auditing for Windows platform, Firewall Logs, Reports, Alarms, and Alerts, Commercial Intrusion Detection Systems	

Text Books:

1) Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81- 265-21791, 2013.
2) Debra Little John Shinder and Michael Cross, "Scene of the cybercrime", 2nd edition, Syngress publishing Inc, Elsevier Inc, 2008

Reference books:

1) Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", 1 st Edition, O'Reilly Media, 2016. ISBN-13: 978-1491912058
2) Charles Dierbach, "Introduction to Computer Science Using Python", 1 st Edition, Wiley India Pvt Ltd, 2015. ISBN-13: 978-8126556014
3) Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365

Course Outcomes:

1. Describe the cyber crime terminologies.
2. Analyze cybercrime in mobiles and wireless devices along with the tools for Cybercrime and prevention
3. Analyze the motive and causes for cybercrime, cybercriminals, and investigators.
4. Apply the methods for understanding criminal case and evidence, detection standing criminal case and evidence.

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
No	**Programme Outcomes / Course Outcomes**															
1	Familiarize the cyber crime terminologies and Acts	1							2					1		
2	Illustrate tools and methods used for cybercrime.		2		3	3								1		
3	Analyze the motive and causes for cybercrime, cybercriminals, and investigators					2								2		
4	Apply the methods for detection and prevention of cyber crimes.					3							2	3		