



BIKANER TECHNICAL UNIVERSITY, BIKANER

बीकानेर तकनीकी विश्वविद्यालय, बीकानेर
OFFICE OF THE DEAN ACADEMICS



SCHEME & SYLLABUS OF UNDERGRADUATE DEGREE COURSE

Data Science
V- VI Semester



Effective for the students admitted in year 2019-20 and onwards.

Approved by 7th AC Meeting held on 1st Nov. 2021 (Agenda 7.5)

Office: Bikaner Technical University, Bikaner

Karni Industrial Area, Pugal Road, Bikaner-334004

Website: <https://btu.ac.in>

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Bikaner Technical University
Bikaner



**B. Tech. Data Science
3rd Year – V Semester**

THEORY

S.No.	Category	Course		Contact hrs/week			Marks				Cr	
		Code	Title	L	T	P	Exam Hrs	IA	ETE	Total		
1	ESC	5DS3-01	Data Wrangling	2	0	0	2	20	80	100	2	
2	PCC/ PEC	5DS4-02	Introduction to Machine Learning	3	0	0	3	30	120	150	3	
3		5DS4-03	Data Communication & Computer Networks	3	0	0	3	30	120	150	3	
4		5DS4-04	Analysis of Algorithms	3	0	0	3	30	120	150	3	
5		5DS4-05	Theory of Computation	3	0	0	3	30	120	150	3	
6		Professional Elective 1: (anyone)			2	0	0	2	20	80	100	2
		5DS5-11	Nature Inspired computing for Data Science									
		5DS5-12	Time Series Analysis and Forecasting									
		5DS5-13	Computer Graphics & Multimedia									
			Sub Total		16	0	0		160	640	800	16
PRACTICAL & SESSIONAL												
7	PCC	5DS4-21	Data Wrangling Lab	0	0	2	2	30	20	50	1	
8		5DS4-22	Machine Learning Lab	0	0	2	2	30	20	50	1	
9		5DS4-23	Analysis of Algorithms Lab	0	0	2	2	30	20	50	1	
10		5DS4-24	Advance Java Lab	0	0	2	2	30	20	50	1	
11	PSIT	5DS7-30	Industrial Training	0	0	1		75	50	125	2.5	
13	SODEC A	5DS8-00	Social Outreach, Discipline & Extra Curricular Activities						25	25	0.5	
		Sub- Total		0	0	9		195	155	350	7	
		TOTAL OF V SEMESTER		16	0	9		355	795	1150	23	

L: Lecture, T: Tutorial, P: Practical, Cr: Credits
ETE: End Term Exam, IA: Internal Assessment

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**B. Tech. Data Science
3rd Year – VI Semester**

S.No.	Category	Course		Contact hrs./week			Marks				Cr
		Code	Title	L	T	P	Exam Hrs	IA	ETE	Total	
1	ESC	6DS3-01	Digital Image Processing	2	0	0	2	20	80	100	2
2	PCC/ PEC	6DS4-02	Web Search & Information Retrieval	3	0	0	3	30	120	150	3
3		6DS4-03	Operating Systems	3	0	0	3	30	120	150	3
4		6DS4-04	Data Mining & Business Intelligence	3	0	0	3	30	120	150	3
5		6DS4-05	Data Handling and Visualization	3	0	0	3	30	120	150	3
6		Professional Elective 1 (anyone)	3	0	0	3	30	120	150	3	
		6DS5-11	Compiler Design								
		6DS5-12	Computer Vision								
		6DS5-13	Cloud Computing								
		Sub-Total		17	0	0		170	680	850	17
PRACTICAL & SESSIONAL											
7	PCC	6DS4-21	Digital Image Processing Lab	0	0	3	2	45	30	75	1.5
8		6DS4-22	Web Search & Information Retrieval Lab	0	0	3	2	45	30	75	1.5
9		6DS4-23	Data Mining Tool Lab	0	0	3	2	45	30	75	1.5
10		6DS4-24	Data Handling and Visualization Lab	0	0	3	2	45	30	75	1.5
11	SODEC A	6DS8-00	Social Outreach, Discipline & Extra Curricular Activities						25	25	0.5
		Sub- Total		0	0	12		180	145	325	6.5
		TOTAL OF VI SEMESTER		17	0	12		350	825	1175	23.5

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5DS3-01: Data Wrangling

Credit: 2		Max Marks: 100 (IA :20, ETE:80)
2L+ 0T+ 0P		End Term Exams: 2hr
S.No.	Contents	Hours
1	INTRODUCTION TO DATA WRANGLING: What Is Data Wrangling? - Importance of Data Wrangling -How is Data Wrangling performed? - Tasks of Data Wrangling-Data Wrangling Tools- Python Basics-CSV Data-JSON Data-XML Data.	6
2	WORKING WITH EXCEL FILES AND PDFS: Installing Python Packages-Parsing Excel Files-Parsing Excel Files -Getting Started with Parsing-PDFs and Problem Solving in Python-Programmatic Approaches to PDF Parsing-Converting PDF to Text-Parsing PDFs Using pdf miner-Acquiring and Storing Introduction to MySQL and PostgreSQL-Non-Relational Databases:	6
3	DATA CLEANUP: Why Clean Data? - Data Clean-up Basics-Identifying Values for Data Clean-up-Formatting Data-Finding Outliers and Bad Data-Finding Duplicates-Fuzzy Matching-Reg Ex Matching-Normalizing and Standardizing the Data.	6
4	DATA EXPLORATION AND ANALYSIS: Exploring Data-Importing Data-Exploring Table Functions-Joining Numerous Datasets-Identifying Correlations-Identifying Outliers-Creating Groupings-Analysing Data-Separating and Focusing the Data Presenting Data-Visualizing the Data-Charts-Time-Related Data-Maps-Interactives-Words.	6
5	WEB SCRAPING: What to Scrape and How-Analysing a Web Page-Network/Timeline-Interacting with JavaScript-In-Depth Analysis of a Page-Getting Pages-Reading a Web Page-Reading a Web Page with LXML-XPath-Advanced Web Scraping-Browser-Based Parsing-Screen Reading with Selenium-Screen Reading with Ghost. Py Spidering the Web-Building a Spider with Scrapy-Crawling Whole Websites with Scrapy.	6
TOTAL		30

Suggested Books

- Jacqueline Kazil & Katharine Jarmul," Data Wrangling with Python", O'Reilly Media, Inc,2016
- Dr. Tirthajyoti Sarkar, Shubhadeep," Data Wrangling with Python: Creating actionable data from raw sources", Packt Publishing Ltd,2019.
- Stefanie Molin," Hands-On Data Analysis with Pandas", Packt Publishing Ltd,2019
- Allan Visochek," Practical Data Wrangling", Packt Publishing Ltd,2017
- Tye Rattenbury, Joseph M. Hellerstein, Jeffrey Heer, Sean Kandel, Connor Carreras," Principles of Data Wrangling: Practical Techniques for Data Preparation", O'Reilly Media, Inc,2017

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5DS4-02: Introduction to Machine Learning

Credit: 3		Max Marks: 150 (IA :30, ETE:120)
3L+ 0T+ 0P		End Term Exams: 3hr
S.No.	Contents	HOUR
1	Introduction: Objective, scope and outcome of the course	1
2	Preliminaries , what is machine learning; varieties of machine learning, learning input/output functions, bias, sample application. Boolean functions and their classes, CNF, DNF, decision lists. Version spaces for learning, version graphs, learning search of a version space, candidate elimination methods.	10
3	Neural Networks , threshold logic units, linear machines, networks of threshold learning units, Training of feed forward networks by back propagations, neural networks vs. knowledge-based systems	6
4	Statistical Learning , background and general method, learning belief networks, nearest neighbour. Decision-trees, supervised learning of uni-variance decision trees, network equivalent of decision trees, over fitting and evaluation.	6
5	Inductive Logic Programming , notation and definitions, introducing recursive programs, inductive logic programming vs. decision tree induction.	5
6	Computational learning theory , fundamental theorem, Vapnik-Chernonenkis dimension, linear dichotomies, and capacity. Unsupervised learning, clustering methods based on euclidian distance and probabilities, hierarchical clustering methods. Introduction to reinforcement and explanation-based learning.	12
TOTAL		40

Suggested Books

- Introduction to Machine learning, Nils J.Nilsson
- Machine learning for dummies, IBM Limited ed, by Judith Hurwitz and Daniel Kirsch
- Introduction to Machine Learning with Python A guide for data scientists, Andreas, C. Muller & Sarah Guido, O'Reilly

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5DS4-03: Data Communication and Computer Networks

Credit: 3		Max Marks: 150 (IA :30, ETE:120)
3L+ 0T+ 0P		End Term Exams: 3hr
S.No.	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Introductory Concepts: Network hardware, Network software, topologies, Protocols and standards, OSI model, TCP model, TCP/IP model, Physical Layer: Digital and Analog Signals, Periodic Analog Signals, Signal Transmission, Limitations of Data Rate, Digital Data Transmission, Performance Measures, Line Coding, Digital Modulation, Media and Digital Transmission System	7
3	Data Link Layer: Error Detection and Correction, Types of Errors, Two-dimensional parity check, Detection verses correction, Block Coding, Linear Block Coding, Cyclic Codes, Checksum, Standardized Polynomial Code, Error Correction Methods, Forward Error Correction, Protocols: Stop and wait, Go-back-N ARQ, Selective Repeat ARQ, Sliding window, Piggybacking, Pure ALOHA, Slotted ALOHA, CSMA/CD, CSMA/CA	9
4	Network Layer: Design issues, Routing algorithms: IPV4, IPV6, Address mapping: ARQ, RARQ, Congestion control, Unicast, Multicast, Broadcast routing protocols, Quality of Service, internetworking	8
5	Transport Layer: Transport service, Elements of transport protocols, User Datagram Protocol, Transmission Control Protocol, Quality of service, Leaky Bucket and Token Bucket algorithm	8
6	Application Layer: WWW, DNS, Multimedia, Electronic mail, FTP, HTTP, SMTP, Introduction to network security	7
TOTAL		40

Suggested Books

- Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks", 5th Edition, Pearson Education, 2013.
- James Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", 3rd Edition, Pearson Education.
- William Stallings, "Data and Computer Communications", 8th edition, Pearson Education.
- Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, McGraw Hill Education.
- Larry Peterson and Bruce Davie, "Computer Networks: A Systems Approach", 4th Edition, Morgan Kaufmann Publishers | Elsevier.

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5DS4-04: Analysis of Algorithms

Credit: 3 3L+0T+0P		Max. Marks: 150(IA:30, ETE:120) End Term Exam: 3 Hours
S.No.	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	Background: Review of Algorithm, Complexity Order Notations: definitions and calculating complexity. Divide And Conquer Method: Binary Search, Merge Sort, Quick sort and Strassen's matrix multiplication algorithms.	06
3	Greedy Method: Knapsack Problem, Job Sequencing, Optimal Merge Patterns and Minimal Spanning Trees. Dynamic Programming: Matrix Chain Multiplication. Longest Common Subsequence and 0/1 Knapsack Problem.	10
4	Branch And Bound: Traveling Salesman Problem and Lower Bound Theory. Backtracking Algorithms and queens' problem. Pattern Matching Algorithms: Naïve and Rabin Karp string matching algorithms, KMP Matcher and Boyer Moore Algorithms.	08
5	Assignment Problems: Formulation of Assignment and Quadratic Assignment Problem. Randomized Algorithms- Las Vegas algorithms, Monte Carlo algorithms, randomized algorithm for Min-Cut, randomized algorithm for 2- SAT. Problem definition of Multicommodity flow, Flow shop scheduling and Network capacity assignment problems.	08
6	Problem Classes Np, Np-Hard And Np-Complete: Definitions of P, NP-Hard and NP-Complete Problems. Decision Problems. Cook's Theorem. Proving NP- Complete Problems - Satisfiability problem and Vertex Cover Problem. Approximation Algorithms for Vertex Cover and Set Cover Problem.	08
Total		41

Suggested Books

- E. Horowitz, S. Sahni, and S. Rajsekar, "Fundamentals of Computer Algorithms," Galotia Publication
- T.H. Cormen, C.E. Leiserson, R.L. Rivest "Introduction to Algorithms", PHI.
- Sedgewich, Algorithms in C, Galgotia
- Berman. Paul, "Algorithms, Cengage Learning".
- Richard Neopolitan, Kumar SS Naimipour, "Foundations of Algorithms"
- Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006

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5DS4-05: Theory of Computation


Credit: 3 3L+ 0T+ 0P		Max Marks: 150 (IA :30, ETE:120) End Term Exams: 3hr	
S.No.	Contents	Hours	
1	Finite Automata & Regular Expression: Basic machine, Finite state machine, Transition graph, Transition matrix, Deterministic and non-deterministic finite automation, Equivalence of DFA and NFA, Decision properties, minimization of finite automata, Mealy & Moore machines. Alphabet, words, Operations, Regular sets, relationship and conversion between Finite automata and a regular expression and vice versa, designing regular expressions, closure properties of regular sets, Pumping lemma and regular sets, Myhill- Nerode theorem, Application of pumping lemma, Power of the languages.	8	
2	Context Free Grammars (CFG), Derivations and Languages, Relationship between derivation and derivation trees, leftmost and rightmost derivation, sentential forms, parsing and ambiguity, simplification of CFG, normal forms, Greibach and Chomsky Normal form, Problems related to CNF and GNF including membership problem.	8	
3	Nondeterministic PDA, Definitions, PDA and CFL, CFG for PDA, Deterministic PDA, and Deterministic PDA and Deterministic CFL, the pumping lemma for CFL's, Closure Properties and Decision properties for CFL, Deciding properties of CFL.	8	
4	Turing Machines: Introduction, Definition of Turing Machine, TM as language Acceptors and Transducers, Computable Languages and functions, Universal TM & Other modification, multiple tracks Turing Machine. Hierarchy of Formal languages: Recursive & recursively enumerable languages, Properties of RL and REL, Introduction of Context sensitive grammars and languages, The Chomsky Hierarchy.	8	
5	Tractable and Untractable Problems: P, NP, NP complete and NP hard problems, Un-decidability, examples of these problems like vertex cover problem, Hamiltonian path problem, traveling salesman problem.	8	
Total		40	

Suggestedbooks

- Hopcroft J.E., Motwani R. and Ullman J.D, "Introduction to Automata Theory, Languages and Computations", Second Edition, Pearson Education.
- John C Martin, "Introduction to Languages and the Theory of Computation", Third Edition, Tata McGraw Hill Publishing Company, New Delhi
- Marvin L. Minsky "Computation: Finite and Infinite" – Prentice Hall, 1967
- Michael Sipser "Introduction to the Theory of Computation" , Third Edition, 2012 Cengage Learning
- Peter Lenz – An Introduction to Formal languages and Automata – 3rd Edition Narosa, 2003
- Thomas A. Sukamp – An introduction to the theory of computer science languages and machines – 3rd edition, Pearson Education, 2007.

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5DS5-11: Nature Inspired Computing for Data Science

Credit: 2		Max Marks: 100 (IA :20, ETE:80)	
2L+ 0T+ 0P		End Term Exams: 2hr	
S.No.	Contents	Hours	
1	Introduction: Objective, scope, and outcome of the course.	01	
2	Computational Problems: Decision Problem, Optimization Problem, Hardness in Optimization Problems, NP class, NP-Hard, examples for NP-Hard problems, tackling NP-Hard problems, Rationale for seeking inspiration from nature	5	
3	Evolutionary Systems: Evolutionary Theory, The Genotype, Artificial Evolution, Genetic representations, Initial Population, Fitness Functions, Selection and Reproduction, Genetic Operators, Evolutionary Measures, Types of Evolutionary Algorithms	05	
4	Collective Systems: Particle Swarm Optimization Algorithm, Hybrid PSO algorithms, Ant Colony Optimization, Artificial Bee Colony, Firefly Algorithm	06	
5	Artificial Neural Networks: Mathematical model of a neuron, ANN architectures, Learning rules Backpropagation network, Backpropagation learning, and its applications	05	
6	DNA Computing: Motivation, DNA Molecule, Adleman's experiment, Test tube programming language, Universal DNA Computers, PAM Model, Splicing Systems, Lipton's Solution to SAT Problem, Scope of DNA Computing	6	
Total		28	

Suggested

- Fundamentals of Natural Computing: Basic Concepts, Algorithms, and Applications, L. N. de Castro (2006) CRC Press.
- Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies, D. Floreano and C. Mattiussi (2008), MIT Press.
- Evolutionary Optimization Algorithms, D. Simon (2013), Wiley.

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5DS5-12: Time Series Analysis and Forecasting

Credit: 2 2L+ 0T+ 0P		Max Marks: 100 (IA :20, ETE:80) End Term Exams: 2hr
S.No.	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	Univariate methods: Simple smoothing methods, Decomposition method, Holt's and Winters' smoothing methods	03
3	Stochastic process. Time-series as a discrete stochastic process. Stationarity. Main characteristics of stochastic processes (means, autocovariation, and autocorrelation functions). Stationary stochastic processes.	04
4	Modeling: Models for Stationary Time Series, Models for Non-Stationary Time Series Model Specification or Identification, Parameter Estimation, Model Diagnostics, Forecasting	05
5	Regression Methods, Review simple regression, RMSE and Coefficient of Determination, Statistical Inference in Multiple Regression, Comparative Analysis Using Regression, Variable Selection in Multiple Regression, Model Selection in Regression, Checking Regression Models, Autocorrelation in Regression	06
6	Box-Jenkins Methods Introduction to Time Series Modelling ARMA Models, Identification of ARMA models, ARIMA Models, ARIMA Models Identification, Building better models from ARIMA, Parameter Estimation and Diagnostic checking, Forecast using ARIMA models, Modelling Seasonal Data	06
7	Introduction to Spectral Analysis, Estimating the Spectrum, Intervention Analysis	03
Total		28

Suggested Books

- Chatfield, C. (2000). Time Series Forecasting. Chapman & Hall/CRC, Boca Raton, FL.
- Box, G. E. P., Jenkins, G. M., & Reinsel, G. C. (1994). Time Series Analysis: Forecasting and Control. Prentice - Hall, Inc., Upper Saddle River, NJ.
- Yaffee, R. and McGee, M. (2000). Introduction to Time Series Analysis and Forecasting with Applications of SAS and SPSS. Academic Press, Inc., San Diego, CA.
- Bowerman, B. L., O'Connell, R. T., and Koehler, A. B. (2005). Forecasting, Time Series, and Regression (4ed.). Duxbury, Belmont, CA.

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5DS5-13: Computer Graphics & Multimedia

Credit: 2 2L+ 0T+ 0P		Max Marks: 100 (IA :20, ETE:80)	
		End Term Exams: 2hr	
S.No.	Contents	Hours	
1	Introduction: Objective, scope, and outcome of the course.	1	
2	Basic of Computer Graphics: Basic of Computer Graphics, Applications of computer graphics, Display devices, Random and Raster scan systems, Graphics input devices, Graphics software and standards	06	
3	Graphics Primitives: Points, lines, circles, and ellipses as primitives, scan conversion algorithms for primitives, Fill area primitives including scan-line polygon filling, inside-outside test, boundary and flood-fill, character generation, line attributes, area-fill attributes, character attributes. Aliasing, and introduction to Anti-Aliasing (No anti-aliasing algorithm).	5	
4	Two Dimensional Graphics: Transformations (translation, rotation, scaling), matrix representation, homogeneous coordinates, composite transformations, reflection and shearing, viewing pipeline and coordinates system, window-to-viewport transformation, clipping including point clipping, line clipping (Cohen Sutherland, liang- bersky, NLN), polygon clipping	6	
5	Three-Dimensional Graphics: 3D display methods, polygon surfaces, tables, equations, meshes, curved lies and surfaces, quadric surfaces, spline representation, cubic spline interpolation methods, Bazier curves and surfaces	6	
6	B-spline curves and surfaces. 3D scaling, rotation and translation, composite transformation, viewing pipeline and coordinates, parallel and perspective transformation, view volume and general (parallel and perspective) projection transformations.	6	
Total		30	

Suggested Books

- Edward Angel, Interactive Computer Graphics: A Top Down Approach Using OpenGL, Pearson Education
- Donald Hearn and M. Pauline Baker, Computer Graphics with OpenGL, Prentice Hall
- F. S. Hill Jr, Computer Graphics using OpenGL, Pearson Education
- J. D. Foley, A. Van Dam, S. K. Feiner, and J. F. Hughes, Computer Graphics - Principles and Practice Addison Wesley

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5DS4-21: Data Wrangling Lab

Credit: 1 0L+ 0T+ 2P		Max Marks: 50 (IA :30, ETE:20) End Term Exams: 2hr
S.No.	List of Experiments	
1	Write a Python script to read each row from a given csv file and print a list of strings	
2	Write a Python program to read a given CSV file as a dictionary.	
3	Write a Python program to convert Python dictionary object (sort by key) to JSON data. Print the object members with indent level 4	
4	Write the python script to Read the XML file	
5	Write a Pandas program to import excel data (child labour and child marriage data) into a Pandas data frame and process the following a. Get the data types of the given excel data b. Display the last ten rows. c. Insert a column in the sixth position of the said excel sheet and fill it with NaN values	
6	Develop the python script to parse the pdf files using pdfminer.	
7	Extract the Table from the child labour and child marriage data using pdfables library	
8	Write a Python data wrangling scripts to insert the data into SQLite database	
9	Develop the Python Shell Script to do the basic data cleanup on child labour and child marriage data a. Check duplicates and missing data b. Eliminate Mismatches c. Cleans line breaks, spaces, and special characters	
10	Import the data into `agate` then explores the table using agate methods and perform statistical correlations	
11	Draw the chart between perceived corruption scores compared to the child labour percentages using matplotlib.	
12	Write the python script to Map the Child Labour Worldwide using pygal.	
13	Write a Python program to download and display the content of robot.txt for en.wikipedia.org	

***Data can be any taken from any valid publicity data set sources such as Unicef**

Suggested Books

- Jacqueline Kazil & Katharine Jarmul,” Data Wrangling with Python”, O’Reilly Media, Inc,2016
- Dr. Tirthajyoti Sarkar, Shubhadeep,” Data Wrangling with Python: Creating actionable data from raw sources”, Packt Publishing Ltd,2019.



5DS4-22: Machine Learning Lab

Credit: 1		Max Marks: 50 (IA :30, ETE:20)
0L+ 0T+ 2P		End Term Exams: 2hr
S.No.	List of Experiments	
1	Implement and demonstrate the FIND-S Algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.	
2	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.	
3	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample	
4	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets	
5	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	
6	Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.	
7	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.	
8	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.	
9	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.	
10	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.	

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5DS4-23: Analysis of Algorithms Lab

Credit: 1		Max Marks: 50 (IA :30, ETE:20)
0L+ 0T+ 2P		End Term Exams: 2hr
S.No.	List of Experiments	
1	Sort a given set of elements using the Quicksort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.	
2	Implement a parallelized Merge Sort algorithm to sort a given set of elements and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.	
3	a. Obtain the Topological ordering of vertices in a given digraph. b. Compute the transitive closure of a given directed graph using Warshall's algorithm.	
4	Implement 0/1 Knapsack problem using Dynamic Programming.	
5	From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.	
6	Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm.	
7	a. Print all the nodes reachable from a given starting node in a digraph using BFS method. b. Check whether a given graph is connected or not using the DFS method.	
8.	Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.	
9.	Implement All-Pairs Shortest Paths Problem using Floyd's algorithm.	
10	Implement N Queen's problem using Back Tracking.	

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5DS4-24: Advance Java Lab

Credit: 1		Max Marks: 50 (IA :30, ETE:20)
0L+ 0T+ 2P		End Term Exams: 2hr
S.No.	List of Experiments	
1	Introduction To Swing, MVC Architecture, Applets, Applications and Pluggable Look and Feel, Basic swing components: Text Fields, Buttons, Toggle Buttons, Checkboxes, and Radio Buttons	
2	Java database Programming, java.sql Package, JDBC driver, Network Programming With java.net Package, Client and Server Programs, Content and Protocol Handlers	
3	RMI architecture, RMI registry, writing distributed application with RMI, naming services, Naming and Directory Services, Overview of JNDI, Object serialization and Internationalization	
4	J2EE architecture, Enterprise application concepts, n-tier application concepts, J2EE platform, HTTP protocol, web application, Web containers and Application servers	
5	Server-side programming with Java Servlet, HTTP and Servlet, Servlet API, life cycle, configuration and context, Request and Response objects, Session handling and event handling, Introduction to filters with writing simple filter application	
6	JSP architecture, JSP page life cycle, JSP elements, Expression Language, Tag Extensions, Tag Extension API, Tag handlers, JSP Fragments, Tag Files, JSTL, Core Tag library, overview of XML Tag library, SQL Tag library and Functions Tag library	



6DS3-01: Digital Image Processing

Credit: 2 2L+0T+0P		Max. Marks: 100(IA:20, ETE:80) End Term Exam: 2 Hours
S.No.	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	Introduction to Image Processing: Digital Image representation, Sampling & Quantization, Steps in image Processing, Image acquisition, color image representation.	04
3	Image Transformation & Filtering: Intensity transform functions, Histogram processing, Spatial filtering, Fourier transforms and its properties, frequency Domain filters, color models, Pseudo coloring, color transforms, Basics of Wavelet Transforms.	06
4	Image Restoration: Image degradation and restoration process, Noise Models, Noise Filters, degradation function, Inverse Filtering, Homomorphism Filtering.	07
5	Image Compression: Coding redundancy, Interpixel redundancy, Psych visual redundancy, Huffman Coding, Arithmetic coding, Lossy compression techniques, JPEG Compression.	05
6	Image Segmentation & Representation: Point, Line and Edge Detection, Thresholding, Edge and Boundary linking, Hough transforms, Region Based Segmentation, Boundary representation, Boundary Descriptors.	05
Total		28

Suggested Books

- Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", 4th Edition, Pearson, 2018.
- Kenneth R. Castleman, Digital Image Processing Pearson, 2006.
- Anil K.Jain, "Fundamentals of Digital Image Processing", Person Educaiton, 2003.



6DS4-02: Web Search and Information Retrieval

Credit: 3		Max Marks: 150 (IA :30, ETE:120)
3L+ 0T+ 0P		End Term Exams: 3hr
S.No.	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Working and Architecture of Search Engine. Information retrieval vs Data retrieval, logical view of documents Information retrieval model, IR model characterization, Information retrieval evaluation. Introduction to Semantic Web	7
3	Query languages and query operation, Meta-data search, text operations- document clustering, compressions and various compression model.	7
4	Indexing and searching- brute force, Knuth-Morris-Pratt, Boyer- Moore, pattern matching, Scoring and ranking feature vectors. Ranking Algorithms and different ranking factors - PageRank (PR) algorithm, OPIC Algorithm	9
5	Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries	8
6	Text and multimedia languages, Social networks, user interface and visualization, information access process, query specification.	8
TOTAL		40

Suggested Books

- Modern Information Retrieval by Ricardo Baeza- Yates, Berthier Ribiero-Neto; Pearson
- Introduction to Information Retrieval by C. Manning, P. Raghavan, and H. Schütze. Cambridge University Press, 2008
- B. Frakes and R. Baeza-Yates Information Retrieval: Data Structures and Algorithms
- C. Manning, P. Raghavan, and H. Schütze: Introduction to Information Retrieval
- Introduction to information retrieval; Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze Cambridge University Press publication.

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6DS4-03: Operating Systems

Credit: 3 3L+0T+0P		Max. Marks: 150(IA:30, ETE:120) End Term Exam: 3 Hours
S.No.	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	Introduction and History of Operating systems: Structure and operations; processes and files Processor management: inter process communication, mutual exclusion, semaphores, wait and signal procedures, process scheduling and algorithms, critical sections, threads, multithreading	04
3	Memory management: contiguous memory allocation, virtual memory, paging, page table structure, demand paging, page replacement policies, thrashing, segmentation, case study	05
4	Deadlock: Shared resources, resource allocation and scheduling, resource graph models, deadlock detection, deadlock avoidance, deadlock prevention algorithms. Device management: devices and their characteristics, device drivers, device handling, disk scheduling algorithms and policies	15
5	File management: file concept, types and structures, directory structure, cases studies, access methods and matrices, file security, user authentication	07
6	UNIX and Linux operating systems as case studies; Time OS and case studies of Mobile OS	08
Total		40

Suggested Books

- A. Silberschatz, P. B. Galvin and G. Gagne, Operating System Concepts (9th ed.), John Wiley, 2012. ISBN 978-1118063330.
- Tanenbaum, Modern Operating Systems (3rd ed.), Prentice Hall India Learning Private Limited, 2019. ISBN 978-8120339040.
- W. Stallings, Operating Systems Internals and Design Principles (7th ed.), Prentice-Hall, 2013.

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6DS4-04: Data Mining & Business Intelligence

Credit: 3		Max Marks: 150 (IA :30, ETE:120)
3L+ 0T+ 0P		End Term Exams: 3hr
S.No.	Contents	Hours
1	Introduction: Objective, scope, and outcome of the course.	1
2	Introduction - Evolution, and importance of Data Mining-Types of Data and Patterns mined Technologies-Applications-Major issues in Data Mining. Knowing about Data- Data Pre-processing: Cleaning– Integration–Reduction–Data transformation and Discretization.	8
3	BI- Data Mining & Warehousing: Basic Concepts-Data Warehouse Modelling- OLAP and OLTP systems - Data Cube and OLAP operations–Data Warehouse Design and Usage-Business Analysis Framework for Data Warehouse Design- OLAP to Multidimensional Data Mining. Mining Frequent Patterns: Basic Concept – Frequent Item Set Mining Methods – Mining Association Rules – Association to Correlation Analysis.	9
4	Classification and Prediction: Issues - Decision Tree Induction - Bayesian Classification – Rule-Based Classification – k-Nearest mining Classification. Prediction –Accuracy and Error measures.	7
5	Clustering: Overview of Clustering – Types of Data in Cluster Analysis – Major Clustering Methods.	7
6.	Introduction to BI -BI definitions and concepts- BI Framework-Basics of Data integration Introduction to Business Metrics and KPI - Concept of the dashboard and balanced scorecard. Tool for BI: Microsoft SQL server: Introduction to Data Analysis using SSAS tools Introduction to Data Analysis using SSIS tools- Introduction to Reporting Services using SSRS tools- Data Mining Implementation Methods.	8
Total		40

Suggested Books

- Han, M. Kamber, “Data Mining Concepts and Techniques”, Morgan Kaufmann
- M. Kantardzic, “Data mining: Concepts, models, methods and algorithms, John Wiley & Sons Inc.
- Paulraj Ponnian, “Data Warehousing Fundamentals”, John Willey.
- M. Dunham, “Data Mining: Introductory and Advanced Topics”, Pearson Education.
- G. Shmueli, N.R. Patel, P.C. Bruce, “Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner”, Wiley India

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6DS4-05: Data Handling and Visualization

Credit: 3 3L+ 0T+ 0P		Max Marks: 150 (IA :30, ETE:120) End Term Exams: 3hr	
S.No.	Contents	Hours	
1	Visualizing Data-Mapping Data onto Aesthetics, Aesthetics and Types of Data, Scales Map Data Values onto Aesthetics, Coordinate Systems and Axes- Cartesian Coordinates, Nonlinear Axes, Coordinate Systems with Curved Axes, Color Scales-Color as a Tool to Distinguish, Color to Represent Data Values , Color as a Tool to Highlight, Directory of Visualizations- Amounts, Distributions, Proportions, x-y relationships, Geospatial Data	8	
2	Visualizing Amounts-Bar Plots, Grouped and Stacked Bars, Dot Plots and Heatmaps, Visualizing Distributions: Histograms and Density Plots- Visualizing a Single Distribution, Visualizing Multiple Distributions at the Same Time, Visualizing Distributions: Empirical Cumulative Distribution Functions and Q-Q Plots-Empirical Cumulative Distribution Functions, Highly Skewed Distributions, QuantileQuantile Plots, Visualizing Many Distributions at Once-Visualizing Distributions Along the Vertical Axis, Visualizing Distributions Along the Horizontal Axis	8	
3	Visualizing Proportions-A Case for Pie Charts, A Case for Side-by-Side Bars, A Case for Stacked Bars and Stacked Densities, Visualizing Proportions Separately as Parts of the Total, Visualizing Nested Proportions- Nested Proportions Gone Wrong, Mosaic Plots and Treemaps, Nested Pies, Parallel Sets. Visualizing Associations Among Two or More Quantitative Variables-Scatterplots, Correlograms, Dimension Reduction, Paired Data. Visualizing Time Series and Other Functions of an Independent Variable-Individual Time Series, Multiple Time Series and Dose-Response Curves, Time Series of Two or More Response Variables	8	
4	Visualizing Trends-Smoothing, Showing Trends with a Defined Functional Form, Detrending and Time-Series Decomposition, Visualizing Geospatial Data-Projections, Layers, Choropleth Mapping, Cartograms, Visualizing Uncertainty-Framing Probabilities as Frequencies, Visualizing the Uncertainty of Point Estimates, Visualizing the Uncertainty of Curve Fits, Hypothetical Outcome Plots	8	
5	The Principle of Proportional Ink-Visualizations Along Linear Axes, Visualizations Along Logarithmic Axes, Direct Area Visualizations, Handling Overlapping Points-Partial Transparency and Jittering, 2D Histograms, Contour Lines, Common Pitfalls of Color Use-Encoding Too Much or Irrelevant Information, Using Nonmonotonic Color Scales to Encode Data Values, Not Designing for Color-Vision Deficiency	8	
Total		40	

Suggested Books

- Claus Wilke, “Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures”, 1st edition, O’Reilly Media Inc, 2019.
- Tony Fischetti, Brett Lantz, R: Data Analysis and Visualization,O’Reilly ,2016
- Ossama Embarak, Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems,Apress, 2018

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6DS5-11: Compiler Design

Credit: 3 3L+ 0T+ 0P		Max Marks: 150 (IA :30, ETE:120) End Term Exams: 3hr	
S.No.	Contents	Hours	
1	Introduction: Objective, scope and outcome of the course.	01	
2	Introduction: Compiler, Translator, Interpreter definition, Phase of compiler, Bootstrapping, Review of Finite automata lexical analyzer, Input, Recognition of tokens, Idea about LEX: A lexical analyzer generator, Error handling.	06	
3	Review of CFG Ambiguity of grammars: Introduction to parsing. Top down parsing, LL grammars & passers error handling of LL parser, Recursive descent parsing predictive parsers, Bottom up parsing, Shift reduce parsing, LR parsers, Construction of SLR, Conical LR & LALR parsing tables, parsing with ambiguous grammar. Operator precedence parsing, Introduction of automatic parser generator: YACC error handling in LR parsers.	10	
4	Syntax directed definitions; Construction of syntax trees, S- Attributed Definition, L-attributed definitions, Top down translation. Intermediate code forms using postfix notation, DAG, Three address code, TAC for various control structures, Representing TAC using triples and quadruples, Boolean expression and control structures.	8	
5	Storage organization: Storage allocation, Strategies, Activation records, Accessing local and non-local names in a block structured language, Parameters passing, Symbol table organization, Data structures used in symbol tables.	08	
6	Definition of basic block control flow graphs; DAG representation of basic block, Advantages of DAG, Sources of optimization, Loop optimization, Idea about global data flow analysis, Loop invariant computation, Peephole optimization, Issues in design of code generator, A simple code generator, Code generation from DAG.	07	
Total		40	

Suggested Books

- A.V. Aho, J. D. Ullman, Monica S. Lam and R. Sethi, Compilers Principles, Techniques and Tools (2 ed.) Pearson Education, 2005. ISBN 978-0321547989.
- John Levine, Tony Mason and Doug Brown, Lex and Yacc (1 ed.), O'Reilly Media, 1992. ISBN 978-1565920002.
- Kenneth C. Loudon, Compiler Construction Principles and Practice (1 ed.), Course Technology Inc, 1997. ISBN 978-0534939724.
- Dhamdhare, Compiler Construction (2 ed.), Macmillan Publication, 2003. ISBN 978-0333904060

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6DS5-12: Computer Vision

Credit: 3		Max. Marks: 150(IA:30, ETE:120)
3L+0T+0P		End Term Exam: 3 Hours
S.No.	Contents	Hours
1	Introduction: Objective, scope, and outcome of the course.	1
2	What is Computer Vision - Low-level, Mid-level, High-level, Overview of Diverse Computer Vision Applications: Document Image, Analysis, Bio-metrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Multimedia, Virtual Reality and Augmented Reality.	7
3	Image Formation Models: Monocular imaging system, Orthographic & Perspective Projection, Camera model and Camera calibration, Binocular imaging systems, Multiple views geometry, Structure determination, shape from shading, Photometric Stereo, Depth from Defocus, Construction of 3D model from images.	8
4	Image Processing, Feature Extraction, and Motion Estimation: Image pre-processing, Image representations (continuous and discrete), Edge detection, Regularization theory, Optical computation, Stereo Vision, Motion estimation, Structure from motion.	6
5	Shape Representation and Segmentation: Contour-based representation, Region-based representation, De-formable curves and surfaces, Snakes and active contours, Level set representations, Fourier, and wavelet descriptors, Medial representations, Multi-resolution analysis, Object recognition.	8
6	Image Understanding and Computer Vision Applications: Pattern recognition methods, Face detection, Face recognition, 3D shapes models of faces Application: Surveillance-foreground-background separation-human gait analysis Application: In-vehicle vision system: locating roadway-road markings-identifying road signs-locating pedestrians.	8
Total		38

Suggested Books

- D. Forsyth and J. Ponce, Computer Vision - A modern approach, Prentice Hall
- Richard Szeliski, Computer Vision: Algorithms and Applications (CVAA), Springer, 2010
- E. R. Davies, , Computer & Machine Vision, Academic Press, 2012
- Dana H. Ballard, Christopher M. Brown, Computer Vision, Prentice Hall 1st Edition (May 1, 1982) , ISB 978-0131653160



6DS5-13: Cloud Computing

Credit: 3 3L+ 0T+ 0P		Max Marks: 150 (IA :30, ETE:120)
		End Term Exams: 3hr
S.No.	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	Introduction: Objective, scope and outcome of the course. Introduction Cloud Computing: Nutshell of cloud computing, Enabling Technology, Historical development, Vision, feature Characteristics and components of Cloud Computing. Challenges, Risks and Approaches of Migration into Cloud. Ethical Issue in Cloud Computing, Evaluating the Cloud's Business Impact and economics, Future of the cloud. Networking Support for Cloud Computing. Ubiquitous Cloud and the Internet of Things	08
3	Cloud Computing Architecture: Cloud Reference Model, Layer and Types of Clouds, Services models, Data centre Design and interconnection Network, Architectural design of Compute and Storage Clouds. Cloud Programming and Software: Fractures of cloud programming, Parallel and distributed programming paradigms-Map Reduce, Hadoop, High level Language for Cloud. Programming of Google App engine.	9
4	Virtualization Technology: Definition, Understanding and Benefits of Virtualization. Implementation Level of Virtualization, Virtualization Structure/Tools and Mechanisms, Hypervisor VMware, KVM, Xen. Virtualization: of CPU, Memory, I/O Devices, Virtual Cluster and Resources Management, Virtualization of Server, Desktop, Network, and Virtualization of datacentre.	8
5	Securing the Cloud: Cloud Information security fundamentals, Cloud security services, Design principles, Policy Implementation, Cloud Computing Security Challenges, Cloud Computing Security Architecture. Legal issues in cloud Computing. Data Security in Cloud: Business Continuity and Disaster Recovery, Risk Mitigation, Understanding and Identification of Threats in Cloud, SLA-Service Level Agreements, Trust Management	08
6	Cloud Platforms in Industry: Amazon web services, Google AppEngine, Microsoft Azure Design, Aneka: Cloud Application Platform -Integration of Private and Public Clouds Cloud applications: Protein structure prediction, Data Analysis, Satellite Image Processing, CRM	06
Total		40

Suggested Books

- Dan C Marinescu, Cloud Computing, Theory and Practice, MK Elsevier
- Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley
- Barrie Sosinsky, Cloud Computing Bible, Wiley
- Jim Smith, Ravi Nair, Virtual Machines: Versatile Platforms for Systems and Processes, MK Elsevier

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6DS4-21: Digital Image Processing Lab

Credit: 1.5		Max Marks: 75 (IA :45, ETE:30)
0L+ 0T+ 3P		End Term Exams: 2hr
S.No.	List of Experiments	
1	Point-to-point transformation. This laboratory experiment provides for thresholding an image and the evaluation of its histogram. Histogram equalization. This experiment illustrates the relationship among the intensities (gray levels) of an image and its histogram.	
2	Geometric transformations. This experiment shows image rotation, scaling, and translation. Two-dimensional Fourier transform	
3	Linear filtering using convolution. Highly selective filters.	
4	Ideal filters in the frequency domain. Non-Linear filtering using convolutional masks. Edge detection. This experiment enables students to understand the concept of edge detectors and their operation in noisy images.	
5	Morphological operations: This experiment is intended so students can appreciate the effect of morphological operations using a small structuring element on simple binary images. The operations that can be performed are erosion, dilation, opening, closing, open-close, close-open.	



6DS4-22: Web Search & Information Retrieval Lab

	Credit: 1.5	Max Marks: 75 (IA :45, ETE:30)
	0L+ 0T+ 3P	End Term Exams: 2hr
S.No.	List of Experiments	
1	Write a program to demonstrate bitwise operation.	
2	Implement Page Rank Algorithm.	
3	Implement Dynamic programming algorithm for computing the edit distance.	
4	Write a program to Compute Similarity between two text documents.	
5	Write a map-reduce program to count the number of occurrences of each alphabetic character in the given dataset. The count for each letter should be case-insensitive (i.e., include both upper-case and lower-case versions of the letter; Ignore non-alphabetic characters).	
6	Write a program for Pre-processing of a Text Document: stop word removal.	
7	Write a program to implement simple web crawler.	
8	Write a program to parse XML text, generate Web graph and compute topic specific page rank.	
9	Write a program for tkinter.	



6DS4-23: Data Mining Tool Labs

Credit: 1.5		Max Marks: 75 (IA :45, ETE:30)
0L+ 0T+ 3P		End Term Exams: 2hr
S.No.	List of Experiments	
1	Demonstration of pre-processing on dataset car.arff	
2	Demonstration of pre-processing on dataset diabetes diagnosis	
3	Demonstration of classification rules process on dataset using ID3 and J48 algorithm.	
4	Implement the classification rules process on car dataset using Naïve Bayes' algorithm in Weka explorer.	
5	Demonstration of classification rule process on dataset using simple K-means algorithm in weka explorer.	
6	Build a Neural Network model to process Diabetic diagnosis dataset.	
7	Demonstration of classification on dataset diabetic diagnosis and car using decision table algorithm in weka explorer.	
8	Demonstration of association rule using dataset diabetic diagnosis using apriori algorithm in weka explorer.	
9	Demonstration of classification on dataset diabetic and car in Matlab.	
10	Demonstration of clustering on dataset diabetic and car in Matlab	

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Page | 27

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6DS4-24: Data Handling and Visualization Lab

Credit: 1.5		Max Marks: 75 (IA :45, ETE:30)
0L+ 0T+ 3P		End Term Exams: 2hr
S.No.	List of Experiments	
1.	Download the House Pricing dataset from Kaggle and map the values to Aesthetics	
2.	Use different Color scales on the Rainfall Prediction dataset	
3.	Create different Bar plots for variables in any dataset	
4.	Show an example of Skewed data and removal of skewedness	
5.	For a sales dataset do a Time Series visualization	
6.	Build a Scatterplot and suggest dimension reduction	
7.	Use Geospatial Data-Projections on datasets in http://www.gisinindia.com/directory/gis-data-for-india	
8.	Create the a trend line with a confidence band in any suitable dataset	
9.	Illustrate Partial Transparency and Jittering	
10.	Illustrate usage of different color codes	

Suggested Books

- Claus Wilke, “Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures”, 1st edition, O’Reilly Media Inc, 2019.