SYLLABUS

M.SC. (COMPUTER SCIENCE / INFORMATION TECHNOLOGY)

3rd SEMESTER

Session 2020 - 2021

Mission of SCS&IT, DAVV

To produce world-class professionals who have excellent analytical skills, communication skills, team building spirit and ability to work in cross cultural environment.

To produce international quality IT professionals, who can independently design, develop and implement computer applications.

Professionals who dedicate themselves to mankind, who are environment conscious, follow social norms and ethics.

School of Computer Science & IT,
Devi Ahilya Vishwa Vidyalaya, Indore
www.scs.dauniv.ac.in

Course Name MSc (CS/IT) 3rd Semester
Subject Code: CS-5713
Subject Name: Data Analytics using R

Aim of the Subject

This course aims to provide sound foundation to fundamental concepts of machine learning and its application and prepare students for advanced research and real time problem solving in machine learning and related fields.

Objectives

1. Ability to understand, analyze and design solutions with professional competency for the real-world problems.
2. Ability to develop software solutions for the requirements, based on critical analysis and research.

Learning Outcomes

1. Understand the fundamental concepts of data analytics.
2. Evaluate the data analysis techniques for applications handling large data.
3. Demonstrate the various machine learning algorithms used in data analytics process.

Unit 1

Introduction: What is Data Analytics?, The Data Analytics Process, Different Types of Data: Quantitative, Categorical. Graphical Summaries of Data: Pie Chart, Bar Graph, Pareto Chart, Histogram. Measuring the Center of Quantitative Data: Mean, Median, Mode. Measuring the Variability of Quantitative Data: Range, Standard Deviation, and Variance.

Unit 2

Regression:Simple Linear Regression, Multiple Regression, Assessing Performance, Ridge Regression, Feature Selection & Lasso, Nearest Neighbors & Kernel Regression.

Unit 3

Classification: Linear Classifiers & Logistic Regression, Learning Linear Classifiers, Overfitting & Regularization in Logistic Regression, Decision Trees, Preventing Overfitting in Decision Trees, Handling Missing Data, Boosting, Precision-Recall, Scaling to Huge Datasets & Online Learning.

Unit 4

Clustering & Retrieval: Nearest Neighbor Search, Clustering with k-means, Mixture Models, Mixed Membership Modeling via Latent Dirichlet Allocation, Hierarchical Clustering

Unit 5

Informative Projections: Linear Projections, Principal Component Analysis I: One Dimensional Projection, Principal Component Analysis II: The Top k Directions Lab: Overview of R, R data types :Vectors, Matrices, Factors, Lists, Data Frames, reading and writing data, Control structures, functions, scoping rules, dates and times. Introduction to Data Cleansing, Missing and Repeated Values, Feature Engineering, Outliers and Errors, Finding Outliers, Cleaning Data with R.

Text Book(s)

Required Texts:

[1]Allan G. Bluman, Elementary Statistics: A Step By Step Approach,10th Edition,McGraw-Hill, 2017.

[2] Tom Mitchell, Machine Learning, First Edition, McGraw Hill 1997.

[3] Use R resources on tutorial point.

Reference Material(s)

Course Name MSc (CS/IT) 3rd Semester
Subject Code: CS 5613
Subject Name: Computer Network

Aim of the Subject

As a result of rapid technological progress, the old model of a single computer serving all the organization's computational needs has been replaced by a large number of separate but interconnected computers.

Objectives

1. Develop knowledge of the function of both hardware (basics) and software aspects of computer network systems.
2. Understand the fundamental principles of various networking architectures and their protocols.
3. Gain an understanding of the principles of operation of a wide variety of network technologies.
4. Develop an appreciation of how network services are developed and knowledge of their uses.
5. Apply knowledge of computers, software, networking technologies, and information assurance to an organization's management, operations, and requirements.
6. Prepare to continue their studies to obtain various industry certifications.
7. Computer networks is a rapidly evolving field, with new standards and improvements in data communication technology occurring, for this included the topics of CSMA/CA, wireless LANs, IPv6, new developments in application layer protocols etc.

Learning Outcomes

1. Familiarity with network terminologies, reference model, applications of network, design issues and how computer network works?
2. Knowledge of Data link layer design issues, Framing, Error correction and Detection techniques.
3. Meaning of flow control and its methods.
4. Problems associated with broadcast network and multiple access control protocols.
5. Knowledge of IEEE 802.3, 802.4 and 802.5, 802.11
6. Latest LAN examples.
7. Design issues related to Network layer like routing, addressing and their protocols.
8. Introductory knowledge of Transport layer protocols like TCP and UDP.
9. Idea about client server architecture and working of DNS, HTTP and E Mail.

10. Security issues in computer network and Introduction to Cryptographic algorithms and Digital Signature.

Unit 1

Introduction - Computer Network, Goals and Applications; Network Classification: Broadcast & point-to-point networks, LAN, MAN & WAN networks; protocol hierarchies; design issues for the layers. Connection Oriented and Connection less services, Service primitives, Relationship between Services and Protocols; Switching Techniques – Circuit Switching and Packet Switching; Reference models – OSI and TCP/IP, comparison and critique of OSI and TCP/IP reference models, Internet Concept.

Unit 2

Data Link Layer: Design issues – Services, Framing, Error Control and Flow Control; Error Detection Techniques - Parity Check and Cyclic Redundancy Check (CRC); Error Correction Technique - Hamming code; Elementary Data Link Protocols - Unrestricted Simplex Protocol, Simplex Stop-and-Wait Protocol, Sliding Window Protocols: One-Bit Sliding Window Protocol, protocol using Go Back N and Selective Repeat; HDLC protocol; Data link layer in the Internet - SLIP and PPP.

Unit 3

MAC Sublayer - Multiple access protocols: Aloha, CSMA Protocols; Collision-Free Protocols, IEEE MAC Sublayer protocols : Ethernet cabling, 802.3 protocol, 802.4 MAC sublayer protocol, 802.5 MAC sublayer protocol and their management. High speed LANs : Fast Ethernet, FDDI; Wireless LANs; Bluetooth; data link layer switching- Bridges and Switches, their difference with Repeaters, Hubs, Routers and Gateways.

Unit 4

Network Layer - Design issues; Routing Principles; Routing Algorithms: Optimality Principle, Shortest Path Routing, Flooding, Distance Vector Routing. Link State Routing, Hierarchical Routing, Broadcasting Routing, Multicast Routing; The Network Layer in the Internet: Internet Protocol, Internet addressing and Internet Control protocols.

Unit 5

Transport Layer - The transport Services; The Internet Transport Protocols: UDP and TCP; The TCP Service Model. Application layer - Client Server Architecture; DNS; WWW and HTTP; Proxy Server; E-mail Protocols; FTP; TELNET. Network Security - Cryptography, Symmetric- key Algorithms, Public- key Algorithms; Digital Signatures

Text Book(s)

Computer Networks, Andrew S. Tanenbaum, Pearson Education, 5th Edition.

Reference Material(s)

1. Data Communications and Networking, B.A. Forouzan, McGraw-Hill, 5th Edition.
2.Computer Networking : James F. Kurose & Keith W. Rose , Pearson Education, Third Edition, 2005.
3.Communication Networks : Fundamentals Concepts and Key Architecture : Alberto Leon-Garcia and Indra Widjaja, , Tata McGraw-Hill Publishing Company Limited, ISBN 0-07-0402235-3.
4. Data and Network Communication : Michael A. Miller, Delmar Thomson Learning inc. ISBN 0-07668-1100-X.
5. Introduction to Computer Networks : Douglas E. Comer , Prentice-Hall.
6. Alberto Leon-Garcia and Indra Widjaja, Communication Networks –Fundamentals Concepts and Key Architecture , Tata McGraw-Hill Publishing Company Limited, ISBN 0-07-0402235-3.
7.Data and Computer Communications : W.Stallings, , Prentice-Hall, 5th Ed., 1997.

Course Name MSc (CS/IT) 3rd Semester
Subject Code: CS 5123
Subject Name: Theory of Computation

Aim of the Subject

The theory of computation is the branch of computer science that deals with whether and how efficiently problems can be solved on a computer. In order to perform a rigorous study of computation, computer scientist's work with mathematical abstractions of

Objectives

1. Introduce students to the mathematical foundations of computation including automata theory; the theory of formal languages and grammars; the notions of algorithm, decidability, complexity, and computability.
2. Enhance/develop students' ability to understand and conduct mathematical proofs for computation and algorithms.

Learning Outcomes

Upon successful completion of this course, you will be able to

1. Discuss key notions of computation, such as algorithm, computability, decidability, reducibility, and complexity, through problem solving.
2. explain the models of computation, including formal languages, grammars and automata, and their connections.
3. Analyze and design finite automata, pushdown automata, Turing machines, formal languages, and grammars.
4. Solve computational problems regarding their computability and complexity and prove the basic results of the theory of computation.

Unit 1

Theory of Automata: String, Alphabet and Languages, Finite Automata, Finite State machine, Basic Definition. Description of a Finite Automaton, Deterministic Finite Accepters Transition Graphs, Languages, Non-deterministic Finite Acceptors-Definition, Finite Automata with ϵ-moves, Equivalence of Deterministic and Non-deterministic Finite Accepters, Conversion of NDFA to DFA, Removal of ϵ transition from ϵ – NDFA, Minimization of Finite Automata –Definition and Construction. Mealy and Moore models Definitions, Transformation of Mealy Machine into Moore Machine and vice-versa.

Unit 2

Properties of Regular Sets: Pumping lemma for regular set, Closure properties of regular set. Formal Language: Basic Definition, Chomsky Classification of languages, Initialization of Finite Automata Regular Expression and Language Regular Expressions, Connection between Regular Expressions and Regular Languages.

Unit 3

Regular Grammars – Right and Left Linear Grammars, Equivalence between Regular Languages and Regular Grammars. Context-Free Grammars: Leftmost and Rightmost Derivations, Derivation Trees, Parsing and Ambiguity, Simplification of CFGs. Chomsky Normal Form, Greibach Normal Form, Cocke-Kasami- Younger Algorithm, Properties of Context-Free Languages.

Unit 4

Pushdown Automata: Definition, Non-deterministic Pushdown Automata, Pushdown Automata for Context Free Languages Context-Free Grammars for Pushdown Automata. Deterministic Pushdown Automata and Deterministic Context-Free Languages.

Unit 5

Turing Machine: Definition of Standard Turing Machine, Turing Machine as Language Accepters and Transducers.

Text Book(s)

1. Mishra and Chandrasekaran, Theory of Computer Science (Automata, language and Computation), 2nd Ed. Prentice Hall of India.
2. J. E. Hopcroft, R. Motwani and J.D Ullman, Introduction to Theory, Languages and Computation; Second Edition, Addison-Wesley, 2001 Narosa Publishing House.

Reference Material(s)

1. Moll, Arbib and Kfoury, an Introduction to Formal Language Theory, Springer-Verlag.
2. Martin, J.C.: Introduction to Languages and the Theory of Computation, McGraw-Hill, Inc.,3rd ed., 2002. ISBN 0-072-32200-4.
3. Brookshear, J.G.: Theory of Computation: Formal Languages, Automata, andComplexity, Benjamin/Cummings Publishing Company, Inc, Redwood City, California, 1989. ISBN 0-805-30143-7.
4. Peter Linz, An Introduction to Formal Languages and Automata, Narosa

Course Name MSc (CS/IT) 3rd Semester
Subject Code: CS- 4211
Subject Name: Object Oriented Programming Using JAVA

Aim of the Subject

To give students a good understanding of basic concepts of object-oriented program design using JAVA. To teach and enable students to develop object-oriented programming skills within the Java language; to enable students to develop object-oriented Java p

Objectives

Briefly describe any course development objectives that are being implemented. (eg increased use of IT or web based reference material, changes in content as a result of new research in the field)
As the technologies in Java are changing frequently so with the textbook, latest changes will also be incorporated in the course using web-based material. Students will also be given programming examples and exercises on every topic. The programming assignments will be checked every week in the computer-lab

Learning Outcomes

- Understand basic principles of object-oriented program design using Java.
- Understand the basic and some advanced issues related to writing classes and methods such as data, visibility, scope, method parameters, object references, and nested classes.
- Understand the basic ideas behind class hierarchies, polymorphism, and programming to interfaces.
- Get exposure to exceptions and basic I/O streams.
- Develop solid Java programming skills and the ability to put in practice the acquired knowledge and understanding of the Java language and object-oriented design in relatively simple case studies

Unit 1

Introduction to Java: Features of Java, Object-oriented Programming Overview, Introduction of Java Technologies, Java Applets and Applications, Java Platform, Java Program structure, Basic Building Blocks (comments, character set, constants), Data Types, Variables, Operators, Expressions, Typecasting, Control Structures, Loops, Memory concepts, Introduction to Class, Objects, Methods and Instance Variables, Naming Conventions, Constructors, Method Overloading, Static Method, Static Field, Math Class, this reference, Garbage collection and finalize method.

Unit 2

String Handling: The String Constructors, String Operations, Character Exaction, String Comparison, String Buffer. Arrays: Creating an array, Enhanced for Statement, Passing Multidimensional Arrays, Arrays to Method, Variable-Length Argument lists, Using Command-line Arguments. Wrapper Class : Introduction to wrapper classes. Inheritance: Relationship between Superclasses and Subclasses, Using super, Constructor in Subclasses, The Object Class, Object Copying in Java. Polymorphism: Method Overriding, Upcasting, Dynamic Method Dispatch, final Field, Method and classes, Abstract classes and Methods, instance of operator, Downcasting, Class class, Runtime type Identification

Unit 3

Packages and Interfaces: Defining a Package, Understanding CLASSPATH, Access Protection, Importing packages, Creating own Packages. Defining an Interface, Properties of Interface, Advantages of Interface Achieving Multiple Inheritance through Interfaces, Variables in Interfaces, Comparable Interface. Exception Handling: Introduction, keywords, Types of Exceptions, Java Exception Hierarchy, finally Block, Chained Exceptions, Declaring new Exception Types, Preconditions and Post-conditions. Streams and Files: Introduction, Data Hierarchy, Files and Streams, Sequential-access Text Files, Object Serialization, Random-Access files, Java Stream Class Hierarchy.

Unit 4

Multithreading: Introduction, Java Thread Model, Thread priorities, Thread life cycle, Creating Thread, Thread Execution, Thread Synchronization, Classes and Interfaces in java.util.concurrent, Monitor and Monitor Locks, Inter-Thread Communication. Introduction To GUI : Introduction, Overview of swing Components, Introduction to Event Handling, Common GUI Event Type and Listener Interfaces, Adapter Classes, Layout Managers Applets: Applet Basics, Applet Architecture, Applet Life Cycle Methods, Applet HTML Tag and Attributes, Executing Applet in Web Browser and in Appletviewer.

Unit 5

Generic and Collection API: Introduction, Motivation for Generic Methods, Generic Methods: Implementation and Compile- time Translation Issues, Overloading Generic Methods, Generic Classes, Raw Types, Generic and Inheritance Database connectivity: JDBC, The design of JDBC, Executing Queries. New Feature of Java: Java Reflection API, Auto boxing, Annotations, Regular Expressions.

Text Book(s)

1. Java 2: The Complete Reference by Herbert Schildt, Tata McGraw- Hill, 8th Edition,
2011.

Reference Material(s)

1. The Java Programming Language, Ken Arnold , James Gosling , David Holmes, 3rd Edition, Pearson Education, 2000.
2. Head First Java, Kathy Sierra, Bert Bates, O'Reilly Publication, 2nd Edition, 2005.

Course Name MSc (CS/IT) 3rd Semester
Subject Code: CS-4508
Subject Name: Computer Graphics and Multimedia

Aim of the Subject

This course aims to combine theoretical approaches with modern techniques of computer graphics and multimedia to design graphics software systems.

Objectives

To introduce the use of the components of a graphics system and become familiar with the building approach of graphics system components and algorithms related to them.

Learning Outcomes

1. To provide an understanding of how to scan convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.
2. To provide an understanding of mapping from world coordinates to device coordinates, clipping, and projections.
3. To learn the basic principles of 3-dimensional computer graphics.
4. To be able to discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.
5. To comprehend and analyze the fundamentals of animation, virtual reality, underlying technologies, principles, and applications.

Unit 1

Introduction to Computer Graphics, Application of Graphics, Display Devices: Refresh Cathode -Ray Tubes, Raster Scan Displays, Random Scan Displays, Color CRT Monitors, Flat Panel Displays. Video cards/display cards, Input Devices: Mouse, Trackball, Space ball, Data Glove, Joystick, Light pen, Scanner, Digital Camera, Touch Panels, Voice Systems. Hardcopy Devices: Printers and Plotters.

Unit 2

Graphics Primitives: Line Generation Algorithms: DDA algorithm, Bresenham's algorithm, Graphics Primitives: Circle Generation Algorithms: Midpoint Circle algorithm, Bresenham's circle generation algorithm, Ellipse Generation algorithm, Polygon filling Algorithms: Scan Line Polygon fill algorithm, Inside - Outside Tests, Boundary-Fill algorithm, Flood - Fill algorithm.

Unit 3

Clipping: Clipping operations, Point clipping, Line clipping: Cohen Sutherland Algorithm, Liang Barsky Algorithm. Polygon clipping: Sutherland- Hodgeman Algorithm.

Unit 4

Two Dimensional Transformations: Translation, Scaling, Rotation, Reflection, Shear, Homogenous coordinate system, composite transformations, raster method of transformation Two Dimensional Viewing: Window to Viewport coordinate transformation, Three Dimensional: 3D Geometry, 3D display techniques, transformations. Projections: Parallel Projection, Perspective Projection.

Unit 5

Color Models and Color Application: Color models: Properties of Light. Standard Primaries and the Chromaticity Diagram, RGB Color Model, CMY Color Model, HSV Color Model, YIQ color model. Advancements in the technology in Computer Graphics. Multimedia: Introduction, Multimedia applications, Multimedia data and File formats.

Text Book(s)

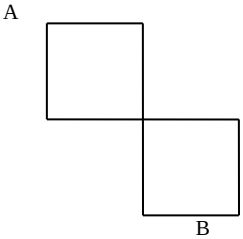
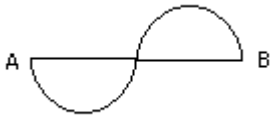
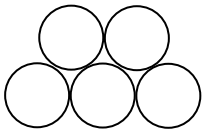
1. Donald Hearn and M. Pauline Baker, Computer Graphics: C Version, Second Edition, Prentice-Hall of India.
2. Tay Vaughan, Multimedia: Making it Works, Seventh Edition, Tata McGraw-Hill Professional, New Delhi.

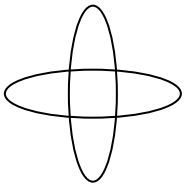
Reference Material(s)

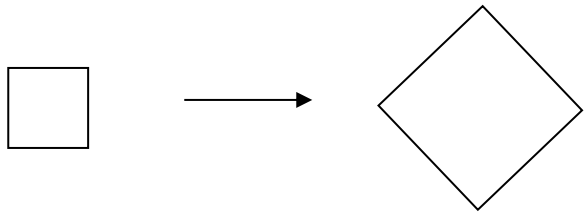
1. David F. Rogers, Procedural Elements for Computer Graphics, Tata Mc-Graw-Hill Publishing Company Ltd., New Delhi, 2001.
2. James D. Foley, Andries van Dam, Steven K. Feiner, John F. Hughes, Computer Graphics: Principles and Practice in C, Second Edition, Addison-Wesley Professional.
3. Zhigang Xiang, Roy A. Plastock, Schaum's outline of Theory and Problems of Computer Graphics, Second Edition, Tata McGraw-Hill Professional, New Delhi

CS-4508 Computer Graphics and Multimedia

List of Assignments

<table>
<tr><th>Week</th><th>Topic</th></tr>
<tr><td>Week 1</td><td>Assignment 1:
1. Write a program to implement DDA algorithm.
2. What are the characteristics of Video Display Devices?
3. Compare and contrast the operating characteristics of Raster Refresh Systems, Plasma Panels and LCDs.
4. Write application of CG in Education and Training.
5. Compare Refresh type and Storage type CRT display.
6. Write a program to draw the following figure:-
 
All sides are equal and point A and B is input.</td></tr>
<tr><td>Week 2</td><td>Assignment 2:
1. Write a program to implement Bresenham’s line algorithm.
2. What are the advantages of Bresenham’s line algorithm over DDA algorithm.
3. How can the Bresenham's line algorithm be modified to accommodate all types of lines?
4. Modify the Bresenham’s line algorithm so that it will produce a dashed-line pattern. Dash length should be independent of slope.
5. Write a program to implement Midpoint circle generating algorithm.</td></tr>
<tr><td>Week 3</td><td>Assignment 3:
1. Write a program to implement Bresenham’s circle generating algorithm.
2. Differentiate between Midpoint & Bresenham’s circle generating algorithm.
3. Write short note on different input devices.
4. Write a program to draw the following figure:-
 
Point A and B is input.
5. Write a program to draw the following figure:-
 
Input is radius of circle as r.</td></tr>
<tr><td>Week 4</td><td>Test-1</td></tr>
</table>

Week 5	**Assignment 4:** 1. Write a program to implement outline character. 2. Write a program to implement bitmap character. 3. Write a program to implement ellipse generating algorithm 4. Write a program to draw the following figure:-  Input is rx, ry and center coordinates.
Week 6	**Assignment 5:** 1. Write a procedure to scan the interior of a specified ellipse into a solid color. 2. Modify the 4-connected boundary fill algorithm to avoid excess stacking. 3. Write the Scan line filling algorithm.
Week 7	**Assignment 6:** 1. Write a short note on viewing transformation. 2. Distinguish between viewport and window. 3. What do you mean by normalization transformation? Why it is needed? 4. Write a program to implement Line Clipping Algorithm using Cohen Sutherland Algorithm. 5. Write a program to implement Line Clipping Algorithm using Liang Barsky Algorithm. 6. Explain the Sutherland and Cohen subdivision algorithm for the line clipping. 7. Explain Liang-Barsky line clipping algorithm.
Week 8	**Assignment 7:** 1. Explain Sutherland-Hodgeman algorithm for polygon clipping. 2. Write a program to Implement Polygon Clipping Algorithm using Sutherland -Hodgman Algorithm. 3. Modify the Liang-Barsky line clipping algorithm to polygon clipping. 4. What do you mean by interior and exterior clipping? 5. Explain how exterior clipping is useful in multiple window environments.
Week 9	**Test-2**
Week 10	**Assignment 8:** 1. Write a program to implement scaling on polygon. 2. Write a program to implement transferring on polygon. 3. Write a program to implement rotation on polygon. 4. Write a program to implement reflection on polygon. 5. Write a Program to implement set of Basic Transformations on Polygon i.e. Translation, Rotation and Scaling.
Week 11	**Assignment 9:** 1. Why are matrices used for implementing transformations? 2. What is the significance of homogeneous co-ordinates? Give the homogeneous co-ordinates for the basic transformations. 3. Write a program to implement set of Composite Transformations on Polygon i.e

	Reflection, Shear (X &Y), rotation about an arbitrary point. 4. Derive the transformation matrix for rotation about an arbitrary axis. 5. Derive the transformation matrix for rotation about an arbitrary plane.
Week 12	**Assignment 10:** 1. Find a transformation of triangle (coordinates will be given) by Rotating 45 degree about the origin and then translating one unit in X and Y direction. 2. Derived transformation matrix for the following figure.  A B 3. Determine the sequence of basic transformations that are equivalent to the x-direction and y-direction shearing matrix. 4. Show that two successive reflections about any line passing through the coordinate origin is equivalent to single rotation about the origin. 5. Show that transformation matrix for a reflection about the line y=x, is equivalent to a reflection relative to the x axis followed by a counterclockwise rotation of 90 degrees.

CS-5713: Data Analytics using R

Data Analytics Assignments

1. What are the differences between supervised and unsupervised learning?

2. How is logistic regression done?

3. Explain the steps in making a decision tree.

4. How can you avoid the overfitting your model?

5. How can you select k for k-means?

6. How can outlier values be treated?

7. What are the drawbacks of the linear model?

8. What is bias, variance trade off ?