RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

CSE-Artificial Intelligence and Machine Learning/ Artificial Intelligence and Machine Learning
IV-Semester

AL401 Introduction to Discrete Structure &Linear Algebra

Unit 1: Set Theory, Relation, Function, Theorem Proving Techniques:Set theory: definition of sets, Venn Diagram, proofs of some general identities on set,Relation: Definition, Types of relation ,Composition of relation ,Equivalence relation, Partial ordering relation,POSET,Hasse diagram and Lattice .

Unit 2: Algebraic structure: Definition, Properties, types: Semi Group, Monoid, Groups, Abelian Group, Properties of group, cyclic group, Normal subgroup, Ring and Fields: definition and standard result, Introduction to Recurrence Relation and Generating Functions.

Unit 3: Propositional logic: Proposition, First order Logic, Basic logical operation, Truth tables, Tautologies and Contradiction, algebra of proposition, logical implication, logical equivalence ,predicates, Normal Forms, Quantifiers
Graph theory: Introduction and basic terminology of graph, types of graph, Path, Cycles, Shortest path in weighted graph, graph colorings.

Unit 4: Matrices: Determinant and Trace,Cholesky Decomposition, Eigen decomposition,Singular Value decomposition(SVD),Gradient of a matrix:Useful identities For computing Gradient.

Unit 5: Test of Hypothesis : Concept and Formulation ,Type-I and Type-II Errors,Time Series Analysis ,Analysis of Variance (ANOVA).

References:

1. C.L.Liu, “Elements of Discrete Mathematics” Tata Mc Graw-Hill Edition.
2. Trembley, J.P & Manohar; “Discrete Mathematical Structure with Application CS”, McGraw Hill.
3. Kenneth H. Rosen, “Discrete Mathematics and its applications”, McGraw Hill.
4. Bisht, “Discrete Mathematics”,Oxford University Press
5. Biswal,”Discrete Mathematics & Graph Theory”, PHI
6. Mathematics For Machine Learning-Marc Peter Deisenroth,A. Aldo Faisal,Cheng soon ong
7.Statistical Method- S.P. Gupta

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AL402 Analysis &Design of Algorithms

Unit I : Definitions of algorithms and complexity, Time and Space Complexity; Time space tradeoff, various bounds on complexity, Asymptotic notation, Recurrences and Recurrences solving techniques, Introduction to divide and conquer technique, example: binary search, merge sort, quick sort, heap sort, strassen's matrix multiplicationetc, Code tuning techniques: Loop Optimization, Data Transfer Optimization, Logic Optimization, etc.

Unit II : Study of Greedy strategy, examples of greedy method like optimal merge patterns, Huffman coding, minimum spanning trees, knapsack problem, job sequencing with deadlines, single source shortest path algorithm etc. Correctness proof of Greedy algorithms.

Unit III : Concept of dynamic programming, problems based on this approach such as 0/1 knapsack, multistage graph, reliability design, Floyd-Warshall algorithm etc.

Unit IV : Backtracking concept and its examples like 8 queen's problem, Hamiltonian cycle, Graph colouring problem etc. Introduction to branch & bound method, examples of branch and bound method like travelling salesman problem etc. Meaning of lower bound theory and its use in solving algebraic problem, introduction to parallel algorithms.

Unit V : Advanced tree and graph algorithms, NP-hard and NP-complete problems, Approximations Algorithms, Data Stream Algorithms, Introduction to design and complexity of Parallel Algorithms.

References:

1. Coremen Thomas, Leiserson CE, Rivest RL, Introduction to Algorithms, Third edition, PHI.
2. Horowitz &Sahani, Analysis & Design of Algorithm, Fourth Edition Computer Science Press.
3. Dasgupta, algorithms, Fifth Edition, TMH
4. Ullmann; Analysis & Design of Algorithm, Addison-wesley publishing company,
5. Michael T Goodrich, RobartoTamassia, Algorithm Design, Wiely India
6. Rajesh K Shukla: Analysis and Design of Algorithms: A Beginner's Approach; Wiley

List of Experiments :

1. Write a program for Iterative and Recursive Binary Search.
2. Write a program for Merge Sort.
3. Write a program for Quick Sort.
4. Write a program for Strassen's Matrix Multiplication.
5. Write a program for optimal merge patterns.
6. Write a program for Huffman coding.
7. Write a program for minimum spanning trees using Kruskal's algorithm.
8. Write a program for minimum spanning trees using Prim's algorithm.
9. Write a program for single sources shortest path algorithm.
10. Write a program for Floye-Warshal algorithm.
11. Write a program for traveling salesman problem.
12. Write a program for Hamiltonian cycle problem.

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AL403 Software Engineering

RATIONALE:
The purpose of this subject is to cover the underlying concepts and techniques used in Software Engineering & Project Management. Some of these techniques can be used in software design & itsimplementation.

PREREQUISITE:-
The students should have at least one year of experience in programming a high-level language and databases. In addition, a familiarity with software development life cycle will be useful in studying thissubject.

Unit I : The Software Product and Software Process
Software Product and Process Characteristics, Software Process Models: Linear Sequential Model, Prototyping Model, RAD Model, Evolutionary Process Models like Incremental Model, Spiral Model, Component Assembly Model, RUP and Agile processes. Software Process customization and improvement, CMM, Product and ProcessMetrics

Unit II : Requirement Elicitation, Analysis, and Specification
Functional and Non-functional requirements, Requirement Sources and Elicitation Techniques, Analysis Modeling for Function-oriented and Object-oriented software development, Use case Modeling, System and Software Requirement Specifications, Requirement Validation,Traceability

Unit III : Software Design
The Software Design Process, Design Concepts and Principles, Software Modeling and UML, Architectural Design, Architectural Views and Styles, User Interface Design, Function- oriented Design, SA/SD Component Based Design, DesignMetrics.

Unit IV : Software Analysis and Testing
Software Static and Dynamic analysis, Code inspections, Software Testing, Fundamentals, Software Test Process, Testing Levels, Test Criteria, Test Case Design, Test Oracles, Test Techniques, Black-Box Testing, White-Box Unit Testing and Unit, Testing Frameworks, Integration Testing, System Testing and other Specialized, Testing, Test Plan, Test Metrics, Testing Tools. , Introduction to Object-oriented analysis, design and comparison with structured SoftwareEngg.

Unit V : Software Maintenance & Software Project Measurement
Need and Types of Maintenance, Software Configuration Management (SCM), Software Change Management, Version Control, Change control and Reporting, Program Comprehension Techniques, Re-engineering, Reverse Engineering, Tool Support. Project Management Concepts, Feasibility Analysis, Project and Process Planning,Resources Allocations, Software efforts, Schedule, and Cost estimations, Project Scheduling and Tracking, Risk Assessment and Mitigation, Software Quality Assurance (SQA). Project Plan, ProjectMetrics.

Practical and Lab work

Lab work should include a running case study problem for which different deliverable sat the end of each phase of a software development life cycle are to be developed. This will include modeling the requirements, architecture and detailed design. Subsequently the design models will be coded and tested. For modeling, tools like Rational Rose products. For coding and testing, IDE like Eclipse, Net Beans, and Visual Studio can beused.

References

1. Pankaj Jalote ,"An Integrated Approach to Software Engineering", NarosaPub, 2005
2. RajibMall, "Fundamentals of Software Engineering" Second Edition, PHI Learning
3. R S. Pressman,"Software Engineering: A Practitioner's Approach", Sixth edition 2006, McGraw-Hill.
4. Sommerville,"Software Enginerring",PearsonEducation.
5. Richard H.Thayer,"SoftwareEnginerring& Project Managements",WileyIndia
6. Waman S.Jawadekar,"Software Enginerring",TMH
7. BobHughes,M.Cotterell,RajibMall"SoftwareProjectManagement",McGrawHill

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AL404 Computer Organization& Architecture

Objectives: Students to be familiarize the basic principles of computer architecture, Designand Multi Processing, Types of data transfer, Concept of semiconductor memories which is useful for research work in field ComputerSystem.

Unit I : Basic Structure of Computer:Structure of Desktop Computers, CPU: General Register Organization-Memory Register, Instruction Register, Control Word, Stack Organization, Instruction Format, ALU, I/O System, bus,CPU and Memory Program Counter, Bus Structure, Register Transfer Language-Bus and Memory Transfer, addressing modes. Control Unit Organization: Basic Concept of Instruction, Instruction Types, Micro Instruction Formats, Fetch and Execution cycle, Hardwired control unit, Micro- programmed Control unit microprogram sequencer Control Memory, Sequencing and Execution of MicroInstruction.

Unit II : Computer Arithmetic**:** Addition and Subtraction, Tools Compliment Representation, Signed Addition and Subtraction, Multiplication and division, Booths Algorithm, Division Operation, Floating Point Arithmetic Operation. design of Arithmeticunit

Unit III :I/O Organization: I/O Interface –PCI Bus, SCSI Bus, USB, Data Transfer: Serial, Parallel, Synchronous, Asynchronous Modes of Data Transfer, Direct Memory Access(DMA), I/OProcessor.

Unit IV : Memory Organization:Main memory-RAM, ROM, Secondary Memory –Magnetic Tape, Disk, Optical Storage, Cache Memory: Cache Structure and Design, Mapping Scheme, Replacement Algorithm, Improving Cache Performance, Virtual Memory, memory managementhardware

Unit V : Multiprocessors:Characteristics of Multiprocessor, Structure of Multiprocessor-Inter-processor Arbitration, Inter-Processor Communication and Synchronization. Memory in Multiprocessor System, Concept of Pipelining, Vector Processing, Array Processing, RISC And CISC, Study of Multicore Processor –Intel,AMD.

Reference Books:

1. Morris Mano , “Computer System Organization”PHI
2. Alan Clements: “Computer Organization and Architecture”, Cengage Learning
3. SubrataGhosal: “Computer Architecture and Organization”,Pearson
4. William stalling ,“Computer Architecture and Organization” PHI
5. M. Usha, T.S. Shrikant: “Computer System Architecture and Organization”, Willey India
6. Chaudhuri, P.Pal: “Computer Organization and Design”,PHI
7. Sarangi: “Computer Organization and Architecture”,Mc-GrawHills

List of Experiments :

1. Study of Multiplexer andDemultiplexer
2. Study of Half Adder and Subtractor

3. Study of Full Adder andSubtractor
4. WAP to add two 8 bit numbers and store the result at memory location2000
5. WAP to multiply two 8 bit numbers stored at memory location 2000 and 2001 and stores the result at memory location 2000 and2001.
6. WAP to add two 16-bit numbers. Store the result at memory address starting from 2000.
7. WAP which tests if any bit is '0' in a data byte specified at an address 2000. If it is so, 00 would be stored at address 2001 and if not so then FF should be storedata the same address.
8. Assume that 3 bytes of data are stored at consecutive memory addresses of the data memory starting at 2000. Write a program which loads register C with (2000), i.e. with data contained at memory address2000, D with (2001), E with (2002) and A with (2001).
9. Sixteen bytes of data are specified at consecutive data-memory locations starting at 2000. Write a program which increments the value of all sixteen bytes by01.
10. WAP to add t 10 bytes stored at memory location starting from 3000. Store the result at memory location300A

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AL405 Machine Learning

Course Objectives: This course provides a broad introduction to machine learning. It offers some of the most cost-effective approaches to automated knowledge acquisition in emerging data-rich disciplines and focuses on the theoretical understanding of these methods, as well as their computational implications.
To provide an understanding of the theoretical concepts of machine learning and prepare students for research or industry application of machine learning techniques

Unit I : Introduction to machine learning, scope and limitations, machine learning models, Supervised Learning, Unsupervised Learning,hypothesis space and inductive bias, evaluation, cross-validation, Dimensionality Reduction: Subset Selection, Shrinkage Methods, Principle Components Analysis, Partial Least Squares.

Unit II : Neural Networks: From Biology to Simulation, Neural network representation, Neural Networks as a paradigm for parallel processingPerceptron Learning, Training a perceptron, Multilayer perceptron, back propagation Algorithm, Training & Validation,Activation functions, Vanishing and Exploding Gradients.

Unit III : Supervised Learning Techniques:- Decision Trees, Naive Bayes, Classification, Support vector machines for classification problems, Random forest for classification and regression problems, Linear regression for regression problems, Ordinary Least Squares Regression, Logistic Regression.

Unit IV : Unsupervised Learning, Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture model, Optimization Using Evolutionary Techniques, Number of Clusters, Advanced discussion on clustering, Expectation Maximization.

Unit V : Design and Analysis of Machine Learning Experiments:Factors, response and strategy of experimentation, Guidelines for machine learning experiments, cross-validation and resampling methods, Measuring classifier performance, Hypothesis testing, comparing multiple algorithms, comparison over multiple datasets

Books and references :

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Introduction to Machine Learning Edition 2, by EthemAlpaydin
3. Introduction to Machine learning, Nils J.Nilsson
4. Machine learning for dummies, IBM Limited ed, by Judith Hurwitz and Daniel Kirsch
5. Introduction to Machine Learning with Python A guide for data scientists, Andreas, C. Muller & Sarah Guido, O'Reilly

List of Experiments:

Different problems to be framed to enable students to understand the concept learnt and get hands-on on various tools and software related to the subject

1. How to calculate important numbers based on data sets, how to use various Python modules and how to make functions that are able to predict the outcome based on what we have learned (Small Dataset)
2. How can we get Big Data Sets, Learn: Data Distribution, Normal data distribution, Random Data Distribution, Scatter Plot.
3. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
4. The probability that it is Friday and that a student is absentis 3%. Since there are 5 school days in a week,the probability that it is Friday is 20%. What is the probability that a student is absent given that today is Friday? Apply Baye's rule in python to get the result.
5. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set.
6. Implement and demonstrate simple Linear Regression Algorithm based on a given set of training data samples. Read the training data from a .CSV file.
7. Implement and demonstrate Logistic Regression (Binomial) based on a given set of training data samples. Read the training data from a .CSV file.
8. Implement and demonstrate 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.
9. 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.
10. Given the following data, which specify classifications for nine combinations of VAR1 and VAR2 predict a classification for a case where VAR1=0.906 and VAR2=0.606, using the result of k-means clustering with 3 means (i.e., 3 centroids)

VAR1	VAR2	CLASS
1.713	1.586	0
0.180	1.786	1
0.353	1.240	1
0.940	1.566	0
1.486	0.759	1
1.266	1.106	0
1.540	0.419	1
0.459	1.799	1
0.773	0.186	1

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AL406 Java Lab

Course Objectives:
1. Understand fundamentals of programming such as variables, conditional and iterativeexecution, methods, etc.
2. Understand fundamentals of object-oriented programming in Java and be familiar of theimportant concepts like class, inheritance and multithreading, AWT and JDBC.
3. Students will able to use the Java SDK environment to create, debug and run simple Javaprograms.

Unit 1. Overview of Java, Installation, First Simple Program, Compilation process, JavaKeywords , Identifiers , Literals, Comments, Data Types, Variables, Dynamic initialization, typeconversion and casting, Operators, Control Statements.

Unit 2. Declaring Objects, Introducing Methods, Constructors, this Keyword, GarbageCollection, finalize Method, Overloading Methods, Overloading Constructors, Using Objects asParameters, Inheritance, Creating a Multilevel Hierarchy, Packages and Interfaces, ExceptionHandling, Multithreaded

Unit 3. The Applet Class: Applet Basics, The Applet Class, Applet Architecture, AppletInitialization and Termination , Simple Applet Display Methods, Simple Banner Applet, Usingthe Status Window, The HTML APPLET Tag, Passing Parameters to Applets, Improving theBanner Applet.

Unit 4. Introducing the AWT: Working with Windows, Graphics, and Text, AWT Classes,Window Fundamentals, Component, Container, Panel, Frame, Working with Frame Windows,Handling Events in a Frame Window, AWT Controls, Layout Managers, and Menus, Addingand Removing Controls, Grid Layout, Border Layout, introduction to swing and servlet.

Unit 5. Event Handling, Two Event Handling Mechanisms, The Delegation Event Model,Events, Event Sources, Event Listeners, Event Classes, The Mouse Event Class and others,JDBC: JDBCODBC bridge, the connectivity model, the driver manager, navigating the result setobject contents, the JDBC exceptional classes, connecting to remote database.

Reference Books:
1. E. Balagurusamy, “Programming with java A Primer”, McGrawHill.
2. Sharanam Shah, “ Core Java 8 for Beginners”, Shroff Publisher.
3. Naughton &Schildt, “The Complete Reference Java 2”, Tata McGraw Hill.
4. Horstmann& Cornell, “Core Java 2” (Vol I &II), Pearson.

List of Experiments:
1. Write a program that accepts two numbers from the user and print their sum.
2. Write a program to calculate addition of two number using prototyping of methods.
3. Program to demonstrate function overloading for calculation of average.
4. Program to demonstrating overloaded constructor for calculating box volume.
5. Program to show the detail of students using concept of inheritance.
6. Program to demonstrate package concept.
7. Program to demonstrate implementation of an interface which contains two methodsdeclaration square and cube.

8. Program to demonstrate exception handling in case of division by zero error.
9. Program to demonstrate multithreading.
10. Program to demonstrate JDBC concept using create a GUI based application for student information.
11. Program to display “Hello World” in web browser using applet.
12. Program to add user controls to applets.
13. Write a program to create an application using concept of swing.
14. Program to demonstrate student registration functionality using servlets with session management.