RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

CSE-Artificial Intelligence and Machine Learning/ Artificial Intelligence and Machine Learning, VI-Semester

AL-601 Theory of Computation

COURSE OBJECTIVE

- To understand computability, decidability, and complexity through problem solving.
- To analyze and design abstract model of computation & formal languages
- To understand and conduct mathematical proofs for computation and algorithms.

COURSE OUTCOMES

After completion of this course, the students would be able to:

- CO1.explain the basic concepts of switching and finite automata theory & languages.
- CO2.relate practical problems to languages, automata, computability and complexity.
- CO3.construct abstract models of computing and check their power to recognize the languages.
- CO4.analyse the grammar, its types, simplification and normal form.
- CO5.interpret rigorously formal mathematical methods to prove properties of languages, grammars and automata.
- CO6.develop an overview of how automata theory, languages and computation are applicable in engineering application.

Unit-I

Introduction of Automata Theory: Examples of automata machines, Finite Automata as a language acceptor and translator, Moore machines and mealy machines, composite machine, Conversion from Mealy to Moore and vice versa.

Unit-II

Types of Finite Automata: Non Deterministic Finite Automata (NDFA), Deterministic finite automata machines, conversion of NDFA to DFA, minimization of automata machines, regular expression, Arden's theorem. Meaning of union, intersection, concatenation and closure, 2 way DFA.

Unit-III

Grammars: Types of grammar, context sensitive grammar, and context free grammar, regular grammar. Derivation trees, ambiguity in grammar, simplification of context free grammar, conversion of grammar to automata machine and vice versa, Chomsky hierarchy of grammar, killing null and unit productions. Chomsky normal form and Greibach normal form.

Unit-IV

Push down Automata: example of PDA, deterministic and non-deterministic PDA, conversion of PDA into context free grammar and vice versa, CFG equivalent to PDA, Petrinet model.

Unit-V

Turing Machine: Techniques for construction. Universal Turing machine Multitape, multihead and multidimensional Turing machine, N-P complete problems. Decidability and Recursively Enumerable Languages, decidability, decidable languages, undecidable languages, Halting problem of Turing machine & the post correspondence problem.

RECOMMENDED BOOKS

- Introduction to Automata Theory Language & Computation, Hopcroft& Ullman, Narosa Publication.
- Element of the Theory Computation, Lewis &Christors, Pearson.
- Theory of Computation, Chandrasekhar & Mishra, PHI.
- Theory of Computation, Wood, Harper & Row.

- Introduction to Computing Theory, Daniel I-A Cohen, Wiley.

LIST OF EXPERIMENTS

1. Design a Program for creating machine that accepts three consecutive one.
2. Design a Program for creating machine that accepts the string always ending with 101.
3. Design a Program for Mode 3 Machine
4. Design a program for accepting decimal number divisible by 2.
5. Design a program for creating a machine which accepts string having equal no. of 1's and 0's.
6. Design a program for creating a machine which count number of 1's and 0's in a given string.
7. Design a Program to find 2's complement of a given binary number.
8. Design a Program which will increment the given binary number by 1.
9. Design a Program to convert NDFA to DFA.
10. Design a Program to create PDA machine that accept the well-formed parenthesis.
11. Design a PDA to accept WCWR where w is any string and WR is reverse of that string and C is a Special symbol.
12. Design a Turing machine that's accepts the following language $a^n b^n c^n$ where n>0

COURSE OUTCOMES

After completion of this course, the students would be able to:

- CO1: judge various computational models.
- CO2: construct abstract models of computing.
- CO3: justify the power of abstract models in computing to recognize the languages.
- CO4: demonstrate analytical thinking and intuition for problem solving in the related areas.
- CO5: discuss the limitations of computation in problem solving.
- CO6: follow set of rules for syntax verification.

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CSE-Artificial Intelligence and Machine Learning/ Artificial Intelligence and Machine Learning, VI-Semester

AL-602 Computer Networks

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

1. Characterize and appreciate computer networks from the view point of components and from the view point of services
2. Display good understanding of the flow of a protocol in general and a network protocol in particular
3. Model a problem or situation in terms of layering concept and map it to the TCI/IP stack
4. Select the most suitable Application Layer protocol (such as HTTP, FTP, SMTP, DNS, Bit torrent) as per the requirements of the network application and work with available tools to demonstrate the working of these protocols.
5. Design a Reliable Data Transfer Protocol and incrementally develop solutions for the requirements of Transport Layer
6. Describe the essential principles of Network Layers and use IP addressing to create subnets for any specific requirements

Unit –I Computer Network: Definitions, goals, components, Architecture, Classifications & Types. Layered Architecture: Protocol hierarchy, Design Issues, Interfaces and Services, Connection Oriented & Connectionless Services, Service primitives, Design issues & its functionality. ISOOSI Reference Model: Principle, Model, Descriptions of various layers and its comparison with TCP/IP. Principals of physical layer: Media, Bandwidth, Data rate and Modulations

Unit-II Data Link Layer: Need, Services Provided, Framing, Flow Control, Error control. Data Link Layer Protocol: Elementary & Sliding Window protocol: 1-bit, Go-Back-N, Selective Repeat, Hybrid ARQ. Protocol verification: Finite State Machine Models & Petri net models. ARP/RARP/GARP

Unit-III MAC Sub layer: MAC Addressing, Binary Exponential Back-off (BEB) Algorithm, Distributed Random Access Schemes/Contention Schemes: for Data Services (ALOHA and SlottedALOHA), for Local-Area Networks (CSMA, CSMA/CD, CSMA/CA), Collision Free Protocols: Basic Bit Map, BRAP, Binary Count Down, MLMA Limited Contention Protocols: Adaptive Tree Walk, Performance Measuring Metrics. IEEE Standards 802 series & their variant.

Unit-IV Network Layer: Need, Services Provided , Design issues, Routing algorithms: Least Cost Routing algorithm, Dijkstra's algorithm, Bellman-ford algorithm, Hierarchical Routing, Broadcast Routing, Multicast Routing. IP Addresses, Header format, Packet forwarding, Fragmentation and reassembly, ICMP, Comparative study of IPv4 & IPv6

Unit-V Transport Layer: Design Issues, UDP: Header Format, Per-Segment Checksum, Carrying Unicast/Multicast Real-Time Traffic, TCP: Connection Management, Reliability of Data Transfers, TCP Flow Control, TCP Congestion Control, TCP Header Format, TCP Timer Management. Application Layer: WWW and HTTP, FTP, SSH, Email (SMTP, MIME, IMAP), DNS, Network Management (SNMP).

References:

1.Andrew S. Tanenbaum, David J. Wetherall, “Computer Networks” Pearson Education.

2 Douglas E Comer, “Internetworking WithTcp/Ip Principles, Protocols, And Architecture - Volume I” 6 th Edition,Pearson Education

3.DimitriBertsekas, Robert Gallager, “Data Networks”, PHI Publication, Second Edition.

4.KavehPahlavan, Prashant Krishnamurthy, “Networking Fundamentals”, Wiley Publication.

5.Uyless Black, “Computer Networks”, PHI Publication, Second Edition.

6.Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill.

List of Experiments:

1. Study of Different Type of LAN& Network Equipments.
2. Study and Verification of standard Network topologies i.e. Star, Bus, Ring etc.
3. LAN installations and Configurations.
4. Write a program to implement various types of error correcting techniques.
5. Write a program to implement various types of farming methods.
6. Study of Tool Command Language (TCL).
7. Study and Installation of Standard Network Simulator: N.S-2, N.S3.OpNet,QualNetetc .
8. Study & Installation of ONE (Opportunistic Network Environment) Simulator for High Mobility Networks .
9. Configure 802.11 WLAN.
10. Implement &Simulate various types of routing algorithm.
11. Study & Simulation of MAC Protocols like Aloha, CSMA, CSMA/CD and CSMA/CA using Standard Network Simulators.
12. Study of Application layer protocols-DNS, HTTP, HTTPS, FTP and TelNet.

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CSE-Artificial Intelligence and Machine Learning/ Artificial Intelligence and Machine Learning, VI-Semester

Departmental Elective AL603 (A) Image and Video Processing

Course Objective:

The students will be able to work with images and videos in several ways. These methods can be used as pre-processing steps for complex models.

Detailed Contents:

Module 1: Image representation and analysis, Introduction to computer Vision, Numerical representation of images, Image augmentation, enhancement, processing, color transforms, geometric transforms, feature recognition and

extraction

Module 2: Image Segmentation Object detection, breaking image into parts, finding contours and edges of various objects in image, Background subtraction for video.

Module 3: Object Motion and tracking Tracking a single point over time, motion models to define object movement over time, analyze

videos as sequences of individual image frames, methods to track a set of features over time,

matching features from image frame to other, tracking a moving car using optical flow

Module 4: Robotic localization

Bayesian statistics to locate a robot in space, sensor measurements to safely navigate an

environment, Gaussian uncertainty, histogram filter for robot localization in python.

Module 5: Image Restoration

Degradation model, noise models, estimation of degradation function by modeling, restoration

using Weiner filters and Inverse filters

Laboratory/ Practicals (if any): Mention list of Practicals

1. Various forms of image representation
2. Apply various image segmentation algorithms
3. Apply object motion and tracking
4. Apply object localization
5. Apply image restoration

Text Books/Suggested References:

1. Audio Video Systems, Bali & Bali, Khanna Book Publishing 2020.
2. Handbook of Image and Video Processing by Alan C. Bovik, Academic Press, 2000.
3. Python 3 Image Processing, Ashwin Pajankar, BPB Publication, 2019.
4. https://www.coursera.org/learn/image-processing

Course Outcomes: After completion of course, students would be able to:

1. Understand images and videos representation in a detailed manner.
2. Apply ML techniques for image processing in different scenarios.
3. Apply various object detection and image segmentation algorithms
4. Apply various image restoration techniques and algorithm

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Departmental Elective AL603 (B) Data and Visual Analytics

Unit 1 : Data Definitions and Analysis Techniques: Elements, Variables, and Data categorization Levels of Measurement Data management and indexing Introduction to Statistical Concepts: Sampling Distributions, Resampling, Statistical Inference and Descriptive Statistics, Measures of central tendency, Measures of location of dispersions

Unit 2: Advance Data analysis techniques: Statistical hypothesis generation and testing, Chi-Square test, t-Test, Analysis of variance, Correlation analysis, Maximum likelihood test, Regression Modelling, Multivariate Analysis, Bayesian Modelling, Inference and Bayesian Network, Regression analysis

Unit 3: Data Wrangling: Intro to Data Wrangling, Gathering Data, Assessing Data, Cleaning Data.

Data Visualization in Data Analysis: Design of Visualizations, Univariate Exploration of Data, Bivariate Exploration of Data, Multivariate Exploration of Data, Explanatory Visualizations.

Unit 4: Data Ecosystem: Overview of the Data Analyst Ecosystem, Types of Data, Understanding Different Types of File Formats, Sources of Data, Overview of Data Repositories, NoSQL, Data Marts, Data Lakes, ETL, and Data Pipelines, Foundations of Big Data, Big Data processing tools such as Hadoop, Hadoop Distributed File System (HDFS), Hive, and Spark

Unit 5: Data Visualization tools: Python visualization libraries (matplotlib, pandas, seaborn, ggplot, plotly), Introduction to PowerBI tools, Examples of inspiring (industry) projects- Exercise: create your own visualization of a complex dataset.

Text Books/References:

1. Joel Grus, Data Science from Scratch, Shroff Publisher Publisher /O'Reilly Publisher Media
2. Annalyn Ng, Kenneth Soo, Numsense! Data Science for the Layman, Shroff Publisher Publisher
3. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly Publisher Media.
4. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge
University Press.
5. Jake VanderPlas, Python Data Science Handbook, Shroff Publisher Publisher /O'Reilly Publisher Media 6. Philipp Janert, Data Analysis with Open Source Tools, Shroff Publisher Publisher /O'Reilly Publisher Media.

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Departmental Elective AL603 (C) Pattern Recognition

Course Objective: To help students understand basic mathematical and statistical techniques commonly used in pattern recognition. To introduce students to a variety of pattern recognition algorithms.

Detailed Contents:

Module 1: Introduction and mathematical Preliminaries Principles of pattern recognition: Uses, mathematics, Classification and Bayesian rules, Clustering vs classification, Basics of linear algebra and vector spaces, Eigen values and eigen vectors, Rank of matrix and SVD

Module 2: Pattern Recognition basics Bayesian decision theory, Classifiers, Discriminant functions, Decision surfaces, Parameter estimation methods, Hidden Markov models, dimension reduction methods, Fisher discriminant analysis, Principal component analysis, non-parametric techniques for density estimation, nonmetric methods for pattern classification, unsupervised learning, algorithms for clustering: Kmeans, Hierarchical and other methods

Module 3: Feature Selection and extraction Problem statement and uses, Branch and bound algorithm, Sequential forward and backward selection, Cauchy Schwartz inequality, Feature selection criteria function: Probabilistic separability based and Interclass distance based, Feature Extraction: principles

Module 4: Visual Recognition Human visual recognition system, Recognition methods: Low-level modelling (e.g. features), Midlevel abstraction (e.g. segmentation), High-level reasoning (e.g. scene understanding); Detection/Segmentation methods; Context and scenes, Importance and saliency, Large-scale search and recognition, Egocentric vision, systems, Human-in-the-loop interactive systems, 3D scene understanding.

Module 5: Recent advancements in Pattern Recognition Comparison between performance of classifiers, Basics of statistics, covariance and their properties, Data condensation, feature clustering, Data visualization, Probability density estimation, Visualization and Aggregation, FCM and soft-computing techniques, Examples of real-life datasets.

Laboratory/ Practicals:

1. Data extraction
2. Pre-processing of images
3. Image segmentation
4. Image classification AICTE

Text Books/Suggested References:

1. Pattern Recognition and Machine Learning by Christopher M. Bishop, Springer, 2006.
2. Pattern Classification by Richard O. Duda , Peter E. Hart, David G. Stork, Wiley, 1973.
3. https://nptel.ac.in/courses/106/106/106106046/

Course Outcomes: After completion of course, students would be able to:

1. Understand basic mathematical and statistical techniques commonly used in pattern recognition.
2. Apply a variety of pattern recognition algorithms.
3. Understand and apply various pre-processing algorithms.
4. Apply various algorithms for image classification.

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CSE-Artificial Intelligence and Machine Learning/ Artificial Intelligence and Machine Learning, VI-Semester

Open Elective AL604 (A) Cloud Computing

Course Objective: The objective of this course is to provide students with the comprehensive and in depth knowledge of Cloud Computing concepts, technologies, architecture and applications.

UNIT I Introduction of Grid and Cloud computing, characteristics, components, business and IT perspective, cloud services requirements, cloud models, Security in public model, public verses private clouds, Cloud computing platforms: Amazon EC2,Platform as Service: Google App Engine, Microsoft Azure, Utility Computing, Elastic Computing.

UNIT II Cloud services- SAAS, PAAS, IAAS, cloud design and implementation using SOA, conceptual cloud model, cloud stack, computing on demand, Information life cycle management, cloud analytics, information security, virtual desktop infrastructure, storage cloud.

UNIT III Virtualization technology: Definition, benefits, sensor virtualization, HVM, study of hypervisor, logical partitioning- LPAR, Storage virtualization, SAN, NAS, cloud server virtualization, virtualized data center.

UNIT IV Cloud security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud, Cloud computing security architecture: Architectural Considerations- General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro-architectures; Identity Management and Access control-Identity management, Access control, Autonomic Security, Cloud computing security challenges: Virtualization security management-virtual threats, VM Security Recommendations, VM-Specific Security techniques, Secure Execution Environments and Communications in cloud.

UNIT V SOA and cloud, SOA and IAAS, cloud infrastructure benchmarks, OLAP, business intelligence, e-Business, ISV, Cloud performance monitoring commands, issues in cloud computing. QOS issues in cloud, mobile cloud computing, Inter cloud issues, Sky computing, Cloud Computing Platform, Xen Cloud Platform, Eucalyptus, OpenNebula, Nimbus, TPlatform, Apache Virtual Computing Lab (VCL), Anomaly Elastic Computing Platform.

References:

1. Dr.Kumar Saurabh, “Cloud Computing”, Wiley India.
2. Ronald Krutz and Russell Dean Vines, “Cloud Security”, Wiley-India.
3. Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper, “Computing for Dummies”, Wiley India Edition.
4. Anthony T.Velte Toby J.Velte, “Cloud Computing – A Practical Approach”, TMH.
5. Barrie Sosinsky, ‘Cloud Computing Bible”, Wiley India.

Course Outcomes: After the completion of this course, the students will be able to:

1. Explain the core concepts of the cloud computing paradigm
2. Demonstrate knowledge of virtualization
3. Explain the core issues of cloud computing such as security, privacy, and interoperability.
4. Choose the appropriate technologies, algorithms, and approaches for the related issues.
5. Identify problems, and explain, analyze, and evaluate various cloud computing solutions

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Open Elective AL604 (B) Information Security & Management

UNIT-I

Introduction: Needs for Security; Basic security terminologies e.g. threats, vulnerability, exploit etc.; Security principles(CIA), authentication, nonrepudiation; security attacks and their classifications; Mathematical foundation - Prime Number; Modular Arithmetic; Fermat's and Euler's Theorem; The Euclidean Algorithms; The Chinese Remainder Theorem; Discrete logarithms**.**

UNIT-II

Symmetric Key Cryptography: Classical cryptography – substitution, transposition and their cryptanalysis; Symmetric Cryptography Algorithm – DES, 3DES, AES etc.; Modes of operation: ECB, CBC etc.; Cryptanalysis of Symmetric Key Ciphers: Linear Cryptanalysis, Differential Cryptanalysis.

UNIT-III

Asymmetric Key Cryptography: Key Distribution and Management, Diffie-Hellman Key Exchange algorithm; Asymmetric Key Cryptography Algorithm– RSA, ECC etc.; Various types of attacks on Cryptosystems.

UNIT-IV

Authentication & Integrity – MAC, Hash function, SHA, MD5, HMAC, Digital signature and authentication protocols; Authorization; Access control mechanism; X.509 Digital Certificate**.**

UNIT-V

E-mail, IP and Web Security: E-mail security – PGP, MIME, S/MIME; IP security protocols; Web security – TLS, SSL etc.; Secure Electronic Transaction(SET); Firewall and its types; Introduction to IDPS; Risk Management; Security Planning.

TEXT BOOKS RECOMMENDED:

1. Michael E. Whitman, Herbert J. Mattord, "Principles of Information Security", 6th Edition, Cengage Learning.

2. Stallings William, "Cryptography and Network Security - Principles and Practice", 7th Edition, Pearson.

REFERENCE BOOKS:

1. Roberta Bragge, Mark Rhodes, Keith Straggberg, "Network Security the Complete Reference", Tata McGraw Hill Publication,

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Open Elective AL604 (C) Intelligent Systems for Robotics

Course Objective:
The students will be able to understand the basic concepts and fundamentals of robotics. They will also be able to use AI in the field of robotics.
Detailed Contents:

Unit 1:
Introduction: Introduction to Robotics Fundamentals of Robotics, Robot Kinematics: Position Analysis, Dynamic Analysis and Forces, Robot Programming languages & systems: Introduction, the three levels of robot programming, requirements of a robot programming language, problems peculiar to robot programming languages.

Unit 2:
Need of AI in Robotics: History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents.

Unit 3:
Game Playing: AI and game playing, plausible move generator, static evaluation move generator, game playing strategies, problems in game playing.

Unit 4:
Robotics fundamentals: Robot Classification, Robot Specification, notation, kinematic representations and transformations, dynamics techniques; trajectory planning and control**.**

Unit 5:
Robotics and Its applications: DDD concept, Intelligent robots, Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems-Specifications of Robot-Speed of Robot, Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems-Hydraulic, Pneumatic and Electric system

Suggested References:

1. Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Peter Corke, Springer, 2011.
2. Robotics: Everything You Need to Know About Robotics from Beginner to Expert, Peter McKinnon, Createspace Independent Publishing Platform, 2016.
3. Introduction to AI Robotics, Second Edition, By Robin R. Murphy, MIT press, 2001.
4. Artificial Intelligence for Robotics: Build intelligent robots that perform human tasks using AI techniques, Francis X. Govers, Packt Publishers, 2018