

**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA,
BHOPAL**

New Scheme Based On AICTE Flexible Curricula

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

AL701 Computer Vision

Course Objectives: Students should be able to

Understand practice and theory of computer vision. Elaborate computer vision algorithms, methods and concepts

Implement computer vision systems with emphasis on applications and problem solving

Apply skills for automatic analysis of digital images to construct representations of physical objects and scenes.

Design and implement real-life problems using Image processing and computer vision.

Unit I: Introduction to computer vision, Introduction to images, Image Processing VS Computer Vision, Problems in Computer Vision, Basic image operations, Mathematical operations on images: Datatype Conversion, Contrast Enhancement, Brightness Enhancement, Bitwise operations: Different Bitwise Operations

Unit II: Binary Image Processing, thresholding, Erosion / Dilation, Overview on Opening and Closing, Connected Component Analysis, Contour Analysis

Unit III: Image Enhancement and Filtering, Color Spaces, Color Transforms, Histogram Equalization, Advanced Histogram Equalization (CLAHE), Color Adjustment using Curves, Image Filtering: Introduction to Image Filtering, What is Convolution, Image Smoothing: -Box Blur, Gaussian Blur, Median Blur

Unit IV: Introduction to Image Gradients: - First Order Derivative Filters, Second Order Derivative Filters, Edge Detection, Image Segmentation and Recognition, Image Classification, Object detection

Unit V: Applications of Computer Vision: Gesture Recognition, Motion Estimation and Object Tracking, face detection, Deep Learning with OpenCV

Books and references

1. Forsyth & Ponce, "Computer Vision-A Modern Approach", Pearson Education.
2. M.K. Bhuyan, "Computer Vision and Image Processing: Fundamentals and Applications", CRC Press, USA, ISBN 9780815370840 - CAT# K338147.
3. Richard Szeliski, "Computer Vision- Algorithms & Applications", Springer.
4. R.C Gonzalez & Richard E Wood, "Digital Image Processing", Addison Wesley Publishin
5. Bharti Motwani, "Machine Learning for Text and Image Data Analysis", Publishers Wiley, 2023

Online Lectures links

https://onlinecourses.nptel.ac.in/noc23_ee39/preview

https://onlinecourses.nptel.ac.in/noc19_cs58/preview

https://onlinecourses.nptel.ac.in/noc23_ee78/preview

PRACTICAL: 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. Such assignments are to be framed for ten to twelve lab sessions

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AL702(A) AI in Gaming

Course Objective: The students should be able to understand and use AI techniques for generating efficient, intelligent behavior in games. Additional attention is to be given to AI algorithms for improving game play experience.

Detailed contents:

Unit I: Introduction: Introduction to Game AI, kind of AI used in game development, model of game AI, AI engine structure.

Unit II: Movement Algorithms and Steering Behaviour kinematic movement algorithms, problems related to the steering behaviour of objects and Solutions. **Coordinated Movement and Motor Control** This unit discusses the concepts related to coordinated movements and motor control.

Unit III: Pathfinding Basic Path finding Algorithms in game development, Path finding for complex solutions

Unit IV: Decision-Making and Uncertainty decision trees and state machines for game development, models for implementing knowledge uncertainty, such as fuzzy logic and Markov systems.

Unit V: Introduction to Learning Mechanisms Board game theory and discusses the implementation of some key algorithms, such as minimax and negamax, Random Number Generation and Minimizing, algorithms for implementing action prediction, decision learning and reinforcement learning.

Alternative NPTEL/SWAYAM Course:

NPTEL Course Name, Artificial Intelligence: Search Methods For Problem Solving, Instructor H Prof. Deepak Khemani, Host Institute IIT Madras

Suggested Reference:

1. <https://www.athabasca.ca/syllabi/comp/comp452.php>
2. <https://www.udemy.com/course/artificial-intelligence-for-simple-games>
- / 3. Artificial Intelligence for Games, Ian Millington and John Funge, CRC Press; 2nd edition, 2009.
4. Artificial Intelligence and Games, Georgios N. Yannakakis and Julian Togelius, Springer International Publishing, 2018.

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

1. Understand identify tasks that can be tackled using AI techniques.
2. Apply appropriate AI technique for the problem under investigation.
3. Create efficient and robust AI algorithms for game tasks.
4. Apply learning mechanisms to gaming problems.

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

AL702 (B) Advance Machine Learning

Course Objective: To introduce advanced concepts and methods of machine learning and to develop an understanding of the role of machine learning in massive scale automation. To design and implement various machine learning algorithms in a range of real-world applications.

Unit I: Artificial Neural Network: Introduction to ANN, Perceptron, Cost Function, Gradient Checking, multi-layer perceptron and backpropagation algorithm that is used to help learn parameters for a neural network, Random Initialization

Unit II: Decision Trees: Representing concepts as decision trees, Recursive induction of decision trees, best splitting attribute: entropy and information gain. Searching for simple trees and computational complexity, Overfitting, noisy data, and pruning.

Unit III: Ensemble Methods: Bagging, boosting, stacking and learning with ensembles. Random Forest

Unit IV: Introduction to reinforcement learning (RL), Reinforcement Learning, RL-framework, MDP, Bellman equations, Value Iteration and Policy Iteration, Actor-critic model, Q-learning, SARSA, Bandit algorithms – UCB, PAC, Median Elimination, Policy Gradient, Full RL & MDPs, Bellman Optimality,

Unit V: Dynamic Programming - Value iteration, Policy iteration, and Q-learning & Temporal Difference Methods, Temporal-Difference Learning, Eligibility Traces, Function Approximation, Least Squares Methods, Fitted Q, Deep Q-Learning, Advanced Q-learning algorithms, Inverse reinforcement learning, Deep Inverse Reinforcement Learning, Generative Adversarial Imitation Learning, Recent Trends in RL Architectures.

Recommended Books:

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer-Verlag New York Inc., 2nd Edition, 2011.
2. Tom M. Mitchell, "Machine Learning", McGraw Hill Education, First edition, 2017.
3. Jeeva Jose, Introduction to Machine Learning, Khanna Book Publishing 2020.
4. Rajiv Chopra, Machine Learning, Khanna Book Publishing 2021
5. Ethem Apaydin, Introduction to Machine Learning, 2e. The MIT Press, 2010
6. Reinforcement Learning: An Introduction, Sutton and Barto, 2nd Edition.
7. Reinforcement Learning: State-of-the-Art, Marco Wiering and Martijn van Otterlo, Eds

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

AL702 (C) Predictive Analytics

Course Objective:

The students should be able to understand how to transform data and make it suitable for data driven predictive tasks. Understand how to compute basic statistics using real-world datasets of consumer activities, like product reviews.

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

1. Apply Python to create interactive data visualizations to make meaningful predictions and build simple demo systems.
2. Apply simple regressions and classifications on datasets using machine learning libraries.
3. Understand the usage of different python libraries.

contents:

Unit I: Introduction Data Product, Data Product Examples in Enterprise, Developing a Data Product Strategy.

Unit II: Reading Data in Python Reading CSV & JSON Files, Processing Structured Data in Python, Live-Coding: JSON, Extracting Simple Statistics from Datasets Data Processing in Python Data Filtering and Cleaning, Processing Text and Strings in Python, Processing Times and Dates in Python

Unit III: Python Libraries and Toolkits Matrix Processing and Numpy, Introduction to Data Visualization, Introduction to Matplotlib, urllib and BeautifulSoup

Unit IV: Gradient Descent Classification in Python, Introduction to Training and Testing, Gradient Descent in Python, Gradient Descent in TensorFlow

Unit V: Diagnostics for Data Meaningful Predictive modelling, Regression Diagnostic, Over- and Under-Fitting, Classification Diagnostics: Accuracy and Error, Classification Diagnostics: Precision and Recall. Codebase for Evaluation and Validation, Model Complexity and Regularization, Evaluating Classifiers for Ranking.

Text Books/Suggested References:

1. <https://www.coursera.org/learn/basic-data-processing-visualization-python>
2. <https://www.coursera.org/learn/design-thinking-predictive-analytics-data-products>
3. <https://www.coursera.org/learn/meaningful-predictive-modeling>
4. Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, Dean Abbott, 2014, Wiley.
5. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, Tom Fawcett, O'Reilly, 1st edition, 2013.

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

AL 702(D) Machine Learning for Data Science

Course Objective: The students will be able to derive practical solutions using predictive analytics. They will also understand the importance of various algorithms in Data Science.

Detailed Contents:

Unit I: Introduction

Algorithms and Machine Learning, Introduction to algorithms, Tools to analyze algorithms, Algorithmic techniques: Divide and Conquer, examples, Randomization, Applications

Unit II: Algorithms

Graphs, maps, Map searching, Application of algorithms: stable marriages example, Dictionaries and hashing, search trees, Dynamic programming

Unit III: Application to Personal Genomics

Linear Programming, NP completeness, Introduction to personal Genomics, Massive Raw data in Genomics, Data science on Personal Genomes, Interconnectedness on Personal Genomes, Case studies

Unit IV: Machine Learning

Introduction, Classification, Linear Classification, Ensemble Classifiers, Model Selection, Cross Validation, Holdout

Unit V: Machine Learning Applications

Probabilistic modelling, Topic modelling, Probabilistic Inference, Application: prediction of preterm birth, Data description and preparation, Relationship between machine learning and statistics

Text Books/Suggested References:

1. Introduction to Machine Learning, Jeeva Jose, Khanna Book Publishing House.
2. Machine Learning, Rajiv Chopra, Khanna Book Publishing House.
3. Data Science and Machine Learning: Mathematical and Statistical Methods Machine Learning & Pattern Recognition, by Dirk P. Kroese, Zdravko Botev, Thomas Taimre, Radislav Vaisman, Chapman & Hall/Crc, 2019.
4. Hands-On Data Science and Python Machine Learning, Frank Kane, Packt Publishers, 2017.
5. <https://www.edx.org/course/machine-learning-for-data-science-and-analytics>
6. Dr. Nageswara Rao, "Machine Learning in Data Science Using Python", Publisher by Dreamtech, 2022

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

1. Apply practical solutions using predictive analytics.
2. Understand the importance of various algorithms in Data Science.
3. Create competitive advantage from both structured and unstructured data.
4. Predict outcomes with supervised machine learning techniques.
5. Unearth patterns in customer behavior with unsupervised techniques

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AL 703(A) Compiler Design

Unit I: Introduction to compiling & Lexical Analysis Introduction of Compiler, Major data Structure in compiler, types of Compiler, Front-end and Back-end of compiler, Compiler structure: analysis-synthesis model of compilation, various phases of a compiler, Lexical analysis: Input buffering, Specification & Recognition of Tokens, Design of a Lexical Analyzer Generator, LEX.

Unit II: Syntax Analysis & Syntax Directed Translation Syntax analysis: CFGs, Top down parsing, Brute force approach, recursive descent parsing, transformation on the grammars, predictive parsing, bottom up parsing, operator precedence parsing, LR parsers (SLR,LALR, LR),Parser generation. Syntax directed definitions: Construction of Syntax trees, Bottom up evaluation of S-attributed definition, L-attribute definition, Top down translation, Bottom Up evaluation of inherited attributes Recursive Evaluation, Analysis of Syntax directed definition.

Unit III: Type Checking & Run Time Environment: Type checking: type system, specification of simple type checker, equivalence of expression, types, type conversion, overloading of functions and operations, polymorphic functions. Run time Environment: storage organization, Storage allocation strategies, parameter passing, dynamic storage allocation, Symbol table, Error Detection & Recovery, Ad-Hoc and Systematic Methods.

Unit IV: Code Generation: Intermediate code generation: Declarations, Assignment statements, Boolean expressions, Case statements, Back patching, Procedure calls Code Generation: Issues in the design of code generator, Basic block and flow graphs, Register allocation and assignment, DAG representation of basic blocks, peephole optimization, generating code from DAG.

Unit V: Code Optimization: Introduction to Code optimization: sources of optimization of basic blocks, loops in flow graphs, dead code elimination, loop optimization, Introduction to global data flow analysis, Code Improving transformations ,Data flow analysis of structure flow graph Symbolic debugging of optimized code.

References:

1. 1. A. V. Aho, R. Sethi, and J. D. Ullman. Compilers: Principles, Techniques and Tools , Pearson Education
2. 2. Raghavan, Compiler Design, TMH Pub.
3. 3. Louden. Compiler Construction: Principles and Practice, Cengage Learning
4. 4. A. C. Holub. Compiler Design in C , Prentice-Hall Inc., 1993.
5. 5. Mak, writing compiler & Interpreters, Willey Pub.

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**CSE-Artificial Intelligence and Machine Learning/ Artificial Intelligence and Machine
Learning, VII-Semester**

AL 703(B) Augmented and Virtual Reality

Course Objective: The objective of this course is to provide students a general introduction of Virtual and Augmented Environments followed by an analysis of features, requirement and issues in real-life applications.

Unit I: Introduction to Virtual Reality- Virtual Reality and Virtual Environment: Introduction, Applications of Virtual Reality, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark 3D Computer Graphics: Introduction, The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory, Simple 3D modeling, Illumination models, Reflection models, Shading algorithms, Radiosity, Hidden Surface Removal, Realism-Stereographic image.

Unit II: Geometric Modeling- Geometric Modeling: Introduction, From 2D to 3D, 3D space curves, 3D boundary representation Geometrical Transformations: Introduction, Frames of reference, Modeling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems.

Unit III: Virtual Environment -Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in betweening, free from deformation, particle system. Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

Unit IV: VR Hardware and Software- Human factors: Introduction, the eye, the ear, the somatic senses. VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. VR Software: Introduction, Modeling virtual world, Physical simulation, VR toolkits, Introduction to VRML

Unit V: Augmented and Mixed Reality- Taxonomy, Technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

References:

1. John Vince, "Virtual Reality Systems ", Pearson Education Asia, 2007.
2. Anand R., "Augmented and Virtual Reality", Khanna Publishing House, Delhi.
3. Adams, "Visualizations of Virtual Reality", Tata McGraw Hill, 2000.
4. Grigore C. Burdea, Philippe Coiffet , "Virtual Reality Technology", Wiley Inter Science, 2 nd Edition, 2006.
5. William R. Sherman, Alan B. Craig, "Understanding Virtual Reality: Interface, Application and Design", Morgan Kaufmann, 2008.
6. Alan B Craig, William R Sherman and Jeffrey D Will, Developing Virtual Reality Applications: Foundations of Effective Design, Morgan Kaufmann, 2009
7. Paul Mealy,"Virtual & Augmented Reality for Dummies", publishers Wiley,June 2018

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Open Elective – AL703 (C) Agile Software Development

Pre-Requisite: Software Engineering

Course Outcomes: After completing the course student should be able to:

1. Describe the fundamental principles and practices associated with each of the agile development methods.
2. Compare agile software development model with traditional development models and identify the benefits and pitfalls.
3. Use techniques and skills to establish and mentor Agile Teams for effective software development.
4. Apply core values and principles of Agile Methods in software development.

Course Contents:

Unit-I: Fundamentals of Agile Process: Introduction and background, Agile Manifesto and Principles, Stakeholders and Challenges, Overview of Agile Development Models: Scrum, Extreme Programming, Feature Driven Development, Crystal, Kanban, and Lean Software Development.

Unit-II: Agile Projects: Planning for Agile Teams: Scrum Teams, XP Teams, General Agile Teams, Team Distribution; Agile Project Lifecycles: Typical Agile Project Lifecycles, Phase Activities, Product Vision, Release Planning: Creating the Product Backlog, User Stories, Prioritizing and Estimating, Creating the Release Plan; Monitoring and Adapting: Managing Risks and Issues, Retrospectives.

Unit-III: Introduction to Scrum: Agile Scrum Framework, Scrum Artifacts, Meetings, Activities and Roles, Scrum Team Simulation, Scrum Planning Principles, Product and Release Planning, Sprinting: Planning, Execution, Review and Retrospective; User story definition and Characteristics, Acceptance tests and Verifying stories, Burn down chart, Daily scrum, Scrum Case Study.

Unit-IV: Introduction to Extreme Programming (XP): XP Lifecycle, The XP Team, XP Concepts: Refactoring, Technical Debt, Timeboxing, Stories, Velocity; Adopting XP: Pre-requisites, Challenges; Applying XP: Thinking- Pair Programming, Collaborating, Release, Planning, Development; XP Case Study.

Unit-V: Agile Software Design and Development: Agile design practices, Role of design Principles, Need and significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated build tools, Version control; Agility and Quality Assurance: Agile Interaction Design, Agile approach to Quality Assurance, Test Driven Development, Pair programming: Issues and Challenges.

Recommended Books:

1. Robert C. Martin, Agile Software Development- Principles, Patterns and Practices, Prentice Hall, 2013.
2. Kenneth S. Rubin, Essential Scrum: A Practical Guide to the Most Popular Agile Process, Addison Wesley, 2012.
3. James Shore and Shane Warden, The Art of Agile Development, O'Reilly Media, 2007.
4. Craig Larman, —Agile and Iterative Development: A manager's Guide, Addison-Wesley, 2004.

5. Ken Schawber, Mike Beedle, Agile Software Development with Scrum, Pearson, 2001.
6. Cohn, Mike, Agile Estimating and Planning, Pearson Education, 2006.
7. Cohn, Mike, User Stories Applied: For Agile Software Development Addison Wisley, 2004.
8. Rama Bedarkar, “Agile Scrum: Improving Practices for Business Gains,” Publishers Wiley, 2022

Online Resources:

1. IEEE Transactions on Software Engineering
2. IEEE Transactions on Dependable and Secure Computing
3. IET Software
4. ACM Transactions on Software Engineering and Methodology (TOSEM)
5. ACM SIGSOFT Software Engineering Notes

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**CSE-Artificial Intelligence and Machine Learning/ Artificial Intelligence and Machine
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AL 703(D) Internet and Web Technology

UNIT I: Introduction: Concept of WWW, Internet and WWW, HTTP Protocol: Request and Response, Web browser and Web servers, Features of Web 2.0 Web Design: Concepts of effective web design, Web design issues including Browser, Bandwidth and Cache, Display resolution, Look and Feel of the Website, Page Layout and linking, User centric design, Sitemap, Planning and publishing website, Designing effective navigation.

UNIT II: HTML: Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms, XHTML, Meta tags, Character entities, frames and frame sets, Browser architecture and Web site structure. Overview and features of HTML5

UNIT III: Style sheets : Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2, Overview and features of CSS3 JavaScript : Client side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes, Advance JavaScript: Javascript and objects, JavaScript own objects, the DOM and web browser environments, Manipulation using DOM, forms and validations, DHTML : Combining HTML, CSS and JavaScript, Events and buttons.

UNIT IV: XML: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Using XML with application. Transforming XML using XSL and XSLT
PHP: Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string, Form processing, Files, Advance Features: Cookies and Sessions, Object Oriented Programming with PHP.

UNIT V: PHP and MySQL: Basic commands with PHP examples, Connection to server, creating a database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs

Reference Books:

1. Developing Web Applications, Ralph Moseley and M. T. Savaliya, Wiley-India
2. Web Technologies, Black Book, dreamtech Press
3. HTML 5, Black Book, dreamtech Press
4. Web Design, Joel Sklar, Cengage Learning
5. Developing Web Applications in PHP and AJAX, Harwani, McGrawHill
6. Internet and World Wide Web How to program, P.J. Deitel & H.M. Deitel, Pearson Education.
7. Developing Web Applications, 2ed by Ralph Mosely, MT Savaliya, Publisher Wiley India Pvt Ltd

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AL 705 Skill Development Lab

The primary objective of skill development lab is to impart the set of skills into students, so that they are industry ready.

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

1. Understand the basics of software as a product.
2. Understand the current requirements of industries.
3. Implement the software as a product using different design patterns.
4. Apply the software development techniques in real life applications.

Unit – I Software product life cycle.

Unit – II Software product development standards.

Unit – III Design patterns – 1

Unit -IV Design Patterns – II

Unit – V Case Study