RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Artificial Intelligence & Data Science, VIII-Semester

AD-801 Big Data

Course Outcomes:

After completion of this course student will be able to:

1. Understand the concept and challenges of Big data.
2. Demonstrate knowledge of big data analytics.
3. Develop Big Data Solutions using Hadoop Eco System.
4. Gain hands-on experience on large-scale analytics tools.
5. Analyze the social network graphs.

Syllabus

Unit I: Introduction to Big data, Big data characteristics, Types of big data, Traditional versus Big data, Evolution of Big data, challenges with Big Data, Technologies available for Big Data, Infrastructure for Big data, Use of Data Analytics, Desired properties of Big Data system.

Unit II: Introduction to Hadoop, Core Hadoop components, Hadoop Eco system, Hive Physical Architecture, Hadoop limitations, RDBMS Versus Hadoop, Hadoop Distributed File system, Processing Data with Hadoop, Managing Resources and Application with Hadoop YARN, MapReduce programming.

Unit III: Introduction to Hive, Hive Architecture, Hive Data types, Hive Query Language, Introduction to Pig, Anatomy of Pig, Pig on Hadoop, Use Case for Pig, ETL Processing, Data types in Pig, running Pig, Execution model of Pig, Operators, functions, Data types of Pig.

Unit IV: Introduction to NoSQL, NoSQL Business Drivers, NoSQL Data architectural patterns, Variations of NoSQL architectural patterns using NoSQL to Manage Big Data, Introduction to MongoDB.

Unit V: Mining social Network Graphs: Introduction Applications of social Network mining, Social Networks as a Graph, Types of social Networks, Clustering of social Graphs Direct Discovery of communities in a social graph, Introduction to recommender system.

Text Books:

1. Radha Shankarmani, M. Vijaylakshmi, " Big Data Analytics", Wiley, 2nd Edition
2. Seema Acharya, SubhashiniChellappan, " Big Data and Analytics", Wiley, 1st Edition
3. Raj Kamal, PreetiSaxena, “Big Data Analytics, Introduction to Hadoop, Spark, and Machine-Learning”, McGraw Hill Education; First Edition,2019.

Reference Books:

1. KaiHwang, Geoffrey C., Fox. Jack, J. Dongarra, “Distributed and Cloud Computing”, Elsevier, First Edition
2. Michael Minelli, Michele Chambers, AmbigaDhiraj, “Big Data Big Analytics”, Wiley.

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Artificial Intelligence & Data Science, VIII-Semester

Departmental Elective- AD-802 (A) Natural Language Processing

Prerequisites

Basic knowledge of Probability, Statistics, Linear algebra, and Python/R

Objective

This course covers fundamental concepts of Natural Language Processing (NLP) such as how natural language is represented in a formal way. It involves the data preparation tasks before analysis of NLP. It introduces the notion of analysisof NLP such as linguistic analysis, syntactic analysis, semantic analysis.

Course Outcome: At the end of the course, the student will be able to:

1. Describe the basic components and fundamentals of NLP
2. Understand the modelling/representation aspects behind natural language
3. Understand the internal structure of words and how they are formed from smaller meaningful units
4. Understand the role of syntactic, semantics, pragmatics of sentences.
5. Apply NLP on various tasks such as Part-of-Speech tagging, Name Entity Recognition, Text classification etc.

Syllabus

Unit I:Introduction: Natural Language Processing(NLP): Definition and scope Applications in various domains, Challenges and limitations. NLP tasks in syntax, semantics, and pragmatics. Different Data Models such as Boolean Model, Vector model, Probabilistic Model. Comparison of classical NLP models: Rule-based model, Statistical model, Information retrieval model, Rule-based machine translation model, Probabilistic Graphical model.

Unit II:Linguistics and Morphology: Linguistic essentials: Phonetics and Phonology, Morphology: Morphens, Syntax, Semantics, Pragmatics, Semiotics, Discourse Analysis, Psycholinguistics, Corpus Linguistics. Word Formation Processes. Morphological analysis. Morphological Finite State Transducers.

Unit III:Word Level Analysis: Tokenization, Part-of-Speech Tagging (POS Tagging), Lemmatization, Stemming, Named Entity Recognition (NER), Word Sense Disambiguation (WSD), Word Embedding. Types of PoS Tagging: Rule-based, Stochastic, Transformation-based, Lexical. Hidden Markov model and Maximum Entropy model. n-grams. Collocations. Applications of NER.

Unit IV:Syntax Analysis: Grammatical Formalisms: Context Free Grammars, Grammar rules for English, Syntactic parsing: Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs).

Unit V:Semantic Analysis: Requirements for representation, First-Order Logic, Description Logics. Syntax-Driven Semantic analysis, Semantic attachments. Word Senses, Relations

between Senses, Thematic Roles, selectional restrictions. Word-sense disambiguation(WSD): WSD using Supervised, Dictionary and Thesaurus. Applications of WSD.

TextBooks:

1. Daniel Jurafsky& James H. Martin, Speech and Language Processing, Perason publication,2018.
2. Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python, First Edition, OReilly Media, 2009.
3. Nitin Indurkhya-. Handbook of natural language processing. Chapman and Hall/CRC, 2010.
4. Manning and Schutze "Foundations of Statistical Natural Language Processing", MIT Press,2009

ReferenceBooks:

1. Dipanjan Sarkar- Text Analytics with Python. Apress/Springer, 2016
2. Rothman, Denis, and Antonio Gulli- Transformers for Natural Language Processing: Build, train, and fine-tune deep neural network architectures for NLP with Python, PyTorch, TensorFlow, BERT, and GPT-3. Packt Publishing Ltd, 2022.
3. Tanveer Siddiqui, U.S. Tiwary, ―Natural Language Processing and Information Retrieval, Oxford University Press, 2008

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New Scheme Based On AICTE Flexible Curricula

Artificial Intelligence & Data Science, VIII-Semester

Departmental Elective- AD-802 (B) Reinforcement Learning

Course Objective: The objective of this course is to learn designing and implementation of deep and reinforcement learning approaches using machine learning for solving real-life problems.

Course Outcomes:

1. Describe in-depth about theories, models and algorithms in machine learning.
2. Compare and contrast different learning algorithms with parameters.
3. Examine the nature of a problem at hand and find the appropriate learning algorithms and its parameters that can solve it efficiently enough.
4. Understand Deep Q-Learning and its applications.
5. Design and implement of reinforcement learning approaches for solving real-life problems.

Syllabus

Unit I: Introduction to reinforcement learning (RL): Defining RL Framework and Markov Decision Process, Polices, Value Functions and Bellman Equations, Explorations, Exploitation, Inside an RL agent, Problems with reinforcement learning.

Unit II: Bandit algorithms – UCB, PAC, Median Elimination, Policy Gradient, Full RL & MDPs, Bellman Optimality, Dynamic Programming - Value iteration, Policy iteration, Policy Evaluation, Value Iteration, Policy Iteration, DP Extensions and Convergence using Contraction Mapping, Monte-Carlo (MC) Learning, Temporal-Difference (TD) Learning, TD-Lambda and Eligibility Traces.

Unit III:Q-learning & Temporal Difference Methods, Temporal- Difference Learning, Eligibility Traces, Function Approximation, Least Squares Methods, Incremental Methods and Batch Methods, Deep Q-Learning analysis, Deep Q-Networks and Experience Replay.

Unit IV: Fitted Q, Deep Q-Learning problems, Advanced Q-learning algorithms, learning policies by imitating optimal controllers, DQN & Policy Gradient, Policy Gradient Algorithms for Full RL, Hierarchical RL, POMDPs.

Unit V: Actor-Critic Method, Inverse reinforcement learning, Maximum Entropy Deep Inverse Reinforcement Learning, Generative Adversarial Imitation Learning, Recent Trends in RL Architectures.

ReferenceBooks:

1. Deep Learning, An MIT Press book, Ian Goodfellow and YoshuaBengio and Aaron Courville
2. Pattern Classification- Richard O. Duda, Peter E. Hart, David G. Stork, John Wiley & Sons Inc.
3. Reinforcement Learning: An Introduction, Sutton and Barto, 2nd Edition.
4. Reinforcement Learning: State-of-the-Art, Marco Wiering and Martijn van Otterlo, Eds

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Artificial Intelligence & Data Science, VIII-Semester

Departmental Elective- AD-802 (C) Robotic Process Automation

COURSEOUTCOMES:

Attheendofthecourse,thestudentwillbeableto,

1. Describe RPA, where it can be applied and how it's implemented.
2. Describe the different types of variables, Control Flow and data manipulation techniques.
3. Identify and understand Image, Text and Data Tables Automation.
4. Describe how to handle the User Events and various types of Exceptions and strategies.
5. Understand the Deployment of the Robot and to maintain the connection.

Syllabus

Unit I:IntroductiontoRPA: Scopeandtechniquesofautomation, Roboticprocessautomation, BenefitsofRPA,ComponentsofRPA,RPAplatforms,Thefutureofautomation.**RPABasics:**History of Automation, RPA vs Automation, Processes & Flowcharts, Programming Constructs inRPA, Types of Bots, RPA Development methodologies, Robotic controlflow architecture,RPA business case, IndustriesbestsuitedforRPA, Risks&ChallengeswithRPA, RPAandemergingecosystem.

Unit II:RPA ToolIntroductionandBasics: Introduction to RPA Tool, The User Interface, Variables, Managing Variables,Managing Arguments, Arguments Panel, Imported Namespaces, Control Flow-If Else Statements, Loops, Advanced Control Flow, Data Manipulation:Scalar variables, collections and Tables, Text Manipulation, Data Manipulation, Gathering and Assembling Data

Unit III:AdvancedAutomationConcepts&Techniques: Recording Introduction: Basic and Desktop Recording, Web Recording, Input-Output Methods, Screen Scraping, Data Scraping,scraping advanced techniques,Selectors, Defining and Assessing Selectors,Customization, Debugging, Dynamic Selectors, Partial Selectors.
RPA Challenge - Image, Text & Advanced Citrix Automation, ExcelDataTables&PDF,DataTablesinRPA,ExcelandDataTablebasics,DataManipulationinexcel–ExtractingDatafromPDF,extractingasinglepieceofdata,Anchors,Usinganchors inPDF.

Unit IV:Handling UserEvents&AssistantBots: What are assistant bots, Monitoring system event triggers, Hotkey trigger, Mouse trigger, System trigger,Monitoringimageandelementtriggers, Launchinganassistantbotonakeyboardevent.**ExceptionHandling:**DebuggingandExceptionHandling,DebuggingTools,Strategiesforsolvingissues,Catchingerrors.

Unit V:Deploying and Maintaining Bot: Publishing using publish utility, Creation of Server, Using Server to control the bots,creating a provision Robot fromServer,connecting a Robot to Server, Deploy Robot to Server, Publishing and managing updates,managingpackages,uploadingpackages, Deleting packages

ReferenceBooks:

1. AlokManiTripathi,"LearningRoboticProcessAutomation",PacktPublishing,2018.
2. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation:aPrimer",Instituteof Robotic ProcessAutomation,1st Edition2015.
3. RichardMurdoch,RoboticProcessAutomation:GuideToBuildingSoftwareRobots,AutomateRepetitiveTasks&Become AnRPAConsultant",IndependentlyPublished,1st Edition2018.
4. Srikanth Merianda," Robotic Process Automation Tools, Process Automation andtheirbenefits:UnderstandingRPAandIntelligentAutomation",Consulting opportunityHoldingsLLC,1st Edition2018.
5. Lim Mei Ying, "Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots and automate business processes", Packt Publishing, 1st Edition 2018.

Web references:

1. https://www.uipath.com/rpa/robotic,process,automation
2. https://www.academy.uipath.com

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Artificial Intelligence & Data Science, VIII-Semester

Open Elective-AD-803 (A) AI for Remote Sensing

Course Outcomes:

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

1. Understand the concepts and principles of remote sensing
2. Understand the different types of remote sensors
3. Process remotely sensed data to make it useful in geographic information systems
4. Perform image enhancement on remotely sensed imagery
5. Understand the applications of IT in remote sensing applications

Syllabus

Unit I: Introduction to Remote Sensing and AI

Definition of Remote sensing, Principles of Remote Sensing, Introduction to Artificial Intelligence, Integration of AI in Remote Sensing

Unit II: Types of Remote Sensing Platforms and Sensors

Sensors: Types and classification of sensors, Platforms: Types of platforms, ground, airborne, and space born platforms

Remote Sensing Data Acquisition and Pre-processing

Data acquisition techniques and image resolution, Data pre-processing and feature extraction techniques, Radiometric and geometric corrections, Data fusion and enhancement methods

Unit III: AI for Remote Sensing

Supervised Learning for Remote Sensing Analysis, Unsupervised Learning for Remote Sensing Analysis, Deep Learning for Remote Sensing Analysis, Image Image Classification Techniques in Remote Sensing.

Unit IV: AI-Assisted Image Interpretation and Feature Extraction

Object detection and tracking in remote sensing imagery, Change detection and time-series analysis, Hyperspectral and LiDAR data analysis, Fusion of multi-modal remote sensing data.

Unit V: Applications of AI in Remote Sensing

Land cover and land use mapping, Environmental monitoring and assessment, Disaster management and response, Precision agriculture and crop monitoring.

ReferenceBooks:

1. Rémi Cresson, “Deep Learning for Remote Sensing Images with Open Source Software”, CRC Press, 1st edition,2020.
2. Moulay A Akhloufi, MozhdehShahbazi,“Deep Learning Methods for Remote Sensing”,MDPI AG, 2022.
3. Alka Rani, Nirmal Kumar, S. K. Singh, N. K. Sinha, R. K. Jena, HimeshPatra, “Remote Sensing Data Analysis Using R”,CRC Press, Taylor & Francis Group,2021.
4. Tammy E. Parece, John A. McGee, James B. Campbell, “Remote Sensing with ArcGIS Pro”,2019.

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Artificial Intelligence & Data Science, VIII -Semester

Open Elective: AD-803 (B) Augmented & Virtual Reality

Prerequisite: Computer Graphics

Course Objectives

1. To understand the need and significance of Virtual Reality.
2. To explore the concepts of Virtual reality and develop 3D virtual environments.
3. To understand the technical and engineering aspects of virtual reality systems.
4. To analyze various techniques for applying virtual reality.
5. To provide a foundation to the fast growing field of AR and make the students aware of the various AR devices.

Course Outcomes

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

1. Describe how VR systems work and list the applications of VR, along with the geometric presentation of the virtual world and its operations.
2. Explain the concepts of motion and tracking in VR systems.
3. Design and implementation of the hardware that enables VR systems tobe built.
4. Describe how AR systems work and analyze the hardware requirement of AR
5. Analyze and understand the working of various state of the art AR devices.

Syllabus

Unit I: Introduction to Virtual Reality, VR Basics, History of VR, VR paradigms, Collaboration, Virtual reality systems, Representation, User interaction

The Geometry of Virtual Worlds, Geometric Models, Changing Position and Orientation, Axis, Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations

Unit II: Motion in Real and Virtual Worlds, Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection

Unit III: Applying Virtual Reality, Virtual reality: the medium, Form and genre, What makes an application a good candidate for VR, Promising application fields, Demonstrated benefits of virtual reality, More recent trends in virtual reality application development, A framework for VR application development

Unit IV: Augmented Reality, Terminology, Simple augmented reality, Augmented reality as an emerging technology, Augmented reality applications, Marker detection, Marker pose, Marker types and identification: Template markers, 2D bar-code markers, Imperceptible markers: Image markers, Infrared markers, Miniature markers, Discussion on marker use, General marker detection application

Unit V: AR Development & Applications, User interfaces, Avoiding physical contacts, Practical experiences with head- mounteddisplays, Authoring and dynamic content, AR

applications and future visions, How to design an AR application, Technology adoption and acceptance, Where to use augmented reality

ReferenceBooks:

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics). Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.
4. Theory and applications of marker,based augmented reality SanniSiltanen
5. Virtual & Augmented Reality For Dummies by Paul Mealy - John Wiley Publication

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Artificial Intelligence & Data Science, VIII-Semester

Open Elective:AD-803 (C) Managing Innovation and Entrepreneurship

Course Objective

The aim of the course is to motivate students to innovate in business. In the first place, to achievethis goal, students will be introduced to the basic terminology, typology of innovations andhistorical context for better comprehension. Also issues of innovation management will be
introduced. Students will become familiar with the impact of innovation, innovative processes
and aspects that affect it, including applicable methods and innovation management techniques.

Syllabus

Unit I: Innovation, the basic definition and classification: The relationship of innovation and entrepreneurship, creation of competitive advantage based on innovation. Innovative models, Product, process, organizational and marketing innovation and their role in businessdevelopment.

Unit II: Sources of innovation (push, pull, analogies), transfer of technology. Creative methods andapproaches used in innovation management. Approaches to management of the innovationprocess (agile management, Six Thinking Hats, NUF test).

Unit III: Project approach to innovation management, method Stage Gate, its essence, adaptation ofaccess to selected business models. In-house business development of the innovation process inthe company. Open Innovation as a modern concept, the limits of this method and its benefits forbusiness development.

Unit IV: Innovations aimed at humans, role of co-creation in the innovation process. The strategy ofinnovation process, types and selection of appropriate strategies.

Unit V: Measurement and evaluation of the benefits of innovation for business (financial and nonfinancial metrics, their combination and choice). Barriers to innovation in business, innovationfailure and its causes, post-audits of innovative projects. Organization and facilitation of aninnovation workshop.

ReferenceBooks:

1. Clark, T. – Osterwalder, A. – Pigneur, Y. Business model generation: aHandbook for visionaries, game changers, and challengers. Wiley Publications
2. Bessant, J R. – Tidd, J. Managing innovation: integrating technological, market andOrganizational change. Wiley Publications