

INT428:ARTIFICIAL INTELLIGENCE ESSENTIALS

L:3 T:0 P:1 Credits:4

Course Outcomes: Through this course students should be able to

CO1 :: Explain the foundations, characteristics, evolution, and applications of Artificial Intelligence across various domains.

CO2 :: Apply state-space modeling and search techniques for solving AI-based problems efficiently.

CO3 :: Apply machine learning algorithms, model evaluation methods, and probabilistic reasoning techniques to AI problems.

CO4 :: Apply deep learning and NLP models to create intelligent language-based applications.

CO5 :: Use generative AI concepts, LLMs, and prompt engineering techniques in AI applications while adhering to ethical and responsible AI principles

CO6 :: Apply data and AI workflows using suitable tools for visualization, model deployment, troubleshooting, automation, and MLOps.

Unit I

Foundations & Applications of AI : What is Intelligence, what is AI, characteristics of artificial intelligence, Foundations of AI, Evolution, and types of AI (narrow, general), Key AI problems and techniques, Applications across domains (business, healthcare, automation, vision, language), Modern AI Toolkits (TensorFlow, PyTorch), Responsible AI

AI Problem Modeling & Search Concepts : Defining AI problems as State Space and Search Problems, Characteristics of AI Problem Spaces, Introduction to AI Workflows & Data-Centric Modeling, Challenges in AI problem solving

Unit II

Problem Solving & Search in AI : Problem formulation and state space search, Introduction to uninformed search, Core search algorithms: Best-first search, A* search, Heuristic search, Constraint satisfaction, Basics of optimization: gradient-based methods and metaheuristics

AI problem design : Complexity, Data requirements, Solution metrics, Introduction to reinforcement learning for sequential decision problems

Unit III

Machine Learning : Probability, Statistics, Linear algebra (applied focus), Supervised, unsupervised, and reinforcement learning: concepts and real-world use, Feature engineering and model evaluation (cross-validation, precision, recall), Bayes theorem, Bayesian networks, and probabilistic reasoning

Unit IV

Introduction to deep neural networks : Introduction to Neural Networks, Perceptron, MLP, CNN, RNN, Transformer Architecture and Applications

Modern NLP : Introduction to NLP, NLP phases, Tokenization, Embeddings, Attention, language models (BERT, GPT), Building chatbots and digital assistants, NLP use cases (sentiment analysis, translation, summarization)

Unit V

Generative AI & Ethics : Fundamentals of Generative AI, LLMs, GANs, Diffusion, How generative models work, Industrial applications (content creation, automation), Ethics and Responsible Use of Generative AI

Prompt Engineering : Fundamentals of prompt, Importance of Prompt Engineering, Overview of language models, Key elements of a good prompt, Prompt Patterns, Prompt Tuning

Unit VI

Data Analysis & Visualization : Data analysis and visualization using AI tools (ChatGPT Advanced Data Analysis, Tableau), Working with structured and unstructured data, Data pipelines and automation

AI Model Environments & Lifecycle Basics : Cloud services, Edge deployment, Error identification, Troubleshooting, AI process automation, Introduction to MLOps and lifecycle management

List of Practicals / Experiments:

List of Practicals

- Implement a simple AI problem as a State-Space Search (e.g., Water Jug or 8-Puzzle).
- Explore Modern AI Toolkits (TensorFlow, PyTorch): Create a basic AI workflow to classify simple data.
- Implement Best-First Search and A* algorithms for pathfinding or optimization.
- Solve a Constraint Satisfaction Problem (e.g., N-Queens or Sudoku Solver).
- Build and evaluate a Supervised Learning Model (classification or regression) using scikit-learn.
- Construct a Bayesian Network and perform inference for a real-life scenario.
- Implement a Neural Network (CNN) for image classification using TensorFlow or PyTorch.
- Develop a Simple Chatbot using pre-trained Transformer or GPT-based API.
- Experiment with Generative AI Models (e.g., text or image generation using GPT/DALL·E).
- Apply Prompt Engineering Techniques (few-shot, role-based, chain-of-thought) to improve model responses.
- Perform Data Analysis and Visualization using ChatGPT Advanced Data Analysis.

Text Books:

1. ARTIFICIAL INTELLIGENCE AND INTELLIGENT SYSTEM by N. P. PADHY, OXFORD UNIVERSITY PRESS

References:

1. ARTIFICIAL INTELLIGENCE: A MODERN APPROACH by STUART RUSSELL, PETER NORVIG, PEARSON
2. A FIRST COURSE IN ARTIFICIAL INTELLIGENCE by DEEPAK KHEMANI, MCGRAW HILL EDUCATION