A Six Months Course

on

IMPLEMENTATION OF AI, ML AND DL ALGORITHMS USING PYTHON

DETAILED COURSE STRUCTURE

COURSE COORDINATOR:

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STRUCTURE OF AI COURSE

SUBJECT NAME — **1. ARTIFICIAL INTELLIGENCE**

UNIT-1		**INTRODUCTION TO AI**
	DAY-1	Definition and Scope of AI History and Evolution of AI AI Agent and Environment Examples and Types of AI: Narrow vs. General AI vs. Super AI
	DAY-2	AI Techniques Logic concepts and Logic Programming Knowledge Representation and Inference Rule-Based Systems
UNIT-2		**EXPERT SYSTEMS**
	DAY-3	Introduction Phases in Building Expert Systems Expert System Architecture Expert Systems Vs. Traditional Systems
	DAY-4	Principles of Expert Systems Truth Maintenance Systems Expert System Shells and Tools Case Studies: Expert Systems in Healthcare, Finance, and Engineering
UNIT-3		**NATURAL LANGUAGE PROCESSING (NLP)**
	DAY-5	Fundamentals of NLP: Tokenization, Part-of-Speech Tagging, and Parsing Named Entity Recognition (NER) and Sentiment Analysis
	DAY-6	Sequence-to-Sequence Models: Encoder-Decoder Architectures, Language Modeling: Introduction, N-Gram Models, Language Model Evaluation, Parameter Estimation,Language Model Adaptation, Types of Language Models, Language-Specific Modeling Problems,
	DAY-7	Multilingual and Cross Lingual Language Modeling , Advanced NLP Applications: Machine Translation, Text Summarization, and Question Answering Systems
UNIT-4		**KNOWLEDGE REPRESENTATION AND REASONING**
	DAY-8	Knowledge Representation Techniques: Case Grammars, Semantic Networks, Frames, and Ontologies
	DAY-9	Logic-Based Reasoning: Propositional and First-Order Logic, Uncertainty and Probabilistic Reasoning
	DAY-10	Case Studies: Knowledge-Based Systems in Decision Support and Planning
UNIT-5		**ROBOTIC PROCESS AUTOMATION (RPA) AND GENERATIVE AI**
	DAY-11	Introduction to RPA, RPA Tools and Technologies: Overview of popular RPA platforms (e.g., UiPath, Automation Anywhere, Blue Prism)

DAY-12	Understanding the components of RPA software (bots, orchestrators, control room), Selection criteria for choosing an RPA tool
DAY-13	Steps involved in RPA implementation (identification, assessment, design, development, testing, deployment), Use Cases of RPA
DAY-14	Introduction to Generative AI, Overview of different generative models (GANs, VAEs, autoregressive models), Generative AI in Practice
	Real-world applications of Generative AI (image synthesis, text-to-image generation, style transfer, etc.)
UNIT-6	**AI APPLICATIONS**
DAY-15	Linguistic aspects of natural language processing, A.I. And Quantum Computing, Applications of Artificial Intelligence (AI) in business
DAY-16	Emotion Recognition using human face and body language, AI based system to predict the diseases early, Smart Investment analysis
DAY-17	AI in Sales and Customer Support, Robotic Processes Automation for supply chain management, AI-Optimized Hardware
DAY-18	Digital Twin i.e. AI Modelling, Information Technology & Security using AI, AI/ML in Smart solutions, AI/ML in Social Problems handling, Block chain and AI
PRACTICAL SESSION-1	
DAY-19	Developing and testing rule-based expert systems in Python
DAY-20	Developing logic-based and probabilistic reasoning algorithms in Python
DAY-21	Implementing NLP tasks using NLTK/spaCy
PRACTICAL SESSION-2	
DAY-22	Implementing RPA tasks using Python libraries
DAY-23	Building and training generative models for image synthesis or text generation tasks
DAY-24	Hands-on project: Developing an end-to-end AI application using Python

STRUCTURE OF ML COURSE

SUBJECT NAME — **2. MACHINE LEARNING**

UNIT-1		**FOUNDATIONS OF MACHINE LEARNING**
	DAY-1	Basics of Supervised, Unsupervised, Semi- supervised and Reinforcement Learning Types of Machine Learning Algorithms: Classification, Regression, Clustering, and Reinforcement Learning
	DAY-2	Overview of the machine learning pipeline: data preprocessing, model training, evaluation, and deployment
UNIT-2		**SUPERVISED LEARNING TECHNIQUES**
	DAY-3	Linear Regression and Logistic Regression Decision Trees and Random Forests
	DAY-4	Support Vector Machines (SVMs), K-Nearest Neighbors (k-NN), Naive Bayes Classifier, Bayesian Neural Networks
	DAY-5	Elastic Net Regression, Ordinal Regression, Gaussian Processes, Ensemble Methods: Bagging and Boosting
UNIT-3		**UNSUPERVISED LEARNING TECHNIQUES**
	DAY-6	K-Means Clustering, Hierarchical Clustering, DBSCAN (Density-Based Spatial Clustering of Applications with Noise), Mean Shift Clustering
	DAY-7	Principal Component Analysis (PCA), Association Rule Learning: Apriori Algorithm
	DAY-8	Gaussian Mixture Models (GMM), Self-Organizing Maps (SOM), Independent Component Analysis (ICA), Isomap (Isometric Mapping)
UNIT-4		**SEMI-SUPERVISED LEARNING TECHNIQUES**
	DAY-9	Self-training Co-Training Semi-Supervised Support Vector Machines (S3VM)
	DAY-10	Label Propagation Semi-Supervised Generative Adversarial Networks (SGANs) Pseudo-Labeling
UNIT-5		**REINFORCEMENT LEARNING TECHNIQUES**
	DAY-11	Introduction to Reinforcement Learning (RL), Key components of RL: agent, environment, actions, rewards, and policies
	DAY-12	Markov Decision Processes (MDPs): Definition and components of MDPs, Markov property and the notion of state transitions Value functions, Bellman equations and optimality conditions
	DAY-13	Dynamic programming algorithms: Policy Evaluation, Policy Improvement, Policy Iteration, and Value Iteration
	DAY-14	Monte Carlo Methods: Introduction, Monte Carlo Prediction and Control, Exploration and Exploitation trade-offs

UNIT-6	**ADVANCED MACHINE LEARNING TECHNIQUES**
DAY-15	Ensemble Learning: GBMs and XGBoost
DAY-16	Dimensionality Reduction Techniques: t-SNE, UMAP
DAY-17	Model Evaluation and Hyperparameter Tuning
DAY-18	Case Studies: Advanced ML Applications in Healthcare, Finance, and Marketing
PRACTICAL SESSION-1	
DAY-19	Implementing linear regression using scikit-learn Implementing K-Means clustering algorithm using scikit-learn
DAY-20	Implementing self-training algorithm for semi-supervised classification, Pseudo-labeling unlabeled data and incorporating it into the training set
DAY-21	Implementing a simple RL environment and agent interaction loop in Python
PRACTICAL SESSION-2	
DAY-22	Training ensemble models on a sample dataset and evaluating performance
DAY-23	Implementing t-SNE and UMAP algorithms for dimensionality reduction
DAY-24	Performing model evaluation using cross-validation techniques, Selecting the best model based on evaluation metrics and hyperparameter optimization results

STRUCTURE OF DL COURSE

SUBJECT NAME — **3. DEEP LEARNING**

UNIT-1		**FUNDAMENTALS OF DEEP LEARNING**
	DAY-1	Introduction to Deep Learning, Neural Network Architectures: Perceptrons, Multi Layer Perceptrons, Feed Forward Neural Networks
	DAY-2	Activation Functions, Unit saturation, vanishing gradient problem, Heuristics for faster training, Nestors accelerated gradient descent, Regularization, Dropout
	DAY-3	Deep Learning Frameworks: TensorFlow, Keras, PyTorch, Keras, MXNet, Caffe, Chainer, TensorFlow.js
UNIT-2		**CONVOLUTIONAL NEURAL NETWORKS (CNNS)**
	DAY-4	CNN Architecture and Components- convolution/pooling layers, Image Classification with CNNs
	DAY-5	Transfer Learning and Fine-Tuning Pre-trained CNNs, Sentence Classification using Convolutional Neural Networks
	DAY-6	Advanced CNN Architectures: ResNet, Inception, EfficientNet
UNIT-3		**RECURRENT NEURAL NETWORKS (RNNS)**
	DAY-7	Basics of RNNs, Applications of RNNs in NLP and Time Series Analysis, Training and Optimization Techniques for RNNs
	DAY-8	Recurrent Neural Networks: LSTM, GRU, Encoder Decoder architectures.
	DAY-9	Analogy Reasoning: Named Entity Recognition, Opinion Mining using Recurrent Neural Networks, Dialogue Generation with LSTMs
UNIT-4		**FAST RCNN, FASTER RCNN AND YOLO MODELS**
	DAY-10	Introduction to Object Detection, Object Detection Techniques, R- CNN Drawbacks of Regional Convolutional Neural Networks, FAST R-CNN Architecture, Moving from FAST R-CNN to FASTER R-CNN.
	DAY-11	Introduction to YOLO Models, Drawbacks of R-CNN and its variants, YOLO Model Examples, YOLO Versions v1 through v7
UNIT-5		**DEEP UNSUPERVISED LEARNING**
	DAY-12	Introduction to Adversarial Generative Networks, Applications of GANs: Image Generation, Style Transfer
	DAY-13	Introduction to Variational Auto Encoders, Applications of VAEs: Image Reconstruction, Anomaly Detection,
	DAY-14	Auto-encoder and DBM Attention and memory models, Dynamic Memory Models
UNIT-6		**DL APPLICATIONS AND CASE STUDIES**
	DAY-15	Applications of Deep Learning to Computer Vision: Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, video to text with

	LSTM models, Attention Models for computer vision tasks
DAY-16	Applications of Deep Learning to NLP: Introduction to NLP and Vector Space Model of Semantics, Word Vector Representations: Continuous Skip-Gram Model
DAY-17	Continuous Bag-of-Words model (CBOW), Glove, Evaluations and Applications in word similarity
DAY-18	Deep Learning in Healthcare: Medical Imaging, Disease Diagnosis Deep Learning in Finance: Algorithmic Trading, Fraud Detection

PRACTICAL SESSION-1

DAY-19	Implementing deep learning models for computer vision tasks (image segmentation, object detection, image captioning)
DAY-20	Implementing transfer learning for image classification and sentence classification Generating dialogue responses with LSTM models
DAY-21	Implementing adversarial generative networks (GANs) for image generation Implementing basic RNN architectures for sequential data analysis

PRACTICAL SESSION-2

DAY-22	Applying variational autoencoders (VAEs) for image reconstruction and anomaly detection
DAY-23	Implementing R-CNN, Fast R-CNN and Faster R-CNN architectures for object detection Implementation of YOLO Models for Object Detection
DAY-24	Applying deep learning techniques to NLP tasks (word vector representations, word similarity evaluation)

REFERENCES

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"Artificial Intelligence: Foundations of Computational Agents" by David L. Poole and Alan K. Mackworth

"Artificial Intelligence: Structures and Strategies for Complex Problem Solving" by George F. Luger

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Machine Learning (ML):

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"Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville

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"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron

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"Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett