Advanced AI and ML - Course Syllabus

Module 1: Data Science

- Introduction to Data Science concepts and scope
- Data Analysis & Pre-processing techniques
- Supervised and Unsupervised Learning paradigms
- Regression and Classification Algorithms (Linear, Logistic, Decision Trees, Random Forests)
- Feature Selection & Dimensionality Reduction
- Cross-Validation & ML Strategy
- Hyperparameter Tuning methods
- Unsupervised Learning Algorithms (K-Means, Hierarchical Clustering)
- Model Evaluation and performance metrics
- Practical Labs: Data Analysis insights, Regression models, Classification tasks, K-Means clustering

Module 2: Deep Neural Networks

- Understanding Perceptron and its role
- Artificial Neural Networks (ANN) and Multi-Layer Perceptrons
- Convolutional Neural Networks (CNNs): filters, padding, strides, pooling, transfer learning
- Advanced CNNs & Object Detection approaches
- Recurrent Neural Networks (RNN, LSTM, GRU) for sequential data
- Practical Labs: Perceptron, ANN, CNN predictions, RNN sequence modeling

Module 3: Natural Language Processing (NLP)

- Converting language to numerical representation
- Techniques: Bag of Words, TF-IDF, Word2Vec
- Feature selection and dimensionality reduction in text data
- Cross-validation and hyperparameter tuning in NLP
- Named Entity Recognition (NER) and sentiment analysis
- Transformer Networks for advanced NLP
- Practical Labs: Sentiment Analysis on reviews dataset, NER, Word Cloud

Module 4: Generative AI

- Background and backdrop of Generative AI
- Transformer architecture and applications
- Working with Hugging Face Large Language Models (LLMs)
- Hands-on Labs: Text completion, classification, translation, similarity
- Hands-on Labs: Text-to-image, Image captioning, Object detection, Speech recognition

Module 5: Application Development (LangChain, LlamaIndex, LangGraph)

- Prompt Engineering (zero-shot, one-shot, few-shot techniques)
- Fine-tuning models on custom datasets
- Building simple applications with LangChain
- Creating conversational customized chatbots with LLMs
- Vector stores and retrievers for search
- Retrieval-Augmented Generation (RAG) concepts
- AI Agents with LangGraphs
- Practical Labs: Prompt engineering, fine-tuning, chatbot creation, vector store setup, PDF QnA RAG